NASA-CR-189319

HUGHES STX CORPORATION
A Subsidiary of Hughes Aircraft Company

Final Progress Report

Computer Systems and Scientific Data Analysis Support Services for the Earth Sciences Directorate and Space Sciences Directorate

Volume I

Triannual Period
June Through September 1993
Contract NAS5-30440

Submitted
October 6, 1993

HUGHES

HUGHES STX CORPORATION
A Subsidiary of Hughes Aircraft Company

October 6, 1993

Mr. Stephen Cimino
Contract Officer—Code 284.6
Building 12, Room E206B
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771

Dear Mr. Cimino:

We are pleased to submit Volume I of the Final Progress Report under contract NAS5-30440 for Computer Systems and Scientific Data Analysis Services. This report covers the triannual period of June 1 through September 30, 1993, and provides a brief summary of work on each active task throughout the contract period of performance.

If you have any questions, please call me.

Sincerely,

Ronald H. Estes
Project Manager
Hughes STX

4400 Forbes Boulevard, Lanham, MD 20706-4392
(301) 794-5000
FAX: (301) 794-7106

INTRODUCTION

This Final Progress Report covers the specific technical activities of Hughes STX Corporation for the last contract triannual period of June 1 through September 30, 1993, in support of assigned task activities at Goddard Space Flight Center (GSFC). It also provides a brief summary of work throughout the contract period of performance on each active task. Technical activity is presented in Volume I, while financial and level-of-effort data is presented in Volume II.

Hughes STX expended an estimated 265,700.1 labor hours toward the level of effort for this last triannual reporting period.

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
02–001–00	050	OSP Support	C. Barth	P. Pashby
02–003–00	051	EOSDIS Support	R. Shapiro	S. Broder
02–006–00	054	EOS Project Science Office Support	C. Griner	D. Zukor
02–008–00	055	Data Formats Study	R. Suresh	T. Meyer
02–009–00	056	Cryogenic Refrigerator Support	J. Marketon	R. Boyle
02–010–00	052	GORF Software Support	J. Cheek	J. McGarry T. Zagwodzki
02–011–00	057	EOS-PM Support	R. Shapiro	P. Hwang
02–012–00	058	Mass Storage Evaluation	G. Hull	B. Kobler
02–013–00	059	Data Formats Study	R. Suresh	T. Meyer
03–015–00	061	GSFC/DAAC Land Task	P. King	B. Meeson
02–745–00	556	DTF Support	R. Kaipa	P. Shu
02–749–00	560	Semiconductor Laser R&D Support	A. Yu	D. Cornwell
12–021–00	150	Neutral Mass Spectrometer Programming and Data Processing	P. Maenner	W. Kasprzak
12–022–00	151	Mass Spectrometer Systems Engineering, Analysis, Laboratory, and Documentation Support	J. Westberg	D. Harpold
12–023–00	152	Pioneer–Venus Programming and Analysis	J. Selekof	R. Hartle
12–027–00	154	Laser Atmospheric Studies Research	U. Singh	T. McGee
12–030–00	156	Fractal Analysis of Clouds	D. Silberstein	R. Cahalan
12–031–00	157	Laboratory for Atmospheres Technical Data Support	M. Tarlton	C. Cote
12–032–00	158	Satellite Microwave Data Precipitation Studies	J. Nucciarone	P. Cuddapah

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
12–034–00	160	Arctic Aircraft Data and EOS Project Studies	P. Guimaraes	M. Schoeberl
12–036–00	162	Raman Lidar for Study of Atmospheric Gases	R. Ferrare	S. Melfi
12–037–00	163	Ozone Trends Study	G. Labow	R. Stolarski
12–038–00	164	Nimbus–7 TOMS Data Processing and Programming	E. Beach	M. Schoeberl R. McPeters
12–039–00	165	Trajectory Modeling in Support of the High-Speed Research Program	L. Sparling	M. Schoeberl
13–040–00	170	ERBE Documentation	D. Augustine	M. King
22–092–00	251	VLBI Unix Systems Support	F. Gomez	W. Wildes
22–093–00	252	LTPCF Support	J.A. Operchuck	W. Webster
22–096–00	254	VLBI Data Analysis Support	D. Gordon	J. Ryan
22–110–02	260	Bidirectional Reflectance Properties of Vegetation Canopies and Soils	T. Eck	A. Kerber
22–110–03	261	ASAS Data Calibration	W. Kovalick	A. Kerber
22–110–04	262	Forest Ecosystem Dynamics Research	L. Prihodko	A. Kerber
22–110–06	264	Atmospheric and Global Vegetation Research	R. Mack	A. Kerber
22–110–08	263	FIFE Support	K. Huemmrich	A. Kerber
22–110–09	266	Sensor Calibration and Atmospheric Studies	S. Ahmad	A. Kerber
22–110–11	268	Support for Analysis of Crop Condition/Yield	F. Irani	A. Kerber
22–110–12	269	BOREAS Research Support	S. Goetz	A. Kerber
22–110–13	267	BORIS Support	J. Newcomer	A. Kerber
22–110–14	270	Semivegetated Landscapes	J. Robinson	A. Kerber

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
22–111–00	280	Gravity Field Analysis	G. Patel	F. Lerch
22–113–00	282	Analysis of Oceanic Normal Modes and Tides	R. Ray	B. Sanchez
22–114–00	283	Magnetometer Calibration	H.B. Iz	R. Langel C. Voorhies
22–116–00	285	Nimbus–7 TOMS Programming and Data Analysis	I. Sprod	L. Walter
22–119–00	288	Scientific Activity Data Base and Liaison	A. Nanan	J. Smith
22–120–00	289	NASA SeaWiFS Calibrations/Validation Support	J. Cooper	J. McLean
22–121–00	290	Tether Magnetometer	L. Huynh	W. Webster
22–122–00	291	Alaskan Geodetic Data	D. Caprette	J. Sauber
32–161–00	350	ROSAT System Engineering	P. Damon	R. Pisarski
33–162–00	380	NCCS Technical Assistance Group	F. Verdier	H. Mitchell
33–163–00	381	NCCS Applications Development	J. Cavallo	H. Mitchell
33–166–00	382	Systems Programming, Communications, and Job Entry Systems Support	C. Lofton	T. Schardt
32–169–00	354	MPP Computer Science Research	C. Packer	J. Dorband
33–172–00	391	EOS Pathfinder Support	A. Ritchie	M. Goodman
32–173–00	356	Library/Brochure Development and Technical Writing and Editing Support	R.B. Estes	J. Hollis
32–174–00	357	Advanced Data Flow Technology Office	P. Lang	P. Gary
32–175–00	358	Science Processing Support Office	H.D. Chang	Y.-C. Lu
32–177–00	361	MHD Coding	P. MacNeice	S. Zalesak
32–178–00	362	Data Compression	E. Seiler	J. Tilton
32–187–00	368	EOSDIS Data Archival and Distribution System Study	A. Dwyer	J. Berbert

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
32–188–00	369	NSI User Support Services	B. Lev	P. Gary
32–191–00	371	EOSDIS Version 0 System Engineering Support	T. Johnson	K. McDonald
32–192–00	372	EOSDIS IMS Version 0 Support	T. Johnson	K. McDonald
32–193–00	373	Astro-D	M. Good	R. Pisarski
32–196–00	365	Science Processing Library	H.D. Chang	Y. Lu
32–197–00	366	V0 DAAC Support	L. Bodden	P. Chan
32–198–00	355	Solar Flare Research	T. Opsahl	D. Spicer
32–199–00	360	HPCC/ESS Network Support	J. Boroumand	P. Gary
33–200–01	383	Applied Research in IDM	S. Chettri	R. Cromp
33–200–02	384	Transfer of IDM Research Results	R. Lovell	R. Cromp
33–200–03	385	IDM Applied to High Performance Computing and Communications	S. Chettri	R. Cromp
32–203–00	387	VR System Development/Integration	T. Opsahl	H. Mitchell
32–206–00	392	XTE Science GOF Support	P. Damon	R. Pisarski
62–232–01–07	650–656	Cosmic Ray Support	N. Nath	E. Eng
62–233–01–14	661–673	X-Ray and Gamma-Ray Programming Support	A. Etienne	T. Sheets
62–236–00	676	X-Ray Laboratory Support	S. Murphy	R. Kelley
62–237–00	677	Compton Observatory Project Data Management Plan Support	K. Pollock	N. Gehrels
62–238–01–08	678–685	HEASARC Support	P. Jacobs	N. Laubenthal
62–241–00	691	ROSAT Analysis	S. Reddy	J. Swank
72–270–00	751	Aperture Synthesis Radiometer and Lightning Radiation Modeling	M. Kao	D. Le Vine

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
72–271–00	752	Analysis of Spaceborne Precipitation Radars	J. Jones	R. Meneghini
72–272–01	753	Polar Ice Studies: Mesoscale Sea-Ice Observations	S. Fiegles	J. Comiso
72–272–02	754	Polar Ice Studies: Sea-Ice and Climate Studies	J. Saleh	J. Comiso
72–272–03	755	Polar Ice Studies: Arctic Sea-Ice Observations	M. Martino	J. Comiso
72–272–04	756	Polar Ice Studies: West Antarctic Glaciology and Ice Sheet Studies	P. Vornberger	J. Comiso
72–272–05	757	Polar Ice Studies: Ice Processes and Microwave Emissivity Studies	A. Allegrino	J. Comiso
72–273–00	763	Processing and Analysis of Microwave Remote Sensing Data	G.D. Vassilou	J. Wang
72–275–00	765	Aircraft–Satellite Instrument Calibration Project	R. Galimore	P. Abel
72–276–00	766	Soil Moisture Studies	R. Pardipuran	J. Wang
72–277–01	767	NSCAT and TOPEX Support	L. Lo	A. Busalacchi
72–277–02	768	Tropical Ocean Modeling Support	J. Beauchamp	A. Busalacchi
72–277–03	769	Oceanographic Altimeter Research	E. Hackert	A. Busalacchi
72–277–04	770	Graphical Analysis of Oceanographic Data	P. Ryan	A. Busalacchi
72–279–00	775	Polar Ocean Graphics	P. Ryan	S. Hakkinen
72–280–00	776	EOS Liaison Support	J. Acker	A. Busalacchi
72–281–00	777	EOS Heat–Water Balance Studies	N. Ahmed	B. Choudhury
72–282–00	778	EOS Hydrologic Modeling Studies	J. Draves	E. Engman
72–283–00	779	SAR Artic Hydrology	G. Linebaugh	E. Engman
72–284–00	780	Ocean Modeling	L. Braunstein	M. Rienecker

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
72–285–00	781	HAPEX-Sahel Experiment	W. Teng	B. Choudhury
82–312–00	884	Late-Type Stellar Coronae	J. Brosius	K. Carpenter
82–313–00	883	Observatory Assistance	R. Cornett	A. Michalitsianos
82–314–00	882	STIS Diffraction Grating Selection and Characterization	C. Standley	B. Woodgate
82–315–00	881	Solar and UV Instruments	B. Puc	T. Gull
82–316–01	879	HST Project Science for Operations and Ground Systems	J. Childs	R. Polidan
82–316–02	880	HST Project Science for Flight Systems and Servicing	J. Childs	E. Cheng
82–317–00	878	Skymap Catalog Enhancement	W. Warren	R. Polidan
82–318–00	877	CDAC Facility Support	G. Gavigan	D. West
82–319–00	850	Computer System Management	P. McCaslin	D. Klinglesmith
82–320–00	851	Core Subsystems and Operations	S. Kaltenbaugh P. McCaslin	D. West
82–324–00	853	SRT Program Support	F. Varosi	A. Silver
82–325–00	854	SMM/HXRBS Support	K. Tolbert	B. Dennis
82–326–00	855	Infrared Spectrometer Laboratory Support	T. Powers	S. Moseley
82–327–00	856	SHOOT, COBE, and AXAF Experiments	T. Hait	S. Volz
82–331–00	860	UIT Operations and Analysis Support	J. Hill	S. Neff
82–334–00	861	LASP System Support	T. Creamean	A. Silver
82–338–00	864	Solar and Stellar Astronomy Research	J. Brosius	G. Holman
82–339–00	865	AXAF BCS Development	B. Puc	B. Woodgate
82–340–00	866	Astronomical Sounding Rocket Project	R. Hill	A. Smith
82–345–00	868	Solar Data Analysis Center Support	R. Nakatsuka	J. Gurman

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
82–346–00	869	SMM Travel Support	J. Childs	J. Gurman
82–347–00	870	Lyot Filter and STIS Development	A. Danks	B. Woodgate
82–348–01	871	FIRAS Software Development Support	S. Read S. Alexander	D. West
82–348–02	872	FIRAS Data Analysis Support	S. Read	D. West
82–349–01	873	DIRBE Software Development Support	J.A.J. Skard	D. West
82–349–02	874	DIRBE Data Analysis Support	H. Freudenreich	D. West
82–350–01	875	DMR Software Development Support	V. Kumar	D. West
92–351–00	950	High Temperature Superconducting Detector and Planetary Atmospheres Instrument Development	B. Lakew	J. Brasunas
92–354–00	952	Geophysical Data Acquisition and Software Support	M. O'Bryan	P. Wasilewski
92–355–00	953	Ulysses URAP Experiment Software Support	R. Hess M. Reiner	R. Stone
92–356–00	954	Voyager Infrared Support	J. Guerber	B. Conrath
92–357–00	955	Voyager and Mars Observer IRIS Support	S. Dason	J. Pearl
92–359–00	956	Interplanetary Plasma Data Conversion and Fitting	D. Berdichevsky	K. Ogilvie
92–360–00	957	Programming and Analysis Support for the San Marco D/L Electric Field Instrument	S. Cobb	T. Aggson
92–362–00	959	Dynamics Explorer Magnetometer Programming and Analysis Support	E. Greene	J. Slavin
92–363–00	960	Dynamics Explorer High- and Low-Altitude Plasma Programming and Analysis Support	J. Humphreys	R. Hoffman
92–368–00	962	Plasma Electrodynamics Studies: Acquisition, Planning, and Analysis of Data From Chemical Release Experiments	P. Marionni	R. Hoffman

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
92–370–00	963	Plasma Electrodynamics Studies: Rocket-Borne Electric Field Experiments	P. Marionni	R. Pfaff, Jr.
92–373–00	966	Data Analysis, Communication, and Display Support	C. Meetre	J. Nuth
92–375–00	968	Magnetometer Data Processing and Analysis	S. Kramer	W. Mish
92–376–00	969	Interplanetary Magnetic Cloud Modeling	J. Jones	R. Lepping
92–379–00	970	Plasma Electrodynamics Studies: Plasma Wave and Electric Field Data Analysis Software Development	P. Marionni	R. Pfaff, Jr.
92–381–00	971	Instrument for GGS/Polar and Mars Project	M. Kirsh	E. Sittler
92–383–00	972	Neural Network Software Development for WIND	C. Meetre	M. Kaiser
92–385–00	974	Non-LTE Modeling of Jovian Atmosphere in the Infrared	R. Halthore	J. Allen, Jr.
92–386–00	975	Inner Magnetospheric Studies	J. Jones	D. Fairfield
92–388–00	976	Rocket-Flight Data Support	P. Twigg	R. Goldberg
92–389–00	977	IR Grating Spectrometer Development	G. McCabe	D. Reuter
92–390–00	978	Cluster Beam Data Acquisition and Analysis	A. Ali	J. Nuth
92–391–00	979	Planetary Radiative Transfer Support for Voyager and Other Missions	N. Nath	R. Samuelson
92–392–00	980	Cassini/CRAF Support	S. Bakshi	E. Sittler
92–394–00	982	AMPTE Analysis	E. Mazur	M. Smith
92–395–00	983	Plasma Electrodynamics Studies: ISTP/GGS Support	P. Marionni	R. Pfaff, Jr.
92–396–00	984	Planetary Geosciences Programs Support	T. Dickinson	J. Nuth

NASA TASK	HUGHES STX TASK	TITLE	HUGHES STX TASK LEADER	ATR
92–397–00	985	ISTP/SMEX Energetic Particle Experiments	S. Kanekal	D. Baker
92–398–00	986	Magnetic Field Software Conversion	S. Hsieh	W. Mish
92–399–00	965	ISTP/SPOF	M. Peredo	S. Curtis
92–400–00	987	Engineering and Graphics Support	J. Kalb	F. Hunsaker
92–403–00	990	Position-Sensitive Particle Detector Development and Support	J. Miller	M. Smith
92–404–00	993	Equipment Data Base Management for Code 690	R. Barnes	J. Hillman
92–405–00	992	Magnetospheric Theory and Analysis	C. Owen	M. Smith
92–406–00	994	Mars Observer Magnetic Field Support	T. Reyes	J. Connerney
92–408–00	996	Geotail Data Support	T. Perry	D. Fairfield
92–410–00	998	LEP System Support	R. Srinirasa	M. Mumma

NASA Task 02-001-00: OSP Support

GSFC ATR: ***P. Pashby***

Hughes STX Task Leader: ***Dr. C. Barth***
Hughes STX Task Number: ***050***

The objective of this task is to provide support for Local Area Network (LAN) communications among the PC's used in managing the project. This involves installing network hardware and system software, installing application software on the network, defining and interfacing project data bases, interfacing with the GSFC Center Network Environment, and educating Orbiting Satellite Project (OSP) personnel.

FINAL CONTRACT SUMMARY

Task personnel ported the tracking system developed for OSP from the Revelation DBMS to dBase IV. Staff performed a redesign to account for features not available in Revelation; added new capabilities and features to the PR handling; and made modifications to provide increased user efficiency and functionality.

Remote access capabilities were developed over time to allow project staff to call up information from offsite. Dial-back capabilities were provided to ensure security. Task personnel provided research on providing access through the GSFC Rolm telephone system.

Ongoing support of the network involved the benchmarking and other evaluation of new hardware and software alternatives, the installation of new hardware and software, backup support, and problem solving. In addition, task personnel aided in the conversion to network support on several packages to provide additional shared access to information.

Task personnel performed all aspects of gaining connectivity to the Center Network Environment (CNE), including design, rib applications, router specification and configuration, changes to support a relocation of OSP offices, changes from ARCNET to Ethernet support, and mail connectivity, both to the Internet and to the CNE cc:Mail hub. In addition, staff provided innovative solutions that minimized the impact of the loss of the analog line, which had been used for remote access.

Task personnel provided quick response to a number of OSP Staff needs, including the generation of financial reports, templates to simplify repetitive writeups (such as the Director's Weekly), and procedures to provide better access to network hardware and software.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff converted the OSP network from ARCNET to Ethernet; made workstation and server changes necessary for transition; provided timely support during office remodeling to minimize downtime; expanded e-mail connectivity to the centerwide system; and provided additional support on office automation, including tracking and automatic forms printing for travel forms.

WORK PERFORMED

Task personnel installed newly acquired Ethernet cards and completed network software modifications to reconfigure the OSP network following the recent move to Bldg. 26. The new configuration should provide increased capacity and connectivity to new services. Additional software changes moved the print servers to the Ethernet and provided access to the NEC Pinwriter through the network. Task personnel interfaced with CNE staff to ensure a smooth transition. IP addresses were obtained for all staff workstations to provide Internet access.

During this period, the OSP offices (Rm. 201 and Rm. 209, Bldg. 26) were completely refurnished. It was necessary to disconnect all of the workstations (except two), to down the network, to move all of the hardware out of the way of the movers and furniture installers, and to reinstall all systems afterwards. These activities were completed with a minimum of downtime.

The task leader upgraded cc:Mail in preparation for connection to the CNE's cc:Mail system. Changes were made to provide automatic directory propagation, allowing directory access to all center cc:Mail users.

Task personnel provided several reporting changes to the financial analysts support personnel. Changes were made on one Ramis report to minimize printer conflict. By spooling the report to an intermediate file, the printer was freed for other uses. Other reports have been reconfigured to access the laser printer and provide higher quality output.

An upgrade to the Travel Manager software was installed on the OSP project secretary's workstation. In addition, a number of changes were made to help support the secretary's new position on the GSFC Scientific Colloquium. These included additional software support and electronic mail additions.

A travel subsystem has been added to the OSPNET project support data base. Task personnel have developed routines to allow travel forms to be printed directly from the data base on the daisy wheel printer.

The task leader installed TCP/IP support on the project manager's workstation to provide an introduction to information server technology.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The task leader will meet with the ATR to discuss directions for support under the new contract. A new Work Control Plan will be developed. Included in the discussions will be an exploration of the application of information server technology to the needs of OSP.

New upgrades will be installed for the tape backup system when it is received. Additional graphs and reports will be developed in conjunction with OSP staff needs.

Evaluations of the MS-Windows version of several software packages will be completed, and indicated conversions and training will be provided for appropriate staff members. Support for OSP personnel and the LAN system will continue.

COMPUTER USE

Minutes	**Computer**
Dedicated	PC's

NASA Task 02-003-00: EOSDIS Support

GSFC ATR: *S. Broder*

Hughes STX Task Leader: *R. Shapiro*
Hughes STX Task Number: *051*

This task provides systems engineering support to the Earth Observing System Data and Information System (EOSDIS) in three major areas: 1) reviewing documents from organizations involved in EOSDIS program planning and development activity, assessing compatibility with EOSDIS plans, and identifying followup requirements; 2) participating in the EOSDIS management and EOSDIS element meetings; and 3) attending reviews, panel meetings, and other organizational meetings involved in EOSDIS-related activities to determine the interactions between them and EOSDIS.

FINAL CONTRACT SUMMARY

Staff supported the ATR in all of his various roles in the EOSDIS (Earth Observing System Data and Information System). Initially the ATR oversaw networks and communications for EOSDIS. Shortly thereafter, the ATR became both the Element Lead for the System Management Center (SMC) of EOSDIS and the Science Operations Manager (SOM). Task members wrote a Data Communications and Data Transfer Requirements Study that presented the impact on EOSDIS data communications and transfers resulting from three distributed data processing scenarios; supported the EOSDIS Non-Advocacy Review (NAR) by defining functions, estimating processing power, proposing architecture, and estimating costs for the SMC; reviewed requirements and information on other EOSDIS elements; and reviewed presentations, documents, and activities of both contractors on the EOSDIS Phase B contract. The Phase B contract ran for 15 months and included five major presentations (System Requirements Review through Detailed Architectural Design) and approximately 30 types of documents.

Task members wrote and submitted science operations and systems management requirements; reviewed numerous iterations of levels 0–4 requirements; wrote the EOSDIS Science Operations Concept document detailing science operations functions; performed intra- and interorganizational actions and coordination necessary to perform those functions; generated and analyzed results of discrete event computer models simulating operational science data processing at the seven DAAC sites; used the models to study overall operations, particularly the impact of data dependencies (e.g., instrument data used for another instrument's processing, inter-DAAC data transfers) on daily processing; built models for EOS-A and B satellites and later for EOS AM, PM, CHEM, ALT and AERO satellites; organized and presented modeling results at the EOS Modeling Forum; reviewed existing and emerging systems management packages that manage distributed and heterogeneous systems architectures (e.g., CA UniCenter, Tivoli Wizard, and OSF's DME); and wrote the Strategic Plan for EOS Modeling Activities at GSFC.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff completed Version 2.0 of the EOS Science Data Plan. The document was mailed to approximately 300 individuals and the EOS DAAC's.

WORK PERFORMED

Staff continued to support M. Schwaller. Version 2.0 of the EOS Science Data Plan was completed, reviewed, and approved for release. The document was sent to approximately 300 individuals and the EOS DAAC's. In addition, a survey was mailed to about 900 individuals who received Version 1.0 to determine if they wanted to receive Version 2.0.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

None.

NASA Task 02-006-00: EOS Project Science Office Support

GSFC ATR: ***Dr. D. Zukor***
Cognizant Scientist: ***Dr. M. King***

Hughes STX Task Leader: ***C. Griner***
Hughes STX Task Number: ***054***

This task provides administrative and scientific support for the Earth Observing System (EOS) Project Science Office.

FINAL CONTRACT SUMMARY

The EOS Project Science Office Support task began in February 1990 with a task manager and a senior scientist. As of September 1993, the task contains the following personnel:

- Full Time—one senior administrator/task manager (C. Griner), one Senior Scientist R. Greenstone, two senior administrators (D. Bennett and C. Madison), two publications specialists (W. Humberson and J. Laue), one documentation assistant (H. Parrish), and one associate publications specialist (C. Spector).
- Part Time—one senior scientist (B. Bandeen) and one associate data technician (P. Purman)

Major Milestones and Accomplishments

Staff achieved the following major milestones and accomplishments:

- Gathered articles and published bimonthly issues of *The Earth Observer* and built and maintained a data base for distribution of the newsletter that has grown from 1,000 in 1990 to over 8,000 in 1993.
- Gathered images and produced two 8- x 10-ft displays that are used in conjunction with EOS activities at scientific conferences.
- Researched, gathered materials, and published the following:
  - A report titled "Operational and Research Satellites for Observing the Earth in the 1990's and Thereafter."
  - An report titled "EOS Instrument Summaries."
  - An updated original EOS brochure.
  - An EOS acronym list.
  - An EOS Pocket Directory.
  - Original and updated EOSDIS brochures.
  - An EOS brochure.
  - An EOS poster.
  - A set of seven multipage brochures for Code 910.
  - An multipage brochure for Code 920.
  - An EOS Press Package Cover.

TRMM Activities

Staff prepared a report titled "First Meeting of the Tropical Rainfall Measuring Mission (TRMM) Project Science Team May 15–17, 1991;" researched, gathered materials, and prepared a TRMM bibliography;

gathered all TRMM publications and placed them in binders; and gathered materials and published a TRMM brochure.

Staff set up and maintained an EOS science library that contains copies of proposals as well as other EOS related materials and set up and maintained a collection of approximately 400 viewgraphs, and a collection of approximately 300 images.

Task members completed an EOS Presentation Guide in original and updated versions. These are used by EOS personnel and others for giving basic presentations.

Staff attended numerous meetings, i.e., instrument, IWG, Payload Panel and SEC, and prepared and distributed minutes; assisted with EOS activities at numerous scientific conferences; and handled all logistics for the large ISPRS Conference held in August 1992.

Task members initiated a Filemaker Pro data base of all software for the EOS Project Science Office; coordinated production of an EOS video, numerous science posters by students at the Corcoran School of Art, and EOS decals, lapel pins, and magnets; assisted with the EOS Aircraft Program, preparing analyses, attending meetings, coordinating flights; and assisted with numerous educational activities relative to the Dunbar High School Project and the Maryland Initiative.

Remaining Objectives

Staff will begin preparation of an EOS educational package, a set of posters on the different science disciplines, a Code 970 multipage brochure, a MODIS brochure, fact sheets on science disciplines, and will begin updating the EOS AM brochure.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff prepared bimonthly issues of *The Earth Observer*; completed the second printing of 26,500 copies of the EOSDIS brochure; gathered images and text, designed, edited, produced, and coordinated printing for both the EOS and TRMM brochures; completed the 10-minute version of the EOS video; and reviewed final proofs of the EOS AM brochure, which were returned to Waldman Graphics on September 22.

WORK PERFORMED

Staff gathered articles, prepared graphics, edited, prepared, and published bimonthly issues of *The Earth Observer* that are now being distributed to over 8,000 individuals internationally.

Staff completed the second printing of 26,500 copies of the EOSDIS brochure. Of these, 100,000 were printed for PAO and 1,500 were printed for the GSFC Personnel Department. Staff also completed the second printing of the EOS decal and the EOS glossary.

Staff gathered images and text, designed, and coordinated printing of the EOS brochure. Twenty thousand copies have been received, and copies were distributed to key EOS personnel at GSFC and HQ. They also were distributed at the PECORA 12 Conference in Sioux Falls, SD.

Staff gathered images and text, designed, edited, produced, and coordinated printing of the TRMM brochure. Copies have been received and distributed.

Staff completed the 10-min version of the EOS video. It was approved on July 19 by G. Asrar, J. Dalton, B. Price, D. Austin, and H. Ramapriyan. One thousand five hundred copies have been ordered.

Staff received final proofs on the EOS AM brochure from Waldman Graphics on September 21, and returned them September 22. Negatives for this brochure should be received by the first of October at which time it can be printed.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue work on the EOS educational package, the series of seven posters, the Code 970 multipage brochure, the MODIS brochure, fact sheets, and the EOS AM brochure. Staff also will continue to publish bimonthly issues of *The Earth Observer*, and assist with the Aircraft Program and EOS educational activities. A Work Control Plan will be prepared to meet the requirements of this task.

COMPUTER USE

None.

NASA Task 02-008-00: Data Formats Study

GSFC ATR: ***Dr. T. Meyer***

Hughes STX Task Leader: ***R. Suresh***
Hughes STX Task Number: ***055***

The purpose of this task is to prepare technical studies and reports in support of the Earth Observing System (EOS) Deputy Project Scientist for Data regarding various standards including data formats, science terminology, map projections, and data product quality tracking.

FINAL CONTRACT SUMMARY

Hughes STX personnel played a key role in the selection of HDF as the standard data format (SDF) for EOSDIS V0. To identify the standard data format requirements, HSTX staff designed and developed a methodology for the evaluation of various common data formats (CDF's) (e.g., FITS, PDS, CDF, HDF, netCDF, CEOS Superstructure, BUFR, GRIB, GF3, CCSDS P2 family of standards, and Fast Format) used in the Earth science community and science community in general. The analyses of the CDF's and the subsequent recommendations by staff were instrumental in the selection of HDF as the standard data distribution format for the EOSDIS V0 system.

Since the task began in April 1990, HSTX staff has given more than 100 presentations and demonstrations to various projects (SeaWiFS, TRMM, TOMS, and NOAA NESDIS), Pathfinder groups, DAAC's, international agencies (ESA, CCRS, DFLR), and other groups (CEOS WGD, and CCSDS P2) on HDF usage and NCSA tools. HSTX staff has provided user support to implement data sets in HDF to EOS DAAC's, Pathfinder groups, other projects and groups, and science users.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff played a key role in the announcement of HDF as the baseline SDF for the EOSDIS V1 system. HSTX staff continued to play a major role in expanding the use of Hierarchical Data Format (HDF) as the SDF for the EOSDIS V0 system and other projects. Staff continued to provide support for the Pathfinder groups and the SeaWiFS, TRMM, and TOMS projects in resolving HDF implementation problems. Several important issues related to international data exchange, and data model and storage formats were discussed with the CCSDS P2 representatives.

HSTX staff continued to provide support for the SeaWiFS project in developing their data and information system. Staff was involved in developing code and also participated in reviewing and testing code for SeaWiFS product generation.

Staff continued to represent GSFC in international (CEOS WGD and CCSDS P2) and interagency (IWGDMGC) groups and contributed to the discussions on data-related issues. HSTX staff is working toward an "EOSDIS V0 Standard Data Format Implementation Guidelines Document." HSTX staff met all schedules and deadlines required by the task.

WORK PERFORMED

HSTX staff provided HDF technical support to SeaWiFS project data processing and Calibration Validation groups. Staff assisted in the development of HDF and other related software. HSTX staff is developing HDF I/O interface routines to be provided by SDPS to Miami for integration into the level-3 processing software (level-3 bin and level-3 map files).

HSTX staff worked toward the preparation of the "EOSDIS V0 Standard Data Format Implementation Guidelines Document." The outline for the document was discussed with DAAC's and revised. Some parts of the document related to metadata, point data, and gridding were completed and distributed for comments. Staff participated in the EOSDIS Data Processing Focus Team (DPFT) Geolocation Tools Working Group meeting. At this meeting, staff members made two presentations on gridding scheme and point data implementation. Staff represented the NASA EOSDIS project at the USGS SDTS Raster Profile meeting. Staff participated and contributed to the discussions on SDF implementation for the Version 1 system at the joint meeting of the EOSDIS ECS contractor, NCSA, and the GSFC representatives. Staff held discussions with NSIDC representatives about point data implementation.

Staff prepared and distributed the point data paper to the EOSDIS Standard Data Format Working Group (SDFWG). Staff tested Mosaic and the collage interface on SGI with HDF data. Staff members reviewed and discussed EDC AVHRR metadata implementation plans in HDF. Staff members prepared and distributed a paper on HDF metadata implementation to the user community. Staff gave a presentation on Earth science data structure implementation in HDF and organized a demo of Mosaic for the ECS team. The SeaWiFS HDF-CEOS translation proposal was submitted to NASA HQ.

HSTX staff participated in a meeting with CCSDS and TISDIS representatives to discuss data format-related issues. Staff members assisted with the preparation of a paper presented at the Pathfinder Interuse workshop at Boulder, CO, on point data and metadata structure implementation in HDF. Task personnel presented a plan for the implementation of TOMS level-2 data product implementation in HDF for the ozone processing team. Staff made a presentation to the ECS team members on HDF implementation of EOSDIS V0 data sets.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue HDF support to DAAC's, other projects and groups, and provide data structure implementation for the EOS AM instruments. Staff also will update the Work Control Plan for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Outline: For the "EOSDIS V0 Standard Data Format Implementation Guidelines Document"
Contributor: R. Suresh

Paper: On HDF point data implementation
Contributor: R. Suresh

Paper: On metadata implementation
Contributor: R. Suresh

COMPUTER USE

Hours	Computer
120	Sun
40	IBM RS 6000
240	SGI
200	NSSDC VAX

NASA Task 02–009–00: Cryogenic Refrigerator Support

GSFC ATR: ***R. Boyle***

Hughes STX Task Leader: ***J. Marketon***
Hughes STX Task Number: ***056***

This task provides support for development of the XRS instrument in the High Energy Astrophysics area. Support includes development and testing of cryogenic refrigerator systems for X-Ray Spectrometer (XRS) and Earth Observing Station (EOS) instruments, preparation of computer interfaces for each test as required, performance of the test per instructions, and assistance in data reduction.

FINAL CONTRACT SUMMARY

During this task, one electrical/electronics technician and one systems analyst/programmer provided support for a number of mechanical cryogenic refrigerators from several manufacturers, including Stirling Technologies, British Aerospace, Hughes, Lockheed, Texas Instruments, and Magnavox. The support ranged from unpacking the cooler to fabricating custom wiring harnesses and electronic control and monitoring circuits. Additionally, computer systems and networks were installed to support both general operations at the Propulsion Test Site and the mechanical cooler testing program. Software was written, debugged, and subsequently enhanced for operating and monitoring the mechanical coolers. Software was written to perform narrowband harmonic vibration control on the mechanical coolers.

SUMMARY FOR CURRENT REPORTING PERIOD

Task members provided technical assistance to the EOS cryocooler support and development effort. Efforts were directed towards developing hardware and software required for long-term simultaneous testing of multiple cryocoolers.

WORK PERFORMED

100 EOS CRYOCOOLER DEVELOPMENT

Staff installed a temporary connection to the main Code 713 computer network in Building 7, attended the Division 710 ADP Planning Committee meeting, began 2-year ADP requirements planning for Code 713, and completed procurement requests for upgraded PTS Macintosh file server.

Task members completed a procurement request for the Matrix Uninterruptible Power Supply to support multiple cryocoolers in the thermal vacuum chamber, updated portions of LabVIEW, continued modifications and feature additions to software, and identified several bugs in the data acquisition software.

A software development plan was created to guide efforts. Staff completed Division ADP Requirements Planning, continued conversion of software from LabVIEW 2.2.1 format to LabVIEW 3.0 format, and completed preparations for a LabVIEW training course and instructed the course.

Staff also added computer control and monitoring of UPS to the data acquisition software, and added autonomous shutdown capabilities to the data acquisition software.

200 PROPULSION SITE SUPPORT

Staff fabricated a master control electronics unit that simultaneously monitors and controls multiple cryocoolers, fabricated a computer interface for master control unit, began integration of test instruments into equipment racks, installed hermetic feedthroughs into thermal test chamber bulkhead, assisted with the thermal strap testing, fabricated custom cabling required for thermal strap experiment and cryocooler testing, fabricated electronic sequence controller for the clean room recirculator, wired Viotran pressure transducers.

Task members completed integration and testing of test equipment racks for cryocooler testing in the thermal vacuum chamber, fabricated required cable harnesses, installed a silicon diode temperature sensor and heater element onto the coldfinger assembly of a Magnavox Tactical Cryocooler.

Staff also fabricated an electronic control unit for Texas Instruments tactical cryocooler, fabricated a second main control unit for control and monitoring of multiple cryocoolers, fabricated a power supply patch panel for multiple cryocoolers.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be prepared for the task under the new contract. Software development efforts will be continued. Technical support will be continued.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh Centris 650
Dedicated	Macintosh Quadra 700
Dedicated	Macintosh IIcx (3)
Dedicated	Macintosh IIx
Dedicated	Macintosh SE

NASA Task 02-010-00: GORF Software Support

GSFC ATR's: ***J. McGarry and T. Zagwodzki***

Hughes STX Task Leader: ***J. Cheek***
Hughes STX Task Number: ***052***

In support of the Space Geodesy and Altimetry Projects Office at the 1.2-m Telescope Laser Tracking Facility at the Goddard Geophysics and Astronomical Observatory (GGAO), the contractor will:

- *Participate as a member of the Software Design Committee in the design of the new servo/ ranging controller software for the entire 12-station CDP Satellite Laser Ranging (SLR) Network. This system will be developed under the LynxOS operating system and will run on 386/486 computers. (LynxOS is a real-time Unix operating system.)*
- *Develop the new servo controller software for the 1.2-m telescope system following the guidelines established by the Software Design Committee. Software should include programs to track stars, satellites, planets, and aircraft.*
- *Maintain the star, satellite, and planetary tracking programs and supporting software on the Compaq/MS-DOS servo computer.*
- *Support the satellite experiments operationally when necessary.*

FINAL CONTRACT SUMMARY

From April 1, 1990, through September 30, 1991, Hughes STX task personnel completed work on the PDP-11 computer to control the 1.2-meter telescope for tracking stars, planets, satellites, and aircraft. The aircraft tracking program was written by current task members; the star, planet, and satellite programs were left over from an earlier SAR/STX/HSTX task. Task members also integrated the X-Y digitizer for use in satellite and aircraft tracking and for semiautomatic star calibrations. A task member also helped develop the flight computer for the GLRS aircraft experiments. Task members provided input and writeups of various off-the-shelf Unix operating systems for PC's for a presentation to the SLR computer panel headed by M. Pearlman (SAO). Work also began on an interim computer system to bridge the gap between the PDP-11 and the Compaq 386 running LynxOS, and the computer used was a Compaq 386 running DOS.

During October through December 31, 1991, HSTX task personnel participated in successfully tracking the Relay Mirror Experiment (RME) satellite. Task members also made the final modifications to the flight computer for the GLRS aircraft experiments. Most of the hardware for the Lynx system was received, installed, and checked out.

During January through May 31, 1992, three out of four GLRS aircraft experiments were 100 percent successful. More than 12,000 shots were recorded from the 3 successful flights. Also the first operational tracking program running under the LynxOS operating system was completed. Much of this version was discarded after staff found better programming methods. The DOS versions of the STAR CALibration (STARCAL) and SATellite TRACKing (SATTRACK) programs were completed.

The period October 1, 1992, through May 31, 1993, yielded the preliminary release Version 0.1 of the STARCAL program integrated into the monitor program supplied by Allied Signal. This version of the program could only track stars and could not calibrate them.

The following objectives must still be accomplished:

- Integrate and test the STARCAL program at MOBLAS6.
- Integrate and test the SATellite TRacKing (SATTRK) program from MOBLAS6/Allied Signal into the 1.2-meter telescope.
- Install STARCAL and SATTRK programs at HOLLAS, Mt. Haleakala, HI.
- Develop an aircraft tracking program for LynxOS at the 1.2-meter telescope.
- Develop a planetary tracking program for LynxOS at 1.2-meter telescope.

SUMMARY FOR CURRENT REPORTING PERIOD

During this period, HSTX task personnel continued to provide software and general hardware support to the 1.2-meter Telescope Laser Tracking Facility at the GGAO.

WORK PERFORMED

Task personnel have continued modifications to the DOS-based 1.2-meter controller while the last few problems are being resolved. Staff is now continuing its testing of the use of the X-Y digitizer for the STARCAL program running under MS-DOS for eventual integration into SATTRK2 for the upcoming launch of the STELLA laser ranging satellite. Task members will attempt to acquire tracking of this satellite visually at the time of launch. If the satellite is acquired visually, staff will attempt to range to the satellite with the laser.

HSTX task personnel continued the Goddard Laser Tracking Network (GLTN) upgrade of all the task's laser ranging systems' tracking and control computers to PC-based machines running the LynxOS operating system. Task personnel released Version 1.0 of STARCAL, and work began on integrating the most recent version of the MONITOR program from Allied Signal in use at MOBLAS6 at the 1.2-meter telescope. This work was demonstrated at the September Software Design Committee meetings that were also attended by several members of the SLR computer panel. Version 1.0 of STARCAL points at stars and allows selection of various types of star tables for specific use either in calibration or alignment and includes an X/Motif user interface. Two types of star calibrations are allowed, a Kalman filtering method and a batch method. Both methods produce a satisfactory solution for the star calibration at the 1.2-meter telescope. Many other options have also been completed with the Motif user interface, although several have not yet been completed.

Because the STARCAL program is nearly completed, night work has been intensified to accommodate testing of the STARCAL program running under LynxOS.

Approximately 15 meetings were attended at GSFC Building 28, the Allied/Bendix Field Engineering Corporation (BFEC) Aerospace building, and the 1.2-meter telescope.

Systems maintenance and backups were performed as needed.

Staff programmed, tested, and demonstrated Version 1.0 of the STARCAL program for LynxOS at the 1.2-meter telescope.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX task members will produce a Work Control Plan for the new contract to meet the requirements of this task. Work will continue on the integration of the MONITOR program into the STARCAL program, and work will begin on the integration of the SATTRACK program under LynxOS. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Documents: STARCAL flow diagrams
Originator: J. Cheek

COMPUTER USE

Minutes	**Computer**
Dedicated	Compaq 386 PC (four machines)
Dedicated	IBM PC/XT
Dedicated	Apple Macintosh

NASA Task 02-011-00: EOS-PM Support

GSFC ATR: ***P. Hwang***

Hughes STX Task Leader: ***R. Shapiro***
Hughes STX Task Number: ***057***

This task develops EOS-PM spacecraft and operation procedures to meet scientific requirements. The project interfaces with EOS Science Data Information (EOSDIS) project in the areas of development of the ground segment of flight operation system and science algorithm development; the project also interfaces with Code 500 for its institutional support in the area of mission operation. This task will provide systems engineering support for the EOS-PM Project's effort in the area of flight operations and interface (e.g., EOSDIS, Code 500, and Instrument Science Teams) management.

FINAL CONTRACT SUMMARY

Work on this task was performed by one part-time, senior systems engineer. Major accomplishments included the development of the comprehensive report format for the EOS-PM Mission Operations Description Document and the distributed outline for the Data Base Interface Document. In addition, Hughes STX staff supported the generation of the EOS-PM Mission Operations Description Document, the EOS-PM MRR, and the EOS-End-to-End Test Concept Document.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff supported the generation of several documents, including the EOS-PM Mission Operations Description Document, the EOS PM MRR, and the EOS End-to-End Test Concept Document. In addition, HSTX personnel assisted in the review of a number of ECS-related documents.

WORK PERFORMED

HSTX staff supported the generation of several documents, including the EOS-PM Mission Operations Description Document, the EOS-PM MRR, and the EOS End-to-End Test Concept Document. In addition, HSTX assisted in the review of many ECS-related documents, including the FOS Operations Concept, ECS Operations Concept, EDOS/ECOM Requirements, GIRD, IRD between ECS and Code 421/AM Spacecraft Simulator, IRD for Format Control between ECS and Code 421 SDB & IDB, IRD between ECS and Code 421 PI/TM, and IRD between ECS and SCF. Staff also supported the EOSDIS SIT meetings.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work elements will be performed under contract NAS5-32350 as directed by the ATR. A Work Control Plan that meets the requirements of contract NAS5-32350.

COMPUTER USE

None.

NASA Task 02-012-00: Mass Storage Evaluation

GSFC ATR: ***B. Kobler***

Hughes STX Task Leader: ***G. Hull***
Hughes STX Task Number: ***058***

The task will assess capabilities of state-of-the-art, high-performance data storage technologies in the context of the Grand Challenge Applications selected by the Earth and Space Science Project under NASA's High Performance Computing Program. This information will be made available to applications such as EOS and lead to recommendations for the evolution of the ESS mass storage testbed. In particular, the task will measure and assess the following: 1) the performance of STK 4480 tape transports and the STK 4400 Automated Cartridge System, to validate previously determined results from mass storage simulations; 2) the capability of Cray Data Migration Facility (DMF), and perform tuning and parameter adjustments to optimize its performance on the CRAY Y-MP-EL; 3) the capabilities of other high-performance mass storage hardware systems such as RAID disk and HIPPI attached devices, other automated tape disk library systems, and other file storage management software systems such as UniTree and the IEEE Mass Storage Reference Mode; and 4) perform beta test evaluations of hardware and software, collaborating with other national storage testbeds in these activities.

FINAL CONTRACT SUMMARY

Staff (one principle systems programmer) completed development and implementation of two test plans for the high-performance data storage technologies group at GSFC. Each test plan focused on testing available STK tape subsystem libraries (STK 4400 and STK Wolfcreek). The first test began in February 1993 and staff completed it in April 1993, when the STK 4400 Tape Subsystem Library was removed and connected to the CONVEX. The second test period began in June 1993, as a beta test of the new STK Wolfcreek Tape Subsystem Library and because of numerous Cray operating system problems testing is still in progress. Performance characteristics and results from the STK 4400 testing were written for publication and will be presented at the 1993 NASA/GSFC Conference on Mass Storage Systems and Technologies. In addition, staff presented these findings via live videoconference to the NASA supercomputer community in July 1993. Task members delivered special presentation comparing the results of the findings for these tests in August for the management levels of the NASA EOS community and its principle contractors. This is STK's fifth Wolfcreek beta test and it was reported by the STK product beta test manager as their most productive. Local STK management informed N. Palm (Head, Systems Operation and Computer Branch, GSFC) by letter of their appreciation for the hard work and dedication to this project and offered their recognition of exemplary effort. The STK Wolfcreek beta will continue until the Cray operating system problems are resolved. Future plans include measuring the performance characteristics of Cray's DMF and of developing a RAID simulator for use within GSFC's tape environment. Future beta tests also may include the ISO optical tape drive and the ASACA high-speed laser optic drive.

SUMMARY FOR CURRENT REPORTING PERIOD

Task members developed and implemented a beta test plan for testing the STK Wolfcreek Tape Subsystem Library. Testing began June 7, 1993, and will continue. Now, testing is on hold until Cray Research, Inc., resolves a number of outstanding operating system problems discovered during the initial 8 weeks of the beta period. A test plan for monitoring user DMF activity and capturing user performance characteristics is being developed as part of this ongoing study. Staff presented preliminary Wolfcreek test results to the NASA supercomputer group and to key NASA and contract EOS project managers. Previously obtained STK 4400 test results were written and included for publication in the 1993 NASA/GSFC Conference On Mass Storage Systems and Technologies to be held in October.

WORK PERFORMED

Staff wrote more than 100 special measurement tools in C and shell scripts to gather, process, and interpret the results obtained from both tests. These tools ran 24 hours per day, 7 days per week under both controlled and uncontrolled system load conditions resulting in over 40,000 run iterations involving the STK 4400 testing and more than 50,000 run iterations for the STK Wolfcreek testing. The STK Wolfcreek testing originally was scheduled for completion in August 1993; however, as noted above numerous Cray operating system problems were isolated and at the request of GSFC, STK, and Cray personnel, testing is still ongoing to provide Cray adequate opportunity to resolve these problems. The following four problems have been documented and are currently being addressed by Cray personnel in Eagan, MN:

- **SPR 68830 (urgent)**—hung tape unload condition.
- **SPR 68240 (urgent)**—user hung in read operation.
- **SPR 67454 (major)**—bad user code hangs tpdaemon.
- **SPR 63708 (major)**—lost pipe causes IPC timeout. A previous operating system problem also was reported, but was fixed in July when Cray installed level 7.0.5 of the UNICOS Operating System. At the request of Cray personnel, staff developed special test cases as an aid to gather additional UNICOS information to help them better isolate the problems experienced. In addition, task members troubleshot the problems and reported the findings to Cray personnel. The Wolfcreek beta will formally end when all parties agree the reported UNICOS Operating System problems have been fixed. Throughout the beta test period, staff submitted daily log reports and attended weekly teleconference meetings to keep all parties up to date. Task members made numerous suggestions to improve the STK product, all were accepted and are scheduled as future hardware and software upgrade features.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will complete preparation of a Work Control Plan for contract NAS5-32350. The STK Wolfcreek beta test will continue until the Cray Operating System problems are resolved. Future plans include measuring the performance characteristics of Crays' DMF and of beginning the development of a RAID simulator for use within GSFC's tape environment. Future beta tests also may include the ISO optical tape drive and the ASACA high-speed laser optic drive.

DELIVERABLES SUBMITTED

Test Plan: Wolfcreek beta test plan to NASA, STK, and Cray Research
Originator: G. Hull

Test Programs: 100+ beta test programs to implement STK Wolfcreek testing given to NASA, STK, and Cray Research; special test programs written and given to Cray Research to help isolate the numerous operating system problems found during the STK Wolfcreek beta
Originator: G. Hull

Software: 50+ performance measuring and processing utilities to interpret data obtained from STK Wolfcreek beta given to NASA, STK, and Cray Research; public domain software "newping" given to NASA and Cray for installation on the Cray Y-MP-EL; second password utility installed and demo'ed for NASA, HSTX, STK, and Cray Research personnel; remote-shell command processor written and installed on the Wolfcreek Sun for the STK customer engineers; public domain software system resource utility "TOP" given to NASA and Cray for installation on the Cray Y-MP-EL; public domain software and programming language, PERL, given to NASA and Cray for installation on the Cray Y-MP-EL
Originator: G. Hull

Documents: STK Wolfcreek beta update/summary report compiled and given to NASA; 12 weekly STK Wolfcreek beta update teleconferences with NASA, STK, and Cray; results of STK 4400 research were submitted, accepted, and published for the NASA/GSFC Conference on Mass Storage Systems and Technologies
Originator: G. Hull

Presentations: 1 live teleconference presentation of STK 4400 test results tot he NASA Supercomputer community; 1 presentation to NASA EOS management on STK Wolfcreek beta results
Originator: G. Hull

Demonstration: STK Wolfcreek product demonstration to NASA and ESO management
Originator: G. Hull

COMPUTER USE

Minutes	Computer
Dedicated	Sun Model 4/200

NASA Task 02-013-00: Data Formats Study

GSFC ATR: ***T. Meyer***

Hughes STX Task Leader: ***R. Suresh***
Hughes STX Task Number: ***059***

This task supports the Standard Data Format (SDF) task segment of the EOS Data and Information System (EOSDIS). The focus of this task is to assist various projects, data centers, science groups, and users in the implementation and development of the SDF system. The users include the SeaWIFS project, EOS instrument teams, Pathfinder groups, and DAAC's.

FINAL CONTRACT SUMMARY

Even though this task began in December 1992, Hughes STX staff has made important contributions to the implementation of HDF by providing superior technical expertise to various projects, including SeaWiFS and TRMM, DAAC's, and Pathfinder groups. One of the most significant accomplishments was the development of new techniques to resolve the problem of the implementation of the HDF gridding schemes. In addition, the technical approach proposed by HSTX personnel in the implementation of HDF many times resulted in better performance of the code and appreciation of the users. In the case of LaRC, one such suggestion resulted in greater performance enhancement (the processing speed was increased by more than 50 percent).

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff continued to play a major role in the implementation of the EOSDIS SDF. Staff supported various groups of users (e.g., Pathfinder groups), projects (SeaWiFS and TRMM), and DAAC's, in resolving HDF implementation problems. Staff actively participated in discussions related to international data exchange, data models, and format translations with the CCSDS P2.

Staff actively participated in the Pathfinder Interuse meeting at Boulder, CO, and presented a paper on the implementation of Earth science data structures in HDF. Staff also participated in discussions with the representatives from NGDC, NSIDC, and NCSA on the implementation of point data. Staff participated in the Data Processing Focus Team (DPFT) Geolocation Tools meeting at GSFC and presented a paper on gridding scheme implementation. HSTX staff worked with SeaWiFS project staff and assisted them in redesigning their data products in HDF. HSTX staff revised the gridding scheme paper to Version 2.0.

WORK PERFORMED

A teleconference was held with the ATR, the task leader, and representatives from the DAAC's to discuss an outline for the data implementation guideline document. The outline was approved with minor modifications to content and section ordering.

The HDF ASCII dump program "hdfdump" evolved into a full-function dumper for HDF Scientific Data Sets (SDS's), including calibration application. Future development will include similar capabilities for BHDF Raster Image Sets (RIS's) and Vgroups/Vdatas as well as the grid structures developed to support level-3 data.

The paper "Gridding Schemes in HDF, Version 1.0" underwent minor modifications in preparation for its second release for review. Input was received from S. Doescher and M. Hardman on the structure and readability of the paper. Consequently, a new section was added to briefly explain HDF Vset and the general structure under which all the gridding schemes are implemented. Also, a meeting was held with M. Darzi and G. Fu (SeaWiFS Project) to discuss proposed modifications to the SEAGrid gridding scheme. The proposed modifications will enhance the flexibility of the scheme at the expense of a more complicated interface for those data producers/users who wish to take advantage of the added flexibility. Version 2.0 of the paper "Gridding Schemes in HDF" was completed. The new version incorporates many changes recommended by people from various instrument teams, DAAC's, and Pathfinder groups. It was distributed for comments.

Assistance was given to P. Hubanks (MODIS Project) in downloading, installing, and troubleshooting HDF 3.3 Beta 1. The compilation procedure was modified so that the library could compile correctly on Hubanks' SGI machine. Such special procedures are usually unnecessary when compiling HDF, but apparently some discrepancy exists between the test machines at NCSA (and ulabziggy) that compiled the code without modification and Hubanks' SGI.

Research was conducted on the availability of low-cost Unix workstations on the market. Special attention was given to vendors with contracts through the SEWP program at GSFC. On the basis of this research, staff began the procurement process for a Sun SPARCstation LX through the ATR.

A presentation was given at the DPFT Geolocation Tools Working Group meeting. The presentation was based on the paper "Gridding Schemes in HDF" and dealt with the storing of geolocated data in HDF, the EOSDIS V0 SDF.

Staff assisted A. Sigmund (AVHRR Land Pathfinder Group) in the use of the HDF library within a Pathfinder group application program.

Staff worked extensively with the SeaWiFS project to redesign the SeaWiFS level-3 data products. The new design was presented to the GSFC DAAC (at a conceptual level only) and was approved. Staff reviewed formal specifications developed by SeaWiFS project members. HSTX staff also began coding of the SeaWiFS level-3 data product I/O routines as specified by F. Patt. The output routines are approximately 30 percent complete.

Task members helped prepare an HDF tutorial (given by M. Folk [NCSA]) and a demonstration of NCSA Mosaic (given by M. Andreessen and C. Houck [NCSA]) to members of the ECS contractor group and other interested groups.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue to provide HDF support to the DAAC's and other projects and groups. Staff also will complete the of EOSDIS V0 SDF Guidelines document. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Paper: Version 2 of the "Gridding Schemes in HDF"
Contributor: D. Ilg

NONLOCAL TRAVEL

Staff attended and actively participated in the Pathfinder Interuse meeting, Boulder, CO, August 11 and 12.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh
Shared	SPSO, Ulabsun (Sun)
Dedicated	UlabIBM (RS 6000) and Silicon Graphics Workstations
Shared	LTP VAX

NASA Task 03-015-00: GSFC/PLDS Task

GSFC ATR: ***B. Meeson***

Hughes STX Task Leader: ***P. King***
Hughes STX Task Number: ***061***

The objective of this task is to provide technical support for the maintenance and operation of the PLDS data system at the GSFC DAAC and to support the transition of selected data sets and software of the PLDS data system to the EOSDIS V0 DAAC at Oak Ridge National Laboratory and other facilities and institutions as designated. The PLDS data system is intended to manage data and information relevant to the FIFE Information System and other data sets of interest to the land science research community and to provide user access to these data and information.

FINAL CONTRACT SUMMARY

The Pilot Land Data System (PLDS) was built from requirements distilled from several years of planning and debate during which the scope of the PLDS varied greatly. When the PLDS vision was finally brought into perspective by the ATR, HSTX staff was able to build a practical data archival system that could meet the needs of the land data science community and provide comprehensive support for that system. The PLDS has now provided service to the general science community for several years. HSTX staff wrote and maintained the GenSQL query tool, the heart of the PLDS user interface, as well as the ordering, request tracking, automated ftp, batch query, ingest, and distribution subsystems and the staff interface. This user interface and portions of the staff interface were also used for the ARC and JPL PLDS sites. HSTX staff also supported all operational activities of data ingest, data distribution, system administration, and data base administration for the GSFC site. PLDS science and user support were both coordinated by HSTX staff at GSFC, which also provided support for the Landsat Browse Office. The PLDS also provided science and user support for the FIFE and BOREAS Information Systems and the FIFE and BOREAS scientists. When work began on the GSFC DAAC, PLDS became one of the foundation systems for the GSFC DAAC, with the majority of its staff moving to the DAAC and ESDIS IMS tasks. Many elements of the PLDS were used in the design of the DAAC software and data base, and PLDS software has been incorporated into the DAAC system. HSTX staff has been heavily involved with writing the data set documentation, among other activities, for the production of the FIFE Prototype CD-ROM and five-volume CD-ROM set.

SUMMARY FOR CURRENT REPORTING PERIOD

The decision to close the PLDS task was finalized in midsummer. PLDS staff worked toward the completion of the FIFE CD-ROM collection, which included the writing of data set documentation, production of CD-ROM brochures, and data base maintenance activities. In August, an intensive effort began to complete the remaining work necessary for publication, resulting in the completion of Volume 5 in September, with Volume 1 to go to premastering in December. PLDS staff developed a plan with the ATR to transition all PLDS components by the beginning of the 1994 calendar year. The VAX equipment and related peripherals will be sent to Code 923, and all other hardware will be absorbed by the GSFC DAAC. System software, third-party software, and hardware/software maintenance contracts will be transferred as appropriate. A copy of the PLDS software was provided to the ORNL DAAC and will also be sent to Code 923 and COSMIC. Data and related documentation will be transitioned to the appropriate DAAC's or returned to the data producers/PI's. Media containing undesired data will be recycled. PLDS staff will be transitioned to the GSFC DAAC.

WORK PERFORMED

100 PLDS SYSTEM MAINTENANCE

System administration activities for the Sun computers continued, with the removal of old accounts and the clearing of disk space from the Sun 4/280 for use by the GSFC DAAC user services group for the production of CD-ROM's. Work was performed to reconnect the SPARCstation after the move from Commerce II to Commerce I, and its dependence upon the SSC machines was dissolved.

Account management functions on the MicroVAX were all but nonexistant because of decreased activity on the operational system. Some accounts were examined before removal.

300 CD-ROM PUBLICATION

The schedule for FIFE data set documentation/CD-ROM production continued to be modified, until it was determined that the data set documentation must be completed by the end of November for premastering and mastering of the CD-ROM's in early December. A full milestone schedule for all CD-ROM publication activities is now in use that dictates a tight schedule for documentation and the preparation of data sets. To meet this schedule, an Intensive Data Publication Campaign has been implemented that attempts to ensure that necessary resources are made available for the required activities, in particular, the data set documentation. The data sets have been divided into groups that essentially allow 1 week per group with the intent of keeping carryover to a minimum. This involves semiweekly meetings for determining what work is entailed for the coming week and what remains to be done from the previous week, as well as several intraweek deadlines for the review of documents. PI's are made aware that they are oncall during the week that their data sets are being worked on. Documentation work is also coordinated with data reformatting and data dictionary modification activities.

PLDS staff continued interaction with FIFE PI's in updating data set documentation, requesting that they finish reviewing their data documents. The following documents were revised: Exotech Transect data, FIFE Site Reference, Digital Elevation Model data, Digital Terrain Model data, Miscellaneous Geographic Reference data, Brutsaert Radiosonde data, Temperature and Humidity Profile data, Radiosonde Wind Profile data, Wind Profile Lidar data, UNL SE590 Reflectance Factors and Radiances data, GSFC SE590 Reflectance Factors and Radiances data, and Helicopter SE590 data.

Several drafts of the FIFE Volume 5 CD-ROM Brochure were written by PLDS staff and reviewed by FIFE.

PLDS staff installed Oracle Version 6 on the FIFE/BOREAS Tasha MicroVAX and created a data base for reformatting the FIFE data set and data dictionary tables for the CD-ROM effort. FIFE tables were imported into the new Tasha data base for final preparation for the CD-ROM's. The Data Set Chart Documentation data base report was revised for the generation of charts to be included on the CD-ROM's.

The data and documentation for FIFE CD-ROM Volume 5 were sent for premastering, with the exclusion of the DEM and the Miscellaneous Geographical Reference, which were not ready.

400 FIFE DATA SET IMPLEMENTATION

The implementation of FIFE data into the PLDS had been on hold for several months, when the decision was made to shut down PLDS by the end of the calendar year. Further integration of data into the PLDS has been canceled.

PLDS staff attended FIFE Group meetings, where efforts continued toward completion of the FIFE Information System.

500 USER SUPPORT

User requests from FIFE and BOREAS scientists and other users were filled for PLDS and FIFE documents and data, science assistance, and information for using the PLDS application, FIFE Information System, querying the data base using SQL, and using the BOREAS Communication System. Staff also assisted users with information concerning the FIFE CD-ROM's and with CD drive equipment and software. Staff distributed items including the FIFE Prototype CD-ROM and Interface, FIFE Experiment Plan, and FIFE Interim Report, FIFE papers list, a tutorial on how to use SQL in the FIS, and the BORIS-CS quick reference guide. For June and July, PLDS staff completed 31 user requests for BOREAS information (data, documentation, software) and 78 user requests for FIFE information (among which were 23 requests for FIFE CD-ROM's, for a total of 82 CD-ROM's mailed). The majority of responsibilities for user support of the FIFE Information System, BOREAS Information System, and the PLDS was transferred to the GSFC DAAC User Services group.

600 DATA INGEST AND DISTRIBUTION

There will be no further ingestion of data into the PLDS. Distribution of requested data and documentation is now facilitated by the GSFC DAAC User Services and Operations groups.

700 BOREAS INFORMATION SYSTEM SUPPORT

PLDS staff attended the BOREAS Group weekly meetings and the BOREAS Information System meeting, where the status of the projects and required actions were discussed. PLDS staff also attended Auxiliary Site meetings for the BOREAS project.

Communications continued with the Canadians on the creation of GIS forest cover maps for the northern study area in BOREAS. Staff helped BOREAS personnel determine what Air Photos they need to have Aerial Photo coverage of their study areas.

Help documentation was written for the PLDSG3 Anonymous FTP account, which BORIS plans on distributing to their users. Help documentation was also written on how to use the NPSS, from Canada, to connect to the PLDS operational machine.

800 PLDS TRANSITION

In mid-July, it was decided that the PLDS task will terminate by the end of the calendar year. Discussion was pursued with the ATR on the entailment of plans to transition all PLDS components to various organizations. A summary plan was written for the transition of all PLDS components.

The PLDS VMS and Unix baselines were examined for packaging scenarios for transmission to COSMIC. The data bases were examined for possible inclusion of sample data with the baseline archive backup.

The VAX/VMS documentation was boxed for shipment to Code 923.

PROBLEM AREAS

The effort in writing documentation for the FIFE CD-ROM's has continued to be slowed by delays in obtaining information and documentation reviews from FIFE scientists. PLDS staff has begun performing FIFE data base activities in order to enable FIFE personnel to attend to other matters concerning CD-ROM publication.

PLDS staff is under pressure to complete the FIFE documentation in a short time frame (approximately 96 documents for CD-ROM Volume 1 in 4 months; it takes at least 5 man-days on the average to research and write up a FIFE draft document, not counting the delays that occur because of investigator reviews).

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The rectification of cross-referencing inconsistencies between the PLDS and FIFE data bases may be resumed in the future.

The documentation for FIFE CD-ROM's Volumes 1 and 5 will continue through early December.

PLDS staff will continue to assist FIFE personnel in reformatting data set tables and maintaining the associated data dictionary.

A milestone chart for PLDS component transition will be completed.

Updated samples of FIFE data base tables may be sent to the ORNL DAAC when the remaining table updates have been completed.

The following are the current plans for transition of the PLDS data holdings:

- ASAS tapes—The 8-mm media will be returned to J. Irons if desired, or sent to the rehab center otherwise.
- FIFE data tapes and video tapes—If ORNL DAAC personnel desire the tapes, they will be packaged and shipped to them. If not, if Code 923 staff desires all the tapes, they will be sent to Bldg. 22. Otherwise, all the tapes will be sent to the rehab center.

- FIFE CD-ROM's—A complement of CD-ROM's will be sent to Code 923 (about 100 sets), and the rest to the ORNL DAAC, along with a copy of the FIFE PR masters. Copies of the artwork and brochure for each CD-ROM will be sent to both organizations.
- FIFE hardcopy documents and files—If ORNL DAAC personnel desire the documentation and files, they will be packaged and shipped to them. If not, if Code 923 staff desires all of them, they will be sent to Bldg. 22. Otherwise, all will be sent to the rehab center.
- FIFE metadata and online documentation—If ORNL DAAC staff desires the metadata and online documentation, the data base tables will be dumped to ASCII files and all files electronically transferred to them.
- IDS-LSC AVHRR and MMS—If EDC DAAC personnel desire the AVHRR tapes, the tapes will be sent to them; otherwise, the tapes will be sent to the rehab center. All MSS tapes will be sent to the rehab center.
- Miscellaneous data—All uningested media will be sent to the rehab center.
- Optical thickness—If GSFC DAAC staff desires the data and documentation, they will be transferred to the DAAC. If not, if the data provider desires the media and documentation, they will be returned to them. Otherwise, all data copies will be sent to the rehab center.
- SMMI and SMMR snow cover—If NSIDC DAAC and/or A. Chang desires the data and documentation, they will be sent to them; otherwise, all data and documentation will be sent to the rehab center.
- SMMR vegetation index—If GSFC DAAC and/or the data provider desires the data and documentation, they will be sent a copy. Otherwise, all will be sent to the rehab center.
- TM A-tapes, Tips P-tapes, and photos—Staff has yet to determine how to transfer these holdings.
- PLDS metadata—If ORNL DAAC staff desires the metadata, the data base tables will be dumped to ASCII files and electronically transferred to them.

The following are the current plans for transition of the PLDS hardware: the MicroVAX 3900 and the VAXStation 4000-VLC along with all peripherals and communication components will be sent to Code 923, and the Sun 4/280 and SPARCstation IPC and all attendant peripherals will be sent to the GSFC DAAC User Services Department.

A copy of both the Unix and VMS baseline will be packaged with documentation and sent to COSMIC.

The following are the current plans for transition of the PLDS documentation: Data set user guides will be sent with the data; software users documentation will be sent to COSMIC with the software; and all VAX/VMS manuals and a copy of the Multinet, Oracle, and Thruway documentation will be sent to Code 923. TAE documentation will be sent to ARC personnel if they want it.

850 User Support

It is not yet known how science and user support for the FIFE and BOREAS projects will be transitioned.

860 Training

It is currently unlikely that any training in the support or use of the PLDS or FIS will be required. A Work Control Plan will be prepared.

DELIVERABLES SUBMITTED

Table:	Remaining data sets to be documented and estimated time to complete the documentation (approximately 370 man-days from the end of July)
Originators:	P. Agbu and J. McManus
Draft Documents for CD-ROM Volume 5:	Second draft: Geosynchronous Operational Environmental Satellites data, Landsat Level-3 Greenness, Landsat Normalized Difference Vegetation Index, and NS001 Thermatic Mapper Simulator data, completed First draft: Digital Elevation Model data, Miscellaneous Geographic Reference data, Derived Digital Terrain Reference data, Multispectral Atmospheric Mapping Sensor data, SPOT Normalized Difference Vegetation Index data, FIFE Site Reference data, and Composite Soil Moisture Maps, completed Draft revisions: Geosynchronous Operational Environmental Satellites data, Landsat Thermatic Mapper Simulator NDVI data, Landsat Thermatic Mapper Simulator Greenness data, SPOT High Resolution Visible NDVI data, Multispectral Atmospheric Mapping Sensor data, NS001 Thermatic Mapper Simulator Reflectance data, and Soil Moisture Map data
Originators:	P. Agbu and J. McManus

COMPUTER USE

None.

NASA Task 02-745-00: DTF Support

GSFC ATR: ***P. Shu***

Hughes STX Task Leader: ***R. Kaipa***
Hughes STX Task Number: 556

This task supports the Detector Test Facility (DTF) with characterization and testing of the ASA & BIB detectors, maintains and improves the Detector Data Acquisition Program (DDAP), and assists in hardware, software, and analysis during the BIB & ASAS detector testing. This task also helps temporarily with the acquisition and analysis of data for EDOP (Doppler radar) group. Finally, this task supports the development and characterization of low-noise silicon JFET's, modeling of future JFET geometry for higher yield, and collaboration with the Naval Research Laboratories on semiconductor structure development efforts.

FINAL CONTRACT SUMMARY

This task was initiated in March 1990. Hughes STX staffed this task with two full-time staff personnel with expertise in real-time software and laboratory data acquisition system development, as well as detector development and characterization. Additional staffing was provided on an as-needed basis for laboratory hardware development work. Detector data acquisition systems were developed to acquire, analyze, and characterize CCD detectors for several programs. Laboratory support was provided for the development and characterization of several detector (JFET's, CCD detector arrays, Metal Semiconductors, and Metal Photodetectors.)

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX provided software, hardware, and testing support to run computer systems at the Detector Test facility; participated in laboratory and field testing of the experiments; developed and tested the Metal Semiconductor Metal (MSM) photo detectors and two types of silicon CCD detector arrays to work as interline transfer and as frame transfer devices.

WORK PERFORMED

The Macintosh Detector Data Acquisition Program (DDAP) has been enhanced to support new requirements and new features were added. These features include: CCD defect table processing and display; options to store single frame, reference frame, or a full data set in a variety of formats to the disk; ability to store in format expected by the CSHELL program running on the Sun SPARCstation; and an improved menu structure and user interface. Because of these changes, these data collected on Macintosh can be displayed on CSHELL programs via a disk file in real time. In addition, pre and postprocessing of the detector data are made simple with more powerful ability to "clean up" the images. HSTX staff and Government personnel attended the Technical Fair sponsored by the Armed Forces Communication and Electronic Association (AFCEA) in Washington, DC, and displayed a visible CCD Camera System. HSTX personnel also attended the community day at GSFC to display the CCD camera system.

Task members are involved in the development of MSM photo diodes from GaAs material. This task involves fine line (1 μm) lithography, reactive ion etching of gold and titanium metals, and picosecond optical impulse measurements on the detectors built to verify and further improve the operations. Staff are also involved in development of two types of silicon CCD detector arrays with interline and frame transfer capabilities. This task involves lithography, etching of silicon and polysilicon, deposition, and etching of aluminum contacts.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

HSTX staff is expected to continue supporting the computing systems, detector testing, and analysis with possible nonlocal travel to attend meetings and for technical exchange. Task personnel will continue with development and testing of photo detectors and CCD's.

NONLOCAL TRAVEL

Task personnel travelled to the Hawaii Infrared Telescope Facility with GSFC personnel to discuss collaboration in IR and visible CCD camera development, attend meetings, and participate in technology transfer programs.

COMPUTER USE

None.

NASA Task 02-749-00: Semiconductor Laser R&D Support

GSFC ATR: ***D. Cornwell***

Hughes STX Task Leader: ***A. Yu***
Hughes STX Task Number: ***560***

This task provides Research and Development support to Codes 715 and 924 in the development of high-power semiconductor lasers for lidar and laser ranging.

FINAL CONTRACT SUMMARY

This task was initiated in June 1993. A Hughes STX scientist was assigned to perform research and development of semiconductor lasers. Task personnel investigated the modulation characteristics of a discrete master oscillator power amplifier (MOPA) laser aimed for coded laser ranging application. These devices are candidate sources for laser remote sensing of atmospheric constituents such as water vapor, using the techniques of differential absorption lidar (DIAL) in conjunction with pseudo-random (PN) code intensity modulation techniques. Generally, the large-signal intensity modulation (IM) of the master oscillator in MOPA results in large-signal frequency modulation (FM), thus moving the laser frequency off of the absorption lines of the desired atmospheric constituent. These undesirable FM were successfully suppressed during large-signal IM by direct current modulation of the power amplifier.

Task personnel are in the process of investigating the modulation characteristics of a monolithic MOPA laser for similar applications. In addition, a semiconductor laser system is being implemented, which consists of a monolithic MOPA and a flared semiconductor laser power amplifier. The objective is to produce a multiwatt PN-coded signal for use in laser ranging.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff designed a thermally and mechanically stable mount for the MOPA laser. Task personnel successfully tested and characterized the MOPA laser under continuous wave and modulation operating conditions, and studied the modulation characteristics of the power amplifier on a discrete MOPA laser.

WORK PERFORMED

Hughes STX personnel evaluated the performance of several new laser devices obtained from SDL by Code 715. These state-of-the-art semiconductor lasers need to operate in 10° C environment. One obstacle encountered is the humidity in the laboratory. Condensation on laser mounting plates or even on the laser facet will cause significant damage to the devices because of the low operating temperature requirements of the MOPA laser and of the tapered traveling wave amplifier (TWA) (7.5° C). We have fabricated and modified some existing Plexiglas enclosures for the lasers and used a dehumidifier to minimize the humidity. The mounting hardware for the TWA was fabricated and water cooling channels were added for more efficient heat removal from the device.

HSTX staff studied the modulation characteristics of the power amplifier in a discrete MOPA laser. Reduction of frequency modulation was observed while having chirp-free intensity modulation of 71 percent. The modulation rate was 100 MHz and a 143 NW peak diffraction of limited power was obtained. Task personnel are in the process of preparing a technical paper for submission to a referred journal for publication.

Task personnel have designed an experiment to investigate the intrinsic frequency response of a semiconductor laser. The technique injects light from a probe laser into a test laser causing a nonlinear process known as four-wave mixing to occur inside the test laser because of the presence of the probe laser. The four-wave mixing signal is detected and data are collected by a Macintosh data acquisition system. By fitting the theoretical model to these data, valuable information on the lasers can be extracted. Two mechanically and thermally stable stages for the lasers were implemented.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contact has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX personnel will continue work on the modulation characteristics of the monolithic MOPA laser and other semiconductor lasers; develop a computer model on the MOPA laser; and work toward the goal of producing an all-semiconductor laser breadboard capable of delivering a multiwatt PN-coded signal for use in laser ranging.

A Work Control Plan will be updated for the new contract to meet the requirements for this task.

COMPUTER USE

None.

NASA Task 12-021-00: Neutral Mass Spectrometer Programming and Data Processing

GSFC ATR: *Dr. W. Kasprzak*
Cognizant NASA Scientist: *Dr. H. Niemann*

Hughes STX Task Leader: *P. Maenner*
Hughes STX Task Number: *150*

This task provides programming, maintenance, and data processing support for the Pioneer–Venus (PV) Orbiter Neutral Mass Spectrometer (ONMS) on the PACF computers. The work includes developing original programs to display, analyze, and archive the flight experiment data. Other major areas of work include testing and modifying programs to ensure compatibility of data and processing programs, and processing and archiving of experiment data. The work also includes support for the transport, display, and analysis of data on personal computers (PC's).

FINAL CONTRACT SUMMARY

This task began in October 1988. Over the life of the task, one data technician (full time until January 1993, then part time), one full time programmer/analyst (since September 1991), and one principal programmer/analyst have worked to achieve the major aim of providing computer programming and production data processing support for the ONMS instrument flown aboard the PV mission, which ended last October after 14 years and more than 5,000 orbits around the planet. New computer software and graphics applications were developed to support the ongoing research activities of the ATR into the composition and dynamics of the Venus neutral atmosphere. Major programming and processing support was provided in the fall of 1992 during the critical end-of-mission period in which the satellite re-entered the lower atmosphere of Venus for the last time. New software, including the Kaleidagraph and Deltagraph applications, were learned and applied to the Macintosh computer, leading to major improvements in the preparation of computer graphics, such as color plotting and 3-D plotting. Support was provided, and acknowledgements were received, for many papers by the ATR that were published in journals like *J. Geophys. Res.*, and presented at conferences such as AGU.

Staff will continue support for the ongoing Venus atmosphere research activities conducted by the ATR under the NASA-sponsored Venus Data Analysis Program (VDAP).

SUMMARY FOR CURRENT REPORTING PERIOD

A linear regression module was added to a general plotting program, allowing the ATR to fit any arbitrary linear function to the data points. A staff programmer and a server computer were moved from GSFC to the Commerce 1 building, which resulted in some network performance problems. Staff copied PV data from 9-track tapes onto optical disks; planned, with another HSTX employee, to network a central data base for branch 915; prepared five-panel plots of standard deviation vs. altitude for ONMS He, N, O, N_2, CO_2; produced plots of neutral density standard deviations comparing old and new data between .5 and 4.5 hours local solar time; created plots of superthermal ion data from MAX files for all orbits 1–5055; completed microfiching; and performed regular backups and processing of data.

WORK PERFORMED

100 CONVERSION SOFTWARE

Staff wrote a batch program to re-create all of the outputs to the reformat program for all orbits from 1–3990. This step was necessary because staff is unable to locate these files on tape for backup to optical disk.

200 GRAPHICS SOFTWARE

Staff prepared a five-panel plot of standard deviations vs. altitude for ONMS He, N, O, N_2 and CO_2. Each panel shows density standard deviations, with error bars at 5 km intervals, along with the standard deviation of the count rate from data file ESTSD.DAT. A second five-panel plot was created using a log scale for the y axis.

Task members produced plots of neutral density standard deviations for He, N, O, N_2 and CO_2 showing the old data, for local time, 0.5–4.5 hours. Staff obtained some statistics on the standard deviations to compare old and new data, above 145 km, and also fitted straight lines through the new data, below 162.5 to get slope of the lines.

Staff prepared a two-panel plot displaying O and CO_2 standard deviations with error bars and triangle symbols denoting the count rate standard deviation data.

Plots were prepared showing ONMS superthermal ion data from the MAX files. Plots of altitude vs. counts for O_2+, N_2+, NO+, and CO_2+ were made for all PV orbits in the orbit range 1–5055.

A program to draw the boundaries of the auroral disk on a map of Earth for various levels of solar activity was developed. The ATR needed this information to determine whether or not the TIMED satellite would intersect this disk.

Staff developed a program to plot the sensitivity vs. the pressure for old data from test instruments.

300 ANALYSIS SOFTWARE

Task members completed the addition of general linear regression capabilities to the GENPLOT program. This allows the ATR to perform curve fitting of data from within this program.

400 DATA PROCESSING

The data technician restored more than 300 EDR files used in PROC_ION reprocessing; produced ion plots for orbits (2000–4600), and backed up reprocessing with the IONBACK program. The data technician completed processing of ion mode orbits; created and maintained a summary report for all completed reprocessing; reorganized microfiche for a new storage area, as requested by ATR; modified backup and cleanup batch files for the task; and archived the processing through following methods: Tape backups of processing, microfiche of plots, and a detailed tracking form. The technician also made preparations for microfiche to be sent out for duplication. Over 8,000 pages of ion processing will be microfiched. The data technician has been working with the programmer on the task of restoring 9-

track data to optical disk over the network. The technician spent 6 hours in the library doing research for the ATR, in preparation for a new publication.

500 GENERAL SUPPORT

A staff member attended a 1-day session at the AGU in Baltimore to hear a PV talk given by the ATR and members of Code 914. Several plots produced by the task were used in these AGU presentations.

Staff acquired and will be evaluating the Khoros scientific visualization software.

A new computer system was set up and the archiving data to optical disk began. The task leader, along with the new system, was moved to the Commerce 1 building. Copying of tapes over the network is proceeding.

A staff member, along with another HSTX personnel, studied the feasibility of setting up a central file server for the users of MS-Windows applications in Code 915 to meet stricter version control demands. A small trial was set up using PV's new computer as the server, which yielded positive results.

The programmer set up a print queue on his offsite computer that all of the other offsite contractors may use.

SIGNIFICANT ACCOMPLISHMENTS

The data technician completed archiving of ion mode processing of 5,000 orbits.

PROBLEM AREAS

The move to the Commerce 1 facility has shown that the T1 data communications link between GSFC and Commerce 1 is inadequate for the demands placed upon it. The result has been a slowing of the task's main goal of the moment—the copying of data from old 9-track tapes onto optical disks. The rate of copying is such that this task, which would have taken about 2 weeks at GSFC, will take about 2 months offsite. In addition to this main goal, two other important functions have been made impossible. Firstly, staff had planned to do backups onto optical disk instead of tape from now on, which now appears impractical. Secondly, staff had planned to increase our disk space on the VAX by mounting the new computer's disk onto the VAX over the network, which now seems unworkable because of the slowness of the data transfers. In addition to the bandwidth problems, a problem with the mounting of tapes to be copied over also exists. As of August 20, 1993, the data technician left the task. Now, the programmer must mount the tapes, which is cumbersome because the programmer must commute to GSFC to do so. In addition, the programmer cannot simply stay at GSFC in the terminal room; occasionally a different optical disk must be mounted on the server, which is at the programmer's offsite office.

On a more positive note, one bandwidth related problem has been solved. When staff first started dumping large amounts of data over the network, they unknowingly saturated it. Network users were not able to do any work until the problem was tracked down and the copying stopped. This problem was solved in two ways: First, staff began copying large amounts of data at night, and second, the programmer did some research into the NFS protocol and discovered that the minor timeout value had to be increased on client machines when going over a slow network. With these changes made, staff no longer saturated the network, even during the day. Staff still perform large amounts of copying in the evening. It has been decided to move the server back to GSFC, which will solve all data transfer rate related problems.

SCHEDULE CONFORMANCE

Work on this contract has been completed. Work will continue as planned except for the data archiving on contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Programming, analysis, and data processing will continue in support of PV-ONMS research activities. It is expected that archiving will be completed.

A Work Control Plan that meets the requirements of contract NAS5-32350 has been completed.

DELIVERABLES SUBMITTED

Plots: Many standard deviation plots, including five-panel plots and a two-panel plot, with error bars
Originator: J. Selekof

Plots: Plots of the auroral disk and plots of the sensitivity vs. pressure were made
Originator: P. Maenner

COMPUTER USE

Minutes	Computer
48,000	PACF VAXcluster
1,000	Macintosh II Si
6,000	Macintosh II Ci
48,000	486 server 415

NASA Task 12-022-00: Mass Spectrometer Systems Engineering, Analysis, Laboratory, and Documentation Support

GSFC ATR: *D. Harpold*
Cognizant NASA Scientist: *Dr. H. Niemann*

Hughes STX Task Leader: *J. Westberg*
Hughes STX Task Number: *151*

This task provides engineering, analysis, laboratory, and documentation support for the development of Galileo Probe Mass Spectrometer (GPMS), the CASSINI GAS Chromatograph MASS Spectrometer (GC-MS) instrument, and the CASSINI ION Neutral MASS Spectrometer (INMS) instrument.

FINAL CONTRACT SUMMARY

This task existed over the lifetime of the contract. The work was performed by one senior scientist, one senior systems engineer, one systems engineer, two senior engineers, one software engineer, one engineer, and one data technician on part-time to full-time basis.

Many major milestones and accomplishments were performed over the lifetime of this task. Timely and effective support was provided to the Principal Investigator (PI), ATR, and Instrument Managers in the preparation of various NASA proposals, project documentation, and presentations. New software was generated for the design and development of the ION Neutral MASS Spectrometer (INMS) calibration system and to facilitate data acquisition in the laboratory. Data compression schemes were devised for instrument data and new software was researched and acquired for GC column studies. Studies were performed on GC columns, GC column heating, and column separation techniques. Timely design and engineering support was provided using AutoCAD, Autoshade, and 3-D design software. Suitable software was located to provide a user-friendly information system for parts and materials inventory tracking.

Task personnel showed a continual interest in professional development by submitting papers and participating in company and Government training courses, conferences, and seminars.

Remaining objectives include the development of a GCMSD laboratory calibration system, the final selection of appropriate GC columns for the GCMS instrument, continuing enhancement of laboratory data acquisition software, finalization of the flight instrument data acquisition scheme, the implementation of a user-friendly parts and materials data base for inventory and tracking of flight parts and materials, and provision of appropriate information to management on the status of instrument development.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff constructed twelve micropacked capillary columns containing porous carbon, zeolite, and polymer as stationary phases. Staff also made a technical presentation to the ACP/GCMS Interface meeting participants that resulted in the decision to use metal capillary columns for the space instrument. Realistic power estimates were made for the GC heaters by using experimental temperature requirements for the heaters. A HSTX staff member participated in discussions on "Understanding Separations by Prepared Liquid Chromatography," held in Rockville, MD, and submitted a paper on

"Chromatography for Space Sciences," that was accepted for presentation at the Federation of Analytical Chemistry and Spectroscopic Society meeting held in Detroit. Staff investigated the feasibility of developing narrow bore wall coated open tubular columns and identified a new software package PROEZGE that will apply to modeling the various chromatographic variables. Features were added to the Data Acquisition software in three general areas: enhancements to the 2-D plotting library, generalizing the CAMAC voltage control routines, and adding LeCroy 1445 voltage controller to the voltage control routines. Staff wrote a general purpose gauge routine to allow the user to monitor a variety of devices using a thermometer-type gauge. Staff wrote routines for Savitzy-Golay digital filtering and determining the Pulse Height Distribution (PHD) for the detectors. Staff connected and timed the EXTRELL Quadrupole Mass Analyzer to the laboratory mass spectrometer system and modeled and tested the AD737 RMS-DC converter and the ISO 100 isolation amplifier in the laboratory. Staff also redesigned the laboratory operational amplifier boxes to accommodate various safety features. Staff developed and presented to the PI and ATR, a Windows-based data base applications along with Microsoft ACCESS to support the instrument parts and drawing inventory. Microsoft ACCESS was also tested for networking the parts data base. Staff located and obtained three multiport network transceivers from access property for use in the parts data base network, and activated and satisfactorily tested the Control Power Company Uninterruptable Power Supply. The vacuum manifold for the ion source test stand was designed by staff in minimum time. A 3-D simulation was set up for the dual quad switching lens. Staff presented a data handling scheme, which was well received at the SPRL/GCMS Descent Strategy meeting held at GSFC. Task members completed a 3-D dual switching lens simulation, optimization of an OS/2 setup, evaluation of the GCMS data compression, starting up of a new simulation for the calibration gun, and setting up the Sun SPARC Classic Workstation. The HSTX engineering design staff completed designs of the housing flange, the five ion source housing, and the design of the GCMS horizontal manifold. Staff also updated the GCMS and INMS monthly instrument development schedule and EID Part B Issue 1, Revision O, dated August 11, 1993.

WORK PERFORMED

100 PROGRAMMING, ENGINEERING, ANALYSIS AND LABORATORY SUPPORT

120 Laboratory Support, Engineering and Data Acquisition

Laboratory GC Column Studies

Staff examined a mathematical relationship between the flow of gases in a GC column and linear gas velocity for capillary and packed columns.

Staff constructed 12 micropacked capillary columns containing porous carbon, zeolite, and polymer as stationary phases. The column dimensions varied from 0.5-mm to 0.75-mm (internal diameter) with lengths of 0.5 to 1 meter. Pore size varied from 5 Angstroms to 20 Angstroms.

Discussions were carried out with the PI, ATR, and a Coinvestigator concerning GC columns with respect to ACP and ACP/GCMS experiments. For this purpose, a technical presentation was made to the ACP/GCMS Interface meeting participants. This meeting resulted in the decision to use metal capillary columns for the space instrument. In response to an action item, the feasibility of narrow bore silicon steel capillary columns (0.18-mm) was ascertained. For this innovation, quotations were obtained from a stainless steel vendor that specializes in constructing tubes with 0.15-mm and 0.18-mm internal diameter. Because these columns will be constructed according to the specifications established by the staff member, sustained efforts are in progress including the procurement of these custom-designed columns. Extensive research and development work is in progress by ascertaining the influence of internal column diameter on flow rate. The effects of changing tube diameter, column length, film thickness, type of carrier gas, and the column outlet pressure were computer simulated for obtaining minimum plate height, analysis time, and corresponding column inlet pressure for a component (C3), under study. This work involved an intensive study and mathematical analysis of the Golay-Gidding equation.

Staff also conducted experiments on di-methyl silicone column with 10 m (L) and 0.28-mm (i.d.). Twenty components comprising of normal acyclic, aromatic hydrocarbons, nitriles, and permanent gases in nitrogen were chromatographically resolved at several isothermal temperatures ranging from 30° to 65° C. Two different flow rates, 0.9 ml/min and 2.0 ml/min were used to obtain differences in the retention time of the components analyzed during this work. The results revealed that 1,2 di-methyl benzene is significantly effected by lower isothermal temperatures. Because the experiment analysis for the time and for a sample in space flight will be 15 minutes each, the minimum isothermal temperatures required to analyze higher molecular weight components were determined. These results were discussed with the PI and ATR.

GC Column Data Analysis

Data analysis of the experiments conducted in the laboratory were carried out to obtain retention times for the analyzed components. Subsequently, thermodynamic retention indices will be obtained by modeling the GC parameters.

GC Software

A new software package PROEZGC from Analytical Innovations was identified, received, and examined for application in modeling the chromatographic variables, time, temperature, length (column), linear gas velocity, type of carrier gas, and its influence on the band width of analysis. For this purpose, an IBM PC/AT was installed with the hardware enabling key of PROEZGC that will be used as an application for GC modeling. With the assistance of another HSTX staff member, several megabytes of hard disk space were made available by freeing up the existing disk space.

GC Heaters

To resolve a power constraint of the GC heaters, staff made realistic power estimates using experimental temperature requirements for the columns. The power consumption is expected to amount to 25 watts-hours or less.

Ion Trap Mass Spectrometer

Staff recalibrated the ion trap mass spectrometer by tuning the mass scan optimizing potentiometer and systematically checking the GC-MS system and MS subsystem calibration performance. Mass-to-charge (m/2) from 10 to 150 a.m.u. were observed in the background. A new silico steel column with dimensions 10 m x 0.28 mm; stationary phase MST-1 was interfaced with the mass spectrometer. Experimental preparations involved establishing accurate flow of carrier gas to obtain the gas hold up time. A 12-component hydrocarbon mixture diluted by Nitrogen was used to characterize the GC column. Experiments were carried out at isothermal temperatures of 30° C. Identification and mass spectral characteristics for hydrocarbons were obtained by using diagnostic ions and their retention times.

Professional Development in Chromatography

A task member participated in a discussion entitled "Understanding Separations by Prepared Liquid Chromatography," held in Rockville, MD. This task member also submitted a paper entitled "Chromatography for Space Science," which was accepted for presentation at the Federation of Analytical Chemistry and Spectroscopic Society meeting to be held on October 17–22, 1993, in Detroit, MI.

Data Acquisition and Analysis Software

Staff added features to the Data Acquisition software in three general areas: enhancements to the 2-D plotting library; making the CAMAC voltage control routines more general; and adding LeCroy 1445 voltage controllers to the voltage control routines.

2-D Plotting Library

The 2-D plotting routines were enhanced so that these data can be described as raw data plus a transform function. These features are currently being used for various mass scan plots such as voltage vs. signal, mass vs. normalized signal, mass vs. log signal, and other relationships. Also, the general least squares solution from Numerical Recipes in C was adapted for Windows. These routines will be used to fit data to an n-order polynomial for mass and voltage calibrations.

With the addition of the mass calibration and several features used in managing multiple, overlaid scans on a single graph, the mass scanning portion of the software is now fairly complete. Staff also used the mass scanning routines in a separate program to automate the time course experiments that another (Code 915) laboratory member was supporting.

Staff added printout capability to the graphics library. Now data acquired (mass scans) PHD's can be plotted on any Microsoft Window-supported printer.

CAMAC Voltage Control Routines

Staff defined a set of properties such as hardware address, minimum, maximum, and calibration (slope and intercept) for D/A voltage controllers and implemented the LeCroy, Joerger, and DSP voltage controllers that are used for scheme.

Staff added mass calibration and voltage optimization and other enhancements to the Data Acquisition software. In addition, staff completed the migration from visual basic to a standalone, native Windows program, written in C.

The voltage optimization section allows the user to select from three different methods of voltage optimization: single, multiple, and sequential. All methods provided real-time display of the voltage that was scanned. The single method simply scans a voltage range and finds the maximum signal output over the range. The multiple method provides a multidimensional approach (currently only implemented with two voltages, yielding a 3-D plot using IDL) in which the signal is measured at every voltage combination. This method can be time consuming because it requires taking N2 readings. The sequential method is a different approach for finding the optimum signal for several voltages. Each voltage is scanned and set its optimum value. This process is repeated for n iterations. For voltages that are not strongly interdependent, the optimum can be found in few iterations, greatly reducing the time. A version of Nelder and Mead's downhill simplex method was coded and tested using simulated data and the approach appears promising. The method will be modified for use with real-time acquired data to determine the best parameters for convergence and termination.

Staff also wrote a general purpose gauge routine. This routine allows the user to monitor a variety of devices using a thermometer type gauge.

Digital Filtering

Staff wrote routines for Savitzy-Golay digital filtering. These types of filters have the advantage of preserving much of the signal resolution while averaging out the noise. They may be also used to find derivatives of the signal.

Also, routines were written to determine the Pulse Height Distribution (PHD) of the detectors. These data acquired in the PHD experiment are the integral of the pulse heights, so the S-G filters are used to find the first derivative, that is the distribution of the pulse heights put out by the detector.

Data Acquisition System Design and Analysis

Staff moved the Mass Spectrometer Test System I from Room 137 to Room 141 in Building 21 and connected it to a laboratory mass spectrometer. Various cables were assembled and patch panels were configured and installed. Windows terminal macros were written to control the LeCroy high-voltage power supply units. Modifications to the QS-450 scalar circuit were made allowing quad discriminator input at 50 ohms impedance.

Staff connected and tuned the EXTRELL Quadrupole Mass Analyzer to the laboratory mass spectrometer system. To properly tune the RF oscillator to the analyzer rods, the RF unit was modified to accommodate the lower capacitative load of the instrument rods. Various problems were encountered while tuning this new version of the analyzer. Its high power (300 Watts @ 2.9 MHz) has caused the breakdown of various MHV connectors. Staff also identified and ordered laboratory test equipment.

Filament Emission Regulator

Design for the FER is under development with 98 percent of the parts identified and tested, and 95 percent of the parts received. A GSFC senior technician assembled the first prototype FER circuit. Staff updated the FER circuit using ORCAD. A layout design will be generated for this circuit after the prototype proves to be operational.

Staff modeled and tested the AD737 RMS-DC converter and the ISO100 isolation amplifier in the laboratory. These units were added to the FER to measure precise total emission current and read voltages of several biasing electrodes.

Laboratory Instrumentation—Staff redesigned the laboratory operational amplifier boxes to accommodate various safety features to include the integration of a dual transient suppression scheme that will avoid, within others, any power supply overshooting effect. A senior GSFC technician will be responsible to integrate these zeners to the actual design.

Staff implemented changes to one laboratory operational amplifier box that operates under normal conditions. Two additional signal diodes were added back to back across the inputs to maintain the required differential output voltage to less than +/- 25V. The results from staff's troubleshooting also indicated that these units operate with less failures if a dual power supply unit is used rather than with individual power supplies (the initial design called for two supplies). Staff researched throughout various suppliers for a dual low-profile power supply unit that will replace our standard setup.

Staff supported the installation and configuration of the mass spectrometer system that will categorize the K&L multipliers.

The LeCroy high voltage system was characterized on the voltage ramping speed and was found to ramp too slowly. Subsequently, 10 of these modules were shipped to LeCroy for modifications at no cost to the Government.

GCMS Parts and Inventory Tracking System

Staff is currently developing a Windows-based data base application to support the GCMS parts and drawing inventory. This system is being developed using the Microsoft ACCESS as the relational data base management system. This system will track every aspect of the development and procurement of the fabricated and commercial parts for the GCMS. Its capabilities will include mechanical drawing cataloging features, ordering and delivery information, and parts location, as well as a vast number of reporting capabilities. This system will serve as the central data management system for all flight and nonflight instruments under development by Code 915. Staff demonstrated the capabilities of the Microsoft ACCESS data base to the PI, ATR, and project managers, who received the demonstration favorably. Currently, staff will identify hardware, software, and manpower requirements to network this effort.

Staff tested Microsoft ACCESS for network operations using various computers currently on the network with the assistance of another HSTX staff member. Future plans are to network this system to several key players within Code 915. More testing is still required to perfect the networking.

Staff located and obtained three multiport network transceivers from excess property for possible use (at least one) to connect users to the GCMS data base system.

Instrument Laboratory Calibration Systems

Calibration System, Stand, and Mount

For the INMS calibration system staff activated and satisfactorily tested the Control Power company Uninterruptable Power Supply (UPS) to be used in the INMS calibration system. This unit will supply backup power for approximately 2 hours based on estimated system load during normal operation. The molecular beam machine (MBM) was made into an independent subassembly capable of working apart from the main chamber. This permits attaching the MBM to the main chamber or wheeling it away to test independently or use on another system. A Tennelec TC-174 preamplifier was the charge-sensitive preamplifier selected for the metastable time-of-flight (MTF) detector. A purchase request was submitted for the TC-174 that was subsequently received. The MBM nozzle was installed and is currently under preliminary tests for vacuum integrity. The protoflight MTF excitation source and detector were assembled and are currently undergoing testing.

For the GCMS, staff designed a vacuum manifold for the ion source test stand. The gas flow manifold for this system is currently being designed. All components for the vacuum manifold and most of the components for the gas inlet manifold were ordered.

Staff cleaned the area around the INMS support table in anticipation of installing the gaskets on the 14-in. and 13.25-in. Conflat flanges. This is the precursor to evacuating the main chamber.

Staff determined that gaskets for the 14-in. ConFlat flanges on the vacuum chamber, bellows, and iris valve had the wrong outside diameter. A discussion was held with several vendors concerning the standard for large ConFlat flanges and the manufacturer was subsequently contacted. A distributor's representative was scheduled to visit and attempt to install a 14-in. gasket to isolate the problem. While investigating the fit of the gaskets, it was determined that the four gasket wells in question on the three flanges were machined with different diameters. Staff assisted the Code 915 machinists with modifying the two existing gaskets to permit assembly to the main chamber and bellows when the vendor attempts gasket installation.

The malfunctioning Drytel Micro turbomolecular drag pumps were returned to the vendor (Alcatel) for servicing.

All major hardware items for the GCMS vacuum/test stand were ordered. To date, the thermocouple gauges and controllers, bellows-sealed Nupro valves, and gas sample volumes have arrived.

Molecular Beam Machine

Staff has operated the MBM excitation source and it is working successfully. One Hertz pulses from the function generator produced 1-Hz oscillations of the emission current. With +28 volts between the anode and filament, a microamp emission current was measured. A Tennelec TC 174 charge-sensitive preamplifier was attached to a MTF detector. A Tektronix analog storage oscilloscope was installed in the rack to monitor the output pulse of the TC 174 preamplifier.

Staff installed gas line connections and a Baratron pressure gauge between the MBM nozzle and a tank of argon. Several bad valves and leaks in the Baratron lines were isolated and replaced and/or repaired. The Baratron and flowmeter appeared to be working properly. With the help of another HSTX staff member, task personnel were able to read the MBM expansion chamber pressures (BA gauge and nozzle pressures) simultaneously with the use of two GPIB-equipped Keithly DVM's connected to the outputs of the respective gauge controllers. This effort was the first attempt at automated monitoring of the MBM. The beam machine was leak checked with helium and acetone; no leak was observed in any of the flanges, valves, or bellows. On July 16, 1993, the pressure in the expansion chamber of the MBM fell to 4 x 10exp-10 Torr. This is the highest vacuum staff has ever obtained in a system.

Argon gas was flowed through the MBM nozzle over a weekend with no ill effects observed on any filaments, however, one Alcatel Drytel Micro pump failed. A similar malfunction by a second Drytel prompted an investigation of the pump internal mechanics and repeated dialog with the manufacturer. The malfunction of the first unit was demonstrated for several laboratory members. These two pumps were shipped back to the manufacturer for repair under warranty.

Additional vacuum system components were ordered by the staff for the gas inlet manifold and technical evaluations were performed on vendor-submitted specifications for the turbo pump RFQ.

Time-of-Flight Detector

Tests continued on the MTF detector. TTL output from a Stanford DS345 programmable function generator was programmed successfully over the GPIB. Another HSTX staff member provided valuable assistance to establish GPIB communications with the DS345>. This effort will permit automation and programming of the DS345 in other laboratories as well. The output from the DS345 was used to pulse a control grid to valve the electron sheet to the anode of the excitation source. Filament emission obtained for this vacuum triode was as high as 0.4 mA with Argon flowing with a pressure of 1.5 a 10exp-5 Torr, present in the expansion chamber. The lowest emission obtainable with the triode off was typically 0.25 percent of the maximum and was attributed to poor electrode geometry.

The ion optics program, SIMION, was used to model the design of the new MTF detector. Failure of the first detector was attributed to the electrode geometry on the excitation source and insufficient isolation of the detector from the source and chamber walls. Design and fabrication of a new excitation source and MTF detector were completed by the staff. A 2.75-in. ConFlat cross was added between the source and detector stages to house an ion trap in the molecular beam path. Two collimation holes were also fabricated to better isolate the MTF detector from the exposed filaments of the ion source.

Instrument Computer Simulations

Staff set up the 3-D simulation for the dual quad switching lens. The dual quad simulation takes up twice the memory as the quad rod simulations that were performed. This new study will be used to design the lens system between the dual switching lens.

The PI assigned a feasibility study on a new simulation for a calibration gun setup for the GCMS. This simulation will require more computing power and is expected to take a month to complete.

Staff completed the dual switching lens simulation, optimization of the OS/2 setup, evaluation of the GCMS data compression, the staring up of a new simulation on the calibration gun, setting up the Sun Sparc Classic workstation, and installing the new Linux SLS 1.03 with v.99 p111. The calibration gun simulation takes a week's worth of computation time on the 486 that is about a magnitude too slow for this type of simulation. The printing service was configured on the SPARC Classic and Yoyodyne. It now works in PostScript mode with the HPIIIP connected on the printer network. Paf and Yoyodyne shares nfs volume so that Paf can run programs for Yoyodyne and Yoyodyne can be used to reach outside the machines. Staff is also attempting to get a C compiler for Yoyodyne.

Staff made several modifications to the ion simulation program to allow for fast voltage adjustments. This effort also allows for change of potentials to future lenses without recalculation of the matrix. This work was accomplished in a 2-week period. Subsequently, staff delivered to the PI 25 different voltage configurations for lens transmission.

Staff configured a Sun Sparc Classic as a disk server for the GCMS parts data base. It has run as a NFS server and work will be accomplished on the PCNFS server as soon as the binaries are located.

Staff spent some time converting 486 to OS/2, Version 2.1, to allow for multitasking while the computer was used for about a week's worth of computation time setting up the fast adjust files. This represents the first use of OS/2 in the group and additional time will be spent learning more about the system. The program to adjust the voltage remains to be written. Staff also reinstalled the OS/2 several times to optimize the 486 for simulation.

Data Handling

Staff members presented a data handling scheme at the Univ. of MI Space Physics Research Laboratory (SPRL)/GSFC GCMS descent strategy meeting held at GSFC. The scheme was well received and approved for prototype.

Staff worked with the Code 915 summer student, who evaluated the data handling scheme for the GCMS. This work included the data compression and error schemes associated with it. Different data sets were used to evaluate the compression ratio. Some of the minor details were optimized.

Staff members also started a new simulation for the GCMS switching lens that will allow a fast voltage adjustment.

Staff also installed Linux SLS 1.03 v.99 p111 onto staff's 386 PC. Staff installed an Orchid fl280+video into the computer and reconfigured the timing for X Windows. Staff also configured the Linux machine paf to network only with local machines that avoid the bugs in the networking software.

Mechanical Design - GCMS Ion Source

Analyzer Lens Assembly

Staff finished the designs for the GCMS housing flanges. The sensor end and the source end flanges were detailed out and a check print prepared and delivered to the PI and ATR for approval. Once the check prints were approved by the PI and the ATR, fabrication prints will be generated.

Staff also worked on the location and interface of the analyzer getter with the sensor tube. The location provided easy assembly and disassembly and it did not interfere with the multiplier flanges and the R/F box. A preliminary design was established and the sensor housing check print prepared. Some details still need to be provided by Swales before the design and fabrication print can be finished.

Additionally, the staff worked on the design of the GCMS adaptor sleeves for the 9-pin and 19-pin headers. A check print was sent to the PI and ATR for approval.

Staff worked on preparing the final fabrication print for the GCMS ion source housing the manifold for the Aerosol Collector Pyrolyzer (ACP) input to the GCMS.

Ion Source Housing Design

Staff also worked on the design of the ion source housing. This houses the five ion sources and switching lenses and provides three interfaces with the five microvalve manifolds and the getters. This complex design was finished and staff generated a check print for review by the PI and ATR.

Staff worked on the design of the ion source housing. The basic design was accepted. Some changes that were suggested by the PI and ATR need to be incorporated and should be ready for fabrication in 2 weeks.

The preliminary designs for the 9-pin and 19-pin header sleeves were sent to ARTEC for brazing.

Manifold Design

Staff completed work on the design of the horizontal manifold and the design is currently being checked by the PI and ATR.

Work was accomplished on the ACP manifold design, which has three valves. The design now has two parts instead of one to make welding easier. The design should be completed soon.

Structural Thermal Pyro Model (STPM)

Staff interfaced extensively with the (Code 915) machinists, who are machining the parts for the GCMS Structural Thermal Pyro Model (STPM). Much of the design critical to the assembly of this model was done in real-time.

200 DOCUMENTATION

Design/Technical Review Support

Staff assisted the GCMS experiment manager with updates to the Huygens Probe Experiment Interface Document (EID Part B), Issue 1, Revision 0, dated February 19, 1993, and Issue 1, Revision 1, dated August 11, 1993. These documents were sent to ESA.

Staff coordinated the schedule update inputs for the GCMS and INMS monthly instrument development schedules. The schedules were delivered to the INMS and GCMS Instrument managers.

Staff attended, wrote, and distributed minutes for the following meetings.

- ACP/GCMS meeting held at GSFC on May 27–28, 1993.
- GCMS Descent Sequence meeting with SPRL held at GSFC on June 9–10, 1993.
- GCMS Progress Review meetings held at GSFC.

Minutes and action items for the above meetings were prepared and distributed to cognizant personnel.

Staff assisted the INMS Instrument manager with the preparation of presentation materials for the Preliminary Interface/Functional Requirements Design Review (PIRDR) held at JPL on July 21, 1993. Booklets were prepared for the GSFC (Code 915) attendees and the PIRDR review board.

SIGNIFICANT ACCOMPLISHMENTS

The discovery of the Microsoft ACCESS software package for applications in the storage, use, reporting, and maintenance of the GCMS and INMS instrument parts and drawings inventory was significant. The effort was the first inexpensive and user-friendly approach to this problem in 2 1/2 years. Integrated inventory schemes for Code 915 was addressed before by vendors and an inhouse investigator, but were placed to rest by high costs, user unfriendliness, or complexity.

An HSTX staff member made a presentation that was well received by the PI, ATR, instrument managers, and other potential users of this application. Real-world examples were used and a thorough evaluation of user requirements was made prior to the presentation. The HSTX presenter made full use of the macros in customizing the menus to enhance easy use. Additional work will be accomplished in this area as more inputs are received from users in the course of implementing the system. Also presented was the potential networking capability of the software to facilitate management participation to make this a true management information system that is well advanced compared to the spread sheet only system currently in use. The option exists to expand the networking capability throughout Code 915. Customized protected reporting will be available to Government management personnel based on their interest and need.

The PI would like the software extended to employ the use of bar coding the flight instrument parts.

The results of this HSTX effort will be a fully integrated parts and drawing inventory management information system. This significant stride was made in only 3 weeks of investigation.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The following activities are planned:

1) Apply PROEZGC software to model GC work; 2) carry out experiments in the laboratory on cyano-methyl and di-methyl polysiloxane columns; 3) carry out a cumulative analysis of model predicted results and experiments to determine optimum structural and experimental conditions for GC columns for space flight; and 4) present a research paper on "Chromatography for Space Science" at the FACSS meeting on October 17-22, 1993 in Detroit, MI.

1) Continue investigating voltage optimization strategies and tie up loose ends in the acquisition software; 2) complete partially implemented sections of software using a variety of detectors and voltage

sources for mass scans; and 3) customize software to automate particular experiments as the need occurs.

1) Integrate a pulser into the MTF detector and perform time-of-flight measurements; and 2) attach the bellows assembly to the main chamber and evacuate the bellows to test the mobility of the assembly under vacuum.

1) Design, identify parts, procure, and prototype the BA gauge controller; 2) integrate the GCMS electrical parts into the parts data base; 3) continue with the design of the data base reports, forms, and queries; 4) implement a barcode identification scheme to be used as storage and track identifiers for most instrument parts; and 5) integrate the data base and network users.

Continue working with calibration gun simulation, data compression codes, networking setup, and Unix machines.

1) Work on the design of the new ion source based on the results of tests performed by the PI on the current source; and 2) work on the ion transfer lenses and their mounting scheme.

1) Assist the GCMS instrument managers with preparations for the Huygens Science Working Team (HSWT) meeting to be held at ESA on September 16–17, 1993, with updates to development schedules and project-related documentation; and 2) maintain the bonded storage facility to accommodate increased parts inspection, storage and disposition.

TRAINING

A staff member participated in the meeting, "Understanding Separations by Preparative Liquid Chromatography," held in Rockville, MD, on June 17, 1993, from 6:30 p.m. to 9:30 p.m.

A staff member submitted a paper entitled "Chromatography for Space" that was accepted for a presentation at the Federation for Analytical Chemistry and Spectroscopic Society meeting to be held on October 1993, in Detroit, MI.

Three task members, V. Navale, E. Campos, and E. Patrick attended the HSTX cmi Awareness Training sessions on August 20 and 27, 1993.

COMPUTER USE

Minutes	Computer
5,700 (wall clock)	IBM 386 PC-AT (Galileo calibration laboratory)
29,455 (wall clock)	Northgate 386/33 PC (AutoCAD Workstation)
24,800 (wall clock)	Dell 486/50 PC (Graphics Workstation)
1,000 (wall clock)	Compaq 386/20 (Graphics Workstation)
13,260 (wall clock)	Gateway 486 PC (Code 915 Laboratory)
8,640 (wall clock)	Dell 486/50 PC (Office Computer, Room 258)

30,900 (wall clock)	Gateway 2000 486/33 PC (Code 915 Laboratory-GC Column)
240 (wall clock)	VAX (Code 910)
9,060 (wall clock)	Dell 80486-50 PC (Cassini calibration laboratory)
0 (wall clock)	Convex 23
3,000 (wall clock)	Chapman (SGI)
7,200 (wall clock)	386/33 PC (Unix) (Code 915, Room 241)
45,600 (wall clock)	Gateway 486/50 PC (Code 915, Room 241)
2,100 (wall clock)	Yoyodyne (Sparc) (Code 915, Room 241)

NASA Task 12-023-00: Pioneer–Venus Programming and Analysis

GSFC ATR: *Dr. R. Hartle*
Cognizant NASA Scientists: *Drs. J. Grebowsky and W. Hoegy*
Hughes STX Task Leader: *J. Selekof*
Hughes STX Task Number: *152*

The task provides computer programming and data analysis support for the Pioneer–Venus (PV) Orbiter spacecraft mission. The research supported is aimed at gaining a better understanding of the composition and dynamics of the Venusian atmosphere as well as the solar wind effects and the magnetic field surrounding the planet. Work will focus on development of computer graphics in color and black and white, data base development and maintenance, and data analysis software. Archiving of PV data for the local Unified Abstract Data Set (UADS) and for NSSDC will also be performed as required.

FINAL CONTRACT SUMMARY

This task began in January 1989. Over the lifetime of the task, one principal programmer/analyst has been working to accomplish the following milestones. Staff supported the PV Orbiter mission, which ended last October after 14 years and more than 5,000 orbits around the planet. New computer software and graphics applications were developed to support a variety of PV research activities, including the study of the composition and dynamics of the Venus ionosphere, the understanding of the magnetic field that shrouds the planet, and the study of the ion escape velocity in the nightside and dayside conditions. Programming support was provided in the fall of 1992 for the end-of-mission activities, a critical period in which the satellite entered the lower atmosphere of Venus for the final time. Last spring, major software and graphics support was provided for a study of the heavy hydrogen (deuterium) that was left behind when hydrogen escaped from Venus, leading to the discovery that at one time there could have been enough water on the Venus surface to cover the entire planet. This research received national attention in the media. New plotting software (Kaleidagraph and Deltagraph) was learned and applied to the Macintosh computer, allowing for major improvements in the generation of computer graphics, including color graphics. Support was provided, and acknowledgements were received, for numerous papers published by the ATR in journals such as *J. Geophys. Res.* and *Geophys. Res. Lett.*, as well as for many papers presented at national and international scientific conferences such as AGU, IUGG, and IAGA.

Remaining objectives to be accomplished include the continued support for the ongoing Venus data studies, within the NASA-sponsored Venus Data Analysis Program (VDAP).

SUMMARY FOR CURRENT REPORTING PERIOD

Computer programming and graphics support was provided for the spring AGU papers given by the ATR and Dr. Grebowsky, as well as a presentation to the AAS at University of California-Berkeley given by Dr. J. Kar (Code 914). Numerous graphics products were prepared displaying ion and neutral composition data from PV for the earlier solar maximum periods and for the entry-phase data at near solar minimum conditions. Working closely with the ATR, software was developed to compute the ion escape velocity for the dayside ionosphere at Venus (previously, the nightside case had been examined). Computer programs were designed to handle 3 special cases: Orbit 418 inbound, orbit 186 inbound, and orbit 184 outbound. Many refinements were made to the programs and numerous data tables and graphics were generated showing the velocity and the mathematical and physical terms in the equations. A number of these data and plots were used by the ATR for an IAGA conference presentation at Argentina. Color and black-and-white plots of the Comprehensive Ionosphere Data Base were produced, depicting the F10.7 parameter vs. year (1964–1984) with timelines representing 11 satellites. High-resolution PV data in the form of C8Y and EDR files were received from Rice University and added to the optical disk data archive. The HSTX task leader was called upon a number of times to provide computer and graphics consulting to several branch members, and to a visiting scientist from SUNY, Stony Brook. The computer programming and graphics work of the HSTX task leader was recognized in acknowledgements in two *J. Geophys. Res.* papers during this reporting period.

WORK PERFORMED

100 GRAPHICS SOFTWARE

Graphics were produced for the ATR's AGU talk in Baltimore. Color and black-and-white figures were prepared showing OIMS averaged data for the early PV data (solar maximum) and for the recent entry-phase data at near solar minimum conditions. Data for the local time periods midnight to 2:00 a.m. and 2:00 a.m. to 4:00 a.m. were chosen. Plots of the hydrogen and deuterium data were made, as well as the H^+/O^+ x neutral O ratio. Many plots also were prepared for Dr. Grebowsky's AGU talk and for a presentation by Dr. J. Kar at the AAS meeting at University of California-Berkeley. Ratios of mass 30 to mass 32 were shown, along with numerous plots of superthermal data from both the ion and neutral spectrometers. The electron density/total ion density plots were also produced, comparing the solar maximum with solar minimum data.

A set of final plots were prepared for the paper that the ATR presented to the IAGA conference in Argentina. These included the following plots for the orbits 418 and 184 cases: A color plot displaying density vs. altitude for O^+, C^+ and O_2^+; a color plot showing ion temperature, electron temperature and plasma temperature vs. altitude; a color plot of beta (horizontal) and the quantity By^{**}_2 + Bz^{**}_2; plots showing densities of O^+, C^+, N^+, He^+, H^+, O_2^+, and CO_2^+; a velocity plot for O^+ showing the computed velocity vs. altitude; a three-panel plot of O^+, O_2^+, and C^+ velocity; a two-panel color plot of the "physical terms" for O^+; and plots of horizontal velocity and horizontal/vertical velocity.

The plot of the Comprehensive Ionosphere Data Base showing F10.7 vs. year was modified. A color version was produced, and the F10.7 data are now plotted from 1964–1984. Time bars were added for 5 more satellites so there are now 11 satellite time bars on the plot, showing the time coverage of the ion composition and electron density in situ measurements.

Plots were prepared of high-resolution ion data for orbits 4775 and 4819, that were of interest to Dr. Intrilligator (Carmel Research Institute). Two sets of diffusive equilibrium plots were made using starting points for the solar maximum data and for the entry phase solar minimum data. At the request of Drs. Hoegy and Cole (Code 914), electron density plots were produced from UADS for 23 selected PV orbits with low periapsis. A set of Ne/Itot and neutral oxygen plots were made for orbits 5014–5055, with each orbit plotted individually, and separate inbound and outbound plots.

200 ANALYSIS SOFTWARE

A major software development effort was carried out during this report period, in support of the ATR's research aimed at understanding the ion escape velocity at the dayside ionosphere of Venus. Previous work concentrated on the nightside ionosphere, while this work focused on performing a similar analysis for the dayside, which turned out to be a much more complex effort. Ion data were plotted for all the orbits within local time ranges 11:30–12:30 for Venus years 1–3. The ATR then selected three orbits for further analysis: Orbit 418 inbound, orbit 184 outbound, and orbit 186 inbound. For each of these orbits, plots of the ion data as well as electron and ion temperature, "beta", and $By^{**}{}_2$ + $Bz^{**}{}_2$ were done, and curves were fitted to these data. In most cases, a polynomial fit was used. The equations for these curves and for some of their derivatives (for scale heights) were then entered into the three programs for the three orbits. In addition to the regular version of the programs, software had to be created to compute the physical terms, and to print the important variables comprising the components of the equations used to calculate the escape velocities.

Once the software programs were developed and tested, numerous runs were made, at the direction of the ATR, in order to "fine tune" the equations so that the results would be physically and mathematically meaningful and valid. During this process, many software modifications were introduced into the programs. The results of this analysis was used to create final graphics that were incorporated into the ATR's IAGA talk in Argentina in mid-August.

At the request of Dr. Grebowsky, a program was developed that takes high resolution PV magnetometer data (from the PV-OMAG instrument) and converts magnetic field data from *x-y-z* coordinates into radial-east-north (r-e-n) coordinates and also computed the horizontal field component. The program was run for 15 selected orbits, periapsis +/– 9 minutes.

The IDL program, AVERAGES.PRO, that is used to compute average and standard deviations from UADS data, was enhanced at the request of Dr. J. Kar. It now allows the user the option to specify whether to take average of the log (base 10) of the data or average of the data.

300 DATA BASE DEVELOPMENT

Ten C8Y tapes were received form Rice University during this period. The tapes contained high-resolution OIMS data for PV orbits in the 500's, 600's, 1700's, and 1800's. The data files were incorporated into the optical disk archive. We also received EDR files, containing raw OIMS experimenter data, for orbits 4800–5055. These files were brought over from Rice University via the SPAN network and copied onto optical disk for permanent storage. A program to read these files was also copied and was run for orbit 5053, creating a printout for Dr. Grebowsky.

400 GENERAL SUPPORT

At the request of the ATR, the HSTX task leader worked a few days with a visiting scientist, Dr. J. Fox (SUNY, Stony Brook), helping her to access and plot the PV UADS data from the entry phase period. Dr. J. Fox and the student that was assisting her were instructed on how to run several programs, create online data sets, and how to display these data on the Macintosh using the Kaleidagraph plotting application. A program was set up for them to extract orbit/attitude data for the orbits of interest, and also a data set was prepared for them containing neutral ONMS data for the entry phase period.

The task leader learned how to use the Fetch 2.1 Macintosh utility program, which allows file transfer between VAX mainframe and the Macintosh hard disk in a faster way than Kermit. It uses the Local Talk protocol over the Ethernet network and is very efficient for transferring large files because it does the transfer at a much higher data rate than Kermit.

Computer graphics support was provided to Dr. C. Reddy and Dr. D. Pesnell (Code 914) for a proposal in response to NASA's Space Physics Supporting Research & Technology Suborbital Program, under the sponsorship of Dr. W. Hoegy. A FORTRAN program was modified to more efficiently produce data sets, and a four-panel plot was created showing residuals vs. scaling factors for four cases. This activity was performed successfully under very short notice with a critical deadline having to be met the next day.

Computer and graphics support was provided to several branch members, including Dr. K. Cole (visiting NRC scientist), Dr. Reddy, Dr. Kar, and E. Gregg.

SIGNIFICANT ACCOMPLISHMENTS

The HSTX task leader was extremely responsive to the needs of the ATR, often working late to meet critical time schedules, in support of both the Spring AGU meeting at Baltimore and the IAGA conference in Argentina. Hundreds of computer graphics were generated and many new programs were developed and tested in a very short time period. The work of the task leader was publicly acknowledged in two papers published in the *J. Geophys. Res.*, and in a presentation to the AAS at University of California-Berkeley.

Because of his computer expertise, particularly with the PV data and the Kaleidagraph graphics application, the task leader was called upon as a consultant to work with many people in the Planetary Atmospheres Branch during this period, including Dr. C. Reddy, Dr. J. Kar, Dr. K. Cole, E. Gregg, and Dr. J. Fox (visiting). This help was provided in a very responsive manner, and appreciation to the HSTX task leader was expressed many times by all involved.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work is proceeding as planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements of this task. Software development and computer graphics development will continue in support of the PV research activities. Work will continue on the ATR's research aimed at understanding the ion escape velocity at the Venus atmosphere, with attention given again to the nightside conditions. Computer support will be provided to the ATR and Dr. Grebowsky for the final PV Science Steering Group meeting in September, and for the Fall AGU in San Francisco.

DELIVERABLES SUBMITTED

Plots: Hundreds of black-and-white and color graphics were produced, showing the comparison of the ion and neutral data from PV for the earlier solar maximum data with the recent entry phase data at near solar minimum; final graphics were used in AGU and IAGA presentations. Numerous plots for Dr. Kar to assist in analysis of Venus ionosphere

Originator: J. Selekof

Software: Major programming was done to support analysis of the dayside ion escape velocity at Venus, including programs VELOC_418, VELOC_184, and VELOC_186 to handle the orbit 418, 184 and 186 cases, as well as special versions of these programs to produce physical terms data and variables listing

Originator: J. Selekof

Data Base: Additional C8Y files added to the optical disk archive, as well as EDR raw experiment data for orbits 4800–5055

Originator: J. Selekof

CONFERENCES

The HSTX task leader attended a one-day session of the Spring AGU to hear the presentation of the PV papers. A number of plots produced by this task were shown by several people at the meeting.

TRAINING

The HSTX task leader attended a 12-hour C course sponsored by Hughes STX.

COMPUTER USE

Minutes	Computer
14,000	PACF VAXcluster
2,000	MITE MicroVAXcluster
14,000	Macintosh IIsi

NASA Task 12-027-00: Laser Atmospheric Studies Research

GSFC ATR: ***Dr. T. McGee***

Hughes STX Task Leader: ***Dr. U. Singh***
Hughes STX Task Number: ***154***

One objective of this task is to assist in assembling, testing, and operating a mobile, ground-based ozone lidar experiment at GSFC and at several remote sites. The lidar system will be used to make ozone measurements in the altitude range of 20 to 70 km. Data from this system will also be used to produce temperature and aerosol profile in the troposphere and the stratosphere. Another objective is to develop, maintain, and operate analysis software for these experiments. Hughes STX personnel will participate in the processing of stratospheric ozone and temperature lidar data and will assist in the presentation of these data in oral and written scientific communications.

FINAL CONTRACT SUMMARY

NASA contract NAS5-30440 has been assigned to this task from the beginning of the contract period (October 1, 1988). One senior scientist and a senior programmer/analyst are working on this task. Since the inception of this task, there have been many accomplishments, and numerous major milestones have been attained. The most important and notable accomplishment of this task was the development of NASA's highly acclaimed Stratospheric Ozone Lidar Trailer Experiment (STROZ-LITE). Major technological advancements on a continuous basis were incorporated in a timely manner to improve the capability and accuracy of the system. The eruption of Mt. Pinatubo in June 1991 heavily overloaded the stratosphere with volcanic aerosols and posed a challenging task of making an accurate measurement of ozone in the aerosol-affected stratosphere. A new Raman-DIAL technique was developed by this task, and the system was extensively modified in record time to develop a unique lidar system capable of making the first accurate DIAL measurement of ozone in the presence of volcanic aerosols. It was a timely development because it provided correlative measurement support to the Upper Atmospheric Research Satellite (UARS) at a altitude range where all other lidars and many other instruments were "blinded" by the aerosols. Task personnel coordinated and participated in six major intercomparison campaigns at several remote locations. Four occurred in the United States and two 2-month UARS/NDSC Correlative Measurement Campaigns in France and New Zealand within this contract period. New data acquisition and analysis software were written, updated, and improved. Timely and effective support were provided to the ATR during preparation of journal publications and conference presentations. Extensive support was also provided in developing and testing the hardware and software of another trailer-based Aerosol and Temperature (AT) lidar. The task was identified and won a carryover award. One task member was awarded for "Outstanding Research Support" by GSFC Code 916.

The future objectives of this task are to prepare and participate in four major intercomparisons (three in New Zealand and one in Australia) over the next year. Other objectives are preparing and submitting papers for journal publication, participating in future data acquisitions and presenting the results at international conferences, and acquiring and analyzing data through the AT lidar system.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff provided excellent technical support during the last triannual period. An HSTX staff member received an award for "Outstanding Support for a Research Project" from Code 916, for outstanding support to the Stratospheric Ozone Lidar instrument. All STROZ-LITE data acquired during the three 1992 UARS Intercomparisons were extensively scrutinized, corrections were made, and the final data products were submitted to the scientific community by the UARS Central Data Handling Facility (CDHF). Extensive repairs to the STROZ-LITE system were also made. Parts of both Lumonics lasers were refurbished, and the entire lidar system was returned to a limited operational status. The system was operated at 50 Hz (rather than the optimal 70 Hz rate) for several nights. The decision to upgrade the entire system to 200 Hz prompted significant changes. Operation was suspended while the Lambda laser was sent to the manufacturer for upgrade to a 200-Hz repetition rate capability. After additional funding was obtained, a new Lambda laser was purchased to replace the two Lumonics lasers. With these changes, additional items had to be acquired: a new chiller and a new laser table were procured for the new Lambda laser. With the imminent transfer to a PC-based software acquisition system, the lidar's real-time analysis software was translated to Lahey FORTRAN and improved to use the multicomputer system. An Artisoft Lantastic peer-to-peer local area network (LAN) was also installed in the trailer, enabling communication between PC's. During this "down" time, an extensive effort was made to prepare papers for publication. These papers report results obtained during the three 1992 Intercomparison periods. Two such publications are ready for submission to *Geophys. Res. Lett. (GRL)*. The upgraded Lambda Physik (351-nm) laser was returned to GSFC and was reinstalled in the trailer laboratory. The system was returned to operational mode and nighttime observations are now being made when weather permits. Intercomparisons between STROZ-LITE and the new AT lidar system have also taken place. HSTX staff has also assisted with the development of this new lidar, including equipment and software development and data analysis. Initial results and comparisons are promising. Extensive tests have been done on the STROZ-LITE system. Optimal laser beam emission configurations and PMT-gating setups are being investigated. Preparations for the 1994 deployments to Lauder, New Zealand, and Darwin, Australia, are also taking place, including the initial paperwork for the ATA Carnet needed for customs clearing.

WORK PERFORMED

100 LIDAR STUDIES

120 Lidar Studies of Stratospheric Ozone and Temperature

The GSFC STROZ-LITE system was returned to a limited operational status. Data were collected in a near-coaxial configuration to test the newly acquired PMT bases and the gating circuit. Data analysis indicated that light was leaking through the gates, making the return nonlinear, and raising the background appreciably. When staff conducted extensive tests, a problem was found with the gating circuit. After discussions with the vendor, staff returned these bases for repair. GSFC's AT lidar was also made operational to test the newly developed acquisition software and hardware. Although the coincident intercomparison of temperature from both lidars seemed encouraging, several problems were discovered and work is ongoing to correct them. Regular ozone and temperature measurements along with software/hardware testing will continue whenever weather allows lidar operation.

130 Laser Repair

Major efforts were directed by HSTX staff toward successfully repairing the two Lumonics online lasers. Operation of the injection-locked excimer laser was restored at 70 Hz. In-house repair was performed, and the entire fan assembly was replaced by an old fan assembly with new bearings. A newly refurbished electrode assembly from Lumonics was installed in the Uniform-Beam (UB) laser. Operation was restored at 50 Hz, but a problem still existed at a higher repetition rate. In the meantime, funding requested to purchase a new laser to replace both Lumonics lasers was approved, and an order was placed to buy a new laser. Because of this new development, emphasis shifted from putting too much effort into repairing the Lumonics lasers. The new laser is expected to be delivered and installed by the 1st week of October 1993. The newly refurbished Lambda Physik laser at 200 Hz was installed in the STROZ-LITE trailer and is being used to take data for temperature and ozone measurements. HSTX staff successfully negotiated with EG&G to take back the two recently procured thyratron tubes for Lumonics lasers (worth about $7,700) and to issue credit for the purchase of three thyratron tubes for Lambda Physik lasers. This is an important savings because staff is disposing of both the Lumonics lasers and will have at least three Lambda Physik lasers for which three spare thyratrons are needed. HSTX staff also ordered laser tables and legs at a reasonable cost, arranged with the vendor to balance two chopper blades at 12,000 rpm, and is preparing an updated equipment list needed for acquiring an ATA Carnet for the upcoming campaigns in New Zealand and Australia.

The organizing committee of International Conference LASER '93 asked an HSTX staff member to make an invited presentation at the conference in Lake Tahoe, NV, in December 1993. An abstract and summary were submitted. HSTX staff members also coauthored a contributed paper, submitted by the ATR, for the same conference. HSTX staff is also working on the first draft of a journal publication about temperature intercomparison during the February and March 1992 campaign.

140 Data Analysis and Interpretations

Data from all three 1992 Intercomparison campaigns were extensively scrutinized. Results were compared with numerous instruments (UARS satellite measurements, ground-based lidar data, other ground-based instrument data, and balloon-borne results) with good results in most cases. All data from this time were distributed to the scientific community by the UARS CDHF. Several papers reporting these results have been prepared for publication and are being submitted to various journals.

The new STROZ-LITE PC-based acquisition system prompted the need for updated real-time analysis software. Improved real-time displays of lidar data were developed and tested. A LAN was also installed in the trailer enabling PC-to-PC communication during data acquisition. The system is from Artisoft (Lantastic peer-to-peer network).

The new PC-based acquisition system will be used in both the STROZ-LITE and the AT lidar systems. This new system produces data files with a new format; therefore, existing analysis software is being changed to accept the new format. In addition, new programs are being developed, and older software is being revised for use with the new AT lidar system. Some initial data have been acquired and subsequently analyzed. Comparisons between the two (coincident) lidar systems show promising results.

SIGNIFICANT ACCOMPLISHMENTS

An HSTX staff member received an award for "Outstanding Support for a Research Project" from Code 916 for outstanding support to the Stratospheric Ozone Lidar instrument.

PROBLEM AREAS

The delivery schedule of the new laser from Lambda Physik is still uncertain. The new laser is expected to arrive by October 1993. The STROZ-LITE system will have new data acquisition software in an IBM PC environment. The entire system must be integrated and tested within such a short period. Work is also needed on the AT lidar that is running behind schedule.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue as planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX staff will continue to operate the GSFC lidar on clear nights. Two Lumonics lasers will be taken out of the trailer and will be replaced by a newly ordered Lambda Physik laser. The new laser and chiller, and electrical wiring and breakers will be installed. The system will be tested with new data acquisition software. Testing of the AT lidar trailer will continue. Further software development for both systems will take place. Journal publications will be prepared and submitted. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

TRAINING

Both HSTX task members participated in a 3-day Scientific Presentation Workshop Training program at GSFC. An HSTX staff member participated in an 8-hour Continuous Measurable Improvement (cmi) training course at the HSTX facility at Lanham.

COMPUTER USE

Minutes	Computer
2,500	DEC LSI 11-73
1,000	Various VAX/VMS Systems
20,000	IBM PC's and Clones (DOS) and Various Computer Peripherals

NASA Task 12-030-00: Fractal Analysis of Clouds

GSFC ATR: *Dr. R. Cahalan*

Hughes STX Task Leader: *D. Silberstein*
Hughes STX Task Number: *156*

This task analyzes data from both the First ISCCP Region Experiment (FIRE) and the Atlantic Stratocumulus Transition Experiment (ASTEX) along with fractal model cloud simulation results.

FINAL CONTRACT SUMMARY

On April 17, 1989, staff was transferred to the current task. This task, staffed by one senior scientist supported the ATR in the areas of scientific data handling and analysis along with the development of software routines to deal with a wide range of issues from statistical programs to handle thousands of liquid water observations from the FIRE experiment to image processing software to work with Landsat satellite data to assess the impact of the Kuwaiti oil fires during the Gulf War on the local and global environment. Staff has kept pace with the technology, developing routines that function interactively and utilize the graphics capabilities of the latest hardware. Throughout the period of the task staff consistently delivered reports and materials supporting the ATR's presentations on time.

Remaining objectives to be accomplished include the analysis of recently received liquid water data from the ASTEX experiment conducted in the Azores.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff transferred code and data from the old workstation to a new branch workstation and IBM mainframe platforms. IDL routines were modified and enhanced to improve output quality and increase user flexibility.

WORK PERFORMED

Staff worked on moving routines from the old IRIS workstation to the new HP workstation. IDL-based routines required only minor modification with the exception of the thermodynamic model routine. In that case, the IDL routine calls a compiled FORTRAN routine to perform the actual thermodynamic computation of each pixel of the cascade generated realization. The FORTRAN code was recompiled using the HP compiler for the routine to work successfully. In general, IDL routines are running more efficiently under the new system. Some minor problems were encountered in the areas of restricted font table access for X-Windows display and in PostScript display of graphical output but suitable substitutions have been found. Catalog additions and enhancements were made to the routine for displaying the albedo bias using IDL in an X-Windows environment. Graphs were generated for the error in the analytic approximation for the absolute and relative cases. Graphs for the difference between the analytic solution generated bias, and the conservative King table based bias also have been produced for a solar zenith angle of 60 degrees. In the process of generating results using the King single scatter albedo table, an oscillation was appearing in the contour plots that had not been present in the Ridgeway table based plots. The question arose as to why this oscillation occurred and if there was any physical basis present. Staff suggested that the King table in its current dimensions of 14 optical depth values by 80 solar zenith angles was inadequate to produce a smoothed result. The ATR then inquired if the original 300-by-300-arrays could be obtained. With the assistance of branch staff and through the use of a key piece of software to convert IBM real values to IEEE acceptable numbers, staff was able to obtain and utilize the finer quality albedo arrays. Software was rewritten on the HP workstation to generate plots of the absolute and relative albedo bias for varying solar zenith angle and mean optical thickness. Plots of the relative albedo bias for varying fractal parameter f and mean optical thickness for single scattering albedos of 1.0 and 0.99 also were regenerated. These contour plots are now evaluated on an 81 by 81 grid in comparison with the 21 by 21 grid on the old Silicon Graphics workstation as the greater computing power of the HP permits more detailed calculations. Plots of the difference between simplified table based bias solutions and the cascade based bias results and the difference between analytic and cascade based bias results were generated as a function of fractal parameter f and mean optical thickness for solar zenith angles of 41, 60 and 75 degrees. Staff was acknowledged for efforts in this area in the paper "Fractal Albedo of Stratocumulus Clouds," which was submitted in June to the *J. Atmos. Sci.*

Much of the work toward the end of the period centered on the handling of irregularly gridded data and subsequent display through routines furnished by IDL. These data consist of a series of Empirical Orthogonal Functions (EOF's) of temperature and precipitation evaluated for January and July measurements this century at 62 weather stations across the United States and Canada. The first step was to take the irregular grid of stations and use the companion IDL routines TRIANGULATE and TRIGRID to establish a regularly spaced grid suitable for contouring. Staff combined map background routines with the previously employed contouring routines to make results more easily locatable. The next step involved dealing with the aspect of highlighting regions where the Eigenvalues were strongly positive or negative. The latest version of IDL (3.1.1) was installed on the branch workstation at the end of August. This version contains the capability for filling contours with various line styles. Staff experimented with various combinations of contour line displays and shading variations to produce the most visually meaningful results. Staff also contoured results of monthly means of temperature and precipitation as part of the overall study from January and July records. Some of the features employed in this project were incorporated into the interactive contouring program. An interface for choosing a map background was established. A user may request a map background and then select a particular region of the globe using widget sliders to establish latitude and longitude boundaries. Label spacing for latitudes and longitudes also may vary and are user specifiable.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work on this contract has ended. Work is proceeding as planned on contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will prepare a Work Control Plan that meets the requirements of contract NAS5-32350, and begin analysis of recently acquired liquid water data from Porto Santo, Azores.

DELIVERABLES SUBMITTED

Data: 4 albedo bias plots for journal paper inclusion 27 plots of EOF, mean and standard deviation results for North American temperature and precipitation data
Originator: D. Silberstein

TRAINING

Staff participated in a company-sponsored cmi awareness training class. A staff member served as team leader and presented a talk on "Improving On/Offsite Communication."

COMPUTER USE

Minutes	Computer
120 (CPU)	IRIS workstation
30 (CPU)	IBM 3090 MVS/ESA

NASA Task 12-031-00: Laboratory for Atmospheres Technical Data Support

GSFC ATR: *C. Cote*

Hughes STX Task Leader: *M. Tarlton*
Hughes STX Task Number: *157*

This task will provide scientific data visualization and presentation design support for the Laboratory for Atmospheres.

FINAL CONTRACT SUMMARY

During the past 5 years, staff has provided graphics, photowork, and publication support to meet the needs and goals of the Laboratory for Atmospheres. The main project during the first 2 years was production and completion of the World Meteorological Organization's *Ozone Trends Panel Report* and all supporting reports and visual materials. This two-volume document encompassed 864 pages and 1,100 pieces of artwork; editing was also provided by other HSTX personnel. Working with the project scientist for the Meteor-3/TOMS project, staff produced the official mission logo, instrument drawings, a 1,500 photo documentation book, and three major documents. Staff produced a large, three-panel exhibit describing the TRMM project, which was exhibited at the 1992 World Space Congress; a copy was sent to Japan for inclusion in an exposition theater. Staff also lent support on two brochures (for GSFC and one for NASA HQ) detailing the TRMM mission. Staff provided major support for the Quadrennial Ozone Symposium, held at the University of Virginia. Working with the local organizing committee, staff traveled to the university to shoot photos for official documents, produced the official logo, posters, symposium proceedings, presentation awards, and photo documentation; and provided logistics support before and during the symposium. HSTX staff produced the lead artwork for GSFC's Earth Sciences Directorate, which will be used for visuals and document art; the original hangs outside the Directorate offices. Other work for Code 900 included framed exhibits and slides for the Educational Program along with work on the EOS program. An exhibit on deforestation in the Amazon Basin was produced for and viewed by then President Bush. For Code 910, staff researched and produced a set of viewgraphs and brochures representing activities within each branch. A large, fully airbrushed piece on the TIMED project also was used in many HQ presentations and in the Report of the TIMED Science Definition Team, which staff helped produce. Working with the FOM, staff developed drawings for facility modifications and refurbishment, helped with moves, performed occasional repairs, and suggested acquisitions. Staff also began learning the Macintosh system, helped with a Corcoran School of Art cooperative project on the Earth sciences, and provided retirement displays for key NASA HQ personnel. HSTX staff received four commendation letters, as well as a group and a Director's Special Act award for work on the Meteor-3/TOMS mission.

SUMMARY FOR CURRENT REPORTING PERIOD

Task personnel assisted HSTX EOS staff with two sets of EOS educational slides, also presented to Code 900 management. Staff completed the overhaul of the TIMED project's logo and lead artwork, incorporating the newest satellite configuration; the final product was a set of viewgraphs to be used by Dr. Klineberg (GSFC) and NASA HQ staff for a major presentation to the NASA Administrator. Staff completed a framed presentation piece for Dr. Fisk (NASA HQ) of representative science disciplines he was involved with; the display required many hours of detective work to locate the "right" images, working with HSTX and GSFC EOS staff. Staff also successfully completed a 1.5-year search for a multidata set of global images produces by Prof. Sakata (Tokei University, Research and Information Center, Tokyo, Japan) for the TRMM project; prints from these transparencies will be used in exhibits and displays for the EOS project. Matted and framed photos representing Laboratory for Atmospheres, TRMM project, ozone journal covers, and ozone poster produced by Dr. G. Feldman (Code 930) were matted and framed; displays were hung in Bldg. 21. Four covers for the Laboratory for Atmospheres and 900 Directorate Office were produced. Staff completed revised updates of viewgraphs representing three Code 910 branches, as well as a major effort to completely redo Earth Sciences Directorate lead art; the display will hang outside Code 900 offices and will be used as the lead visual for any presentation in staff reports. Staff worked with Dr. F. Hasler (Code 912) on a lighted transparency showing Earth and cloud formations during Hurricane Andrew. Working with Code 917, staff was instrumental in acquiring images for matting, framing, and displaying in the Willie Norberg Conference Room in Bldg. 22.

WORK PERFORMED

HSTX staff, at the request of the TRMM office and NASA HQ, completed 1.5-year effort to locate multiviews of Earth showing equatorial cloud patterns. The original computer-enhanced transparencies were produced by Prof. Sakata. HSTX staff produced four different covers for the Laboratory for Atmospheres and the Earth Sciences Directorate and revised updates of the viewgraphs representing three branches. Task personnel completed a major undertaking to completely redo the lead art/visual and display for Code 900. Staff responsibility spanned researching the photos to getting final pieces framed; the original art will hang outside the Directorate offices.

At the request of the EOS Educational office, staff produced two sets of slides (with help from HSTX staff J. Burns and M. Odell) for use in a presentation to EOS and Code 900 management staff. An overhaul of the TIMED project logo and lead artwork was completed, incorporating the newest satellite configuration. The final product was a set of viewgraphs to be used by Dr. Klineberg and Dr. Huntress (NASA HQ) for a major presentation to the NASA Administrator, Dr. Goldin.

A framed presentation piece for Dr. Fisk was completed, showing representative science disciplines he was involved with at GSFC. This display required many hours of detective work to locate the right images. C. Boyle (Code 900) was instrumental in providing leadership in acquiring these photos.

Photos representing the Laboratory for Atmospheres, the TRMM project, ozone journal covers, and an ozone poster produced by Dr. Feldman were matted and framed for exhibition in the halls of Bldg. 21.

Staff worked with Dr. Hasler on a lighted transparency showing Earth and cloud formations during Hurricane Andrew. Staff also located a vendor to supply the light box that, when framed, will be displayed in the Director's office at GSFC.

Finally, working with P. Cogswell (Code 917), staff acquired images for matting, framing, and displaying in the recently refurbished Willie Norberg Conference Room in Bldg. 22.

SIGNIFICANT ACCOMPLISHMENTS

The graphics facility was packed up and relocated twice during this reporting period. Staff worked weekends and afterhours to minimize the impact on production.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work is expected to continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A new Work Control Plan for this task will be developed according to funding from Code 914, 916, EOS, and the Earth Sciences Directorate. Staff will complete a cover for the EOS Educational Materials Manual along with exhibits for the Code 900 office complex.

DELIVERABLES SUBMITTED

Deliverables: Photo displays/exhibits: 17
Photomosaics: 1
Photos: Color - 203; b/w - 42
Negatives: Color - 46; b/w - 14
Viewgraphs: 51
Slides: 74
Photostats (b/w): 32
Copies: Color - 238; b/w copies - 620
Art: Color - 14; b/w - 4
Originator: M. Tarlton

COMPUTER USE

Access to shared Macintosh II

NASA Task 12-032-00: Satellite Microwave Data Precipitation Studies

GSFC ATR: ***Dr. P. Cuddapah***

Hughes STX Task Leader: ***J. Nucciarone***
Hughes STX Task Number: ***158***

The objectives of this task are to provide analysis of the Nimbus-7 Scanning Multichannel Microwave Radiometer (SMMR) and Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave/Imager (SSM/I) satellite dual polarization multichannel microwave data using statistical and theoretical methods, assist in the development of suitable theoretical and empirical models to retrieve precipitation rates and atmospheric water vapor from these data, and generate climatological maps and data sets from these retrieved parameters. Assistance will be provided for analysis of the global warming signal from Microwave Sounding Unit (MSU) and High Resolution Infrared Sounding (HIRS) data. Tropical Rainfall Measurement Mission (TRMM) related activities will also be supported.

FINAL CONTRACT SUMMARY

On May 7, 1990, this task started on contract NAS5-30440. Over the lifetime of this task, one senior programmer/analyst and one scientist have each been working full-time.

There have been many major milestones and accomplishments over the lifetime of this task. Among them have been timely and effective support provided to the ATR during the preparation of proposals, papers, technical memoranda, and presentations. Programming and scientific support have been provided for the development of an algorithm to retrieve rain rates and a climatology of atmospheric water vapor from microwave data observations over oceans.

Analysis of the global warming signal from microwave data has continued in a timely fashion. Because of the ongoing nature of these studies, this work is expected to continue into the next contract. This research has resulted in the publication of several papers and technical memoranda. All previous task software has been ported from an IBM mainframe environment to Unix-based workstations; task personnel were instrumental in acquiring a Unix workstation for task work. New plotting software was learned and applied to existing programs. Documentation of software and analysis procedures has been written and updated on a continual basis. Data have been provided in a timely fashion to colleagues of the ATR at GSFC and other institutions. All old microwave data have been moved from IBM tape storage onto 4-mm DAT's in a local, task-maintained library.

Remaining objectives to be accomplished include the conclusion of work on the latest rain retrieval paper and continued support for the global warming signal analysis.

SUMMARY FOR CURRENT REPORTING PERIOD

During this period HSTX staff sustained their high level of support for the ongoing research in this task. HSTX staff assisted in the revision of the paper "Convective and Stratiform Rain: Multichannel Microwave Sensing Over Oceans" by providing rapid production of various statistical products based on the 19-, 37-, and 85-GHz channels of SSM/I and assistance with the revision of the text to better reflect how this paper represents an extension of previous research. Staff assisted in the preparation of an abstract, based on the discrimination of rain type from SSM/I data, for the fall 1993 AGU meeting. Task members processed the GPCP AIP-2 ground truth radar data using a clever combination of C, FORTRAN, and IDL routines. Global warming support continued with a rigorous analysis of quantitative measurements of the water vapor contamination of MSU Channel 2 (Ch. 2) data. Staff members worked closely with visiting scientists and provided guidance to summer interns. Staff continued to add nadir HIRS and MSU data to the local data library on 4-mm DAT's. Task workstation maintenance included upgrading the C, C++, and Object-Oriented C compilers. System backups were performed on a regular schedule.

WORK PERFORMED

100 NIMBUS-7 SMMR PRECIPITATION STUDIES

Several zonal means for SMMR derived rainfall were generated and compared to results obtained from SSM/I for similar time periods. The SMMR algorithm needs to be fine-tuned to more closely correlate with the SSM/I retrievals.

200 DMSP SSM/I PRECIPITATION STUDIES

Revision of the rain paper "Convective and Stratiform Rain: Multichannel Microwave Sensing Over Oceans," coauthored by the ATR and the HSTX task leader, continued. This paper was submitted during the last period for a special issue of the journal *Meteorology and Atmospheric Physics*. The paper was not approved; the ATR was contacted by the editor and asked to revise and resubmit the paper. In the revision, some of the reviewers' ideas were incorporated, such as including radar ground truth information along with some of the SSM/I statistics. GPCP AIP-1 radar data off the coast of Japan were gridded onto a 0.25° by 0.25° scale and matched to SSM/I data on the same grid. A bidimensional histogram of these joint data was then generated. The results clearly proved the main ideas of the rain paper. These histograms were then incorporated into the new version of this paper. Several other plots of data for this region on different time scales were then generated and incorporated into the text. The radar-derived rain rate and the SSM/I-derived rain rates from this test case were then compared. While the correlation between the two is very high ($\sim$0.75), the SSM/I-derived rainfall tended to overestimate the radar-derived rainfall. As a result, sensitivity studies were performed to tweak some of the terms in the rainfall algorithm. It was hoped that the correlation would improve and that the rainfall would be more in line with the radar results. Results of this study were not encouraging; when the bias in the SSM/I rainfall was reduced, the monthly rainfall mean, which was previously in good agreement with climatology, was severely reduced. Similar differences were encountered for radar comparisons off the Florida coast, the previous ground truth data used in the paper. The studies performed in the GPCP AIP-1 study area were also applied to the Patrick Air Force Base radar study area. The results of this test were nearly identical to the AIP-1 study case. This difference in single SSM/I swath returns vs. monthly retrievals is caused by differences in sampling of the rain events. The text of the paper was modified to reflect these results.

Sections of the text were rewritten, reviewed, and revised further. In the earlier version of this paper, the reviewers indicated that the new algorithm, as presented, did not represent a sufficient extension of the earlier version of the algorithm, published in 1992 in the *J. App. Meteor.* An important difference between the two algorithms is that the current version uses three channels of SSM/I: 19-, 37-, and 85.5-GHz in horizontal polarization. The earlier version used only the 37-GHz horizontally polarized channel. The advantage of including the two other frequencies is to aid in the discrimination of rain type, an important climatological variable. The ATR felt that inclusion of algorithm output of the discriminated rain type would sufficiently prove the extension of the previous work. Maps of percent total rainfall of the convective, mixed, and stratiform type rain were generated. Zonal means of these quantities were also generated. Minor bugs in the zonal mean program were encountered, and the code was suitably modified to correct these errors.

Studies for SSM/I rain retrievals over land started again in earnest. Many maps, using March 1988 SSM/I data, were generated to analyze for the rain signal. Using histogram information generated over small land areas, SSM/I data were analyzed globally to determine whether this criterion could be easily implemented. Percentage of observation of the data that fall into a certain range of relationships based on 37-GHz polarization difference and 37- and 85-GHz relationships were analyzed. The ATR is still investigating these results and hopes to have a preliminary algorithm ready in time for the fall 1993 AGU meeting.

The results of the GPCP AIP-2 were obtained. Several graphs were made of various statistical products provided by the GPCP. For rain detection skill, the rain algorithm scored the highest compared to the other 18 submitted microwave algorithms. The ATR attended the AIP-2 workshop in Reading, England, to obtain the final report. The radar ground truth data were then processed. The data arrived in VAX format and were converted on the fly using built-in C functions on the task workstation. The supplied ground truth radar data were received on a preprojected polar stereographic grid. This preprojected grid could not easily be displayed with existing GrADS and IDL software. An IDL routine was developed that normalized the preprojected grid onto a unit square Mercator projection along the equator. This normalized, or warped, image was then reprojected onto a polar stereographic grid. The resulting display contained some minor registration errors. Problems with the way IDL handles the overlaid image margins resulted in an incorrect map registration when this image was saved as a PostScriptTM file. The task leader is looking into a fix for this inconsistency. Utility software supplied by the British Meteorological Office was called from the Wentz C code to map the SSM/I latitude and longitude into the preprojected grid so that SSM/I-Radar rainfall comparisons could be made.

201 DMSP SSM/I Code Maintenance and Development

The Wentz C code used for SSM/I data analysis was ported to the new Code 913 workstation, climate. The code was then fully tested. The SSM/I analysis code libraries were reorganized into a system library; this will simplify the command needed to compile the code. Functions were also recompiled using the newest version of the gnu C compiler and stored in a separate archive.

204 Task Workstation System Administration

Regular full and partial system backups were performed on schedule.

A cooling fan was replaced on one of the external disk subsystems.

New Unix utility software was transferred to the workstation and compiled. These utilities are a new file compression program (gzip) and a PostScriptTM file viewer (ghostscript). The new file compression utility keeps the system in line with the gnu foundation standards. Problems were encountered when ghostscript was compiled. Text-only files could not be properly displayed without error messages being displayed. One workaround was to use an older version of ghostscript. However, graphics files were not as sharply displayed as with the new version. A bug report regarding the problems displaying text was filed. Based on the numerous bug reports from various users, the program authors released a code path to fix the problems. This patch was applied to the code and compiled.

The C, C++, and Object-Oriented C compilers were updated. Staff also upgraded graphics software on the task Apple Macintosh computer.

The IRIS S-Video and Indigo Video capabilities were demonstrated at the Workstation Users Group meeting. Staff also demonstrated expertise with the text formatter LaTeX at the Workstation Users Group.

Task members ran short on disk space resulting in a slowdown of work; some task members' files on the data disk that were not immediately needed were compressed to make room for the needed data. Disk space was also short when the task leader attempted to load all of the March 1988 SSM/I data to disk. The SSM/I decoder code was modified to load one 6250 bpi equivalent file at a time from 4-mm DAT. Tape read errors and a 4-mm drive failure led to even more slowdowns, resulting in a dramatic reduction in productivity. The drive manufacturer was contacted, and a service technician repaired the drive. Tape read errors still persisted because of media errors. A temporary solution was to split the entire SSM/I monthly data record over several disk volumes and to use symbolic links to fool the decoder code into thinking the data were maintained on one volume. The task leader is still looking into the media error problems.

208 Global Warming Support

During the last period, two of the major activities performed were the MSU and HIRS data transfer from reel tapes to 4-mm DAT on the task workstation and the scrutiny of the MSU Ch. 2 observations to assess the amount of built-in contamination in the data. This contamination is caused partly by clouds and partly by precipitation. The MSU data in Ch. 2 (54 GHz) are sensitive to the thermal state of the atmosphere in the middle troposphere, while Channel 1 (Ch. 1) (50.3 GHz) is more sensitive to the cloud and precipitation activities near the surface of Earth. Various approaches to examine this contamination have been explored in this study. The intent of this research is to develop a suitable technique to clean the MSU Ch. 2 data so that any global warming signal inferred from these supposedly clean data would lead to a less suspect conclusion.

Among the various approaches used for scrutinizing the data, one method was to study the deviations of monthly means from their ensemble (several-year) means. Because of the lack of a sufficient record of the data to compute this ensemble mean, this analysis could not lead staff to any conclusion. The variations of the MSU Ch. 1 and Ch. 2 observations in the equatorial belt were viewed by scatter diagram in 10° x 10° grid boxes around the latitude circle. These plots show a negative slope over the ocean and a positive slope over land in the tropical regions. The method used by Spencer and Christy (1992) was applied to screen the data. This method checks brightness temperatures in scan positions 3-9 for deep-convective ice signatures. This signature appears as localized brightness temperature depressions of up to several degrees. Any brightness temperature more than 0.5 °C cooler than a linearly interpolated brightness temperature computed for that scan position (from the warmer brightness temperatures found on either side of the point in question) was discarded. To stringently check the cleanliness of the Ch. 2 observations, data screened by this method were further analyzed to assess the possibility of any remaining contamination, if any. To do this, data in five latitude belts each of 10° width were further regrouped in 10° latitude x 10° longitude boxes, and in each of these boxes the least-square linear regression fit was applied to compute the slope of the regression line between Ch. 1 and Ch. 2, with Ch. 1 data as the independent variable. It is known that the MSU Ch. 1 is more sensitive to the cloud and precipitation activities at lower levels. Therefore the slope of the regression line between Ch. 1 and Ch. 2 should give some sort of measure of the extent to which the Ch. 2 data are still influenced by cloud and precipitation contamination. If this measure is quantitatively significant, then any conclusion based on this limited screening may have some chance of giving a misleading result. This analysis is continuing using a more rigorous screening approach.

Another of the different approaches applied so far to clean the MSU Ch. 2 data was on the basis of fair weather conditions, using colocated HIRS and MSU Ch. 1 data from the same satellite. In general, globally observed HIRS maximum brightness temperatures correspond to clear sky conditions. For MSU Ch. 1, the maximum observed T_b's over the land and minimum observed T_b's over the ocean correspond to fair weather situations. The MSU Ch. 2 observations in a 10° brightness temperature band from colocated HIRS brightness temperature maximums should indicate the fair weather data. Monthly mean maps and zonal means as well as area averages of the Ch. 2, HIRS, and Ch. 1 data in the 10° band vs. all observations over the land, over the ocean, and globally are computed on a monthly basis to examine their seasonal and annual variation. These computations are also performed for a separate set of data that is being cleaned using Spencer and Christy (1992) screening criteria.

On the basis of various runs of a microwave simulation model using clear sky and cloudy conditions, it was found that in the tropics the Ch. 2 brightness temperature variation from fair weather to cloudy-precipitating conditions ranges about 6 K, while this range is only 2 K in the mid-latitudes. The Ch. 1 observations with values of 235 K and above were found to be influenced by clouds and precipitation. Two sets of weights—one for the tropics and another for mid-latitudes—based on model simulations and empirical analysis of microwave data, were decided upon to compute the quantitative measure of contamination in Ch. 2 data on the basis of Ch. 1 observations. Monthly and zonal mean maps of the contamination in Ch. 2 data were computed for the tropics and middle latitudes separately. This result is at the preliminary stage, and a rigorous analysis is underway to check this more stringently. This computation will also be repeated for the data that have been cleaned using Spencer and Christy (1992) 0.5 criteria. Monthly and zonal means of HIRS data for 24 months (of 1982 and 1983) is underway to see the zonally averaged seasonal and annual variation.

The MSU and HIRS data transfer from reel tapes to 4-mm DAT on the task's Unix workstation continues. Almost all the MSU data that were available in the tape library have been transferred. This work is performed during weekends and evenings to help minimize mainframe computer usage charges.

SSM/I-derived winds were computed for the global oceans for a 4-day period in March 1988 using the Goodbert et al. algorithm. Winds over a certain speed result in an emissivity change over the oceans that would induce a sufficient difference in MSU Ch. 2 brightness temperature observations. The ATR felt a small enough rise in the surface wind speed would induce enough of a change to affect the MSU Ch. 2 observations by 0.2 K. Because the global warming signal is on the order of 0.2 K, any more noise in the data would render the data set useless.

Several global maps of land and ocean areas using SSM/I were generated for March 1988 to analyze for scattering in the 85.5-GHz channel. Criteria very similar to those used above for SSM/I rain retrievals over land were applied. Based on the limited histogram information available, the criteria applied were insufficient to obtain any meaningful signal.

PROBLEM AREAS

Network problems isolated the Code 913 computers from systems outside Bldg. 22 intermittently. Intermittent network problems between the task workstation and task members' X terminals created some bottlenecks with workstation-to-terminal communication; Code 913 staff is examining this problem.

There were various computer system (IBM MVS/ESA, Cray, and Convex) and network failures during the period. None were of any significant duration. Because the task has reduced reliance on these systems, impact on task work was minimal.

The task workstation started to run short on disk space during periods of research involving monthly SSM/I data analysis. A temporary solution was to split the entire SSM/I monthly data record over several disk volumes and to use symbolic links to fool the decoder code into thinking the data were maintained on one volume.

Tape read errors and a 4-mm drive failure during the period of disk space shortages led to a temporary, albeit dramatic, reduction in productivity. The drive manufacturer was contacted, and a service technician repaired the drive. Tape read errors still persisted because of media errors. The task leader is still looking into the media error problems. The most likely cause of these errors is that the medium of the data tape in question is of poor quality. The most likely fix is to recopy the data on this tape to a new, fresh DAT.

The UniTree MDSDS suffered several serious outages during the period, slowing data transfers. These outages were related to problems staging archived data to disk. Stage requests timed out often. Several overnight and weekend runs did not occur because of these failures.

Severe weekend weather had knocked the task workstation offline until the following Monday. No work time was lost because of this system downtime.

SCHEDULE CONFORMANCE

Task work under this contract has ended. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work will be completed on the revisions to the microwave rain paper.

Basic research will proceed on implementing the SSM/I-based microwave rain retrieval algorithm over land. Work will primarily concentrate on seasonal histogram collection and obtaining ground truth data from rain gauge and radar data.

Ground truth data from the GPCP AIP–2 will be further analyzed.

The SSM/I liquid water contamination correction term for the water vapor retrieval algorithm will continue.

Sensitivity studies of the rainfall retrieval algorithm will continue.

Work will proceed as planned with the ATR, especially concerning further improvements to the rain algorithm and water vapor retrievals.

The MSU-HIRS analysis to clean the MSU Ch. 2 data for global warming analysis will continue.

The remaining years of nadir HIRS and MSU data will be extracted from IBM 3480 cartridges and stored in the local data library on 4-mm DAT. Data stored on the IBM MVS HSM system will be migrated to tape storage on the task workstation.

A Work Control Plan will be completed.

CONFERENCES

Staff attended the spring 1993 AGU meeting at the Baltimore Convention Center.

Staff attended most of the weekly Climate and Radiation Branch-sponsored seminars.

TRAINING

Staff attended the HSTX 8-hr course on continuous measurable improvement (cmi). Staff applied cmi in the form of improving communication with the ATR.

DELIVERABLES SUBMITTED

Data: Generated all ATR-requested text, plots, and data printouts of MSU, HIRS, SST, and SSM/I
Originators: J. Nucciarone and V. Dubey

Abstract: Prepared and delivered an abstract for the fall 1993 AGU meeting to the ATR
Originators: J. Nucciarone and V. Dubey

Graphics: Submitted new figures for the revised microwave rain paper to the ATR
Originators: J. Nucciarone and V. Dubey

Maps: Supplied color and gray-scale maps of total rainfall percentage for the convective, mixed, and stratiform rain types to the ATR
Originators: J. Nucciarone and V. Dubey

Maps: Supplied maps of statistical output of the GPCP AIP/2 results to the ATR
Originators: J. Nucciarone and V. Dubey

Graphics: Generated figures and transparencies for the ATR's spring 1993 AGU presentation
Originators: J. Nucciarone and V. Dubey

COMPUTER USE

Hours	Computer
20 (CPU)	IBM 9021 ESA
5 (CPU)	Convex AVS
1 (CPU)	Cray Y-MP
50 (CPU)	Climate (HP750)
500 (CPU)	Microwave (SGI Indigo)

NASA Task 12-034-00: Arctic Aircraft Data and EOS Project Studies

GSFC ATR: *Dr. M. Schoeberl*

Hughes STX Task Leader: *P. Guimaraes*
Hughes STX Task Number: *160*

This task provides support services for the proposed Arctic Aircraft Mission and the EOS project. Software support will be provided to develop and document data analysis algorithms for the aircraft missions. Maintenance of data sets and operating system software will be performed, and graphics visualization packages and routines to read the various data will be developed.

FINAL CONTRACT SUMMARY

This task, created in January 1991, has had one senior systems programmer working from .5 Full-Time Equivalent (FTE) (January–May 1991) to 1 FTE (June 1991–present) and one senior programmer analyst working .5 FTE (July 1992–present).

Over the lifetime of this task, task members managed all the members of the Unix-based cluster of workstations in Code 916. This cluster, which was composed of four workstations at the beginning of the task, has grown significantly in the last 2 years, and is presently composed of 19 workstations, 30 X Window terminals, and several printers. Management of this cluster involved performing basic day-to-day system administration tasks, as well as writing an enormous amount of software to continually improve the efficiency of all system administration tasks. Members of this task also provided hardware and software support for the Airborne Arctic Stratospheric Expedition II (AASE II) in Bangor, ME, and to the Stratospheric Photochemistry Aerosols and Dynamics Expedition (SPADE) at NASA/Ames Research Center in Moffett Field, CA.

Remaining objectives to be accomplished include the continuation of the management of the Unix-based cluster of workstations.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff installed software on the central system to monitor the network and did an initial inspection of the network. Task personnel discussed the reconfiguration of the Unix-based cluster with all the system administrators. Staff became familiar with the new disk configuration and the procedure to automatically mount disks on demand on all the systems in the cluster. Staff modified the script that installs a new workstation into the Unix-based cluster to use the new disk configuration and installed the new workstations into the cluster. Task members consulted with several users in the TOMS project in an effort to use their disk space in the most efficient way. Staff worked with the customer support engineer from QStar to test the new optical jukeboxes. Task members interacted with the users to get the necessary information to create the volume sets in the jukebox, created the volume sets, and made them available to the TOMS workstations. Task personnel troubleshooted serious problems with two of the workstations in the cluster and took the necessary actions to remedy the situation. Staff aided in the move of some computer equipment to the offsite facility.

WORK PERFORMED

200 SYSTEM ADMINISTRATION AND MAINTENANCE

Staff installed the NetVisualizer software on the central system and did an initial inspection of the network. Staff also tried to create a log of network traffic for a week but had trouble running the software. Staff has been in contact with Silicon Graphics (SGI) in order to solve the problem.

Task members discussed the reconfiguration of the Unix-based cluster with all the system administrators. Task members became familiar with the new disk configuration and the procedure to automount disks on demand on all the system that in the cluster. Staff modified the script that installs a new workstation into the cluster to use the new disk configuration. Staff ran the installation script on the new workstations to make them members of the cluster.

Staff interacted with SGI personnel to have two of the workstations upgraded to an Indigo R4000.

Task personnel consulted with several users in the TOMS project in an effort to use their disk space in the most efficient way. Task personnel worked with the customer support engineer from QStar to test the new optical jukeboxes. Staff interacted with the users to get the necessary information to create the volume sets in the jukebox. Staff created the volume sets and made them available to the TOMS workstations.

Task personnel interacted with several people in an effort to select the appropriate bridge/router to be purchased to expand the network capabilities of the Unix-based cluster.

Staff wrote several scripts to be executed before and after an upgrade of the operating system on the central system in order to allow the installation of certain subsystems on partitions other than the root and user partitions. Staff also cleaned up the root partition on the central system and created a list of files that should always exist on the systems in the cluster. This list will be used to clean up the root partitions on the other systems.

Task members troubleshooted serious problems with two of the workstations in the cluster and took the necessary actions to remedy the situation. Task members also troubleshooted problems with some disks and X Window terminals and had them repaired.

Task personnel aided in the move of some computer equipment to the offsite facility.

Staff made full and incremental backups of all systems in the Unix-based cluster.

300 AIRCRAFT MISSION SUPPORT

Staff prepared several viewgraphs about the flight planner to be presented at a SPADE meeting.

SIGNIFICANT ACCOMPLISHMENTS

Task members were heavily involved in the design and implementation of the new disk configuration for the Unix-based cluster, which greatly facilitated moving disks and users' disk space among the various workstations in the cluster. This implementation also improved network traffic by mounting disks through the Network File System (NFS) software only on demand.

Staff participated in the testing and setup of the optical jukeboxes and consulted with the users to create volume sets that would allow for efficient access of the jukebox.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work on this contract has ended. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will work on software to separate the Unix-based cluster into several subclusters, which can then be generally administered by the group leaders.

Staff will work on the flight planner program.

Task personnel will work on creating a data base to hold information about all the equipment in the Unix-based cluster and will also write routines to access this data base.

Task members will continue to perform system administration tasks on the Unix-based cluster of workstations and X-terminals.

A Work Control Plan will be completed.

TRAINING

One task member attended an intensive course on X Windows Programming from August 3–6. Another staff member took the HSTX-sponsored continuous measurable improvement (cmi) awareness training.

COMPUTER USE

Minutes	Computer
55,200 (wall clock)	Unix-Based Cluster of Workstations

NASA Task 12-036-00: Raman Lidar for Study of Atmospheric Gases

GSFC ATR: *Dr. S. Melfi*

Hughes STX Task Leader: *R. Ferrare*
Hughes STX Task Number: *162*

This task participates in spectroscopic studies of atmospheric gases using a laser-based remote sensing experiment. It will aid in data processing, assembly and testing of the laser system, laser operations, and test and maintenance. The task also participates in field missions at remote sites.

FINAL CONTRACT SUMMARY

On February 1, 1991, this new task was started under contract NAS5-30440. On March 2, 1991, a senior programmer analyst began working at 1 FTE and has worked on this contract to date. On July 15, 1992, a senior scientist began working at 1 FTE on this contract as well. There have been many major milestones and accomplishments over the lifetime of the task. Some of these are now listed. Extensive real-time support was provided to the ATR during the deployment of the GSFC Raman lidar during several field experiments. Real-time data acquisition and analysis support was provided during these experiments. Software was developed to acquire, display, and analyze these lidar data as well as to analyze supporting data provided by radiosondes and instrumented aircraft. Research regarding water vapor, aerosol and temperature measurements and water vapor spectra were written and published in scientific journals, presented at conferences, or both. Additional support was also provided to the ATR and other researchers in the preparation of other journal articles. Data and assistance in the analysis of these data were provided to several other research groups. Support was also provided to the ATR by the preparation and writing of: 1) a safety guidelines document and 2) a proposal for Raman lidar measurements that was funded by the Department of Energy.

Remaining objectives to be accomplished include the support of the GSFC Raman lidar during the field deployment of this instrument at Wallops Island, VA.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff worked on various aspects of Raman lidar data analysis. Staff continued to use the Raman lidar data to examine the relationships between atmospheric water vapor and aerosol extinction and scattering and found that the extinction/backscatter ratios observed by the lidar are consistent with those predicted by Mie theory. Staff began writing a paper discussing the correlation between water vapor and aerosol characteristics as determined from the lidar data. Staff also wrote a draft version of a paper discussing Raman lidar temperature retrievals. Staff wrote software to estimate the aerosol extinction to backscatter ratio needed for this analysis and to compute the errors associated with the derived temperatures. Staff found the Negler-Meade resolving time correction algorithm extends the range for deriving temperatures. Staff computed profiles of upper tropospheric water vapor mixing ratio and relative humidity using the lidar data; integrated water vapor amounts measured by the GOES VAS sensor agreed with the lidar measurements. Staff modified software and hardware to permit the use of Lahey FORTRAN V5 to run successfully under OS/2 Version 2.1. Staff supported the Raman lidar measurements made during July and August at GSFC and the deployment of the instrument at Wallops Island in early September.

WORK PERFORMED

100 LASER SUPPORT

HSTX staff supported daytime water vapor lidar measurements that were designed to determine whether afterpulsing could be reduced in the daytime solar blind photomultiplier tubes. Daytime data were collected using a new technique that involved preheating the high-sensitivity nitrogen channel photomultiplier tube. This support involved setting up and operating the data acquisition system and performing preliminary analysis to determine data quality. Initial results showed that fluorescence effects are negligible. Staff also supported the deployment and data acquisition of the lidar system at Wallops Island in September.

200 NIGHTTIME SOFTWARE

201 Temperature Retrieval

HSTX task members continued to investigate the retrieval of atmospheric number density and temperature from the Raman lidar nitrogen channel data. The error analysis associated with the temperature retrievals was revised and used to determine that 10-minute profiles were optimum for the temperature retrievals. Using high-channel data, staff found that preliminary results show that the Negler-Meade algorithm for resolving time correction will give temperature calculations to a lower altitude. Staff wrote software to perform error analysis of the estimated extinction to backscatter ratio that is required for the temperature calculation. Staff also created a program to calculate the aerosol extinction to backscatter ratio for many files using different model data. This software was used to compute aerosol profiles corresponding to the 10-minute data files for 130 10-minute periods spanning 20 days. Staff also began incorporating comments received on the first draft of a temperature paper into the second draft that is currently being written.

202 Aerosol Optical Properties

Staff continued investigating the relationship between aerosol optical and physical properties and water vapor using the lidar data acquired at Wallops Island during July and August 1992. The work focused on two additional days, July 31 and August 4, 1992. Staff computed water vapor and aerosol profiles for these additional days using both vertical pointing and scan data. Before plotting aerosol properties as a function of relative humidity and water vapor mixing ratio, staff revised and upgraded graphing software programs to permit plotting many different cases on the same graph. The software that computes aerosol extinction using the Klett method was modified to include error analysis. Staff found that the aerosol extinction profiles computed using the method agreed with those computed using the Raman nitrogen channel only if the correct aerosol extinction/backscatter ratio was specified. Staff computed aerosol size parameters and indices of refraction using Mie scattering software and found that these were consistent with the extinction/backscatter ratios observed by the lidar. Staff also examined the systematic errors introduced in the water vapor mixing ratios and aerosol scattering ratios by uncertainties in the wavelength dependence of aerosol extinction. These errors could be large (5–10 percent) for scan data acquired near the horizontal and for large aerosol loading. Work is currently underway to determine whether this differential transmission effect can be used with actual (i.e., noisy) data to estimate the wavelength dependence of aerosol extinction.

203 Spectral Analysis

Staff researched and implemented the Maximum Entropy Method (MEM) for spectral estimation. Although this method gives higher statistical accuracy than the Fast Fourier Transform (FFT) method, in doing a spectral analysis, both should be used to get the most information. Initial results from the MEM show a smooth slope of –2 where the FFT had many (spurious?) peaks.

204 Goddard-Sandia Water Vapor Comparison

Staff worked closely with J. Goldsmith (Sandia National Laboratories) on a publication dealing with the joint Raman lidar water vapor experiment that took place at GSFC during November 1992. Staff collected and examined surface and upper air meteorological data and wrote a section of the paper on the meteorological conditions that existed during the experiment. Staff also examined the calibration and comparison characteristics between the two lidars and the coincident radiosondes that were launched at GSFC during the experiment. After preparing various graphs that displayed these comparison results, staff also wrote a section of the paper on these comparisons. Staff also coordinated the transfer of comments about this paper between the two groups.

205 Upper Tropospheric Water Vapor Retrievals

Staff produced upper tropospheric profiles of water vapor and relative humidity for use by personnel at the University of Wisconsin-Madison Space Science and Engineering Center and NOAA Geophysical Fluid Dynamics Lab (GFDL). The integrated vapor computed from these profiles agreed well with the corresponding values measured by the 6.7-mm channel of the VAS instrument on the GOES satellite. Staff wrote software to compute various vertical and temporal averages to determine the best way to compute these upper tropospheric profiles. Profiles were computed for several nights during the FIRE-II experiment in November and December 1991. Staff also wrote a description of the lidar system, measurement, and analysis procedures for a paper to be submitted to the *J. Geophys. Res.* describing this comparison.

300 OTHER SOFTWARE

HSTX staff loaded OS/2 Version 2.1 onto the computer and began testing Lahey FORTRAN 5.0, the LAN server net, and TCP/IP software. After staff encountered problems with the IBM LAN server software, it was replaced with the TCP/IP communications program for transferring data to and from the server. HSTX personnel completed converting nearly all computer operations to use the IBM OS/2 operating system, Version 2.1. Most of the water vapor and aerosol analyses programs have been run successfully under Version 5.0 of Lahey FORTRAN under OS/2. Staff also installed the new version of System 7 (System 7.0.1) in the Macintosh IIx and tested the compatibility of various applications. No serious problems have been found to date.

HSTX personnel began learning to use the GpfSystems graphics tool that makes OS/2 display windows and generates the C code to create them at runtime. This tool will be used to create new and improved real-time data analysis display programs. Staff modified the Lahey FORTRAN water vapor and aerosol display software to display (as vertical stripes) data taken at any selected scan angle. This software was also modified to use new clock timing routines for real-time operation.

400 WALLOPS ISLAND EXPERIMENT

Staff prepared for this experiment currently underway by analyzing water vapor and aerosol test data acquired at GSFC in July and August. Good agreement was found between the lidar water vapor profiles and those measured by National Weather Service radiosondes launched at Dulles Airport. Staff also produced initial color images of the water vapor profiles taken at three scan angles. In addition, staff trained in the deployment and use of an automatic sunphotometer used by B. Holben (Code 923). This instrument automatically measures aerosol optical thickness, sky radiation, and solar almucantar. One of these instruments is now deployed at Wallops Island for the ongoing experiment. Staff traveled to Wallops Island at the beginning of September and assisted in the deployment, checkout, and initial data acquisition of the Raman lidar system.

SIGNIFICANT ACCOMPLISHMENTS

Staff prepared, organized, and presented the poster "Laser Measurements of Atmospheric Water Vapor and Aerosols" for the GSFC Space Data and Computing Division Tea and Poster Session in Building 28. Several GSFC personnel attended this session and asked questions about the Raman lidar system.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The following activities are planned:

- Assist with the data collection and real-time analysis of the Raman lidar data acquired during the water vapor experiment held at Wallops Island.
- Analyze lidar water vapor calibration characteristics after comparing them with the relevant data from radiosonde and surface sensors.
- Continue writing a paper that discusses aerosol properties and their relationship to atmospheric water vapor.
- Perform indepth analysis of the vertical and horizontal spectra of the water vapor mixing ratio and debug the order-2 information fractal analysis program.
- Continue writing a paper on temperature retrievals in the lower atmosphere.
- Assist in the determination of the proper method to apply the Negler-Meade algorithm to correct for resolving time limitations.
- Update the Work Control Plan for the new contract to meet the requirements of this task.

NONLOCAL TRAVEL

Staff traveled to NASA/GSFC/Wallops Flight Facility for the water vapor experiment that is currently underway.

TRAINING

The task leader and K. Evans completed the course "Giving Successful Presentations," given by Don Swenholt and Associates. Evans finished the "Achieving Writing Excellence" video course, given at GSFC. The task leader completed the course "Introduction to C Programming," given at Howard Community College, Columbia, MD.

DELIVERABLES SUBMITTED

Plots: Temperature retrieval, spectral analysis, and aerosol scattering ratio
Originator: K. Evans

Profiles: Depicting upper tropospheric water vapor mixing ratio and relative humidity
Originator: R. Ferrare

Statistics: Meteorological analysis and comparison statistics for GSFC-Sandia Water Vapor Lidar Experiment
Originator: R. Ferrare

Poster Paper: "Laser Measurements of Atmospheric Water Vapor and Aerosols"
Originators: R. Ferrare and K. Evans

Software: Upgraded water vapor and aerosol display software
Originators: K. Evans and R. Ferrare

COMPUTER USE

Minutes	Computer
38,000	IBM PC (DOS)
6,000	IBM PC (OS/2)

NASA Task 12-037-00: Ozone Trends Study

GSFC ATR: ***Dr. R. Stolarski***

Hughes STX Task Leader: ***G. Labow***
Hughes STX Task Number: ***163***

This task provides programming and data processing support for the Total Ozone Mapping Spectrometer (TOMS) on the Nimbus 7 satellite. The work includes developing original programs to reformat, analyze, and display the data from the TOMS instrument and to interpret the results in order to find trends in the ozone data to further our understanding of the complex ozone creation/destruction cycle. Data and analysis requests from other scientists are also filled.

FINAL CONTRACT SUMMARY

Task work on contract NAS5-30440 began on January 1, 1991, and will be transferred to contract NAS5-31755 on October 1, 1993. Over the lifetime of this task, one programmer/analyst has been working full-time.

This task has provided programming and data processing support for TOMS onboard the Nimbus–7 and Meteor–3 satellites. Software has been written to analyze many other types of data including balloonsonde, UARS/MLS, Umkher, Dobson TIROS/TOVS, BUV, and SBUV data. Various results have been presented at several conferences and published in scientific journals. Support has also been given to various NASA scientists as well as to NOAA, ESA, and other scientists.

Remaining objectives to be accomplished include publishing a major paper on the state of ozone in the early 1970's as seen by the BUV instrument, finding a proper way to determine column ozone from the UARS Microwave Limb Sounder, publishing a paper on TOMS/Dobson trends for the lifetime of Nimbus–7, and finding a reasonable method to append TOMS ozone data from the Nimbus–Meteor–Earthprobe satellites.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff finished the analysis of Nimbus–7 TOMS vs. Dobson groundstation and sent the results to the World Meteorological Organization in Downsview, Canada, for publication in its Ozone Data for the World catalogue. These results were also presented at the TOMS science meeting held in New Carrollton, MD, May 17–20. Task personnel created many software routines that compare the UARS/Microwave Limb Sounder (MLS) with TOMS. Comparisons are made in both total column ozone (in Dobson units) as well as ozone profile shape (in mixing ratio). Ozone trend analysis continued until Nimbus–7 ceased delivering data. An ozonesonde data base was acquired from various sources around the world. Code has been written to read and display sonde data. Staff attended the American Geophysical Union meeting in Baltimore, May 24–28. Many data requests were completed for both GSFC and offsite scientists.

WORK PERFORMED

Software Written/Data Analysis

The TOMS/Dobson comparisons have been plotted and analyzed for nearly 100 groundstations, and the results are being published (see Summary for Current Reporting Period). By using TOMS as a calibration tool, staff hopes to show that the groundstations have errors in their data. It is hoped that the station data will be corrected and reprocessed so that staff has a better data set available in the future.

Much work has been done with the UARS/MLS instrument. Many routines have been written to display comparisons of MLS with SBUV standard profiles using the TOMS total ozone as a transfer standard. Results are both preliminary and puzzling. It is hoped that tropospheric ozone can be deduced by the difference between the MLS column (which measures down to 100 mb) and TOMS, but initial results show that the MLS data may be too "noisy" to be of any use at 100 mb.

Code has been written to reformat and display balloonsonde data. These data will be useful in deducing tropospheric ozone because the sondes have good resolution below 100 mb.

Many data requests have been filled for both NASA/GSFC personnel and foreign scientists. These requests vary from simple plots of QBO or recent ozone trends to requests for color slides and viewgraphs of TOMS or BUV ozone maps.

SIGNIFICANT ACCOMPLISHMENTS

Releasing the TOMS/Dobson data set was extremely significant in that the ozone scientific community now has a basis for judging the relative variability of each station.

PROBLEM AREAS

Moving offsite has presented several problems, specifically with the computer systems. Support has not been adequate, and a task that should have taken a day to set up took 3 weeks. In addition, numerous paperwork problems were encountered with the transfer of the equipment.

Task members still cannot print a hardcopy from their system because the queues have not been set up, the task leader cannot access some of the science directories at GSFC, and the network is so oversubscribed at times that work comes to a grinding halt for minutes at a time.

SCHEDULE CONFORMANCE

Task work under this contract has been completed and the task assignment has been transferred to contract NAS5-31755.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-31755

Staff will continue programming, analysis, and data processing to meet the specific needs of the ATR. Papers concerning the early 1970's BUV data will be written some time in the near future as well as another paper dedicated exclusively to the TOMS/Dobson comparisons for the entire lifetime of Nimbus-7 TOMS. MLS analysis will continue until a satisfactory method has been found to calculate total column ozone. Results from this analysis may be presented at the AGU meeting this winter.

A Work Control Plan will be prepared.

CONFERENCES

Task personnel attended the Baltimore AGU meeting held May 24–28, 1993, and the TOMS science meeting in New Carrollton held May 17–20, 1993.

COMPUTER USE

Minutes	Computer
60–120 CPU	SGI Workstations (Chapman, Hyperion, and Ozone)
30–60 CPU	VAX Machines (OZ, SGCCP, and PACF)

NASA Task 12-038-00: Nimbus-7 TOMS Data Processing and Programming

GSFC ATR's and Cognizant NASA Scientists: ***Drs. M. Schoeberl and R. McPeters***

Hughes STX Task Leader: ***E. Beach***
Hughes STX Task Number: ***164***

This task supports the development of software for visualization of ozone data products. Other duties include responding to requests for visualization products or specialized data sets, processing of the data, and maintaining the various types of data sets. Data products are obtained from the Nimbus-7 TOMS, Meteor-3 TOMS, and SBUV instruments. A contribution to the management of the workstation cluster is also provided by the task. This includes running backups, establishing new user accounts, and installing new software on the cluster.

FINAL CONTRACT SUMMARY

This task was initiated on November 9, 1992, and over the lifetime of this task, one senior programmer/analyst and one programmer/analyst worked to accomplish the following milestones:

Providing timely and effective support to Code 916 and the ATR during the ozone hole period in the fall and winter of 1992; production of various data products, graphs, and images for members of the branch; development of TOMS imaging system to display, graph, and analyze ozone data on the Unix platform. Writing software to handle the new ASCII formatted ozone data; development of full-size poster depicting monthly mean Nimbus-7 images. The data spanned over the entire 14-year lifetime of the instrument. Assistance was given to the branch and the ATR in the display of real-time ozone data during the present ozone hole period. These data are also being sent out to researchers worldwide on a daily basis. Remaining objectives to be accomplished include the continuation of the real-time data processing and distribution, the completion of the text for the back of the Nimbus-7 poster, and the continuation of the development of the TOMS imaging system.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX personnel spent time processing data from the Nimbus-7 TOMS and the Meteor-3 TOMS instruments. Reduced ozone and various zonal means files were produced using the ASCII formatted production data. All Nimbus-7 data were processed since thc instrument's death on May 6, 1993. Task personnel also spent time filling numerous requests for ozone images and data from scientists and the media. Support for Antarctic field missions was handled by HSTX task personnel. Contour maps, images, and grid data were made available on a daily basis to the scientists in the field. This near-real-time system finally has been automated so that little interaction is required by task personnel. HSTX task member worked on producing a poster showing monthly mean images over the lifetime of the Nimbus-7 TOMS instrument. A 2-x-3 ft poster has been made, and six panels of text for the reverse side are being prepared now. The poster should be ready for distribution within two months. Task members continued to develop software for display of Nimbus-7 and Meteor-3 TOMS data for the Unix-based cluster. Additional widget options were incorporated for selection of menu inputs after trying several different widget types, and options were added for display of multiple images. HSTX staff also continued work on a 'quicklook' program to process calibration data for Nimbus-7 and Meteor-3

TOMS. The program includes options to compute and plot albedo, and to write test results into summary files.

WORK PERFORMED

100 PRODUCTION OF GRAPHICS AND DATA PRODUCTS

HSTX staff sent data products (wax prints, transparencies, paper plots, and slides) to various scientists and organizations. Images and other products were all made from Nimbus-7 TOMS data. Various requests for actual data were also handled by an HSTX task member. Several requests for specially formatted data were fulfilled and numerous requests for access to the real-time data handled. HSTX personnel has worked with E. Feldman (Code 903.2) and Goddard Public Affairs to produce a poster depicting all of the monthly mean ozone images taken over the lifetime of the instrument. The text that will be placed on the back of the poster is written so the poster should be printed by the middle of October.

200 REAL-TIME DATA PROCESSING

Processing of the real-time Nimbus-7 data has been halted due to instrument failure. Meteor-3 TOMS data are now being processed at the real-time pace. The turnaround time for a full day's coverage is about 17 hours. The data are being used to make contour maps, which are sent to Antarctica daily. Images also are being made on a daily basis and placed on our anonymous file transfer protocol (FTP) account. RO-files are being made at a near real-time pace also for users who still use the VAX- based system. An attempt will be made to automate the processing that creates the different PostScript images for the FTP account.

300 NIMBUS-7 PRODUCTION DATA PROCESSING

Nimbus-7 production data processing has stopped due to instrument failure on May 6. The production data for February through May has been completed. Various files including RO, RR, MM, MZM, and ZM files were created for each month. The Nimbus-7 data will be reprocessed into a version 7 in the near future. No reflectivity data were produced using the new system, so no RR files were created.

400 METEOR-3/TOMS DATA PROCESSING

HSTX task personnel processed the May, June, and July 1993 Meteor-3 TOMS data into RO, MM, MZM, and ZM files. During the end of May, the instrument's chopper wheel lost synchronization, so data quality since the end of May has varied. A slight improvement in the data quality during the latter part of June appeared to occur, so task members are hopeful that the instrument has recovered.

500 GENERAL SUPPORT

Task personnel produced monthly mean data files from the grid-t ASCII for the entire Nimbus-7 lifetime. A program was written to read and average the daily files into a monthly mean. The files were then output into the same ASCII format as our CD-ROM's. These files have been released to several scientists who have requested them. Personnel distributed grid-t data files to various scientists. Task members also extracted certain ozone amounts for specified latitudes and longitudes in an effort to correlate ozone amounts with an observed increase in solar UV. Personnel also spent time writing text for the back of the Nimbus-7 TOMS lifetime ozone poster that is being produced.

A task member helped set up new system (ozone.stx.com) at the Commerce I building and installed some general purpose software. Task personnel also installed three X-terminals at Commerce I, after installing the necessary software on the workstation from which the terminals will boot.

600 SOFTWARE DEVELOPMENT

HSTX task personnel incorporated calls to locally developed mapping routines in the TOMS program to reduce the overall computational time. The HSTX task member fixed some problems resulting from the choice of azimuthal equidistant projection in the TOMS basic menu. The task member also revised the code to reduce the total memory requirements. HSTX task personnel wrote a widget-based program to read and plot the TOMS calibration data. Staff simplified the IDL code that brings up the widget menu in the TOMS program. Task personnel also worked on a routine to calculate and plot the histogram of ozone values within a specified area of a TOMS map. Another routine that zooms into a TOMS map with options for variable zoom factors also was incorporated into the TOMS program. HSTX personnel continued to work on a program to check calibration data for Nimbus-7 and Meteor-3 TOMS with options to check the quality of the monitoring data, including plotting radiance and irradiance values and their ratios for different wavelength combinations. The program has been tested on different sets of calibration data. Continued work on a 'quicklook' program to process calibration data for TOMS and METEOR-3. Staff included options to compute and plot albedo and write test results into summary files.

SIGNIFICANT ACCOMPLISHMENTS

HSTX task personnel worked as part of a team to successfully produce a poster that shows ozone measurements during the entire lifetime of the Nimbus-7 TOMS instrument. This poster required new software to be written and a great deal of collaboration with other members of the branch.

PROBLEM AREAS

HSTX personnel had trouble writing software to produce a South Pole contour map for ozone. The trouble seemed to be cause by the IDL subroutines that were being used. The contour map's contours were too close together and the routine did not allow for the map to be expanded. The problem was overcome by using another routine on a different system.

Much time was spent on setting up X-terminals at the Commerce I building. This resulted from lack of information specific to the network router in that building. The problem was resolved by resourcefulness of staff.

SCHEDULE CONFORMANCE

Most of the work on this task has been transferred to the Ozone contract.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

100 PRODUCTION OF GRAPHICS AND DATA PRODUCTS

HSTX task personnel will continue to produce images and data products as they are requested for by various scientists and organizations.

200 REAL-TIME DATA PROCESSING

Real-time data are being processed as production data.

300 NIMBUS-7 PRODUCTION DATA PROCESSING

All Nimbus-7 data processing has been stopped due to instrument failure. A reprocessing of the data is planned, but no firm date has been set.

400 METEOR-3 PRODUCTION DATA PROCESSING

HSTX task personnel will process all Meteor-3 data as soon as they become available. The RO processing system will be altered to process RR files for reflectivity as soon as the data becomes available. Meteor-3 TOMS has become our main instrument after the failure of Nimbus-7 TOMS.

500 GENERAL SUPPORT

Requests for data will be handled as they are received. Programs are normally written or altered to handle these requests for specific data.

600 SOFTWARE DEVELOPMENT

Work will continue on the TOMS display program.

The IDL-based calibration program will be developed to include options for goniometry. Some other options (like hardcopy output for plots will be included), and the program will be tested on a PC.

700 VISUALIZATION TECHNIQUES

A Work Control Plan has been prepared.

DELIVERABLES SUBMITTED

Data: Various plots, color images, and VHS movies of the ozone hole to various scientists, universities, and private companies

PostScript images of northern and southern hemisphere ozone from Meteor-3 to our anonymous FTP account on a daily basis so that users could easily download the latest ozone hole images

Faxed contour maps of the ozone hole to several scientists around the world on a daily basis

14 October ozone hole images showing the growth of the ozone hole over the past 14 years.

1 poster showing all of the monthly mean images during the Nimbus-7 TOMS lifetime.

Originator: E. Beach

COMPUTER USE

Minutes	Computer
13,200	VAXcluster (PACF)
16,000	Unix Workstation

NASA Task 12–039–00: Trajectory Modeling in Support of the High-Speed Research Program

GSFC ATR and
Cognizant NASA Scientist: ***Dr. M. Schoeberl***

Hughes STX Task Leader: ***Dr. L. Sparling***
Hughes STX Task Number: ***165***

This task uses the GSFC 3-D isentropic parcel trajectory model to investigate transport processes in the middle atmosphere. In the initial phase of the task, the effects of subgrid scale fluctuations in the meteorological fields on particle dispersal will be evaluated using the IDL version of the trajectory code.

In the next phase of the project, the trajectory code will be converted to FORTRAN and made parallel. Timing studies will be designed to accurately measure code performance, and the trajectory results will be compared to the results from other computationally intensive grid-point models.

FINAL CONTRACT SUMMARY

NASA Task 12–039–00 under NASA contract NAS5-30440 began January 4, 1993. Staff assigned to this task has been limited to one full-time senior scientist. The main accomplishments during the short lifetime of the task are the following. Several statistical analyses of air parcel trajectories have been performed in connection with the High-Speed Research Program, including studies of horizontal dispersion away from flight paths, analysis of minimum temperatures, and effects of diabatic heating. The compilation of these results in a research paper has begun, but is not completed. A paper focusing on more general issues related to trajectory modeling and containing many original results has been completed. A version of the trajectory code was translated from IDL to FORTRAN, and data sets were prepared and sent to High-Performance Computing and Communications (HPCC) collaborators at the National Parallel Architectures Center (NPAC) at the Univ. of Syracuse. Further work on the project has been suspended. Work was done on code development and maintenance for a 2-D advection code and Kalman filter for the 2-D advection dynamics in connection with the HPCC project. Continuation of this project is expected in the next task assignment.

SUMMARY FOR CURRENT REPORTING PERIOD

The work for this period was a continuation of the statistical analysis of air parcel trajectories initialized along various projected flight paths in order to assess the potential impact of a proposed fleet of high-altitude aircraft on stratospheric chemistry. Fluctuations in the horizontal distribution of parcels were characterized by a binning method, and an evaluation of the importance of diabatic effects on horizontal dispersion was made for the New York-London route. Seasonal variations in dispersal of aircraft exhaust away from flight corridors for the London-New York route were studied by comparing horizontal dispersion for January, April, July, and November. The Los Angeles-Sydney route was added to the flight paths studied in order to have a tropical route represented. Staff attended a NASA High-Speed Research Program conference, "Atmospheric Effects of Stratospheric Aircraft," June 6–10, 1993. The trajectory results were presented by the ATR at this conference, and a paper is in preparation.

An analysis of the effect of diabatic heating on horizontal transport was performed by comparing adiabatic and diabatic trajectories for an ensemble of parcels. The ATR and the task leader completed the paper, "Trajectory Modeling," which will appear in the Italian Physical Society Proceedings of the International School of Physics.

FORTRAN-readable meteorological data sets were prepared and sent to collaborators at NPAC in order to test a data-parallel version of the trajectory code. An analysis of the system integration problems involved in porting data sets to a remote supercomputer locations at Caltech and Jet Propulsion Laboratory has led to a reevaluation of the project. Work has been suspended, and a new task assignment related to the HPCC project is expected.

Staff attended the AGU conference held in Baltimore, MD, May 25–28.

WORK PERFORMED

100 TRAJECTORY MODEL ANALYSIS

A major portion of the work for this period was a continuation of the analysis of air parcel trajectories initialized along several projected flight paths for a proposed high-speed, high-altitude aircraft fleet. Fluctuations in the horizontal distribution of parcels were characterized by partitioning the globe into equal area regions and looking at the fluctuations in the number of parcels in each bin. This was done to identify regions that contain larger-than-average concentrations of aircraft exhaust. In addition, studies of deformation of material lines of exhaust show many examples in which density fluctuations are a consequence of the dynamics and not the initial conditions.

A series of diabatic trajectories, initialized uniformly along 12 meridians, was computed and compared with adiabatic trajectories in order to assess the effect of diabatic heating and the validity of the isentropic assumption. The deviations from isentropic trajectories were computed by looking at the differences in the horizontal projections of the diabatic and adiabatic trajectories. The differences become significant after about 10 days for an ensemble initialized in the Northern Hemisphere in the beginning of January. An evaluation of the importance of diabatic effects on horizontal dispersion was also made for parcels initialized along the New York-London route; the statistical distribution does not appear to be sensitive to individual trajectory errors. Seasonal variations in dispersal of aircraft exhaust away from flight corridors for the London-New York route were studied by comparing horizontal dispersion for January, April, July, and November. The Los Angeles-Sydney route was added to the flight paths studied in order to have a tropical route represented. In this case, much more aircraft exhaust is deposited in, and migrates to, the Southern Hemisphere.

A paper was completed "Trajectory Modeling," by the ATR and the task leader. This will appear as a chapter for the June 1993 International School of Physics conference proceedings, "Diagnostic Tools in Atmospheric Physics." This paper is a summary of the applications and limitations of trajectory modeling and includes many original results.

200 CODE MAINTENANCE/DEVELOPMENT

FORTRAN-readable NMC data sets were prepared and sent to collaborators at NPAC. However, because of the following considerations, the decision to parallelize the trajectory code has been reevaluated. The trajectory code has rather modest CPU requirements—the central computational issue is the interpolation from large data sets. The necessity of porting large data sets to supercomputing centers at

Caltech and/or JPL in California has changed the focus of the problem, which has now become more of a systems integration problem and high-speed data transport between machines is necessary. This I/O problem is not yet solved. The high-speed network technology is under development; at the present time, no fast data links exist between GSFC and any of the parallel supercomputer centers. Because the CPU requirements are minimal, the code would spend a great deal of time waiting to receive online data; the data sets must be ported sequentially because of storage limitations. A CPU-intensive code could be CPU-active while other nodes were handling I/O; for the trajectory code, however, the CPU would be idle during this time. This is an important consideration because the parallel machines under consideration are not time-sharing machines. Thus, in light of the I/O problems, which cannot be solved with current technology, the project has been suspended. Some version of a trajectory code may be incorporated into a parallel Semi-Lagrangian GCM, and staff expects to use results from the parallelization of the interpolation kernal for this. Work began on another project involving the development of a parallel version of an error propagation calculation for a Kalman filter, data assimilation system. The application to attend the Third National Summer School in Geophysical and Environmental Fluid Dynamics Cambridge, England, was rejected because of a lack of space.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has ended. Work is planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The aircraft dispersal studies will continue, and the paper describing these results will be completed. A new task will be assigned. The new task is expected to be a continuation of the trajectory studies and will also involve parallelization of the Kalman filter for a 2-D advection model.

A Work Control Plan will be completed.

COMPUTER USE

Minutes	Computer
18,000 (wall clock)	SGI Crimson Workstation

NASA Task 13-040-00: ERBE Documentation

GSFC ATR: ***Dr. M. King***

Hughes STX Task Leader: ***D. Augustine***
Hughes STX Task Number: ***170***

This task organizes and maintains ERBE documentation, processes and archives ERBE data, performs system administration duties for several Macs and an IRIS workstation, develops analysis code and manipulates data on the Mac, and provides support for work on the NCCS mainframe computers.

FINAL CONTRACT SUMMARY

The duration of the task was March 2 through September 30, 1993. One systems administration programmer/analyst data technician supported the task. During this task, staff has completed processing of CAR active scan data. The remaining objective is the conversion of production code to run on multiple platforms.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff completed processing of the Cloud Absorption Radiometer (CAR) data for all experiments. Staff members continued upgrading the group's computers to the newest versions of the software available to it. Staff also began conversion of existing IBM code to run on local computers.

WORK PERFORMED

The task involved installing and upgrading the software on the group's computers, which includes system software and applications. The CAR active scan data from the ALASKA experiment (flights 1446–1453) and from the SCAR-A experiment (flights 1605–1612) were processed. The CAR active scan code was modified to run on a Macintosh computer running Language Systems FORTRAN. Although significant, the speed difference was not so bad that it would preclude using the Macintosh to run in a production mode. The CPU time to process 56 Mb of data on the IBM was ~45 seconds and ~19 minutes on a Macintosh IIfx.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

With the downsizing and loss of performance of the IBM mainframe, the main objectives during the next period will be centered on the conversion of FORTRAN code from the IBM being run on other in-house platforms (i.e., SGI Indigo and Macintosh computers). The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

System support of Code 913 Macintoshes and IRIS workstations.

NASA Task 22-092-00: VLBI Unix Systems Support

GSFC ATR: ***W. Wildes***

Hughes STX Task Leader: ***F. Gomez***
Hughes STX Task Number: ***251***

This task provides general systems support for the Very Long Baseline Interferometry (VLBI) Unix system computers and workstations.

FINAL CONTRACT SUMMARY

Work under this task was performed by one systems programmer. There were major milestones and accomplishments performed over the lifetime of this task. Among them are the following:

- Continual improvements to the PGPLOT library as well as its C interface, "pc8'" (written by staff).
- A Unix installation script for SKED and DRUDG (VLBI scheduling programs).
- Prompt HP-UX operating system updates (from 6.5 to 9.01) as they became available for the Unix systems.
- Total system configuration for many new HP 9000/700 machines (+20 more).
- Total integration of an optical jukebox across all machines. This included creating and tuning 64 new file systems, software to handle jukebox contention because of its two-drive limitation, as well as continual maintenance of any problems that have occurred.
- Creation of the X1K library (TG1K emulation) for the 700 series machines and its nearly seamless integration with existing VLBI applications such as CNPLT.
- Creation of new Unix TAR-based magnetic tape utilities with the capability of restoring multiple versions of the same file.
- Creation of a function key interface program and customizable function key interfaces to important utilities.
- Creation of a fast command stack utility.
- Porting and installing a complex mapping utility called "NCAR'".
- Porting and installing a MIT-produced GPS analysis tool called "GAMIT'".
- Porting and installing a utility called "PostScript'" that enable PostScript plotting on the HP Laserjet IIIsi printer.
- Creation of "'fman,'" an online help facility.
- Porting and installing a large package called "'TeX'" that is used for fancy documentation.
- Porting and installing a mapping package called "'GMT'".
- Installing many peripheral devices as well as recovery from numerous hardware failures.

SUMMARY FOR CURRENT REPORTING PERIOD

This task provided general systems support for the Very Long Baseline Interferometry (VLBI) Unix system computers and workstations.

WORK PERFORMED

Staff efficiently completed numerous system configuration changes for the VLBI and Geodesy groups under this task from June to September 1993. All aspects involved in maintaining a trouble-free computing environment for the users were covered. Changes involving hardware included the following:

- Installed network cards into four PC's.
- Recovery from a failed 700 series internal disk.
- Installed a new Annex terminal server.
- Assembly and configuration of a new 715, a new jukebox, and a new X display terminal.
- Added 10 new disks to various machines.
- Setup a new color PostScript printer. Routine system tuning and maintenance included the creation of many new user accounts.
- Installing HPUX 9.0 on two HP300 series machines.
- Installing optional packages (keysh, gprof, and SCCS, ..) on various machines.
- Addition of a sub-login account for gemini's anonymous FTP.
- Reconfiguration of daily backups for faster restoral (5x) of files.
- Updated 700R/X server boot code on gemini.
- Availability of HP online documentation from CD-ROM and restored many files.

Application programs were written or enhanced in a variety of languages such as C, [Bourne-C-Korn] Shell, AWK, and Perl, often blending different languages for some utilities were necessary. Some examples are the following:

- "'mail_oldies'" notifies users of old and large files for deletion.
- Rewrite of the "'datesort'" utility in Perl.
- "'readlog'" extracts log files from a 9-track tape.
- "'lptex'" sends TeX files to the printer".
- "'ps2ppm'" a PostScript to PPM format converter.
- "'gomh'" extracts the latest delta from an SCCS file.
- "'colrm'" emulates BSD utility of same name.
- "'dftpup'" transfers HP1000 directory structures directly to HP9000's.

The list is not complete; numerous other utilities were written to meet with user requests. A number of third-party utilities were evaluated. The ones deemed valuable were extracted, compiled, and installed on the systems. Actions involving third-party contributed utilities included installing GIPSY/OASIS on santafe and leo. Much useful public domain shareware such as nocore, gzip, tcsh, vim, gnu c++, imake, joe, and others were installed. Most of the utilities were kept up to date when newer versions were introduced.

100 UNIX SYSTEM ADMINISTRATION

110 Operations System Maintenance

(aquila=HP9000/735,	leo=HP9000/735,	gemini=HP9000/845,
bootes=HP9000/370,	algol=HP9000/318,	sirius=HP9000/340,
mimosa=HP9000/340,	rigel=HP9000/317,	virgo=HP9000/735,
Xhpterm1=HP700/RX,	Xterm2=HP700/RX,	Xterm3=HP700/RX,
dorado=HP9000/720,	geodesy=HP9000/735,	geodesy2=HP9000/735,

viper=HP9000/710,	usgrant=HP9000/710,	jukie=HP9000/705,
wildbill=HP9000/705,	santafe=HP9000/735,	lupus=HP9000/710,
draco=HP9000/834,	jazz=HP9000/715,	buffalo=HP700/RX)

File system swap space was increased for leo to prevent a user's program from being immediately killed at the start of execution.

"'Finger'" information for user accounts tvd and vat were corrected on all machines.

A crontab entry was set up on geodesy2 to run the "'mail_oldies'" script regularly.

The huge netdist directory was removed from leo's /data11 directory.

HP was notified that their "'mkrs'" (make recovery system) utility was broken at HPUX 9.0 for the 300 series machine.

Network cards were installed into PC's altair and mizar.

HPUX 9.0 was installed on two HP 340's destined for Chile and Easter Island. Their temporary network names are chilean and pascua.

The HP 9.0 release notes and TOOL.700 fileset were removed from gemini's anonymous FTP area.

A sub-login account to access all VLBI data bases was added to gemini's anonymous FTP system.

Geodesy and geodesy2's /etc/exports files were modified to allow aquila NFS root access necessary for noncorrupt daily backups.

Geodesy2 kernel memory parameters were increased per user request.

A user requested heavy customization of the user's vue startup script, which was done.

All machines' /etc/exports files were modified to allow aquila and leo NFS root access necessary for successful remote backups.

Nodename "'tvd'" was registered with network data base machine cnedb per user request.

Archived and removed the aquila:/data3/kjh directory per user request.

Archived and removed the leo:/users/vat directory per user request.

PC "'tvd'" was physically connected to the local network.

700/RX server binaries were placed in gemini's anonymous FTP area per user request.

More file system swap space was enabled on aquila to allow it to run larger programs.

The window system on lupus inexplicably failed with the message "'/dev/tty: no such device'". Somehow the permission bits on the /usr/spool/sockets/X11 directory was mangled. After the bits were set back to their proper values, the window system was functioning again.

A general space cleanup was performed on machines aquila, virgo, and dorado.

A new Annex terminal server box arrived and was installed in place of the loaner box we had been using for testing.

HP was called to replace the internal disk on lupus after it had failed catastrophically.

The obsolete "'cak'" account was removed from bootes and gemini. The directory /users/cak was archived and deleted from both machines.

A new optical jukebox arrived in Building 22 and was connected to geodesy. New filesystems were made on all platter sides (64) and all were mounted on newly created mount points on geodesy. Users were given instructions on how to use the jukebox effectively and information on its limitations.

HPUX 8.05 was installed on the new lupus disk to be able to update to 9.01. HP would not provide us with 9.01 install media because they said we did not purchase it for lupus (it had the OS preloaded).

All necessary custom configuration was performed and now everything is functioning normally.

The DAT drive on geodesy was reconfigured with a new address after the jukebox was added to the SCSI bus.

The new Annex terminal server was registered with cnedb.

User jlr was added to group mk3 on leo and aquila.

A copy of libpgplot.a for the 700 systems was loaded on gemini's anonymous FTP area per user request.

Mira's hardware address was changed and registered with cnedb.

User nz was added to group mk3 on leo.

The jukebox on jukie is experiencing some problems with a stuck drive. HP will probably have to be called to check into this problem.

/data9 on aquila was given export permission to machine denali so that a user could dump an exabyte tape to /data9 from denali. We have no exabyte drive here.

New external disks were added to geodesy and geodesy2. Each machine got two new disks. Each disk had an unformatted capacity of 1.2 gigabytes. The new disks were cross-mounted among all machines. Their mount points were /geod5, /geod6, /geod7, and /geod8. Scratch directories were created on the new disks. Nightly cleanup of these areas was set up.

Group solad was eliminated from leo; the primary group of the solad user was set to mk3.

File /etc/logingroup was linked to /etc/group on bootes, per user request. When they are linked this way, a user can be a member of many groups at the same time without using the "'newgrp'" command constantly.

Leo:/data2/gps was archived and deleted per user request.

The guest account on gemini now requests the person's name before allowing the login process to continue. This step was added to enable users to contact that person if any problems arise with the account.

All daily backups were reorganized on aquila as well as on geodesy and geodesy2. They now all use HP's utilities fbackup and frecover. This effort was changed to increase the speed of restorals. Restorals now take 1/5 the time as before.

Export was enabled on all geodesy jukebox platters. All platters were NFS mounted on geodesy2 and santafe. Each machine's /etc/rc file was modified to automatically do this on bootup.

HP online documentation was made available on aquila by mounting the LaserRom CD-ROM.

The server for 700/RX downloadable boot code was updated on gemini to Version 4.02.

Gypsy verification software was obtained from bodhi.jpl.nasa.gov and placed on aquila.

A new network card (HA 02 60 8c 3c ba b4) was installed on a PC with nodename anasazi.

The /tmp directory on aquila was linked to /data4/tmp to conserve space on the root filesystem.

The /usr/diag/bin directory on aquila was linked to /data4/usrdiagbin to conserve space on the root filesystem.

The anasazi nodename was registered with machine cnedb.

A new color PostScript printer ("color") was connected and configured with jukie.

Online HP documentation was made available on geodesy2.

The /tmp directory on santafe was made to point to /taos/tmp to conserve space on the root filesystem.

Jukie's color PostScript printer was connected remotely to all machines.

A new HP9000/715 was assembled and configured in Building 22. It's name is "'jazz'".

A new 700/RX display server was assembled and configured in Building 22.

It's name is "'buffalo'". The boot code was installed on santafe from CD-ROM.

A new network card was installed in PC mizar. Networking was enabled.

PC mizar's new hardware address was registered with machine cnedb.

The Building 22 jukebox was taken off geodesy and reconnected to a new machine, jazz. All NFS mounts were redone for machine geodesy, geodesy2, and santafe. New drivers were added into jazz's kernel to handle the jukebox. All necessary device files and mount points were also created.

Gemini's /systuff/ncar directory was made to point to wildbill's /ncar directory to conserve space on gemini's root filesystem.

Filesystems were checked and preened weekly to prevent any filesystem corruption from accumulating.

Weekly and monthly backups were made.

120 User Assistance

Many user problems or requests, including the usual printer or terminal problems, space problems, mail problems and restoration of files, were addressed and resolved. Some examples are the following:

New accounts:

geodesy: dkubitsc
geodesy2: rray, cpotz, sluo, dkubitsc, kristine, georger
jukie: weh
leo: tsj, peng, solad
lupus: kdb
santafe: cpotz, krachlin, kristine, georger

A user was having a problem with a program core dumping continually. It was determined after much examination that the problem was not with the program but with the data files that were created on a foreign machine.

A user requested information about utilities to show shared memory status, that was provided (ipcs and ipcrm system utilities).

A list of bad superfiles was built and sorted for a user, per that user's request, after the user's application behaved unexpectedly.

A user requested some files from a foreign exabyte tape. Since there was no exabyte drive, one was borrowed and the user's files were extracted successfully to aquila.

A user requested information on GSFC's X500 name lookup service, that was provided.

Restored leo:/data2/snp/snoop/sess_list per user request.

A user was having random font and window color problems in a user's vue session. These problems were fixed after explicitly specifying these attributes in the terminal emulator.

Restored leo:/data2/mk3/src/solve/proc/*,cres/*,cutil/* per user request.

A user requested detailed information on the usage and construction of makefiles.

Restored leo:/data2/mk3/src/solve/accor/* per user request.

Restored geodesy2:/users/krachlin/Mail/* per user request.

/users/weh/Mail/received was restored on gemini for user weh.

/data2/mk3/src/solve/newdb/newdb.f was restored on leo for user mwh.

/geod4/jwiser/sys/sp/data/cntl.arc was restored on geodesy2 for user jwiser.

/geod4/sblackwe/scripts/* was restored to geodesy2 for user bputney.

A user requested information on how to create PPM format files given a PostScript format file.

A user was instructed on how to use the f_tar* utilities to archive old and large mail files.

data2/mk3/src/includes/param.i was restored on leo for user dgg.

/solve/save_files/SOLMOD was restored on aquila for user jmg.

data/cgmarg/cgm/*g*x* was restored on gemini for user cma.

A user requested command stack setup on all his accounts, which was done.

A user asked for a list of zero-length files that existed on data base areas. This task was done after a script was written to create the list.

A user requested a customized script that would remove lines containing a pattern and the next 3 lines from a file. A Perl script called "'eop'" was written to accomplish the task.

Geodesy2:/users/jwiser/* was restored for user jwiser.

A rib application was obtained from the Small Systems Group and given to a user who requested it.

Leo:/data2/mk3/src/pwxcb was restored for user dgg.

A user was experiencing problems with certain characters while using the "'elm'" utility. This problem was solved by writing a small script that took these characters into account before calling elm.

A user asked for information concerning shared memory in linux (a free Unix-like operating system available for PC's). The following was given:

Geodesy:/geod1/bputney was restored for user bputney.

A user was having a problem with a program that didn't display output properly depending on what terminal type was given. It was determined that a "'refresh'" call had to be specifically called after some portion of the coding of the application, then the output displayed properly.

More documentation was added to the file that contains information about all the utilities written under this task.

200 SOFTWARE SUPPORT

210 New Software

Script "'dftp'" was written. It allows transfer of whole directory structures from remote machines. It was written to get around regular FTP's limitation in this respect.

Matlab's "bprint'" function was modified to allow it to find Ghostscript initialization files.

"'lptiny4'" was modified to allow it to find Ghostscript initialization files.

Script "'mail_oldies" was written. It produces a list of files owned by a user that was old and very large in order to facilitate space cleanup.

A new daily backup script was written on aquila to get around DAT traffic on leo.

Program "'lsof" (list open files) was rebuilt on all machines due to being broken at HPUX Version 9.01.

Program "'top'" (show top CPU processes) was compiled and installed on geodesy and geodesy2.

A customized backup script was written per user request (drowland). It is called "'lunar_bkp'" and is located on geodesy2.

A script called "'showperms'" was written that shows files or directories with specific permission bits set.

Two scripts "'mount_db_anonftp'" and "'umount_db_anonftp'" were written to mount and unmount all VLBI data bases in gemini's anonymous FTP area.

A minor modification was made to script "'fsort'" to switch around the order of its arguments per user request.

Program "'nocore'" was compiled and installed on all machines. It prevents a process and all its child processes from dumping core.

PUX's "'keysh'" utility was installed on santafe per user request.

Two scripts, "'show_no_wread_f'" and "'show_no_wcd_d'", were written per user request. They find all files that are not world-readable and all directories that are not world-executable.

/data2/snp was set up for daily and weekly backup by modifying the respective scripts.

A script called "'list_gsfc_database'" was written to produce a table of contents for the VLBI data bases in gemini's anonymous FTP area. It was not possible to run a simple "'find'" command due to soft mounts timing out for the jukebox.

HPUX's "'gprof'" (program time profiler) utility was installed on aquila per user request.

Script "'rm_tmp'" was modified to leave mail and vi files alone.

A user requested a script that would separate tagged entries from several files and put them into different files. The script is called "'pcal'".

A new compression utility called "'gzip'" was compiled and installed on all machines. It compresses better than the standard Unix compress utility by about a factor of two.

Program "'det'" was compiled and installed on jukie. It provides detailed information about a machine's architecture useful for programming needs.

HPUX's SCCS (Source Code Control System) package was installed on leo per user request.

The "'datesort'" utility was totally converted into Perl script to increase its robustness.

A script called "'automonth'" was written to aid in producing monthly reports.

Csh lookalike "'tcsh'" was compiled and installed on all machines per user request. Source code was provided by the user.

The GIPSY package was installed on santafe. A newer version is pending from the developers since the current version still has some bugs.

Program "'talk'" was installed on geodesy and geodesy2 per user request.

Script "'readlog'" was written to extract log files from a tape on the Unix tape drive. It was necessary because the usual extraction mechanism, the A900 tape drive, was broken.

A script to automatically print TEX files was rewritten to make it more efficient. The script is called "'lptex'". It was installed on all machines.

A script to convert PostScript files to PPM format files was written per user request. It was installed on geodesy2 as "'ps2ppm'".

Modified versions of the "'cmdall'" and "'setdate'" utility were written to act on various common subsets of machines. They are called "'cmdall22'" and "'setdate22'".

A user requested a script that would extract the latest delta from an SCCS generated report. A Perl script called "'gomh'" was written to accomplish the task.

A user requested a utility that would show aliases matching a given pattern in the system mail aliases file. A script called "'sysalias'" was written for this function (and highlights the user pattern).

A vi clone called "'vim'" was installed on all machines. It is a superset of vi that also has many extra features that vi lacks. It also fixes some vi limitations that many users complained about. The major improvements are that there is no practical limit on the size of the file that may be edited, there is column cutting and pasting (with highlight), there is an automatic "'ruler'" if needed, and it has online help.

Many jukebox utilities were written in the course of getting the geodesy jukebox up and running: "'mountjuke'", "'newfsall'", "'tunefsall'", and "'mkmountp'".

A user requested a small Perl script to count frequencies of a certain pattern in a directory. "'names.freq'" was written to perform this effort.

A user requested some Perl scripts that would change the date format in a file. Scripts "'cdate'" and "'cdate.go'" were written to perform this effort.

The bulk of a new program called "'xyz'" was written per user request. It uses the xlk graphics library to color code 3-D data, grouping data in similar ranges with the same color.

The gnu c++ compiler was reinstalled on lupus after its disk drive crash.

Xaw (v 5.00) header files were installed on lupus. They are X11 extensions that enable some public domain packages to compile correctly.

The "'imake'" utility (v 5.00) was installed on lupus. It enables smoother compilations for public domain X software.

Tcsh (v 6.04) was installed on lupus. The current version contains a fix for arrow motions on HP terminal emulators.

A Perl script called "'colrm'" was written per user request. It emulates the SUN utility "'colrm'" exactly.

Plotting utility "'cplotx'" was transferred to aquila from USNO's maia per user request. It's an interactive X Window plotting utility.

A script called "'dftpup'" was written that enables the transfer of HP1000 directory structures to HP9000 machines.

A public domain Wordstar-like editor called "'joe'" was installed on all machines.

A small bug was fixed up in utility "'fpaste'" involving parsing of 2-digit field numbers.

The "'psview'" utility was modified to ask the user at the end whether to send the plot to the new color PostScript printer. A script called "'pscolor'" was written to perform this function.

A script called "'inAandinB'" was written per user request. It prints lines in a first file that also occur in the second file. It also has field-oriented capabilities.

SIGNIFICANT ACCOMPLISHMENTS

- Wrote "'dftp'" directory structure transfer script.
- Added extra file system swap to leo.
- Modified "bprint'" to find Ghostscript initialization files.
- Modified "'lptiny4'" to find Ghostscript initialization files.
- Wrote "'mail_oldies'" to notify users of old and large files.
- Wrote "'all_our_daily'" for aquila for daily backups.
- Rebuilt "'lsof'" utility.
- Wrote crontab entry for "mail_oldies'" on geodesy2.
- Installed "'top'" on geodesy and geodesy2.
- HP notified about broken "'mkrs'" utility.
- Network cards installed into altair and mizar.
- Installed HPUX 9.0 on chilean and pascua.
- Wrote customized backup script "lunar_bkp'" for a user.
- Wrote "'showperms'" show permissions script.
- Wrote "'mount_db_anonftp'" and "'umount_db_anonftp'".
- Built and sorted a bad superfile list for a user.
- Added sub-login account for gemini's anonymous FTP.
- Compiled and installed program "nocore'".
- Extracted exabyte files for a user.
- Installed "'keysh'" on santafe.
- Wrote scripts, "'show_no_wread_f'" and "'show_no_wcd_d'".
- Modified geodesy and geodesy2's /etc/exports file.
- Wrote "'list_gsfc_database'".
- Installed "'gprof'" on aquila.
- Modified "'rm_tmp'" script on all machines.
- Increased geodesy2 kernel memory parameters.
- Heavily customized a user's vue session startup script.
- Wrote "'pcal'" for a user.
- Modified all machines' /etc/exports files and reran exportfs to update all changes.
- Compiled and installed "'gzip'" on all machines.
- Registered nodename "'tvd'" with cnedb.
- Compiled and installed "'det'" on jukie.
- Installed SCCS package on leo.
- Rewrote "'datesort'" utility in Perl.
- Compiled and installed new shell "'tcsh'" on all machines.
- Installed GIPSY package on santafe.
- Connected PC "'tvd'" to the network.
- Installed "'talk'" on geodesy and geodesy2.
- Wrote "'readlog'" log file extraction script.
- 700/RX server binaries were installed on gemini's anonymous FTP area.
- Fixed window system on lupus.
- Space cleanup on machines aquila, virgo, and dorado.
- Wrote "'lptex'" which prints TeX files.
- Installed new Annex terminal server.
- Wrote "'ps2ppm'" PostScript to PPM converter.
- Installed and configured new jukebox on geodesy.

- Lupus was rebuilt after disk catastrophe.
- Wrote "'gomh'" to extract latest delta from SCCS file.
- Wrote "'sysalias'" to highlight user patterns in alias file.
- Installed "'vim'" vi superset on all machines.
- Wrote jukebox utilities "'mountjuke'", "'newfsall'", "'tunefsall'", and "'mkmountp'".
- New disks (4 total) were added to geodesy and geodesy2. All new disks were cross-mounted across all machines.
- Wrote bulk of color application "'xyz'".
- File /etc/logingroup was linked to /etc/group on bootes.
- Re-installed gnu c++ compiler on lupus.
- Imake (v 5.00) was configured and installed on lupus.
- Tcsh (v 6.04) was installed on lupus.
- A Perl script called "'colrm'" was written.
- All daily backups were reconfigured using fbackup and frestore.
- Jazz jukebox was configured across all machines.
- Wrote "'dftpup'", a script that transfers HP1000 directory structures to HP9000's.
- HP online documentation was made available on aquila.
- Editor "'joe'" was installed on all machines.
- 700/RX server boot code on gemini was updated.
- New network card on anasazi was installed .
- Added new color PostScript printer to jukie.
- Online HP documentation was made available on geodesy2.
- Jukie's color PostScript printer was connected remotely to all machines.
- Modifications were made to the "'psview'" utility. "'Pscolor'" was written.
- Assembled and configured machine "'jazz'" in Building 22.
- Assembled and configured machine "'buffalo'" in Building 22 after installing boot code on santafe.
- A new network card was installed in PC "'mizar'". Networking was enabled.
- Wrote "'inAandinB'" per user request.
- Reconnected Building 22 jukebox to machine jazz.
- NFS mounted gemini:/systuff/ncar directory to wildbill:/ncar.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Work on the following activities will continue:

- Periodic system checkup and backup.

- User assistance.
- Shell script programming.
- C system programming.

DELIVERABLES SUBMITTED

Software:	"'dftp'"	(Bourne shell, Perl)
	"'bprint'" modifications	(Bourne shell, Perl, AWK)
	"'lptiny4'" modifications	(Bourne shell, AWK)
	"'mail_oldies'"	(Bourne shell, AWK)
	"'all_our_daily'"	(Bourne shell)
	"'lunar_bkp'"	(Bourne shell)
	"'showperms'"	(Bourne shell)
	"'mount_db_anonftp'", "'umount_db_anonftp'"	(Bourne shell)
	"'fsort'" modifications	(Perl)
	"'show_no_wread_f'", "'show_no_wcd_d'"	(Bourne shell)
	leo:"'all_daily'" modifications, gemini:"'gem+700_weekly'" modifications	(Bourne shell)
	"'list_gsfc_database'"	(Bourne shell, Perl)
	"'rm_tmp'"	(Bourne shell, AWK)
	"'pcal'"	(Perl)
	"'datesort'" conversion	(Perl)
	"'automonth'"	(Perl)
	"'readlog'"	(Perl)
	"'lptex'"	(Bourne shell, Perl, AWK)
	"'ps2ppm'"	(Bourne shell,C)
	"'cmdall22'", "'setdate22'"	(Bourne shell)
	"'gomh'"	(Perl)
	"'sysalias'"	(Perl)
	"'mountjuke'", "'newfsall'", "'tunefsall'", "'mkmountp'"	(Bourne shell)
	"'names.freq'" frequency counter	(Perl)
	"'cdate'", "'cdate.go'" to change date formats	(Bourne shell, Perl)
	"'xyz'"	(C)
	"'colrm'"	(Perl)
	"'dftpup'"	(Perl)
	"'fpaste'" bugfix	(Bourne shell, AWK)
	"'psview'" modifications, "'pscolor'"	(Bourne shell)
	"'inAandinB'"	(Bourne shell, AWK)
Originator:	F. Gomez	

COMPUTER USE

Minutes	Computer
300	HP 318 Algol
1,200	HP 735 Aquila
1,200	HP 370 Bootes
200	HP 700/RX Buffalo
1,200	HP 720 Dorado
300	HP 834 Draco
1,200	HP 845 Gemini
500	HP 730 Geodesy
500	HP 730 Geodesy2
300	HP 715 Jazz
1,200	HP 705 Jukie
1,200	HP 735 Leo
300	HP 710 Lupus
300	HP 340 Mimosa
300	HP 317 Rigel
500	HP 730 Santafe
300	HP 340 Sirius
300	HP 710 Usgrant
300	HP 710 Viper
1,200	HP 735 Virgo
300	HP 705 Wildbill
300	HP 700/RX Xhpterm1
300	HP 700/RX Xterm2
300	HP 700/RX Xterm3

NASA Task 22-093-00: LTPCF Support

GSFC ATR and
Cognizant NASA Scientist: ***Dr. W. Webster***

Hughes STX Task Leader: ***A. Operchuck***
Hughes STX Task Number: ***252***

Task personnel will provide the technical and user support for science applications within the Laboratory for Terrestrial Physics Computer Facility (LTPCF), including determining the hardware and software requirements of LTP users and designing, documenting, implementing, and verifying software.

FINAL CONTRACT SUMMARY

Hughes STX provided various types of support to the LTPCF since the inception of the current HSTX contract in October 1988. Task personnel support has ranged from two to the current four FTE's. HSTX task personnel provided high-quality support over the years by: 1) upgrading and developing new software components for the Land Analysis System (LAS) image processing package, 2) supporting users of ARC info through digitizing assistance and conversion of digitized data into images for use in conjunction with other multispectral image data, 3) evaluating commercial image processing system for use on Unix workstations, 4) working with the vendors of the Matrix and Kodak film recorders to develop user friendly software that allowed color prints to be made easily, 5) developing various data format conversion software utilities, 6) conscientious and responsive system administration of the multivendor Unix workstation network in Code 920, and 7) rapid and courteous service in handling IBM PC, Macintosh, and networking problems with Code 920.

SUMMARY FOR CURRENT REPORTING PERIOD

Support was provided in the following areas: 300—UNIX System and Network Support; 400—Personal Computer Support; 500—Miscellaneous LTP Support; and 600—Training and Conferences. Task personnel provided technical and user support for the scientist and administrative staff of the LTP. This included determination of the hardware and software requirements of the LTP users on the Unix, Intel, and Macintosh platforms. Many user problems were solved.

WORK PERFORMED

300 UNIX SYSTEM AND NETWORK ADMINISTRATION

Staff accomplished include the following routine tasks:

- Resolved a moderate number of Unix network problems.
- Resolved a moderate number of Unix hardware problems.
- Installed hardware and software on a moderate number of Unix workstations.
- Assisted a moderate number of users with proper use of hardware and software.
- Registered a moderate number of new network nodes.

Staff accomplished the following nonroutine tasks:

- Added a task member to help with Unix administration.
- Resolved automount problems on SGI machines with much help from SGI.
- Implemented first part of a plan to put all password file entries for the LTPCF cluster under NIS Eliminated "dead" users from LTPCF cluster.
- Began work on a machine data base that will contain all pertinent information about the workstations the task supports.
- Installed QMH, a help desk system based on the MH mail handler. That task member is now using it to track and schedule work requests.
- Brought up a large SGI 440 machine. After many problems with both hardware and software, and several visits from SGI service personnel, it appears to be operating correctly.
- Installed a script on an SGI workstation that converts lp (Sys V print spooler) commands to lpr (BSD print spooler) commands to enhance compatibility between Unix platforms.
- Continued researching Amanda, a public domain backup system.
- Successfully isolated a nagging problem on an HP workstation related to memory (it turned out to be a problem with swap space configuration) and, is presently working with HP support to resolved it.
- Resolved IDL license problems caused by new motherboards (upgrades to R4000) in the LTPCF SGI machines.
- Performed hardware work relating to the trading in of various machines.
- Assisted with the SEDS Project's cataloging of its files (the findfile program).

400 PERSONAL COMPUTER SUPPORT

Staff accomplished the following routine tasks:

- Installed popular hardware and software on a large number of PC's and Macintoshes.
- Connected a moderate number of machines to the Center ethernet network.
- Resolved a moderate number of disk crashes, Appletalk problems.
- Advised a moderate number of users on purchasing new hardware and software.
- Advised a large number of users on proper use of existing hardware and software.
- Produced the monthly LTPCF-user's newsletter.

Staff accomplished the following nonroutine tasks:

- Added a new task member to help with PC support.
- Began evaluating the newest version of OS/2 (ver 2.1) and its interoperability with the Unix systems.
- Installed DESQview/X, a version of the DESQview multitasking DOS enhancement package that includes the X-Window's server, on a Compaq 486 PC. The task member also installed OS/2 on the same machine (it also includes an X-Window's server). Thus far, both the OS/2 and DESQview/X servers are operational but neither runs IDL (a commonly used package) very well. The task member is working to resolve these problems and to find other solutions.
- Continued working with base networking to implement a Netblazer router to allow faster communications with the GSFC network from remote locations. Thus far, the task member has MacPPP working for the Macintosh environment, and has SLIP working for the Intel based machines. The task member is still working to get Appletalk Remote Access working for the Macintosh.
- Continued evaluating Solaris for x86 (Unix for the Intel platform). Staff still needs to get some additional hardware for a true evaluation. The task member is evaluating which hardware to purchase.
- Located a Windows POP client e-mail package and staff is starting to install it on user machines.
- Located the newest version of Nupop, an e-mail POP client for DOS. The task member evaluated it and began to install it on user machines. The newest version includes many other network utilities such as Gopher and Telnet.
- Discovered and established a means of backing up DOS machines to a Unix workstation tape drive using TCP/IP. Staff is notifying users and starting to install it in the user community. This requires setting up a backup strategy and policy.
- Established a means of printing to Unix and Apple printers over the network using the NCSA Telnet package.
- Began evaluating the merits of setting up a Gopher server for the LTP. It will provide a means of easier dissemination of information.

600 TRAINING AND CONFERENCES

A task member attended SGI system administration training (a full week) and also attended the SANSII conference in Arlington (2 days). In particular the task member learned about the COPS and Tripwire security packages, the perl language, and an interesting approach to e-mail service that we may well implement in the LTPCF.

A task member attended a 2-day Apple system and network administration course and gained many helpful tips, many that will go in the monthly newsletter.

A task member attended a 4-day training course in Microsoft Windows NT to evaluate the merits of Windows NT.

PROBLEM AREAS

None.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will evaluate Windows NT and Solaris 2.x for x86 (runs on Intel-based machines) in our continuing evaluation of operating environments for Intel-based machines; continue to evaluate standard email packages for use by Code 920 Unix users; staff will continue to work with the base networking people to get Appletalk Remote Access working on the NetBlazer, and staff work on a backup strategy and policy for the Intel-based environment.

COMPUTER USE

Minutes	Computer
8,000	Sun workstations
48	Silicon Graphics IRIS workstations
12	LTP VAXcluster (11/780 and 8250)
300	IBM PC's and compatibles
300	Macintosh

NASA Task 22-096-00: VLBI Data Analysis Support

GSFC ATR: ***J. Ryan***

Hughes STX Task Leader: ***Dr. D. Gordon***
Hughes STX Task Number: 254

This task processes and analyzes data for Very Long Baseline Interferometry (VLBI) experiments and provides software support for the VLBI processing and analysis system.

FINAL CONTRACT SUMMARY

Data bases were created and processed for 15 Space Geodesy Program (SGP) VLBI experiments and 7 of these were analyzed by staff. The Earth orientation file was updated with final UT1/Polar Motion values through June 18, 1993. Staff reprocessed and reanalyzed 5 IRIS-A, 7 IRIS-P, 5 IRIS-S, 15 NEOS-A, 3 NEOS-B, 4 SHS, 1 MV1/Yellowknife, 2 Navex, and 14 GSI/Japanese VLBI experiments.

Staff extensively debugged the Calc 8 'consensus' relativity model delay and delay rate computations, and made necessary corrections. A new algorithm was derived and coded for the axis offset module in which the 3-D vector offset and its rate of change are computed. The IERS recommended Earth tide displacement model and its time derivative were coded, debugged, and validated. Program CNPLT was overhauled extensively with structured logic, documentation comments, error corrections, and new features. A time roundoff problem in program Pwxcb was corrected and the program was made more user friendly and forgiving. Major enhancements were made to the data base handling system and the solution archiving system. A public domain plotting program, GMT, was obtained and installed, and was adopted for use in making VLBI velocity maps. New versions of programs Dbcal and Sumry were obtained from the USNO and reloaded onto the GSFC VLBI workstations.

Preparatory work was done for the 1993 annual VLBI report. Cross-checking for missing 1992 experiments was done, and necessary work on the SNOOP/MSNOOP/GSNOOP family of programs was begun.

SUMMARY FOR CURRENT REPORTING PERIOD

Over the 5-year lifetime of this task one senior support scientist, one programmer/analyst, and one programmer have worked full time (FTE), and one data technician has worked between 0.6 and 1.0 FTE. Numerous accomplishments and major milestones were met over the lifetime of this task including the following.

The VLBI data base catalog system and all VLBI data base creation and processing were moved to the much faster HP Unix workstations. Data base archiving was transferred from 9-track magnetic tape to much higher density DAT cassettes. A solution archiving system for cataloging and archiving the large GLOBL solutions and their control files was developed. The capability of solving for high-frequency (hourly) Earth orientation was developed and implemented in the GLOBL/SOLVE VLBI analysis package. Staff supported VLBI operations by making 13 trips to VLB I stations to set up and operate the antennas for VLBI experiments. Staff members authored one scientific paper and coauthored five other scientific papers on VLBI observations of regional deformation, earthquakes, global plate motions, reference frames, and other topics. Staff also authored two and coauthored three presentations at meetings of the American Geophysical Union. A staff member participated as author or coauthor in all five annual VLBI reports (during 1988–1992) by the GSFC VLBI group.

WORK PERFORMED

100 DATA PROCESSING SUPPORT

110 Receipt of Correlated Observational Data

Task personnel received and processed 10 Unix DAT and 7 standard magnetic tape B-tapes from the Mark IIIA correlators at Haystack Observatory, the U.S. Naval Observatory (USNO), and the Bonn Correlator.

120 Sort/Merge of Observational Data

Program Dedit was run to put B-tape correlator data on disk and to sort and merge these data by experiment. The following experiment data base files were generated:

$93FEB10X/S	(Polar-S1)
$93APR15X/S	(X-Asia-1)
$93APR20X/S	Astom-1)
$93APR21X/S	(Survey-N1)
$93APR27X/S	(GGAO-R&D-2)
$93APR28X/S	(R&D-4)
$93MAY04X/S	(Polar-N1)
$93MAY04XA/SA	(Phase Delay-1)
$93MAY06X/S	(GGAO-R&D-3)
93MAY12X/S	(R&D-5)
$93MAY13X/S	(GGAO-R&D-3X)
$93MAY21X/S	(PPMS-2)
$93JUN16X/S	(Hawaii-2 ties)
$93JUN25X/S	(R&D-6)
$93JUL19XA/SA	(H-W Ties-1)

Also, program Dedit was run to add reprocessed data from two sources into the Survey-S1 experiment ($93JAN27X/S).

130 Generation of Model Data

Ut1pm was run once to update the NEOS UT1/polar motion file with final values. The file is now current with final values through June 18, 1993.

Programs Setup and Calc 7.6 were run to enter the initial ephemeris data, UT1/polar motion data, and theoretical delays and rates into the data bases for the following experiments:

$93JAN27X/S	$93FEB10X/S	$93APR15X/S	$93APR20X/S	$93APR21X/S
$93APR27X/S	$93APR28X/S	$93MAY04X/S	$93MAY04XA/SA	$93MAY06X/S

$93MAY12X/S	$93MAY13X/S	$93MAY21X/S	$93JUN16X/S	$93JUN25X/S
$93JUL19XA/SA				

Additionally, programs Setup, Apriori, and Calc 7.6 were run to enter final NEOS Earth orientation data, ephemeris data, and recomputed theoretical delays and rates into 15 NEOS-A, 3 NEOS-B, 2 NAVEX, 5 IRIS-A, 7 IRIS-P, 5 IRIS-S, 4 SHS, 1 MV1 Yellowknife, and 14 Japanese GSI data bases.

140 Processing of Calibration Data

Cable and weather data were processed into calibration files using program Pwxcb and inserted into the following data bases using program Dbcal:

$93JAN27X	$93FEB10X	$93APR15X	$93APR20X	$93APR21X
$93APR27X	$93APR28X	$93MAY04X	$93MAY04XA	$93MAY04SA
$93MAY06X	$93MAY12X	$93MAY13X	$93MAY21X	$93JUN16X
$93JUN16S	$93JUN25X	$93JUL19XA	$93JUL19SA	

200 DATA ANALYSIS SUPPORT

210 Data Base Analysis–NASA/SGP Experiments

Seven new NASA Space Geodesy Program (SGP) VLBI experiments were analyzed by a task member. These included experiments X-Asia-1 ($93APR15), Astrom-1 ($93APR20), Survey-N1 ($93APR21), Polar-N1 ($93MAY04), GGAO-R&D-3 ($93May06X), R&D-5 ($93MAY12), and Hawaii-2 ties ($93JUN16). The analysis included ambiguity resolution, ionosphere correction, auto-clock and auto-atmosphere parameterization, editing, and updating the data bases. Additionally, the Survey-N1 experiment ($93JAN27) was reanalyzed after some reprocessed data from two sources were added to them.

220 Data Base Analysis–NGS Experiments

Five IRIS-A, seven IRIS-P, five IRIS-S, four SHS, and one Yellowknife VLBI experiment received from the National Geodetic Survey (NGS) were reanalyzed by staff members. Reanalysis included setting auto-clock and auto-atmosphere intervals and constraints, editing, reweighing, and updating.

230 Data Base Analysis–USNO Experiments

Fifteen NEOS-A, three NEOS-B, and two NAVEX experiments received from the USNO were reanalyzed and updated. Reanalysis included setting auto-clock and auto-atmosphere intervals and constraints, turning off delay rates, editing, reweighing, and updating.

240 Data Base Analysis–Japanese Experiments

Fourteen VLBI experiments ftp'ed from the Japanese GSI were reanalyzed and updated. Reanalysis included recomputing the ionosphere corrections for some of the experiments, setting or resetting auto-clock and auto-atmosphere intervals and constraints, editing, reweighing, and updating.

260 Annual Report

Staff has begun preliminary work towards the 1993 annual VLBI report. One task member cross-checked the 1992 multiagency VLBI schedule against all 1992 experiments generated at GSFC or imported from other agencies. Two outstanding NOAA/NGS experiments were identified, but these have serious problems and have not been released yet by the correlators (and will probably never be released). A second task member is preparing the SNOOP/MSNOOP/GSNOOP programs and the plotting (Mapit/GAMIT) programs (see items 314 and 317). Work on the report itself (tables, figures, and text) is expected to begin early in the next report period.

300 MARK III SOFTWARE

301 SOLVE Maintenance and Enhancement

Solve's plotting program, CNPLT, is an old program dating back to the late 1970's. It has been modified many times over the years and as a result has become a very disorganized program. It is only sparsely commented, tangled with 'GO TO' statements, and filled with complicated paths between its subroutines. At the request of the ATR, a task member is currently restructuring the entire program, purging obsolete code, and adding in documentation comments to make it easier to maintain and enhance in the future. 'IMPLICIT NONE" statements and full variable declarations are also being added to conform to SOLVE standards. In addition to preserving all of CNPLT's current capabilities, several errors are being corrected, and numerous new features and performance improvements are being added. These include:

- CNPLT will no longer change (e.g., downweight, shift) points outside the current vertical plot limits.
- CNPLT will no longer attempt to make hardcopies of plots with colored points, because they will not show up on the hardcopy. Instead, CNPLT will advise the user to redraw the plot in black and white, then try again.
- The autocopy feature, which stopped working during a previous update to CNPLT, is being reactivated. This feature makes hardcopies of all residual plots in a data base with a single keystroke.
- Units will be added to plot labels that currently lack them.
- Delay vs. elevation plots will now be scaled to reasonable units. For example, if the plot range were on the order of thousands of picoseconds, the scale would be in nanoseconds.
- Users will now be able to access commands on menu page "4" by characters, not just by cursor positioning.
- If users identifying points by cursor position accidentally select two very close points, CNPLT will let the user enter 0 to pick a default point, rather than forcing the user to specify one of the points by number.
- CNPLT will now plot all points of a single color at once, rather than plotting each point in order, regardless of color. This will make plotting faster, because it takes time to change from one color to another.
- Two menus will be neater.
- The nonfunctional plot SNR and plot quality code options will be revived.
- The baseline page and page 2/3 menus will be corrected, so that incorrect input coordinates will be rejected, preventing range errors further in the program.

- Pages 1, 2, and 3 will be compressed to fit on windows of the standard HP size, 80 characters by 24 lines.
- The plot (source) character list will now fit on one screen.
- The number of observations allowed per data base will be parameterized.
- CNPLT will now report its success or failure in toggling the first point attempted during each selection of the toggle option.

Most of the necessary changes have been coded and tested. As testing of these changes began, it became apparent that the flags that record a data point's restoration status (and that are used throughout SOLVE) had developed errors over time because of various modifications in many of the SOLVE programs. Therefore, staff is putting off the testing of CNPLT's suppression/restoration code until the status of these flags is redefined and all necessary corrections are made. Also, staff researched and summarized the current use of the SOLVE restoration status flags in a preliminary memo to the ATR.

The ATR then decided to prepare a more complete and formal internal document, so he was assisted in additional research, and his document was given an initial review. The ATR is currently preparing the second draft of this document.

Meanwhile, two errors recently discovered in the old CNPLT were investigated and fixed or referred to the SOLVE programmer (M. Hayes, NVI, Inc.). The first error suddenly caused the suppression of plot titles. It was traced to the xlk library, which was recently recompiled for the first time under HPUX System 9.0. An xlk subroutine was relying on having a variable retain its values between calls, a bad assumption treated less leniently by System 9.0 than by previous system releases. A task member fixed this error. The second error resulted in analysts having to restore certain points twice before they were accepted into the solution. The ATR was assisted in tracing this error to a recent change in program CRES, which the SOLVE programmer subsequently fixed.

A program called resdmp was written to dump the resfl, the CRES-CNPLT communication file, thus providing a tool for programmers working with CNPLT.

307 CALC Maintenance and Enhancement

Work continued on Calc 8.0 during the period. Corrections were made to the atmosphere module in the compution of the aberrated and refracted source unit vector and its time derivative. The axis offset module was enhanced to compute the J2000 vector axis offset, rather than just the delay contribution because of the axis offset; and to use the aberrated and refracted source unit vector and its time derivative for these computations. The computation of the axis offset partials was also modified to match the new axis offset algorithm and it was validated that the partials are numerically the same as before except for the corrections made in the use of aberration and refraction. The consensus relativity module was enhanced to include the relativistic effects on the axis offset. All components to the delay rate were checked by computing numerically the rate of change between consecutive observations (same source, same baseline) and comparing them with the calc 8.0 computed time derivatives. A few errors were found and corrected. The JPL ephemeris and subroutines to compute the positions of the Sun, Moon, and all planets (except Pluto) will be obtained from the USNO and incorporated into Calc 8.0 for full implementation of the Consensus relativity model in the near future. A new algorithm for computing Earth tide displacements was coded into the Earth tide module as recommended by the IERS. The time derivative of this delay algorithm was also derived and coded. It was validated that differences from the older, more complicated algorithm were small (less than .15 mm). The computation of Earth tide partials will also be modified, as necessary, to match the new displacement algorithm.

308 PWXCB Maintenance and Enhancement

Several enhancements were made to program Pwxcb. The specification of the default path for output file names, previously hardcoded in subroutine Autonm, was moved to the param.i file for easier changing by other institutions. (Param.i contains defaults for programs Dedit, Apriori, Utlpm, Skeleton, Sscat, and now Pwxcb.) Code was added to handle mistyped answers to editing questions in a more forgiving way. Now if the user types in an illegal response, the program asks again instead of terminating the editing session. Also, it was found that the time in Modified Julian Date (MJD) was being rounded off too much as a Real*4 number. Originally, Real *4 was used because the screen plotting program (TG1K, and later x1k) would only accept Real*4 numbers. Also, time was stored in a number that used one less significant digit than MJD. When MJD is stored as a Real*4 number, the roundoff error can be up to a minute. This problem was fixed by changing the time array into a Real*8 array, and converting each point to Real*4 as it is plotted.

309 DBCAL Maintenance and Enhancement

An error was found in the newest version of Dbcal, which had recently been updated by the USNO. This error resulted in losing track of which stations had been previously weather calibrated when one station was recelebrated. A description of the problem was communicated to the USNO, and a task member assisted M. White (USNO) in fixing the problem. It was found that a variable for the number of weather stations, which had previously been passed between subroutines, had been left out of a new common block created at the last update. The problem was solved by placing that variable into the new common block.

310 SUMRY Maintenance and Enhancement

A new version of the Sumry program was ftp'ed from the USNO 735 workstation (miai) and installed. After using the new version several times, staff suggested a few additional enhancements that would make the program easier to use. Currently, the user must answer many questions before the program starts.

311 Catalog System Maintenance and Enhancement

Several months ago, the ATR renamed the qcat4 and chain4 routines with longer, more descriptive names. Unfortunately, some of these names exceeded a little-known Unix limit of 14 characters, and since then, the 'makefiles' were unable to track these routines in the libraries. Each time 'make' was run, the system looked for the full name in the library and found only the first 14 characters. Thinking there was no match, these routines were recompiled and appended to the library again. Thus, time and space were being wasted. To fix this problem, the makefiles were revised to use an option (f option) that looks only for the first 14 characters of the routine. The libraries were then purged and remade. The makefiles also now advise analysis centers without the (f option) to delete their libraries and start from scratch each time they relink them.

Some fixes were made to the way the catalog system subroutines assign internal FORTRAN unit numbers and C file descriptors to their files. The catalog system tracks unit numbers already assigned to its files and issues consecutive numbers to files subsequently accessed. The subroutines remember each file's unit number and keep reusing that number, but two subroutines, Fspce and Sspace, kept requesting new unit numbers, until the catalog system ran out of unit numbers. These two subroutines were modified to keep using the same numbers. Similarly, the Clcat subroutine was failing to release the catalog's file descriptor after closing the catalog, and therefore another subroutine used up new descriptors instead of getting and releasing the same one repeatedly. Clcat was corrected as needed.

The USNO VLBI group found that the Catlg MO (data base moving) command moved an entire subdirectory whenever they tried to move a data base whose disk file name contained a dollar sign. The ATR was assisted in correcting this problem. An examination of the catalog system code indicated that this problem would also occur in the Catlg command to import data bases into the catalog if the user asked to change a data base's disk name. This error was also fixed.

In an attempt to catch references to out-of-bounds array elements, the ATR recompiled the catalog system with a FORTRAN option to abort when such references occurred. Subsequently, illegal references were found and fixed in seven subroutines (Catlg, Import, Keyjd, Rsv_switch, Switch_area, Zarpth, and Zgnfp).

Two errors were fixed in the Catlg command, which imports data bases into the catalog. The code that changes a data base's disk file name falsely assumed that an array of LU (logical unit) numbers representing directories had LU number n in array element n. At another place in the code, a jukebox platter was being released instead of reserved as intended.

Two minor changes were made to the fspce routine, which finds a catalog system directory with enough space to hold a data base. A parameter was increased so that fspce can check up to 150 block devices. This became necessary when the Unix system recently began mounting extra block devices to do routine backups. Also, the error message, which warns that there are too many block devices to check, was modified to report how much the parameter must be increased, rather than forcing the programmer to find this out.

At the request of a user, a qcat4 subroutine was recompiled to place all new data base versions on magnetic cartridges for quicker access. Previously, updates to pre-1992 experiments were being placed on the optical jukebox cartridges, which are slow to access.

An instance occurred in which the gemini (HP845) copy of Catlg restored 19 data bases to disk but only updated the catalog to indicate that 3 data bases had been restored. An investigation of the problem indicated a sporadic, nonreproducible error, so some tracer statements were put into Catlg to help debug the error if it happens again.

While installing the Integer*4 catalog system at USNO, Dr. B. Archinal found two obsolete Integer*4 directories. These directories were deleted to prevent future confusion.

Some time ago, the Unix system administrator wrote a shell script, 'file_users' that identifies which user and program have a file open. One common use of this script is to see who is using the data base catalog. File_users actually replaced a less powerful script, 'cat_users', for checking the catalog. However, at least one user found it inconvenient to use this new script, so a new, short version of cat_users was written to call file_users to specifically check on the data base catalog.

The ATR was assisted in debugging the Haystack Observatory's copy of the fspce subroutine. It was going into an infinite loop that did not occur here at GSFC. The problem was traced to Haystack's use of relative data base directory names. Fspce was expecting all data base directories to be specified as absolute paths starting with /'s. However, the Haystack directories started with ., which cannot be matched to root or any other block device, so fspce looped endlessly trying to make a match. The ATR did not want much time spent on upgrading fspce to deal with relative directories, so he was assisted in coding a simplistic, but quick workaround.

Assistance was given to five other analysis centers using the catalog system. Dr. A. Nothnagel of Bonn University was told how to convert his catalog file to be compatible with the Integer*4 catalog system code he is ready to install. Dr. P. Charlot of the Paris Observatory was given instructions on cataloging some data bases from a temporary tape, via the TD command. Dr. C. Ma (Code 921) relayed the question and answer. V. Thorandt of IFAG (German Geodetic Inst.) was given a demonstration in the use of Catlg while here at GSFC. He was later given help in the use of a specific command after returning to IFAG. Dr. B. Archinal (USNO) was assisted in correcting his copy of Catlg when it failed to recognize a catalog expansion done by program Expct. He was also assisted with three problems encountered while installing the Integer*4 catalog system. Dr. A. Niell (Haystack Observatory) was assisted in running Catlg on two occasions. He was given the proper file format for adding data bases from tape and was assisted in cleaning up his catalog after he used an 'add' file with a bad format. In addition, he was familiarized with a Catlg work around for an HPUX system 9.0 tape ring checking error, after he installed the latest Catlg version at Haystack and encountered the workaround for the first time.

314 SNOOP Programs Maintenance and Enhancement

To expedite installation of the SNOOP-SOLARCH interface, the ATR was assisted in installing a qsol subroutine in SNOOP. This subroutine reads the solution catalog to get the location of a spool file specified by its solution key and version.

The SOLOP interface to GSNOOP was enhanced to allow the user greater power to search out spoolfiles. This entire modified interface was then incorporated into MSNOOP.

The menu structure in GSNOOP was reworked to provide greater flexibility in the selection of tables to be created from data extracted from spoolfiles. GSNOOP was also enhanced to search for and cull out special cases in velocity solutions in which station East, North, and Up were adjusted for individual observing sessions. These are separated and output to their own file. A new program, plot_uen, was written to plot these adjustments so that the observed motion of the station could be used to evaluate the solution. This plotting feature will be incorporated into GSNOOP.

315 Solution Archiving System (SOLARCH) Maintenance and Enhancement

An enhancement was made to SOLOP to allow running the ed1k or vi editors on all items with the same group number. In the process, a new standard (to use a negative number to specify a group number) was set. Therefore, the LI and SE commands, the only other commands that handle group numbers, were revised to conform to this standard.

Three new SOLOP commands, MR, TA, and GR, were written at the requests of several users. These commands respectively locate a selected solution item, then perform a "more" (screen-by-screen dump), "tail" (dump of the final 20 lines), or "grep" (pattern search) on the item's contents. GR was subsequently enhanced to let users choose between a case-sensitive (upper/lower case) or case-insensitive search.

A new SOLOP command, OR, was written to check a specified SOLARCH directory for orphans (items on disk that are not recognized by the catalog) and ghosts (items the catalog mistakenly thinks are on disk). Several improvements were subsequently made to this command. It was enhanced to check all primary and/or secondary disk storage areas with one keystroke to facilitate daily checks of the directories. It was revised to suppress file numbering and normal files (files expected by the catalog and found on the directory) from its output, to make it easier to compare successive OR listings, without having to deal with changes caused by normal moves within the system. OR was also revised to count the ghosts and orphans found, by category, to give a quick check of the progress being made in cataloging pre-SOLARCH solution files, which currently appear as orphans. It was also enhanced to flag orphans whose disk file names suggest that they might be casualties of SOLOP commands, rather than items waiting to be cataloged. It was upgraded to list information about the orphans, including their read/write permissions, owners, sizes, and dates of last update. Finally, the heading for each directory's listing was changed to list the actual directory rather than just the number that represents the directory in the catalog.

A new command, BR, was written at the request of an analyst, to let him browse through operational attributes of the catalog system. BR lists the tapes in the system's archive library, reporting the number of bytes remaining on each, the percentage of the tape filled, and the number of items archived. Another new SOLOP command, RC, was written to let users revise the catalog comments for a solution item. Originally, these are comments originally taken from the solutions' control file ID lines.

The SOLOP DF command, which 'diffs' (finds the differences between) two cataloged solution items, was upgraded to diff uncataloged files, specified by their full paths, as well.

Also the SOLOP RE command, which revives solution items from secondary to primary storage, was upgraded to report the specific directories to which the items are revived. This is necessary to accommodate minor user programs will continue to ask users for the path to an item, rather than being upgraded to automatically get the item's location from the catalog, via an interface subroutine.

Some upgrades were made to the SOLOP LI (catalog listing) command. Previously, LI listed every item in every version when asked to list a solution Key. The listing can now be restricted to a specific version or item type (all versions). The Key listing option also now lists the solution level comment at the start of the listing. In addition, the / option, which lists all solutions belonging to the user and falling in a date range, was made more precise, user friendly, and robust. Previously, the range had to be specified as a pair of months, but now it can be specified as a pair of days. If the user wants to list a single month, he no longer needs to repeat the month in his request. Finally, SOLOP no longer aborts if the user makes an error in specifying the range.

Until recently, the addition of a new solution owner to SOLARCH required several complicated steps, such as using the program catlx to manipulate individual catalog chains and records, and then recompiling SOLOP. Recently, this process was streamlined so that the SOLARCH programmer can add owners more easily and quickly, and users can also add owners now for the first time. Some qsol subroutines were modified to get the list of owners from the catalog rather than from a parameter file, eliminating the need to recompile. Also, a new SOLOP command, OW, was created to perform all the steps to add new owners, as well as list the current owners.

Recently, the nightly Unix system backups have became so long that they usually continue into the start of the next work day. This began causing problems in running solutions, because one of the SOLARCH routines that catalogs solutions expects each block device to be mounted once, but the backup mounts an extra copy. To avoid these problems, SOLARCH was modified to handle the extra block device.

A sporadic archiving problem was investigated and was found to be the result of a user deleting a solution while it was being archived. This caused the archiving to abort, but with recovery of all items archived before that solution. It was decided that users be given a week to decide whether or not to keep their solutions before they are archived to lessen the possibility of this happening again. So the SOLOP DT (archiving) command, which identifies and chronologically lists solution items that need archiving, was modified to list the items' run dates so that recent items could be deferred.

Minor improvements were made to several SOLOP messages. Three confusing messages were reworded in the CL, GR, and MV commands. Two messages were added to give additional information in the CL and MV commands. Crucial information was highlighted in a user prompt displayed throughout SOLOP. A CL message was made neater.

Some time ago, the Unix system administrator wrote a shell script, file_users, that identified which users and programs have a file open. File_users can be used, with an input file path, to see who is currently using the solution catalog. Typing the input catalog path is cumbersome, so a small script, called sol_users, was written to automatically run file_users on the solution catalog.

SOLOP contains code to allow importing a back solution as version number 2 of an existing solution, but this code was never tested until recently. A user wanted to use this feature, so it was tested and found to work okay.

316 SOLVE-SKED Interface (SSKEDH) Development

During the previous triannual reporting period, SSKEDH was developed and tested to the point that it could set up SOLVE scratch files that produced predicted formal errors close to, but not identical to those predicted by program Auto-Sked. The ATR and a task member investigated this discrepancy and found that the predicted observation sigmas passed by Auto-Sked to SSKEDH were less precise than those used by Auto-Sked to predict formal errors. Therefore, the Auto-Sked programmer, Dr. N. Vandenberg (NVI, Inc.), revised Auto-Sked to pass more precise predicted sigmas, and staff revised SSKEDH to handle them. The comparisons were then repeated and they now match as well as originally expected.

SSKEDH has been changed to automatically set up a delay reweigh value of 30 picoseconds, instead of the original value of 15 picoseconds. The new value is more useful to C. Thomas (NVI, Inc.), who will initially be SSKEDH's main user. SSKEDH was also changed to set the indicated Calc version to "Calc 99.9" for display by SOLVE, rather than "Calc 9.0", which will probably be a valid Calc version sometime in the future.

317 GMT and MAPIT

Work on MAPIT, the menu-driven interface to program GMT proceeded into alpha testing. Staff tested a procedure for printing color output at a remote location (Bldg. 22). This test was unsuccessful, and the procedure proved to be too cumbersome to warrant further efforts. It was noted that many maps made on the local paintjet were corrupt. With the system manager's help, some of these problems were identified as being because a loose cable and were corrected.

Several files of digitized fault information were located on the HP A900 (Puppis) and ported over to the Unix workstations for incorporation into the GMT (General Mapping Utility) data base. Also, a table of high resolution coastline information was extracted from the GMT libraries for use by Dr. J. Sauber (Code 921).

318 Miscellaneous Utility Programs

A shell script, cpswork, was written to copy the spool and workfiles from a set of SOLVE run initials to the files belonging to a second set of SOLVE run initials.

Program Modarc was written to allow automated updating of the arcfile list in GLOBL control files. Modarc compares the version numbers of the arcfiles in the arclist with the most recent version found in the superfile catalog, SUPCAT, and updates the list appropriately. It also finds uncommented arcfile records in the GLOBL arcfile list and inserts the corresponding comment (which describes the observing session) from the file sess_list.

Work began on a C program, Ifthenp, which will mark 'IF THEN' clauses and 'DO' loops on a printout of a FORTRAN program. This will be a tool for programmers, who find it helpful to have an overview of a program's structures, but must currently locate and mark the clauses and loops by hand. A first draft was coded, and about half of the subroutines were desk checked. It will be completed during the next period.

400 OPERATIONS SYSTEM SUPPORT

For VLBI operations, 649 data bases were restored or added from tape to disk, 800 were archived, 1,169 were purged, and 83 were deleted. Superfiles were produced for 85 data bases. Three DAT data base cassettes were made for other VLBI analysis centers.

Thomas was trained in using SOLVE to set up and run a simple site solution.

When gemini's Catlg restored 19 data bases to disk but only updated the catalog to recognize the first 3, the catalog was updated to recognize the remaining 16 by using the debugger.

Two staff members cleaned up some orphans found by the SOLOP 'OR' command. Also, two partially cataloged solutions discovered in the cleanup were investigated and manually removed from the catalog so that they could be cataloged fully using the standard software. In one case, SOLOP had apparently aborted in the middle of cataloging and in the other case, the orphaned item was simply missed in the original cataloging.

The data base catalog value that tells Catlg the size of a DAT was corrected. The value had been set to the solution archiving value in bytes, which made it twice as big as it should be since the data base system deals with words.

A new directory, /data/arc1/dbase, was added to the data base catalog system at the request of Dr. Ma. Staff then transferred all data bases on /data/arc1 to the new directory, at Dr. Ma's request, to hide them from listings of /data/arc1.

A visitor from IFAG (V. Thorandt) was assisted in deleting a data base version he had created and then was unable to delete. It turned out that he had created the version under someone else's session and did not have permission to delete it under his own session.

Three solution items were purged from primary storage after Cpysol tried to remove them by moving them to secondary storage, but failed because legal copies of the items were already there.

Staff archived 222 solution items during 10 runs of the SOLOP feature, which locates unarchived items and prepares an archive file. A new DAT archive tape was labelled in the process.

The SOLOP OW command was used to add two new owners, Dr. T. vanDam (NVI, Inc.) and Dr. Sauber, to the SOLARCH catalog. In addition, run initials for Thomas and Dr. Vandenberg were added to SOLVE, at the ATR's request.

The solution catalog was cleaned up after 12 solutions failed. In nine cases, the pending solutions were removed from the catalog, and in three cases their cataloging was completed. One failure occurred after a system crash. Two others occurred after users killed their solutions despite warnings from SOLARCH that it was in the middle of setting up the solutions and should not be killed. Three occurred because of user errors. Five failures occurred because a test version of BATCH was accidentally run. The final error occurred because a sporadic and infrequent SOLARCH error, which will be investigated as more cases occur.

Two separate investigations were carried out to find out why nightly runs of Cpysol (copies the solution archive catalog) had failed. In one case, a customized version of the 'rm' (remove file) command had temporarily been set up and Cpysol did not have permission to use it. An item that had been moved to secondary storage, but not updated in the catalog, had to be moved back so that Cpysol could try again. In the second case, Cpysol could not reserve any jukebox cartridges because two users had left two jukebox cartridges (the maximum) reserved.

After Dr. Ma asked a user to free up some disk space by having his solutions cataloged, the user (Dr. D. MacMillan, NVI, Inc.) was given instructions in what needed to be done to prepare his solutions for the data technician to catalog them.

A new directory, /juke22a, was added to the solution archiving system, to provide more space for CGM's.

A task member attended the East Coast VLBI Meeting at Haystack Observatory (Westford, MA), held September 27-29, 1993.

600 STUDIES AND SCIENTIFIC RESEARCH

601 Geophysical Studies

A task member used program GMT to make several maps for presentations at the spring American Geophysical Union meeting (AGU) in Baltimore, MD. The same task member installed program Harvard Graphics on a local PC and used it to generate several viewgraphs for an interagency presentation by SGP officials. Also, staff helped prepare a poster presentation by Dr. J. Degnan (Code 901) on applications of space geodesy. Several velocity maps were made, as well as figures illustrating the link that VLBI provides between the terrestrial and celestial reference frames and how VLBI is insensitive to Earth's center of mass.

SIGNIFICANT ACCOMPLISHMENTS

The SOLVE plotting program, CNPLT, was restructured, documented, corrected, and enhanced. The 'consensus' relativity model, a new axis offset algorithm, and the new IERS recommended solid Earth tide displacements model were coded, tested, and validated for use in Calc 8.0. A public domain program, GMT, was obtained and has been adopted for use in making VLBI velocity maps.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue to work on the following activities:

- SGP data base processing, calibration, analysis, interpretation, and archiving on the HP 700 series Unix workstations.
- Re-analysis and archiving of NGS, USNO, and Japanese data bases.
- Generation of SOLVE superfiles.
- Maintenance and enhancement of the processing and analysis programs on the HP 735 workstations.
- Continued development of the solution archiving system, the Solve/Sked interface system, Calc 8.0, and the GMT interface program Mapit.
- Production of 1993 annual VLBI report.

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

DELIVERABLES SUBMITTED

Software: CATLG, SOLOP, SOLARCH, SSKEDH, CNPLT, SNOOP, fspace, qcat4-modified; resdmp, cpswork, cat_users, sol_users-new utility programs and scripts created
Originator: K. Baver

Software: Calc and Pwxcb-modified; Dbcal and Sumry-new versions imported from USNO and reloaded
Originator: D. Gordon

Software: MSNOOP and GSNOOP-modified; Mapit, Modarc, and Map_uen-new programs created
Originator: D.S. Caprette

Data: 15 new NASA SGP VLBI data base experiments created; 1 recent experiment regenerated
Originators: C. Lonigro and D. Gordon

Data: 7 new SGP experiments analyzed and updated; 1 recent experiment reanalyzed and updated
Originator: D. Gordon

Data: 15 NEOS-A, 3 NEOS-B, and 2 NAVEX experiments from the USNO; 5 IRIS-A, 7 IRIS-P, 5 IRIS-S, 4 SHS, and 1 MV1/Yellowknife experiment from NGS; and 14 mobile experiments from the Japanese GSI-reprocessed, re-analyzed, and updated
Originators: C. Lonigro and D. Gordon

Data: Cable, temperature, pressure, and humidity files and plots for 15 VLBI experiments
Originator: C. Lonigro

Data: Updated blokq.dat apriori file and new skeleton data base
Originator: D. Gordon

Data: USNO 'concrete' Earth orientation series, updated with final values through June 18, 1993
Originator: D. Gordon

Superfiles: 85 superfiles for VLBI GLOBL analysis
Originator: C. Lonigro

COMPUTER USE

Minutes	Computer
10,000	HP A900
40,000	HP845
120,000	HP735 workstations

NASA Task 22-110-02: Bidirectional Reflectance Properties of Vegetation Canopies and Soils

GSFC ATR: *A. Kerber*
Cognizant NASA Scientist: *Dr. D. Deering*

Hughes STX Task Leader: *T. Eck*
Hughes STX Task Number: *260*

This task provides support for programming and analysis of data sets from the Portable Apparatus for Rapid Acquisition of Bidirectional Observations of Land and Atmosphere (PARABOLA) instrument. The spectral bidirectional reflectance of various plant canopies is measured for a complete set of viewing angles under differing solar irradiance conditions. The task includes theoretical and experimental analyses of hemispherical albedo from PARABOLA and Spectron Engineering 590 (SE 590) radiometers. Assistance in acquiring field data with the PARABOLA instrument is also provided. Microcomputer systems will be configured, and software will be developed for processing and analyzing PARABOLA data.

FINAL CONTRACT SUMMARY

On September 30, 1993, the NASA contract was completed. For the majority of this task period, one senior scientist and one principal scientist worked half time each, and one programmer/analyst worked full to half time. Also, for 4 years, a principal programmer/analyst worked from quarter to full time, and an additional senior programmer/analyst worked half time for 1 year. Major milestones and accomplishments during the course of this task included support of the FIFE, KUREX, GRSFE, and FED experiments. Several scientific journal papers were written in support of this task, in addition to major software development for data processing and analysis of PARABOLA instrument data. Assistance was provided in field data acquisition and in data analysis and computer graphics.

SUMMARY FOR CURRENT REPORTING PERIOD

Task personnel processed, plotted, and analyzed PARABOLA, PSII spectrometer, and pyranometer data sets from field experiments conducted in Hawaii in January 1993 and in North Carolina in June 1993. HSTX task personnel revised first drafts of journal papers titled "Spectral Bidirectional Reflectance Characteristics of Russian Steppe Vegetation and Comparison to U.S. Prairie Grasslands" and "Estimation of Total Albedo from Spectral Hemispheric reflectance for Steppe Grassland." These papers are now ready for review and will be submitted for publication in a special issue of the *J. Rem. Sens. Revs.* on the KUREX-91 experiment.

WORK PERFORMED

130 KUREX-91 Data Processing and Analysis

Task personnel finished revising the first drafts of two papers to be submitted to a KUREX-91 experiment special issue of the *J. Rem. Sens. Revs.* The titles of these papers are "Spectral Bidirectional Reflectance Characteristics of Russian Steppe Vegetation and Comparison to U.S. Prairie Grasslands," by D.W. Deering and T.F. Eck, and "Estimation of Total Albedo from Spectral Hemispheric

Reflectance for Steppe Grassland," by T.F. Eck and D.W. Deering. Staff finished writing several uncompleted sections including abstracts, site descriptions, and instrumentation descriptions.

180 PARABOLA Data Processing and Analysis of Hawaii and North Carolina Data

Pyranometer data sets collected from 7 days in January 1993 were plotted and comparison plots against a clear day, January 22 were made. A data summary table was generated giving information on which files contain data for various sites for both the PSII and PARABOLA instruments. This table also includes the time and solar zenith angle for each data set name. All of the barium sulfate data was corrected for panel anisotropy using coefficients measured by the University of Nebraska. The spectral anisotropic correction factors for the SE590 were smoothed as a function of wavelength using a third-order polynomial fit. The PSII data spectra for the sites with differing biomass levels and differing types of background were plotted for comparison. The January 29 measurements of leaf optical properties made with the SE590 instrument were analyzed. The transmittance for both the tops and bottoms of the leaves was computed and plotted.

The June 24 North Carolina PSII data for barium sulfate and spectralon pucks were processed and comparisons were made to the computed "100 percent" reflective spectralon puck value. Significant deviations were noted for several of the spectralon pucks relative to the specified values for these pucks.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Data processing and analysis of PARABOLA and PSII measurements made in Hawaii in January 1993 and North Carolina in June 1993 will continue. Staff will continue in the data processing and analysis of the KUREX-91 data, including SE590 and PARABOLA. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
40,000 (Wall clock)	Compaq PC's

NASA Task 22-110-03: ASAS Data Calibration

GSFC ATR: *A. Kerber*
Cognizant NASA Scientist: *J. Irons*

Hughes STX Task Leader: *W. Kovalick*
Hughes STX Task Number: *261*

This task supports research for the Advanced Solid State Array Spectroradiometer (ASAS) project in Code 623 and includes software development, ASAS data preprocessing, analysis of calibration data, radiometric correction of ASAS data, geometric rectification, and instrument operation during airborne data acquisition missions.

FINAL CONTRACT SUMMARY

This task has been ongoing since the start of the contract period. There have been 2–3 full-time programmer/analysts during most of that time. Currently, there are three full-time and one half-time task members. At least this level of effort is anticipated for the new contract period. All major objectives for the previous contract period have been met, including: 1) establishment of a Unix-based processing pipeline utilizing state-of-the-art hardware and software, 2) radiometric calibration of all data sets acquired from 1987–92, 3) development of an upgraded instrument and acquisition platform, and 4) development of software to operationally process data acquired with the upgraded instrument. Other goals that have been met include the procurement of a digital image analysis package, development of rudimentary atmospheric and geometric rectification capabilities, the incorporation of a new ascii header format, and improved quality control measures. Remaining objectives for this task are 1) replacement of the Ampex tape drive with a VHS-based tape recorder for in-flight data acquisition, 2) completion of a stabilized platform to minimize aircraft motion effects, 3) improved atmospheric and geometric correction, 4) successful data acquisition for the BOREAS and other projects, and 5) further enhancements to the data processing pipeline.

SUMMARY FOR CURRENT REPORTING PERIOD

All 18 requested HAPEX II/Sahel data sets have been calibrated and distributed to investigators. Six of the Landsat–7 data sets acquired on April 27, 1993, have been calibrated, spectrally unshifted and used to generate simulated panchromatic data. A variety of customized film products were generated for a nadir image of the Washington, DC, Mall and forwarded to the Landsat–7 Project Scientist. The instrument's entrance slit was realigned; the misaligned slit had caused spectral shifting of the Landsat–7 simulation imagery. The design for the stabilized in-flight platform was completed and the procurement process for remaining hardware components is well underway. Several enhancements were made to the in-flight platform control software, including interactive specification of a 3-axis motion profile. Maintenance for the hardware and software resources, of the task has been established for FY '94. Purchase orders were prepared for several new hardware and software resources including a CD-ROM drive, an 8-mm tape backup system, and additional memory and magnetic disk storage.

WORK PERFORMED

100 SOFTWARE SUPPORT

110 Software Development for New Data Format

A program named "l7cal" was developed to calibrate ASAS imagery acquired for the Landsat-7 project on April 27, 1993. Several problems were encountered during this development including one related to saturation of pixels in bands 2 and 64. A program named "panimg" was developed to generate simulated Landsat-7 panchromatic data from calibrated ASAS imagery. Operational use of these programs is successful.

Several enhancements were made to the in-flight platform control software. It now accepts a "motion profile" file that specifies the horizontal, vertical, and pitch movements of the platform during data acquisition. It outputs the platform tilt and yaw angles to the data system for inclusion in the image data subframes. It prompts for additional information at program start up for inclusion in a log file. In-flight testing of the software will be performed during a test flight scheduled for late September.

Staff met with the project engineer to plan for the integration of aircraft navigation system data into the ASAS data system. It was decided that a total of 19 additional items such as latitude, longitude, altitude, heading, and drift will be stored in the subframe headers of the data stream. Work is underway to finalize the storage formats and related implementation details.

Many of the known bugs in the header editing software were repaired. The new version of EDHDR appears quite robust.

120 IDL Software Development

The IDL environment is being expanded as follows: 1) the existing single user node-locked license is being updated to enable technical support and software upgrades and 2) two single-user floating network licenses are being purchased.

An IDL procedure named "asaspic" was developed to merge each image segment in an ASAS site pass to create a large, annotated image that depicts the sequence of data acquisition. A merged image may then be printed on the Kodak film processor for generation of hardcopy.

Two simple procedures were developed for handling of Sun raster files: 1) makesrf—creates a Sun rasterfile from an ASAS or non-ASAS file with an option to rotate the image by 90 degrees and 2) dispsrf—displays a 24-bit SUN rasterfile.

The "rpar" procedure was updated to enable specification of minimum and maximum wavelengths (.4-.7 um hardcoded previously).

Staff developed a procedure named "asashelp" that provides a categorical menu-based interface for identifying in-house developed IDL procedures.

The various programs are categorized into several different applications to expedite the location process. Online help is displayed in a text window when a given procedure is selected with the mouse.

130 EASI/PACE Software Development

A task member attended a PCI User's Group Meeting at the United States Geological Survey in Reston, VA, on September 10. Several PCI demos were presented, as well as an update on a new release of their image processing software.

140 Miscellaneous Software Development

Task personnel modified a C program for generating audio cassette tape labels to format labels for 8-mm Exabyte tapes containing digital ASAS data. The program will provide more standardized, professional-looking distribution products.

150 Software Installation

New accounts were added on the ASAS cluster for A. Abuelgasim, a graduate student in the USRA program and D. Helder, a postdoctorate working on the Landsat–7 data compression project.

200 HARDWARE SUPPORT

A staff member arranged for a demonstration of the CD-ROM, write once CD-ROM technology manufactured by Pinnacle Micro. More information is being collected and evaluated for other optical technologies.

HSTX staff took a lead role in setting up maintenance for the hardware and software resources of the ASAS task. Maintenance has been extended to the new system GYRFALCON for this year. Paperwork has been submitted to have all systems covered by hardware support for FY '94.

A list of suggested hardware/software upgrades was compiled. The following items were approved, and purchase orders have been prepared for them: One 644-MB Desktop SunCD Pack (CD player); one SoftPC, v3.0, Insignia Solutions (runs DOS and MS Windows on a Sun SPARCstation); two external 1.05-GB SCSI-II magnetic disk drives; one 2.1-GB internal magnetic disk drive; one 5-Gb, 8-mm Exabyte 8500 tape drive; and six Solaris 2.2 operating system for Sun workstations.

Work continued on the development of a mounting platform for installing the ASAS instrument on a NASA P3-B aircraft based at the Wallops facility. The design process for the modified platform is complete. The gimbals and mainframe have been fabricated and integrated with the existing ASAS platform. This configuration was successfully flown during an April mission. Staff members currently are fabricating the remainder of the mounting fixtures for the platform. The fabrication is being done at Wallops and being supervised by Wallops engineers and HSTX personnel. The procurement process has been initiated for the servomotors, controllers, drives, worm gears, bearings, and other required hardware. Once the fabrication and procurement process is complete, the assembly process will begin. Software will then be developed to control the servomotors in response to information provided by the Inertial Navigation System (INS) of the P3-B airplane.

300 DATA SUPPORT

320 Data Processing

Staff members conducted a spectral calibration of the ASAS instrument after the entrance slit was realigned.

A total of 18 HAPEX II/Sahel site passes were processed through calibration and archived on 8-mm "tar" tapes, six tapes to a set. Five distribution copies were created for the principal investigators of the HAPEX experiment. Task personnel are currently creating hardcopy raster images of all of the site passes for inclusion in a "browse" notebook.

A total of six data sets acquired for the Landsat-7 project on April 27, 1993, were fully processed and archived on 8-mm "tar" tapes. The processing included decommutation, radiometric calibration, and spectral shifting (to correct a known problem). Four-channel HRMSI simulation data sets also were generated for each.

340 Data Quality and Sensor Performance Assessment

Staff analyzed spectra of ASAS data collected for the Landsat-7 project and discovered that a slit misalignment occurred resulting in imagery with a spectral variation in the across-track dimension. To correct this problem, a program named "unshift" was developed that creates a simulation of the spectral bands that existed prior to the slit misalignment. The simulated bands are created using a spectral band trapezoidal integration for each detector. Staff assisted in the realignment of the entrance slit to the optical axis of the instrument to prevent this spectral shifting problem in the future. A new program called "align_it" was developed on the PC to assist in the realignment procedure.

Calibration data were acquired using the integrating hemisphere. These data were compared to earlier data acquired using the integrating sphere to determine which data set combination should be used for deriving calibration gains and offsets for use with the Landsat-7 simulation data. The sphere data that were available at an early date were used for the preliminary calibration of the Landsat-7 data. The hemisphere data provided more data points and has been used to produce gains that will be applied to the distributed data products.

Staff assisted in the derivation of an appropriate order sorting filter for the ASAS instrument. A filter is needed that will enhance the signal on the low and high end of the detector response spectrum while avoiding saturation in the middle wavelength regions. A number of custom plots were generated for this purpose.

400 DOCUMENTATION

Staff converted some FIFE documentation and the ASAS header data dictionary to "html" hypertext format for easier browsing.

Documentation on aircraft platforms and the ASAS pointing platform were converted to HTML hypertext. This is part of a small ongoing effort to improve access to documentation.

900 MISCELLANEOUS SUPPORT

Staff generated numerous Kodak and ColorFire film recorder products for an ASAS nadir image of the Washington, DC, Mall that was acquired on April 27, 1993. A simulated false color image at 5-m resolution was developed by: 1) deriving four simulated HRMSI channels and one panchromatic channel using the "panimg" program, 2) geometrically rectifying all five data sets to a 5-m UTM grid, 3) intentionally degrading the multispectral data to 10-m resolution, 4) merging the 10-m data for HRMSI channels 4, 3, and 2 with the 5-m panchromatic data using the Intensity-Hue-Saturation (IHS) transform and replacing the intensity component with the panchromatic data. A corresponding area from a 1985 Landsat TM scene was coregistered to the ASAS data and the IHS merge technique applied as well. These activities were performed to demonstrate the image sharpening possibilities of the proposed HRMSI panchromatic channel.

Staff generated Kodak prints of ASAS data used in a compression study by Dr. Pen-Shu Yeh (NASA) for the Landsat science working group meeting.

Staff assisted in the move of the ASAS laboratory from the third floor of Bldg. 22 to the first floor. The decommutation hardware for pass 1 processing was successfully reconfigured in the new room.

Task personnel assisted two summer guest researchers working with ASAS data.

Task personnel prepared a list of tools for inclusion in an ASAS toolkit.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will provide assistance to the Landsat-7 Project Scientist as needs dictate. A test flight is scheduled for late September to test updated data system circuit boards and software. Operational calibration will be completed for the Landsat-7 data sets acquired during April, 1993. The Ampex tape drive will be replaced with a VHS-based tape recorder for in-flight data acquisition. The stabilized platform will be completed. The atmospheric and geometric correction capabilities will be enhanced. Data will be acquired for the BOREAS and possibly other projects. Further enhancements will be made to the data processing pipeline. A detailed Work Control Plan also will be prepared.

COMPUTER USE

Minutes	Computer
1,670	SPARCstation 1, 1+, 10-30, Sun 3/160

NASA Task 22-110-04: Forest Ecosystem Dynamics Research

GSFC ATR: *Dr. A. Kerber*
Cognizant NASA Scientist: *Dr. K. J. Rason*

Hughes STX Task Leader: *L. Prihodko*
Hughes STX Task Number: *262*

This task supports the collection, processing, and analysis of high-resolution spectrometer data gathered over various forested sites. The work activities involve: 1) acquisition, processing, and analysis of Spectron Engineering (SE) 590 and Barnes Modular Multiband Radiometer (MMR) spectrometer data acquired from the NASA H-1 helicopter system (HELO); 2) periodic calibration and maintenance of the radiometers; 3) development of software for data reduction and analyses; 4) intercomparison of results from various spectroradiometers; and 5) compilation of data gathered from field campaigns at the Howland Experimental Forest in Maine for inclusion in a data base.

FINAL CONTRACT SUMMARY

Over the lifetime of this task, one programmer/analyst has accomplished the following major milestones: Developed a Geographical Information System (GIS) data base for the project, which continues to be populated with data and used for analysis; developed analytical and graphical presentation techniques within the GIS and provided technical support to associates; and continued involvement in software development, data procurement, and data distribution.

Staff also performed image processing procedures on ASAS, AVIRIS, SAR, TM, SPOT, and KOSMOS image data, which included false color composites, band simulations, computing vegetation indexes, georeferencing the image data, and image calibration. Staff provided graphical and analytical support for a journal's special issue. Recently, task personnel have been involved in a project to automate field work methods using GIS techniques.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff populated the FED GIS with data and developed procedures for importing and displaying data. An evaluation of the digitizing process for some of the coverage was completed and recommendations were made. A significant amount of time also was spent producing maps and graphics for publication. Staff also gave technical support to assistants and visiting summer researchers. In addition to work on the FED GIS, staff worked with global data sets for analysis and presentation. During the second half of this period, attention shifted to a stem mapping project in support of the FED component of the BOREAS project. An automated stem mapping procedure using image processing and GIS was designed, developed, and tested.

WORK PERFORMED

100 IMAGE DATA PROCESSING

110 Aircraft Imagery

Staff ingested, subset, and mosaicked new AVIRIS data to prepare them for inclusion in the GIS. A new atmospheric correction was checked by picking sample areas and comparing spectra between the old and new data sets.

A graphic comparing information attainable from SAR vs. SPOT data was prepared; it included four scenes on the same page with annotation, for publication and presentation.

An attempt was made to scan aerial photos with an available scanner (University of Maryland, College Park). Resolution was too poor to work with, so they were scanned at the University of Maryland, Baltimore County by the Imaging Research Center.

Three sets of aerial photos were registered, and a subset will be prepared for field use.

Some image processing work was done to try to isolate tree crowns in the scanned black-and-white aerial photos mentioned above. At the suggestion of one of the civil servants on the project, the task leader searched the Internet for a medical image processing program that locates and labels cells (which would hopefully locate tree crowns using the same methodology). The task leader found a program, tested it, and found it did not work very well on the types of trees that were in the initial photo on which testing was preformed.

Two image filters were then developed in conjunction with B. Knox (a PI, FED Project). These filters were designed to isolate tree crowns in scanned aerial photos of Jack Pine and Black Spruce trees. For the Jack Pine site, information on individual crowns was extracted, and a filter considered an average for a Jack Pine crown was created. The image itself was remapped such that when the filter was run it would produce bright spikes where tree crowns were located. After the filter was run over the image, it was rotated 90 degrees and run again on a newly scaled image to decrease shadowing effects from the Sun angle. A pseudocolor table was then created to highlight the potential tree crowns and maps of the tree crowns, with site grids were produced. For the Black Spruce, a geometric model (paraboloid) was used to simulate a tree crown since extracting individual crowns from the image proved to be too difficult. After being run over the image once, this filter was edited and run several times to produce an image in which thresholding of the values would produce a potential stem map of the area. A map of the area with the grid overlaid was produced, but individual 50-by-50 m field maps of the filtered image were not produced because of time limitations.

120 Satellite Imagery

Staff performed the following tasks: Ingested and subset new thematic mapper data, from which a false color composite was generated; ingested mixture model image products received from an associate researcher that are to be registered and put into the GIS; and ingested and checked a newly arrived thematic mapper scene.

200 GIS ACTIVITIES

210 Data

Staff accomplished the following tasks: Determined UTM coordinates for a forest stem map, and put resulting data into the FED GIS; put elevation contours derived from the ERDAS topographic data into the FED GIS; put species count and biomass data into the data base; added extended soil data to the existing soil map; put the Matthews cultivation index into the GIS, and calculated the areal extent of natural vs. cultivated vegetation for the globe; and developed a procedure for importing data from the Global Grass CD-ROM.

Tests on the digitizing process are complete, and an evaluation of the results suggests some alterations of the data set will be necessary. The process of correcting existing data for problems includes correcting the coordinates of all vector and raster products. Vector coverage data will be corrected first.

Soil coverage data that have been digitized by an assistant were imported, and it was determined that further editing of the coverage data would be necessary.

Vector coverage data of the BOREAS project were imported and subset for registration of the aerial photos. Staff produced various maps from this coverage to aid in the registration. UTM grids for the BOREAS stem mapping project were produced.

220 Map and Graphics Generation

Staff members performed the following tasks: Produced for publication a map of colored AVIRIS NDVI with soil carbon boundaries overlaid; produced a graphic of false color AVIRIS NDVI overlaid on topography and the corresponding image in two dimensions for presentation; created a soil map of the world from the Global Grass CD-ROM; produced a map of the SAR data subset in a 500-m radius around the tower site for publication; created a global vegetation map from the Matthews global vegetation data set for presentation with a new custom color table; created a global map of vegetation, preagricultural and postagricultural, from the Matthews global vegetation data set for presentation and publication; and made 19 field maps of a 50-by-50-m square areas of a filtered stem map image with a pseudocolor table, and applied UTM grids.

An overview map of the Jack Pine field site with the UTM grid overlaid and corresponding field map identifiers were produced. A map of the Jack Pine field site and surrounding area with the UTM field site grid applied was made to be used to determine location in the field. A map of the Black Spruce field site and surrounding area with the UTM field site grid applied was made to be used to determine location in the field.

230 Other GIS Support Activities

Staff gave technical support to an assistant who is digitizing soil maps for the project, and technical advice and support on digitizing and registering images in ARC/INFO to research associates.

Staff evaluated and began to use new ARC/INFO software tools, ARCTOOLS and ARCVIEW; began creating an easy access data base for investigators in ARCVIEW; and attended ESRI user's group meeting and a FED project meeting at the University of Virginia.

Ideas for storing metadata online, including a FED gopher, and various hypertext languages were explored. No decisions have been made yet. Development and population of the data log for the FED data base continue. Staff gave technical advice and support to visiting summer researchers involved with the FED project.

300 FIELD WORK

During the week of August 7-14, the task leader traveled to Prince Albert, Saskatchewan Canada, to assist one of the PI staff on the FED task in field work for the BOREAS experiment. Staff supported the Synthetic Aperture Radar (SAR) overflight of the southern research site through field measurements.

Staff worked primarily in four subsites, Old Jack Pine, Young Jack Pine, Trembling Aspen, and a Young Aspen site we found using satellite photos and maps. At each site staff took plot measurements of tree density, stem diameter at breast height, and tree height.

Staff also made measurements of tree geometry, including: Felling a tree, measuring the total length of the tree, the length of the crown, diameter at the top, middle and bottom of the tree, a count of the branches, length of branches, and a count of the number of leaves or needles per branch. Staff also assisted in taking measurements of the dielectric constant of the trees at each subsite.

400 OTHER SUPPORT ACTIVITIES

An abstract was prepared for a GIS conference in Colorado where staff will be presenting a poster.

Various small support tasks, such as providing FED data to research associates, data acquisition (TM), preparing various presentation graphics, and searches for historical MSS data were completed.

Staff assumed the responsibility of performing level-0 dumps (complete machine backups) of computers in the FED cluster.

500 SOFTWARE DEVELOPMENT

A simple program in IDL to compare spectra of AVIRIS data for training sites was developed.

600 MODELING SUPPORT

Task personnel requested the systems group to acquire and install the latest version of GCC on the Forest and Cheshire workstations. Test compilations showed that the new versions had not been configured properly. Task personnel are working with the systems group to get the latest version of GCC installed correctly.

Task members are developing a configuration tool for generating the driver files for the forest modeling task. The first job is to develop a configuration tool for the Zelig model. Task personnel have been involved in extensive design meetings where the structure and communication between the different elements of the overall modeling effort are being determined.

SIGNIFICANT ACCOMPLISHMENTS

A technique was developed this month to facilitate stem mapping (field mapping of tree stem location, diameter, and species) for the BOREAS project. This technique should improve the speed with which the measurements are made and should provide georeferenced stem maps in a timely fashion for analysis with remotely sensed data. The development of this technique included significant image processing (WBS 110) and GIS (WBS 200) activities.

Potential sites for stem mapping were located on aerial photos of the southern BOREAS research sites. These photos were then scanned, registered, and subset over the potential sites. Since the stem mapping for each site was to encompass a hectare (100 by 100 m), an image covering 250 by 250 m was created to allow for adjustment in the field. Ten-by-ten meter grids and 1-by-1 meter grids were created to overlay the photos for location in the field. Spatial filters were developed to isolate tree crowns in the scanned images. After these were applied, a pseudocolor table was created to highlight the potential tree crowns for one of the scanned images.

The grids were overlaid, and 50 by 50 m maps were created to carry into the field for location and identification of trees. An overall map of the area where the site was located and an image of the grid with corresponding numbers to the field maps were created for field reference. These maps have since been taken into the field for testing, and the results of how well the spatial filter worked and if mapping speed was increased will be evaluated.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work will continue on developing the GIS and populating it with data. This may include software development, image and data processing, digitizing, data analysis, map production, and documentation.

Staff also will be attending two conferences devoted to GIS, one local and one in Colorado. Work should conclude on the stem mapping project during this period.

A Work Control Plan will be updated that meets the requirements of contract NAS5-32350.

DELIVERABLES SUBMITTED

Maps:
Colored AVIRIS NDVI with soil carbon boundaries overlaid for publication
Color, hardcopy soil map of the world
500 m subset of SAR data around FED tower site, black and white, for publication
A map of global vegetation with a custom color table for presentation
A map of global vegetation, preagricultural and postagricultural, for presentation and publication

19 color maps of the filtered stem map image with pseudo color table and stem map grid applied were prepared for the field
Photographic quality, hardcopy of Jack Pine field site with grid and field map identifiers
Photographic map of Jack Pine field site and surrounding area with grid applied
Photographic map of Black Spruce field site and surrounding area with grid applied

Originator: L. Prihodko

Graphics: False color AVIRIS NDVI overlaid on topography with the same image in 2-D on the page, hardcopy and transparency for presentation
False color composite of TM data, hardcopy
Spectra comparison plots of old and new AVIRIS data, hardcopy
A comparison of SPOT and SAR data, four scenes on one page with annotation for presentation and publication

Originator: L. Prihodko

NONLOCAL TRAVEL

Staff traveled to Prince Albert, Saskatchewan Canada, to assist with field work.

COMPUTER USE

Minutes	**Computer**
426	Sun workstation

NASA Task 22-110-06: Atmospheric and Global Vegetation Research

GSFC ATR: *A. Kerber*
Cognizant NASA Scientist: *Dr. C. Tucker*

Hughes STX Task Leader: *R. Mack*
Hughes STX Task Number: *264*

The objective of this task is to provide the Global Inventory Modeling and Monitoring Studies (GIMMS) technical staff with a wide range of support for their activities in Atmospheric and Global Vegetation (AGV) research. This work includes studying atmospheric attenuation, estimating photosynthetically active radiation (PAR), monitoring global deforestation, monitoring the clear cutting and fragmentation of old growth forests in the Northwest United States, developing computer software to assist research activities in the GIMMS group, and designing and implementing a global NDVI processing system for the AVHRR Pathfinder project.

FINAL CONTRACT SUMMARY

HSTX has been supporting work activities for the Atmospheric and Global Vegetation Research task since its conception in FY 88. The number of task personnel on this task during the peak support included five senior scientists of global vegetation studies, atmospheric correction of remotely sensed data, the processing of coarse and fine spatial resolution data, and software development and support. Accomplishment to data include: 1) software to process an analyze data from NOAA's AVHRR satellite, 2) software to access the AVHRR data from the SONY WORM drives, 3) published papers on activities, 4) participation in aerosol and biomass burning field experiments in Brazil, forest/conservation project in Bhutan, and the Madagascar forest classification project, 5) image processing and analysis support for the mapping of old growth forest in the Willamette National Forest in Oregon and Gifford Pinchot National Forest in Washington State, 6) participation in the Central African Global Climate Change (CAGCC) project, and 7) support of vector-borne disease studies in Kenya and Senegal.

SUMMARY FOR CURRENT REPORTING PERIOD

Task personnel participated in an experiment in Brazil from August 25–September 17, 1993, to characterize the optical properties of smoke from biomass burning using sunphotometers and pyranometers. In preparation for the trip, Hughes STX task members provided assistance in testing the Cimel sunphotometers, setting gains, and preparing them for calibration and deployment in Brazil. The work involved intercalibration of sunphotometers, calibration of sky sensors from integrating sphere measurements, and providing assistance in verifying operation of instruments and shipping them to Brazil.

HSTX task personnel presented a paper entitled: "The AVHRR Land Pathfinder—Global Data Processing for Global Change Studies" at the Pecora 12 conference in Sioux Falls, SD.

Task personnel tested the portability and benchmarked the Pathfinder processing software system by building the software on the following Unix workstations: HP Series 9000 Models 730 and 735, SUNSPARC 10 Model 30, IBM 6000 Model 530H, SGI Crimson VGX, and SGI Challenge M. Results show that the HP 735 can process one day's worth of data more than six times faster than is possible with current hardware.

WORK PERFORMED

100 ATMOSPHERIC RESEARCH

110 Regional Atmospheric Attenuation Research

HSTX task personnel provided assistance in testing the Cimel sunphotometers, setting gains, and preparing them for calibration and deployment in Brazil. Work involved intercalibration of sunphotometers, calibration of sky sensors from integrating sphere measurements, and assistance in verifying operation of instruments and shipping them to Brazil. Task personnel participated in an experiment in Brazil from August 25–September 17, 1993, to characterize the optical properties of smoke from biomass burning using sunphotometers and pyranometers.

Task personnel installed an automatic Cimel sunphotometer on Hog Island, VA, in support of the Surface, Clouds, and Aerosol Regional (SCAR) experiment and Long Term Ecological Research (LTER) program. Task personnel provided assistance with the data collection during the SCAR experiment and in setting up a sunphotometer at Hog Island, VA Coast Reserve.

200 FOREST ANALYSIS

220 Temperate Forest Mapping and Monitoring

HSTX task personnel provided C. Welden, (a collaborator at Southern Oregon State University) with a new version of the H.J. Andrews TM subset for band 7. Welden's version of band 7 was lost or corrupted. After confirming the data set needed, the replacement band was sent to Weldon's computer via network file transfer protocol.

HSTX task personnel revisited the H.J. Andrews TM data set to determine the amount of effort necessary to produce supervised classification results and to extract image values for training and test sites that would be merged with ground truth data. HSTX staff decided to test a different supervised classification on the H.J. Andrews TM data set.

This algorithm seemed to work better than the maximum likelihood classification tested previously. A quantitative test of the results require that the test sites delineated be grouped by class. The test sites were grouped, but a confusion matrix has not been generated.

300 GIMMS COMPUTER HARDWARE/SOFTWARE SUPPORT

Routine EASI/PACE user support continued. Task personnel provided help in writing EASI/PACE procedures for S. Los (Univ. of Maryland), investigated ways of adding a legend to an image for M. James (Code 902), discussed the advantages and disadvantages of PCI's EASI/PACE image system with Dr. E. Cook (Univ. of Illinois), and installed an updated version of EASI/PACE on the SGI and HP workstations. Task personnel also investigated a potential problem in the HP version of EASI/PACE for H. Zhang (Univ. of Maryland). HSTX staff determined that the problem was limited to the version of EASI/PACE installed at the Univ. of Maryland and was not a problem in the version of EASI/PACE used by the GIMMS group. Task personnel provided assistance to S. Hay (Oxford U., in the UK) in converting vector data of tsetse fly distributions from ARC/INFO format to vectors in the EASI/PACE format. In addition, task personnel trained S. Hay on the use of the GIMMS Mapping System (GMS) and the general use EASI/PACE image processing system.

Task personnel attended the PCI's June users group meeting. Topics discussed at the meeting included schedules for the next release of EASI/PACE and new features that will be available in Version 5.2. In addition, the representatives of PCI demonstrated the new features that are part of the current release (Version 5.1).

HSTX staff tested the new NDVI and associated channels products and the scan angle product that were added to GMS. Minor problems found during testing were corrected.

HSTX personnel modified GMS to allow for processing of the AVHRR level-1B data residing on 4-mm DAT tapes. The modifications consisted of new code to automate input file extraction from the DAT tapes based on the user-selected time period and the continent to which the data to be processed belongs. Also, new code was written to automate output file naming based on the above criteria.

XGMS, the X-Window graphical user interface to GMS was modified to reflect the new capabilities. A new interface window for the continent and time period selection was added, and a new main menu option for internal path configuration was created and tested.

As part of the integration of the global AVHRR processing with GMS, task personnel developed a program (GMS2PCI) that facilitates the quick transfer of GMS product images into PCI data base. HSTX staff also wrote the program XTRACT, to retrieve from EASI/PACE data base image values located at a given set of latitude and longitude values. This program will be used by S. Hay in his research on the relation between the NDVI, temperature, and tsetse fly distributions.

At the request of J. Kendall (SSAI) task personnel modified the program FIRE to print a different heading when the fire report is generated.

400 AVHRR PATHFINDER DEVELOPMENT SUPPORT

Task members attended biweekly meetings with M. James (Code 902) to discuss the progress of the pathfinder activities.

Task members monitored the computers systems performance using the tools, sar, netstat, and nfsstat. Pathfinder run times for both the SGI multiprocessor (upolu) and the SGI Indigo (landho) workstations show that the times on upolu do not seem to indicate any major system problems when compared to the process times on landho. The times on landho are about three times faster than the times on upolu. These times are to be expected (from SGI announcements) when moving from the R3000 processor to the faster R4000 processor. The only way to make processing on upolu faster would be to upgrade the processors, install a faster controller, or faster magnetic disks. The sar information shows that there seems to be a correlation between longer chunk processing times and heavy I/O. The system (CPU's) seems to spend a great deal of time waiting for access to the file system. An indication that the CPU's are being "pushed" very hard is also present. With the current load on the upolu (two pathfinder processes, development work, and optical access), 40+ hours to process a day's amount of data is about all that can be expected from the current hardware configuration and processing software. The run times will fluctuate depending on the system activity.

Task personnel tested the portability of the Pathfinder software system by building the software on the following workstations: HP Series 9000 Model 730 and 735, SUNSPARC 10 Model 30, IBM 6000 Model 530H, SGI Crimson VGX, and SGI Challenge M. The software ported to each platform very quickly with only a few minor changes. (Note: The file format CDF did not port to the IBM workstation.) One day's amount of data (14 orbits) were run on each system as a benchmark. The HP 735 workstation time of 6 hours and 48 minutes was the faster. The SUNSPARC ran slowest at 17 hours 46 minutes. Both these times are faster than the 42 hours it takes to process the benchmark on the current Pathfinder system (SGI 340 VGX).

Task personnel developed and tested a modification to the Pathfinder system that "throws away" scans that are flagged with NOAA quality control flags.

Currently, all data are used in processing, and the NOAA flag is recorded and inserted into the Pathfinder quality control product.

Task personnel continued the coding of the software to ingest standard NOAA level-1B GAC data for processing in the Pathfinder software system. Currently, the software only handles the modified level-1B GAC format that was used when the data were archived onto the SONY WORM platters.

HSTX staff wrote and presented the paper entitled: "The AVHRR Land Pathfinder—Global Data Processing for Global Change Studies" at the Pecora 12 Symposium in Sioux Falls, SD.

Task personnel attended the AVHRR Land Pathfinder Science Working Groups (LSWG) meeting at the Sheraton Hotel in New Carrollton, MD.

HSTX staff acted as software configuration manager for the pathfinder group.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will prepare a Work Control Plan that meets the requirements of Contract NAS5-32350.

100 ATMOSPHERIC RESEARCH
110 Regional Atmospheric Attenuation Research

Task personnel will assist in the analysis of data collected during the sunphotometer experiment in Brazil.

200 FOREST ANALYSIS

220 Temperate Forest Mapping and Monitoring

This task will not be continued in the next period because the HSTX staff will be on maternity leave.

300 GIMMS COMPUTER HARDWARE/SOFTWARE SUPPORT

HSTX staff will continue work on integrating the global AVHRR production processing with the GMS software and the EASI/PACE image processing system.

Task personnel will determine whether the GIMMS group will use the World Data Bank Data Base (WDB II) or the Digital Chart of the World (DCW) as the source of vector data for the geopolitical features such as continental and political boundaries, rivers, and lakes.

HSTX task personnel will provide assistance in making the vector data from either of the above mentioned sources available for use with EASI/PACE; specifically:

- WDB II or DCW files will be transferred to SGI workstations so that they can be used with EASI/PACE.
- Programs to overlay the vector data from WDB II or DCW onto images mapped with GMS will be written.
- Task personnel may create map files for the world (low resolution) and the individual continents (higher resolution) for quick integration into GAC products.
- Task personnel will create a land and ocean mask for images mapped with GMS and displayed using EASI/PACE on SGI's.

400 AVHRR PATHFINDER DEVELOPMENT SUPPORT

HSTX staff will continue to support the AVHRR Pathfinder project by testing, maintaining, documenting, and performing software changes. Task also personnel will continue the coding and testing of the software to ingest standard NOAA level-1B GAC data for processing with the Pathfinder software system. HSTX task staff will act as software configuration manager for the pathfinder group.

DELIVERABLES SUBMITTED

Software: Program GMS2PCI facilitates the quick transfer of GMS product images into PCI data base.
Program XTRACT used to retrieve from EASI/PACE data base, image values located at a given set of latitude and longitude values.

Originator: K. Donaldson

CONFERENCES

HSTX task staff attended and presented the paper entitled: "The AVHRR Land Pathfinder—Global Data Processing for Global Change Studies" at the Pecora 12 Symposium in Sioux Falls, SD; attended the AVHRR LSWG meeting at the Sheraton Hotel in New Carrollton, MD; and attended the PCI's June users group meeting held at the GSFC.

COMPUTER USE

Minutes	Computer
600	VAX
26,500	HP
46,800	SGI Personal Iris
690	Macintosh

NASA Task 22-110-08: FIFE Support

GSFC ATR: ***A. Kerber***
Cognizant NASA Scientist: ***Dr. F. Hall***

Hughes STX Task Leader: ***K. Huemmrich***
Hughes STX Task Number: ***265***

This task will provide technical personnel support to the First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE) Information System (FIS) and related data analysis. The work will include: 1) deriving digital map layers from existing maps of terrain, soils, and vegetation; 2) developing, testing, and operationally using software to read, preprocess, and create output products from the data received; 3) tracking all FIFE data through design and operation of a data base inventory system; 4) developing and maintaining an online data base of specified FIFE data; 5) interacting with FIFE investigators to ensure the functional capability of the data handling and analysis facilities; 6) supporting the FIFE Staff Science instrument calibration and correction activities; and 7) analyzing portions of the collected data at the direction of the cognizant NASA scientist.

FINAL CONTRACT SUMMARY

HSTX has been supporting work activities for the FIFE Information System (FIS) since the start of the existing contract in October 1988. During this time the level of support has ranged from 10 to the current 4 FTE during this period to provide needed support of project field infrastructure, data collection activities, development of software and design of the online data base system to support the integration of investigator and staff data. Accomplishments to date include: 1) five CD-ROMs of data were produced, 2) software to provide an interface with the CDs, 3) Image Data compression software, 4) workshop support for 5 workshops, 5) scientific papers (4), 6) integration and documentation of 103 data sets, 7) online data base development and support, and 8) interactions with the Pilot Land Data System.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX personnel continued archiving FIFE data to CD-ROM. The fifth CD of the series is completed and contains Level-2 and -3 image data, and the FIFE geographic reference data. For CD-ROM 5, all images were created and compressed, the documentation has been reviewed, the CD directory has been created, and the program for viewing the data has been updated. Staff began on FIFE CD-ROM 1; this CD-ROM will contain the FIFE nonimage investigator and staff science data sets. Task personnel have updated the data dictionary for 25 data tables and quality checked 26 data tables.

100 FIS OPERATIONS

110 Image Processing

Staff reviewed the AirSAR tapes received from S. Saatchi (JPL). The tape contains data from June 8, 1988, and August 3, 1989, in a compressed format. Additional information needs to be obtained from S. Saatchi before proceeding further.

112 Level-2 Image Data

For E. Peck's (HYDEX) level-3 soil moisture maps, task personnel developed and tested software that converted the listing files of UTM coordinates and soil moisture values into spatial arrays (images). The software also generated ASCII header files that contained summary information and statistics about these data. A separate software utility was developed to write the data to tape for offline storage.

Task personnel reviewed the level-2 and level-3 TM NDVI and the level-2 and level-3 SPOT NDVI imagery for consistency and errors.

114 Atmospheric Correction of Image Data

An intercomparison of thermal radiance measurements acquired over the FIFE study sites and water targets on August 15, 1987 was conducted. Image digital counts from the NS001 and Landsat—5 Thematic Mapper were extracted over the water targets and converted to calibrated radiances. The radiances were then corrected for atmospheric attenuation using local radiosonde profiles in the Lowtran-7 atmospheric radiance model. The same procedure was used to correct radiances over vegetated targets. All aircraft and satellite-corrected radiances were then converted to surface temperatures and compared with temperature measurements taken at the surface. The results were consistent with those found on August 4, 1989; Landsat-5 TM overestimates surface temperature by 5–7° C, the NS001 agrees within 1–2° of surface measurements, and the helicopter MMR overestimates surface temperature by about 3–4° C. The bias towards overestimation of surface temperature by most instruments is believed to be caused by the fact that the AMS instruments observe a relatively small surface area that generally is more vegetated due to reduced grazing by livestock, hence cooler. However, there is still a significant overestimation of surface temperature of the water targets by the TM.

Tests of the constants used in the Planck formulation for calculation of apparent temperature from sensor response filtered radiances suggest that the constants can be estimated more accurately. This modification results in a reduction of apparent temperature of 1° C. A test of the Lowtran-7 model also was conducted by comparing it with a similar model of higher spectral resolution. The atmospheric emission and transmission values derived from the Modtran model resulted in an additional degree reduction in TM apparent temperature. Despite these refinements, the TM still overestimates surface temperature by 3–4° C. Investigation of these observations continued.

120 Online Data Base

Staff performed weekly backups of data base files and exports; logged the level-3 soil moisture map data files and tape into the online data base; and logged the level-2 and level-3 TM NDVI and the level-2 and level-3 SPOT NDVI imagery into the online data base.

Task personnel began the process of adding the SITEGRID_ID column to all the tables in the FIFE data base. The grid locations are checked for accuracy and appropriate instrument identifiers are appended.

Hughes STX staff created an inventory table for the data in the table SURF_MET_DATA, and began writing documentation for these data.

Task personnel completed writing documentation of the NOAA radiosonde data in the table NOAARAD89_DATA.

Task personnel worked on the historic meteorological data from Manhattan, KS. The Kansas state climatologist was contacted to gather background information on the data collection methods and to get daily data for 1986–1989. The data base table was redesigned, the data were moved from the old table into the new table, and the new data were input. Work began on writing the documentation of this data set.

Task personnel updated the gamma ray soil moisture data table with revised data from E. Peck (HYDEX).

Staff revised the column names and definitions in the soil respiration data table.

Task personnel changed the STATION_ID's in the PARABOLA_DATA and _INV tables, because of new information on the location of the PARABOLA instrument during FIFE.

Staff restructured the LEAF_ANGLE_DATA (making a single angle column and a TYPE column to explain it) to allow for a complete table rebuild later.

Task personnel created new views for the SE590 spectroradiometer data, creating three views, one for each experiment group.

Task personnel rebuilt the data dictionaries for the following tables: BRUT_SONDE_DATA, BRUT_DERV, LIDAR_HEIGHT_DATA,SODAR_DATA, TEMP_PROFILE_DATA, WIND_PROFILE_DATA, BIOMASS_DATA, EXOTECH_TRANSECT_DATA, KSU_MOW_DATA, PARABOLA_DATA, PLANT_PRODUCTION_DATA, SOIL_GAS_FLUX_DATA, LEAF_ANGLE_DATA, LEAF_H2O_POTENTIAL_DATA, LIGHT_BAR_DATA, LIGHT_WAND_DATA_KSU, LIGHT_WAND_DATA_UNL, ROOT_DATA, VEG_BIOPYS_DATA, VEG_SPECIES_DATA, VEG_SPECIES_REF, SE590_LEAF_DATA, SE590_GROUND_GSFC_DATA, SE590_GROUND_UNL_DATA, HELO_SE590_DATA.

Upper air station identification numbers were changed for two stations on the NOAARAD89_DATA table to correspond to the identification numbers contained in the FIFE_SITE_REF table. The NOAARAD89_DATA table also was inventoried into NOAARADIO_INV. An identical procedure was followed for finalizing the SURF_MET_DATA table The surface station identification numbers were changed within the table for thirteen stations, and the table was inventoried into NOAASURFACE_DAY_INFO.

Task personnel created, loaded, and quality checked the table SE590_LEAF_DATA, which contains spectral reflectance and transmittance data of grass leaves.

Staff updated the view azimuth angles in the SE590_GROUND_UNL_DATA table to correct some errors and to accurately reflect the resolution of the measurements.

130 Data Archive and Browse

Task personnel copied 17 level-2 NS001 image data tapes to two 8-mm tapes and made duplicate copies of the 8-mm tapes. Also copied were level-1 Landsat tapes to 8-mm tapes and duplicate copies were made. With the two 8-mm tape drives now attached to the BOREAS VAX 6410, task members duplicated 10 tapes containing the level-0 Landsat TM and SPOT imagery.

The following data base tables contain needed reference information:

FIFE_SITE_REF
SOIL_HYDRAULIC_CONDUC_REF
SOIL_MOISTURE_RELEASE_REF
SOIL_REFK_REF
SOIL_SITE_REF
SOIL_WATER_PROPERTIES
SURFACE_FLUX_VARIABLES
VEG_SECIES_REF

The following table summarizes the image data in the FIS table (some gaps exist in the date ranges given):

IMAGE TYPE	UNITS	# OF UNITS	PROCESSING LEVEL	DATES COVERED (DD/MM/YY)
ASAS	Site Pass	39	Level-1	26/06/87–12/10/87
				04/08/89
AVHRR–GAC	Images	1,890	Level-0	01/06/86–26/10/88
		160	Level-1	02/12/86–27/02/87
AVHRR–LAC	Images	1,706	Level-0	02/02/87–13/10/89
		707	Level-1	03/02/87–13/10/89
		139	Level-2	08/05/87–29/10/87
				15/01/88–26/09/88
				08/06/89–13/10/89
	Images	3	Calib	17/07/87–10/02/88
GOES (NESDIS)	Days	1,142	Level-0	02/07/85–23/10/88
		1,142	Level-1	02/07/85–23/10/88
GOES (Scripps)	Days	121	Level-0	01/01/87–16/10/87
	Days	57	Level-2	IFC's 1, 2, 3, 4
Landsat TM				
DNs	Images	25	Level-0	15/12/82–04/08/89
		14	Level-1	09/04/87–04/08/89
		14	Browse	09/04/87–04/08/89
Greenness	Images	6	Level-3	11/05/87-18/10/87

IMAGE TYPE	UNITS	# OF UNITS	PROCESSING LEVEL	DATES COVERED (DD/MM/YY)
NDVI	Images	14	Level-2	09/04/87-04/08/89
	Images	14	Level-3	09/04/87-04/08/89
MAMS	Images	8	Level-3	04/06/87, 05/06/87
NERDAS	Files	82	Level-0	IFC's 1, 2, 3, 4, 5
NS001	Images	804	Level-0	17/06/85-21/06/85 IFC's 1, 2, 3, 4, 5
		69	Level-1	04/06/87–11/10/87 04/08/89–11/08/89
	Images	17	Level-2	06/06/87 15/08/87 11/10/87 04/08/89
	Images	66	Calib	23/01/87–26/04/88
PBMR				
Brightness	Images	33	Level-2	IFC's 1, 2, 3, 4, 5
		33	Level 3	IFC's 1, 2, 3, 4, 5
Soil moist	Images	18	Level-2	IFC's 1, 2, 3, 4, 5
		18	Level 3	IFC's 1, 2, 3, 4, 5
SPOT Multispectral				
DNs	Images	43	Level-0	20/03/87–09/08/89
	Images	42	Level-1	20/03/87–09/08/89
	Images	42	Browse	20/03/87–09/08/89
NDVI	Images	41	Level-2	20/03/87-09/08/89
	Images	41	Level-3	20/03/87-09/08/89
SPOT Panchromatic				
DNs	Images	4	Level-0	06/06/87–04/08/89
	Images	4	Level-1	06/06/87–04/08/89
	Images	4	Browse	06/06/87–04/08/89
TIMS	Images	745	Level-0	IFC's 1, 2, 3, 4, 5
	Images	3	Level-2	04/08/89

The following summarizes the analog data in the FIS:

DATA TYPE	UNITS	# OF UNITS	DATES COVERED (DD/MM/YY)
C–130 Video Tapes	Tapes	69	IFC's 1, 2, 3, 4, 5
C-130 Flight Logs	Folders	84	17/06/85–21/06/85

DATA TYPE	UNITS	# OF UNITS	DATES COVERED (DD/MM/YY)
C-130 Aerial Photography	Canisters	21	IFC's 1, 2, 3, 4, 5 17/06/85-21/06/85 IFC's 1, 2, 3, 4, 5
Flux Aircraft Microfilm	Canisters	22	26/05/87-12/07/87 26/07/89-12/08/89
Flux Aircraft Video Tapes	Tapes	35	26/05/87-12/07/87 26/07/89-12/08/89
Helicopter Video Tapes	Tapes	71	IFC's 1, 2, 3, 4, 5
Helicopter Flight Logs	Folders	27	IFC's 1, 2, 3, 4
Helicopter Photography	Canisters	58	IFC's 1, 2, 3, 4, 5
Lidar Video Tapes	Tapes	18	IFC's 2, 5

The following table summarizes the point-source data in the FIS:

DATA TYPE	DATES COVERED (DD/MM/YY)
Aircraft Flux	IFC's 1, 2, 3, 4, 5
AMS (online)	01/05/87-31/12/87 25/06/88-13/08/88 01/01/89-10/11/89
(5-min tape)	01/05/87-31/12/87 01/01/89-10/11/89
(30-min avgs.)	01/05/87-31/12/87 01/01/89-10/11/89
Brutsaert	
(Radiosonde)	IFC's 1, 2, 3, 4, 5
(Std Levels)	IFC's 1, 2, 3, 4, 5
(Temp Profile)	IFC's 1, 2, 3, 4, 5
Cloud Camera	
(Grid Data)	IFC's 1, 2, 3
(Photo Data)	05/03/87-12/08/89
DCP (Level 0)	24/05/87-05/04/88
Extracted Image Data	
AVHRR-LAC	03/02/87-13/10/89
Landsat TM	09/04/87-04/08/89
NS001	04/06/87-11/10/87 04/08/89-11/08/89

DATA TYPE	DATES COVERED (DD/MM/YY)
SPOT	20/03/87–09/08/89
Extracted Image Data	
Correction Coefficients	
AVHRR-LAC	10/02/87–13/10/89
Landsat TM	09/04/87–04/08/89
SPOT	20/03/87–09/08/89
Gemma Spectrometer	04/08/89–12/08/89
Helicopter-based	
IRT Data	28/07/89–11/08/89
Scatterometer	IFC's 2, 3, 4
Kansas State	
(Exotech)	03/07/89–18/08/89
(Light Bar)	03/07/89–18/08/89
(Light Wand)	03/07/89–18/08/89
Lidar Height	30/06/87–09/07/87
	28/07/89–11/08/89
LTER Rainfall	27/04/82–30/12/89
LTER Stormflow	01/01/87–01/01/88
Manhattan Rainfall	
(monthly)	01/01/1858–28/02/1987
(daily)	01/01/1900–31/12/1985
Middleton SE590	
Nadir view	IFC's 1, 2, 3, 4, 5
MMR Data	
(Calibration)	06/06/87–11/10/87
	26/07/89–11/08/89
(Ground)	03/06/87–13/10/87
	15/06/89–11/08/89
(Helicopter)	04/06/87–13/10/87
	28/07/89–08/08/89
NMC Upper Air	02/07/85–23/10/88
NOAA Radiosonde	02/07/85–31/10/89
NOAA Surface Reports	02/07/85–31/10/89
PARABOLA	IFC's 1, 2, 3, 4, 5

DATA TYPE	DATES COVERED (DD/MM/YY)
Photosynthesis	
Sellers Box	01/07/87–12/10/87
Norman Respiration	06/06/87–16/08/87
Princeton Rainfall	29/05/87–29/10/87
SODAR	26/05/87–22/08/87
Soil Density	IFC's 1, 2, 3, 4
Soil Gas Flux	28/05/87, 28/06/87
Soil Moisture	
(Gravimetric)	20/05/87–06/11/87
	11/04/88–21/10/88
	19/07/89–12/08/89
(Impedance probe)	24/05/87–13/10/87
	27/07/89–10/08/89
(Neutron probe)	28/05/87–06/11/87
	11/04/88–29/09/88
	24/07/89–10/08/89
(Thermal conductivity)	18/10/87
Soil Respiration	24/07/89–12/08/89
Storm Flow (LTER)	01/01/87–01/01/88
Stream Flow	
(LTER)	14/06/85–31/12/87
(USGS)	01/04/79–05/09/88
(15-min)	25/12/84–03/03/88
Sun Photometer	
(C–130)	04/06/87–11/10/87
	04/08/89–11/08/89
(Fraser)	25/06/87–14/07/87
	25/07/89–12/08/89
(JPL)	30/05/87–08/10/87
	28/07/89–08/08/89
(KSU)	06/02/87–11/10/87
	08/02/88–01/12/88
	15/06/89–31/10/89
Surface Flux	
(Daily average)	26/05/87–16/10/87
(6 minute)	06/06/87–16/08/87
(30 min)	14/05/87–19/10/87
	27/04/88–16/09/88

DATA TYPE	DATES COVERED (DD/MM/YY)
	29/06/89–16/08/89
TOVS Profiles	01/01/87–31/12/87
Univ. of Nebraska	
(CR21X)	30/05/87–30/09/87
(EVEREST)	15/06/89–11/08/89
(IRT112)	03/06/87–13/10/87
(Light Bar)	30/06/87–13/10/87
	26/07/89–10/08/89
(Light Wand)	13/06/89–11/08/89
(Longwave)	03/06/87–13/10/87
	15/06/89–11/08/89
(MMR Leaf)	01/06/88–12/08/88
	14/06/89–12/08/89
(PSP)	30/05/87–13/10/87
(SCHED)	03/06/87–13/10/87
	15/06/89, 14/07/89
(Water Potential)	14/06/89–12/08/89
Vegetation	
(Biomass)	28/05/87–12/10/87
(Biophysical)	26/05/87–05/11/87
	19/04/88–25/10/88
	03/07/89–18/08/89
(Exotech)	30/05/87–13/10/87
(Leaf Angle)	09/06/87–04/08/87
(Mowing Experiment)	07/05/87–28/10/87
(Productivity)	18/05/87–13/10/87
(Root Biomass)	01/06/87–12/11/87
(Species)	09/05/84–19/07/84
	01/07/85–16/10/85
	23/04/86–25/09/86
	22/05/87–10/10/87
	14/08/89–18/08/89
Water Temperature	
(Pond)	28/06/87–13/10/87
(Reservoir)	22/07/89–08/08/89
Wind Profile	
(Lidar)	24/06/87–11/07/87
(Radiosonde)	25/05/87–16/10/87
	24/07/89–12/08/89

140 Software Maintenance

Staff upgraded the PC Oracle Table Designer software to have it create a SQL INSERT file that updates the online data dictionary for FIFE. This way, the table designer can be used to enter new tables into the data dictionary without the need for SQL*FORMS.

150 User Support

Task personnel sent five level-3 Landsat TM images to R. Dejardins (Agr.Canada).

200 FIS DEVELOPMENT

HSTX staff wrote a Pascal program to convert lists of STATION_ID's from the data base into batch files of SQL UPDATE commands to add the SITEGRID_ID's to the data tables specified.

Task personnel continued study of the Prograph Compiler, an Object-Oriented, graphically based development system for the Macintosh. It is hoped that this system will allow the development of a Macintosh version of the FIFE CD-ROM interface in the near future.

240 CD-ROM Production

Task personnel were able to get the CD-ROM drive on the CD-ROM premastering computer (386 PC) to finally read CD-ROM's. Now, further development on the FIFE CD-ROM interface software can continue.

Task personnel have processed the 42 SPOT acquisition dates to level-2 for CD-ROM 5. Task personnel added driver functions to the compression software package to control compression of the Landsat TM and SPOT NDVI products and the composite soil moisture maps. Staff compressed the level-3 composite soil moisture maps, level-3 SPOT NDVI images, and level-3 TM NDVI images for inclusion on CD-ROM 5. Using existing image data compression software, a new program was developed to compress the GIS images for inclusion on CD-ROM 5. Task personnel created and compressed reference files of latitude and longitude coordinates for the level-3 SPOT and Landsat TM NDVI images and for the level-3 Landsat TM greenness images for inclusion on CD-ROM 5. Staff created summary ASCII header files for the Landsat TM greenness images.

Staff reviewed documents for level-3 MAMS, level-2 GOES, level-3 Landsat TM NDVI images, level-3 SPOT NDVI images, light bar data from Kansas State University and the University of Nebraska (UNL), light wand data, and SE590 data that were prepared by P. Agbu.

Task personnel created the directory structure map for FIFE CD-ROM 5. This CD-ROM will contain level-2 and -3 image data, and the FIFE geographic reference data. Staff downloaded all current data to the Premastering PC, checked it for errors, and upgraded the IMAGES interface program, adding several new features.

Software was developed that incorporated ideas on ways to improve the extraction and formatting of data from the data base into ASCII files for the CD-ROM. The software, written in C, uses the data base table definitions to instruct the data base on how to extract and sort the data. The software also replaces the multiple spaces between columns with a single comma to allow the CD-ROM interface to distinguish between the column entries. The program brings together into one step, the several steps that were used before to do the same operation.

300 FIFE RESEARCH

The 41 SPOT images prepared for FIFE DC-ROM were used to investigate temporal dynamics of NDVI at the FIFE site. Twenty-six images were from the 1987 growing season, 10 in 1988, and 5 in 1989. Plots of seasonal variability in retrieved surface reflectance in the visible and infrared and in NDVI were generated. These plots were developed from scene averaged statistics for only those acquisitions that were cloud-free. It was found that there is not as much difference in NDVI between years as might be expected from the meteorological data (1987 was unusually wet and 1988 was unusually dry), although there are significant differences at the time of typical peak growing activity (June). The infrared reflectances in 1989 are noticeably lower than the other two years, but there are probably not enough acquisitions in 1989 to tell whether the data adequately characterize vegetation growth activity. However, intercomparisons on August 4, 1989, suggest that the SPOT retrieved reflectance are quite comparable with TM, helicopter and surface measurements. Staff noted that variations in viewing geometry are evident in observed differences in NDVI between consecutive days for four pairs of SPOT scenes that were acquired one day apart in 1987. However, the effect of view zenith angle on IR reflectance in SPOT data is not as clearly pronounced as in the LAC data. The seasonal variation in surface reflectance and NDVI derived from LAC data was also examined. Seasonal variability was found to be driven by a combination of green LAI and viewing conditions (BRDF). When only those acquisitions with view zenith angles of <35 degrees are considered, the seasonal variation in retrieved surface reflectance is significantly reduced. Furthermore, the view zenith angle effect on LAC infrared reflectance shows a marked directional component, with acquisitions viewing in the backward scattered direction (relative to the solar plane) showing a particularly strong dependence on view zenith angle. Various plots showing these characteristics were developed.

The seasonal variability in NDVI derived from LAC, SPOT, and TM acquisitions over the FIFE study area in 1987 were compared. In contrast to the compatibility between the SPOT and TM sensors, the LAC NDVI values show a substantial amount of variability that is most likely due to viewing geometry differences relative to the solar plane rather than to variations in surface conditions (e.g., green LAI). It was concluded that to model short-term variability in surface parameters (PAR interception and stomatal conductance) through the growing season using a combination of sensors, it will be necessary to adequately characterize and compensate for directional reflectance effects, or constrain observations to a limited range of view angles. Limiting the number of acquisitions due to directional reflectance effects results in an inadequate characterization of short-term variation in surface parameters. This suggests a need to normalize the off-nadir SPOT and LAC acquisitions for the directional effects.

Task personnel began work on using the SAIL model to invert multiangle near-infrared reflectance from the AVHRR instrument on the NOAA satellites to make estimates of leaf area index for the FIFE sites. Four plots were produced.

400 OTHER SUPPORT ACTIVITIES

Staff identified a problem with the PC premastering computer (FTP batch files were corrupting the large hard disk) and corrected it.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

Task personnel will perform the following tasks:

- Get needed tape copying done to maintain the integrity of the offline archive data.
- Complete the production of FIFE CD-ROM 5. This CD-ROM will contain level-2 and -3 image data and the FIFE geographic reference data.
- Complete the production of FIFE CD-ROM 1. This CD-ROM will contain the FIFE nonimage investigator and staff science data sets.
- Prepare a Work Control Plan that meets the requirements of Contract NAS5-32350.

DELIVERABLES SUBMITTED

Graphics: Eight photographic prints, each with 5–6 SPOT visible band images
Originator: S. Goetz, J Nickeson

Report: Summary of FIFE NOAA–9 LAC, SPOT, and TM atmospheric corrections and characterization of seasonal dynamics
Originator: S. Goetz

Graphics: 20 plots of seasonal variation in LAC, SPOT, and TM retrieved reflectance and NDVI, and the dependence of reflectance on viewing geometry
Originator: S. Goetz

COMPUTER USE

Minutes	Computer
Dedicated	LTP VAX 11/780, 8250
Dedicated	LTP VAX 11/780, 8250
Dedicated	LTP VAX 11/780
Dedicated	Tandy PC, IBM PS/2
Dedicated	Apple Macintoshes

NASA Task 22-110-09: Sensor Calibration and Atmospheric Studies

GSFC ATR: *A. Kerber*
Cognizant NASA Scientist: *B. Markham*

Hughes STX Task Leader: *Dr. S. Ahmad*
Hughes STX Task Number: *266*

This task provides support for the sensor calibration and atmospheric studies research in Code 923. This support effort includes data collection, analysis, and algorithm development for sensor calibration, atmospheric characterization, and atmospheric corrections relative to the Boreal Ecosystem-Atmosphere Study (BOREAS) and First International Satellite Land Surface Climatology Project (ISLSCP) Field Experiment (FIFE).

FINAL CONTRACT SUMMARY

From 1989–93, two principal scientists and one data technician worked on this task to support research activities for the sensor calibration and atmospheric studies relative to FIFE, NASA Airborne Spectrometer (NASIC), BOREAS, and the Landsat–7 payload.

Hughes STX task members took an active part in major field experiments (FIFE, HAPEX, KUREX, and BOREAS). The major milestones such as data collection in the laboratory and field, analysis, algorithm development for sensor calibration (NASIC, NS001, MMR, sunphotometer), radiometric characterization of new sensors (automatic sunphotometer, Landsat ETM+, and HRMSI) atmospheric characterization and development, and evaluation of atmospheric correction algorithms were accomplished.

HSTX personnel published about eight papers as authors and coauthors in refereed journals (such as *Rem. Sen. of Environ., J. Geophys. Res., and SPIE*) and made more than eight presentations at different symposia.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX task staff took an active part in the BOREAS intensive field experiment. The sunphotometer was successfully installed and tested. An HSTX task member trained a summer intern to operate the automatic sunphotometer at the Prince Albert National Park, the BOREAS study site. The HSTX task member also helped a summer student at GSFC to complete that student's internship project.

An HSTX task member was awarded a certificate of appreciation for his contribution to the summer internship program. HSTX task personnel also helped the ATR in submitting a letter of intent in response to the joint Earth Sciences and Engineering Directorates' research opportunities announcement to obtain funding for the infrared sunphotometer project. The Nakajima's algorithm-based computer code was transferred from Cray to the VAX system. This algorithm will be used to retrieve aerosol size distribution.

HSTX staff performed detailed sensitivity analysis relative to the filter-induced noise in the response of Landsat–7 HRMSI shortwave detectors. Tanre atmospheric code called 5S was modified, and simulation runs were made for different scenarios of detector noise and surface and atmospheric conditions. Error analysis results were delivered to ATR for presenting at the Landsat-7 Performance and Image Quality Working group (PIQWG) meeting. HSTX task personnel also made several runs of Modtran atmospheric code for the evaluation of the accuracy of a parametrized relation used for the retrieval of surface temperature.

WORK PERFORMED

100 BOREAS

110 BOREAS Sunphotometer Calibration

HSTX task personnel prepared and tested the sunphotometer for participation in the BOREAS-intensive field experiment. An HSTX member traveled to Canada and, with the help the of ATR, successfully installed the sunphotometer. An HSTX task member trained a summer intern to operate the automatic sunphotometer at the Prince Albert National Park, the BOREAS study site. Data from this sunphotometer were obtained at GSFC via a satellite link through Wallops Island.

HSTX staff helped a summer student at GSFC to complete an internship project relative to aerosol study.

An HSTX task member was awarded a certificate of appreciation from Bowie State University for his contribution to the summer internship program. An HSTX task member helped the ATR write an abstract as a letter of intent in response to the Earth Science Technology Development and Opportunity Review announcement for the Earth Sciences and Engineering Directorates attempt to obtain funding for the infrared sunphotometer project.

The Nakajima, algorithm-based computer code was transferred from Cray to the VAX system. This algorithm will be used to retrieve aerosol size distribution. An HSTX task member also analyzed aerosol measurements made at Kursk. Results will be included in a technical paper.

200 LANDSAT-7 PAYLOAD RADIOMETRIC CHARACTERIZATION ANALYSES

HSTX task personnel performed sensitivity analysis relative to the filter induced noise in the Landsat-7 HRMSI detector's spectral response.

Tanre's atmospheric code called 5S was modified. At-satellite radiances were simulated assuming different scenarios of surface and atmospheric conditions. Spectrally flat detector response (used as a reference) modified with ± 15 percent sinusoidal amplitude of different frequencies was used in the simulation process. Tables and graphs depicting the errors induced in the measurements caused by filter noise were generated.

The ATR presented these results in Landsat-7 PIQWG meeting.

HSTX task personnel also made several runs of Modtran atmospheric code to simulate atmospheric transmittance and radiances. These simulated radiances were used in establishing the accuracy of a parametrized relation developed for the surface temperature retrieval.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Task personnel will continue the analysis of sunphotometer measurements and characterization of atmospheric parameters. A Work Control Plan that meets the requirements of contract NAS5-32350 will be prepared.

DELIVERABLES SUBMITTED

Abstract: Letter of intent for developing an infrared sunphotometer
Originator: R. Halthore

Tables and Graphs: Depicting filter induced errors in the HRMSI response.
Originator: S. Ahmad

NONLOCAL TRAVEL

A task member traveled to Prince Albert National Park (BOREAS Study Site) in Canada from August 9–20, 1993.

COMPUTER USE

Minutes	**Computer**
1,200 (wall clock)	LTPVAX 11/780
15,000 (wall clock)	IBM 386

NASA Task 22-110-11: Support for Analysis of Crop Condition/Yield

GSFC ATR: *A. Kerber*

Hughes STX Task Leader: *F. Irani*
Hughes STX Task Number: *268*

This task supports the processing and analysis of data obtained by NOAA Advanced Very High Resolution Radiometer (AVHRR), Landsat, and SPOT satellite platforms. The work involves developing a streamlined processing capability that will help users to perform the needed data corrections and manipulations using the Land Analysis System (LAS) on a VAX/VMS system.

FINAL CONTRACT SUMMARY

This task was begun in April 1991, and has employed two part-time programmer analysts. The first step was to review the current setup and processing tasks. Then task personnel set up baseline procedures and configured the system to allow optimal referencing and use. The original MIDWEST.PDF procedure existing at BARC was upgraded several times to allow per-county Normalized Difference Vegetation Index (NDVI) statistics to be generated. A procedure was created to mask AVHRR scenes by indexing pixels that fall outside of 25 degrees from nadir. The USNDVI procedure was modified to create geometrically registered, spectrally calibrated temperature AVHRR images bands. Users were safeguarded from software development changes by establishing a parallel software configuration that isolates operational from developmental software.

SUMMARY FOR CURRENT REPORT PERIOD

The task leader installed and debugged the ADAPS V3.0 and DMS V3.0. He trained the BARC staff in updating information necessary to investigate the recent Mississippi Valley floods and supported a CIA scientist investigating the flood. He delivered a procedure to produce annual NDVI difference images and established and trained the task member on film-recorder usage at BARC. He also made workstation hardware and software recommendations. The task member provided ongoing science and programming support for cloud screening and atmospheric correction research. She ported a BARC-developed Aerosol Optical Depth Calculation program, a thermal band atmospheric correction algorithm and an improved version of the 6S program to the LAS V5.0 environment. She also extracted and processed various AVHRR data sets, generated cloud masks, applied atmospheric corrections, classified, displayed, and pseudocolored resultant images. She prepared algorithm flow charts for use at an international conference in Brazil, and other charts, as well as posters for a visiting USDA minister. She also wrote a detailed report on the implementation of an applied cloud detection algorithm.

WORK PERFORMED

100 SOFTWARE SUPPORT AND DEVELOPMENT

110 Las System Administration

The task leader installed, configured, and tested a new delivery of the AVHRR Data Analysis and Processing System (ADAPS V3.0) from EDC.

At the request of the task leader, R. Sunne and L. Huewe (EDC), prepared a DMS display source code delivery for installation at BARC. The task leader received this software and installed it at BARC by for use with the ADAPS V3.0 (see Software Development).

120 USNDVI Procedure Enhancements

The task leader trained BARC staff in obtaining and configuring updates to the navigational ephemeris information necessary to process current AVHRR acquisitions necessary for BARC investigations of the recent Mississippi Valley floods.

130 Software Development

The task leader evaluated and debugged portions of the test version of the AVHRR Data Analysis System (ADAPS V3.0). He reported his findings to ADAPS programmers at EDC for incorporation into the baseline release of this system at EDC. The task leader found and corrected problems in the navigation algorithm portion of the new LAS AVHRR tape ingest program. The BARC site is the first VAX/VMS platform for the new LAS software. The lack of byte swapping of time stamp information read from AVHRR LAC tape headers prevented users from subsetting desired study areas from full scenes by specifying latitude/longitude coordinates. The task leader reported the required software corrections to EDC staff in Sioux Falls, SD. Corrections were made to the software at EDC and delivered to BARC for installation by the task leader.

New problems were found in the INGEST1B application program, which affected the navigational modeling applied later in the ADAPS V2.1 scenario. The task leader worked with T. Rockvam (EDC), by telephone to isolate this problem. He mailed a copy of the NOAA/Wallops Island-originated AVHRR LAC CCT tape to Rockvam for her inspection. She was then able to isolate the problem and make corrective changes to the INGEST1B software at EDC. This problem pointed out significant differences between the information contained on EDC vs. NOAA/Wallops island-originated AVHRR LAC tapes that would have affected many users in the future.

The problem fix delivered by Rockvam required software modifications at BARC to the INGEST1B program. In order for BARC to implement a full copy of the program as delivered to EDC by Rockvam, the task leader had to obtain and install new ADAPS support software from EDC. It is the desire of BARC to stay as current with the EDC software configuration as possible. Too early a divergence from the EDC development, before a baseline release of the system, may prevent the ability for BARC from accepting important updates in the system that may be made at EDC.

Any attempt to run existing DMS display software in the new environment caused access violation reports from VMS. This required BARC users to switch between the old and new environments in order to test the ADAPS V2.1 USDAN procedure and display its intermittent images. At the request of the task leader, Sunne and Huewe prepared a DMS display source code delivery for installation at BARC. This software was received and installed at BARC by the task leader for use with the ADAPS V3.0.

200 UNIX SUPPORT

This task is largely on hold until further notice from P. Doriaswamy. A Sun workstation was procured by BARC and an additional Silicon Graphics IRIS (SGI) workstation is being planned for procurement this fall.

The task leader read the XID display software Unix tar file, on an SGI workstation at GSFC to ensure that a regular backup of this software is available to BARC. This EDC software will provide LAS image display capabilities under Motif and X Windows on future graphics workstations at BARC.

300 INTERAGENCY SUPPORT

The task leader investigated options for hardcopy image printing capabilities in support or the NASS support activity at BARC (see Investigations).

At the request of Doraiswamy, the task leader devoted several days to A. Johnson of the Central Intelligence Agency (CIA) to produce, classify, and display wetness index images from AVHRR data acquired during the Mississippi valley flood.

The task leader investigated different means to print 5,000 square pixel images at full resolution as a requirement from the National Agricultural Statistical Agency (NASS). The task leader spoke to representatives from Autometrics, Inc., in Alexandria, VA, as well as to GSFC staff responsible for Colorfire 240 customer services.

The task leader developed and delivered a procedure to produce annual NDVI difference images as required by NASS. In addition he produced a procedure to annotate, color, and concatenate several of these images into a form suitable for submission to the Colorfire 240 film recorder at GSFC.

The task leader initiated contact with GSFC to allow BARC to obtain film products using the GSFC film recorder and photolab facilities. He negotiated billing procedures, opened accounts, and established procedures for submitting data and receiving results from GSFC. The request of Dorasiwamy, he obtained detailed information on procuring color roll film for the Colorfire 240.

The task leader and the task member compiled and submitted between 5 and 10 Colorfire negative image files for processing at GSFC. The task leader subsequently met with the GSFC photolab engineer to discuss the quality and consistency of the products obtained from the Colorfire at BARC. The task leader relayed the engineer's recommendations back to Doraiswamy.

The Colorfire activity is in support of requirements from both NASS and BARC (see Training).

400 SCIENCE SUPPORT

The HSTX analyst continued to provide science and programming support for cloud screening and atmospheric correction research at BARC on an ongoing basis. She is also supporting efforts to publish intermittent findings of this work in conjunction with the visiting scholar and for demonstrations and presentations at science meetings intermittently attended by Doriaswamy et al., from BARC.

410 Atmospheric Correction and Cloud Screening

The task member tested and debugged an "Aerosol Optical Depth Calculation" program developed by a scientist at BARC and ported the final software to the LAS V5.0 environment.

The task member also ported an improved version of the 6S (French Atmospheric Correction model) to the LAS environment. The task member processed 1988 AVHRR data with these newly ported atmospheric correction algorithms for AVHRR visible and thermal bands.

The task member updated the algorithm developed for the atmospheric correction for the thermal bands of AVHRR data based on the requirements of the scientist.

The task member processed the NOAA-9 1987 data with USNDVI procedure to extract a set of noncalibrated data in the IOWA area.

The task member applied the cloud screen algorithm on NOAA-9 (1987) AVHRR data in IOWA. The raw images were processed by the BARC USNDVI procedure and then atmospherically corrected using 6S for Channel 1 and 2 data and by using LOWTRAN on the thermal Channel 4 and 5 data.

The task member processed the AVHRR 1990 data for Arizona. This effort included generating cloud masks based on channel 1, 2 4, 5, and NDVI data; applying atmospheric corrections on Channels 1, 2, and 4 data; classifying the resultant images using the LAS procedure ISOCLASS; and then finally displaying and pseudocoloring the images for a final product.

420 Science Publication Support

The task member prepared two flow charts on a PC for the ATR to use at an international conference in Brazil.

The task member prepared a hardcopy demonstration poster board for the ATR to present to a visiting USDA minister.

The task member wrote a detailed report on the implementation of a cloud detection algorithm that was applied on the NOAA-9 and-11 (1987, 1988, 1990) AVHRR data over Iowa and Arizona. The task member also produced a flow chart for Doraiswamy describing the cloud detection algorithm that will be delivered to the USDA/NASS.

430 6S Implementation

The HSTX analyst wrote algorithm flow charts for the determination of aerosol optical depth, atmospheric correction, angular effect correction for reflectance of AVHRR Channels 1 and 2 and for the Normalized Difference Vegetation Index (NDVI).

The HSTX analyst also wrote algorithm flow charts for atmospheric correction for AVHRR thermal channels and for processing AVHRR data in the Arizona USDA study area.

600 INVESTIGATIONS

The task leader made recommendations for appropriate hardware and software configurations for installing LAS on a Silicon Graphics IRIS (SGI) workstation. This configuration will complement the Sun workstation environment currently being configured by BARC staff.

700 DEMONSTRATIONS

A demonstration script file developed earlier in the year was used to demonstrate current BARC activities to a USDA undersecretary. Special efforts had been made to include California as an area of interest for this demonstration.

800 TRAINING

The task leader trained BARC staff in obtaining and configuring up-to-date ephemeris information from EDC required to process daily AVHRR acquisitions of the Mississippi valley area during the summer flood period.

The task leader trained the task member on the production of film products at GSFC according to the BARC and NASS requirements.

900 TRAVEL

No local or nonlocal travel was requested by BARC from June to September 1993.

SIGNIFICANT ACCOMPLISHMENTS

In support of NASS and BARC, the task leader established contacts, procedures, and mechanisms to allow BARC to successfully obtain Colorfire 240 film products from NASA/GSFC.

At short notice, the task leader provided training and technical support in the BARC effort to depict Mississippi flood conditions using AVHRR imagery. Doraiswamy reported that this activity gave favorable visibility to the BARC Remote Sensing Research Laboratory (RSRL) at USDA.

The task member tested and debugged an "Aerosol Optical Depth Calculation" program developed by a scientist at BARC and ported the final software to the LAS V5.0 environment. She also ported an improved version of the 6S (French Atmospheric Correction model) to the LAS environment and subsequently processed 1988 AVHRR data with these newly ported algorithms for AVHRR visible and thermal band LAS images.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

The USDAN procedure will be stabilized and delivered to the NASS facility in Fairfax, VA, early in Fiscal Year 1994. Unix workstation activities will begin.

Integration of ERDAS GIS and LAS Image Analysis work flow will begin.

Atmospheric correction and cloud screening activities will continue.

LAS System Administration will continue.

The new AVHRR data calibration, atmospheric correction and cloud screening techniques, developed at BARC, will be integrated into the new USDAN procedure.

DELIVERABLES SUBMITTED

Data/Images: Specialized raster images
Originator: F. Irani

Data/Images: Intermediate imagery
Originator: W. Serafino

Software: LOTRAN under LAS/TAE
Originator: W. Serafino

Software: FORTRAN programs
Originator: W. Serafino

Software: Science software routines
Originator: W. Serafino

Software: ADAPS V3.0 operational system
Originator: F. Irani

Software: ADAPS V3.0 corrections
Originator: F. Irani

Software: USDAN procedure
Originator: F. Irani

Artwork: Hardcopy software flow charts
Originator: W. Serafino

Artwork: Presentation posters
Originator: W. Serafino

Artwork: Memorandums on investigations
Originator: F. Irani

Artwork: High-Level demonstration pkg.
Originator: F. Irani

Artwork: BARC/EDC cooperative effort summary
Originator: F. Irani

Artwork: Operational script files
Originators: W. Serafino, F. Irani

COMPUTER USE

Minutes	Computer
16,000 hours	VAX 4000 (RS4000) BARC

NASA Task 22-110-12: BOREAS Research Support

GSFC ATR: *A. Kerber*
Cognizant NASA Scientist: *Dr. F. Hall*

Hughes STX Task Leader: *S. Goetz*
Hughes STX Task Number: *269*

Hughes STX provides technical personnel to support the BOREAS research effort. The work focuses on remote sensing, radiative transfer, and ecophysiological modeling of boreal forest phenology, disturbance and succession for the purpose of examining carbon cycle components. It also includes support for the preliminary design of the BOREAS experiment, including site selection and stratification tasks. The research focuses primarily on image analysis of seasonal growth patterns, biophysical properties, disturbance regimes, and primary productivity. Modeling work complements the remote sensing approach in each of these research areas.

FINAL CONTRACT SUMMARY

This task was created in fiscal year 1991—92. Over the lifetime of this task, one senior programmer/analyst has been working 0.50 FTE, one senior programmer/analyst has been working 0.25 FTE, and one programmer/analyst has been working 0.25 FTE.

The major milestones and accomplishments over the lifetime of the task include:

- Support for the development of BOREAS experiment design, site stratification, flux tower and auxiliary site locations, workshops, field activities, and other general infrastructure tasks.
- Development of a realistic forest canopy radiative transfer and photosynthetically active radiation (PAR) interception model and validation of the model in different forest stands.
- Development and validation of remote sensing-based methods to estimate phenological status, seasonal canopy PAR absorption, net primary production, and interannual variability in photosynthetic capacity.
- Development of an on line data base and the publication of a technical memorandum of biophysical, morphological, canopy optical property and productivity data from the Superior National Forest.
- Publication of research results in professional proceedings and refereed journals.

SUMMARY FOR CURRENT REPORTING PERIOD

Task members participated in preparation of various aspects of the BOREAS experiment plan, participated in a Canadian field campaign, and reviewed a series of papers on boreal forest canopy characteristics and soil properties.

WORK PERFORMED

100 BOREAS EXPERIMENT DESIGN

Staff participated in preparation of various aspects of the BOREAS experiment plan, particularly satellite and airborne sensor data plans, auxiliary site selection, and gridded data set preparations.

110 Site Selection

Task members participated in field work at the BOREAS study sites in Canada to identify and visit tower flux and biophysical measurement (auxiliary) sites. GIS maps of forest composition, density, age, and productivity were developed and used in the field in conjunction with the TM satellite images and spectral classifications (WBS 120) to select all possible auxiliary sites that met our criteria. This included approximately 150 sites in the Northern Study Area (NSA) and Southern Study Area (SSA). Approximately half of the sites were visited on the ground where measurements of canopy composition, height, diameter, and age were collected, together with understory and ground cover composition and soil properties. In sites that were acceptable as potential auxiliary sites, data sheets were filled out.

The data sheets were keyed into electronic spread sheets upon return. The spread sheets were used to categorize the sites into various age and productivity classes. Missing categories were identified and prioritized. Initial results of the field work were presented at the BOREAS Workshop in Winnepeg, Canada in May, where a consensus was reached to select additional mixed composition stands. Results of the field visits and the workshop decisions were prepared for personnel involved in the auxiliary site selection work. The results were further summarized, put in the context of experiment objectives, and submitted as part of the BOREAS Experiment Plan.

To assist auxiliary site selection work, additional aerial photographs and maps were ordered for areas around the study sites following the May site visits. The photos, maps, and images were used in conjunction with notes taken from aircraft overflights during the May field visit to select additional sites in low-frequency categories. Copies of the maps and imagery were sent to Forestry Canada personnel, who are currently undertaking the task of making more detailed site descriptions and placing more permanent location markers. Task members collaborated with Forestry Canada personnel during the FFC in the NSA in August to fill in missing site categories using the prioritization scheme developed earlier. The final stratification of sites includes 66 forest sites: 40 in mature stands and 26 in earlier age classes. Of 16 fen sites, 8 are in mature quasi-stable wetlands and 8 are in other wetlands. The resulting 82 sites include the 9 tower flux sites and a total of 73 additional (auxiliary) sites. A yet to be determined number of mixed composition stands will also be selected from the potential sites identified to date.

120 Site Stratification and Image Classification

The TM classification of the SSA was further refined with input gathered during the May field visit and additional forest cover maps. The Landsat imagery of the NSA was reprocessed and the size of the image was increased to include additions to the study area. The SSA image now covers approximately 135 km by 100 km and the NSA image now covers approximately 135 km by 85 km. Image reclassification of the NSA was begun.

200 RESEARCH SUPPORT

211 Seasonal Productivity Analysis

A series of papers on boreal forest canopy characteristics and soil properties were reviewed to extract realistic parameters required for terrestrial carbon exchange (TCX) model simulations in the Superior National Forest stands.

212 Remote Sensing and Canopy Model Analysis of Phenology and APAR

A task member gave a presentation at a BOREAS workshop for the Terrestrial Ecology and Remote Sensing Science teams in Colombia, MD. The presentation summarized the results of retrieving canopy PAR interception in boreal forest ecosystems from a combination of remotely sensed spectral vegetation indices and a canopy geometric-optical model.

Work also began on modifying the forest canopy reflectance model (Shadow) to calculate the fraction of absorbed photosynthetically active radiation (Fapar) both instantaneously and daily.

300 GENERAL DATA ANALYSIS

310 Image Rectification

A plan was developed to have all radiometers measuring thermal-emitted radiance acquire data in coincidence at Candle Lake in the SSA several times per IFC during Landsat-5 overpasses. The thermal intercomparison effort will allow a detailed analysis of surface temperature retrieval from multisensor, multiresolution instruments. It may also facilitate the identification of inconsistencies between instruments and allow corrective measures as early as possible in the course of the experiment. Skin temperature measurements were planned to be made from a boat using a radiometer similar to those mounted on aircraft. Measurements were also planned for the NASA helicopter and the NASA C-130 at two altitudes to test sensor calibration relative to ambient air temperature. The helicopter will acquire at least PRT-5 measurements and the C-130 will carry the Thermal Infrared Multispectral Scanner (TIMS), the NS001 Thematic Mapper Simulator (TMS), and a PRT-5. all of which include thermal channels.

320 Geographic Information System Analysis

A series of GIS maps acquired from Forestry Canada were used in conjunction with spectral classifications to identify potential auxiliary site locations (see WBS 110).

SIGNIFICANT ACCOMPLISHMENTS

A dedicated effort was undertaken to select 40 auxiliary sites at each BOREAS study area for biophysical measurements. This effort included development of spectral classifications of Landsat-5 Thematic Mapper images and GIS maps of forest cover types to identify approximately 150 potential sites and visit those sites in the field. Two weeks of field work in May resulted in selection of approximately 60 of the potential sites that meet the criteria of the experiment. Field measurements at these sites were summarized and used to prioritized future site selections. The selected sites were further prioritized to identify the best candidates based on composition, age, and productivity. The potential sites were then revisited in 2 weeks of field work in August. Canopy flagging was installed at the sites to assist in helicopter visits in the spring.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

Work will continue on fixing auxiliary site locations, refining image spectral classifications, and developing papers that report the combined results of phenology and net primary production research, canopy reflectance and interception simulation modeling, and carbon flux modeling.

DELIVERABLES SUBMITTED

Graphics: Numerous plots of canopy reflectance and PAR interception
Originator: K. F. Huemmrich

Report: A summary of the auxiliary site selection work and results of two field visits to the sites
Originator: S. Goetz

Graphics: Large format Landsat image maps for use in field work
Originator: J. Nickeson

COMPUTER USE

Minutes	Computer
5,200 (Connect)	LTP VAXcluster
10,500 (Connect)	Macintosh PC

NASA Task 22-110-13: BORIS Support

GSFC ATR: *Dr. A. Kerber*
Cognizant NASA Scientist: *Dr. F.G. Hall*

Hughes STX Task Leader: *J. Newcomer*
Hughes STX Task Number: *267*

Hughes STX will provide technical personnel to support the development and the implementation of the Boreal Ecosystem Atmosphere Study (BOREAS) Information System (BORIS). Work will include the following:

- *Preliminary planning and design of BORIS. This includes specification and location of required background data sets (e.g., climatological data), as well as the development of methods to inventory and archive the data.*
- *Development of Geographic Information Systems (GIS) for the two principal sites.*
- *Processing and analysis of satellite data as needed for the execution of the experiment.*

FINAL CONTRACT SUMMARY

HSTX staff has been supporting work activities for BORIS since FY '92. The number of task personnel has grown to about 5 FTE's during this period to provide needed support for project field infrastructure, data collection activities, development of software, and design of the online data base system to support the integration of investigator and staff data. Accomplishments to date include: 1) making major contributions to Version 1.0 of the BOREAS Experiment Plan, 2) establishing working relationships with key personnel from the major Canadian agencies involved with BOREAS, 3) developing a grid system and coordinate conversion software utility to ease integration of the collected data sets, 4) developing software for use at CCRS facilities in Ottawa for reformatting Landsat MSS and TM data products, 5) supporting field activities that include tower site location determination and preliminary data collection, and 6) establishing plans and budgets for upper air and surface meteorological networks.

SUMMARY FOR CURRENT REPORTING PERIOD

The overall activities for the period centered on preparing for the August test field campaign. These activities included: 1) completing Version 1.0 of the BOREAS Experiment Plan, 2) improving computer system hardware capabilities and operations, 3) establishing a set of data base tables for data inventory and project information, 4) completing negotiations on the surface and upper air meteorological networks, 5) deriving initial sets of gridded GIS data (e.g., soils) for review, 6) support of the August test field campaign in Canada, and 7) implementation of X Windows image display capabilities under the LAS.

WORK PERFORMED

100 COMPUTER OPERATIONS AND MAINTENANCE

The second 8-mm tape drive was installed on the VAX 6410 after it was returned from maintenance repairs. After some performance problems were noted with the controller on which the 8-mm and 9-track tape drives were installed, the task leader worked with systems personnel to perform a series of benchmark tests on each drive individually and in various combinations to assess the problem. The 8-mm drives functioned properly, both individually and together, but the 9-track drive would not software mount. A service notice was sent to System Industries (the supplying vendor) to have the 9-track drive checked. System Industries subsequently serviced the 9-track tape drive and it is now functional. However, it was decided not to connect the 9-track drive to the system until cables of the proper length were available. Once the shorter cables arrive, system personnel will install the cable and 9-track drive at the next system maintenance date.

110 Tape and Floppy Disk Library Maintenance

The task leader discussed with E. Masuoka (Head, Code 920.2) about the need for data grade 8-mm tapes for the BOREAS archive. The needed data grade tapes were received from the LTP Computer Facility (LTPCF).

120 System Administration

System functions, system devices, scheduled batch jobs, backups, and system queues were regularly monitored by B. Colesanti (SSAI), and reports were submitted to the HSTX task leader for review. In addition, regular monthly meetings were held with LTPCF staff to review the status of operational procedures and any problems that arose.

200 INVESTIGATOR-RELATED DEVELOPMENT AND PROCESSING

The BOREAS coordinate conversion software was updated to include the completed grid and area locations. In addition, the BOREAS coordinate conversion software input menu was refined to be less confusing to users. The software was built into Macintosh and PC executable versions for local project use and placed in the ftp anonymous account on the PLDSG3 VAX system for access by investigators.

210 Software Development for Support of Investigator Data

The prototype data formatting software was completed along with appropriate user documentation. Several copies of the software and documentation were made and sent to the chairpersons of the project science discipline groups for review and comment. The software was subsequently updated based on both internal and external review comments.

300 IMAGE PROCESSING DEVELOPMENT AND PROCESSING

HSTX staff generated updated overpass times for the AVHRR-LAC, Landsat, and SPOT platforms for the study areas and transect region. These tables were created on the Macintosh using OrbiTrackFPU, transferred to the VAX 6410 for editing, retransferred to the Macintosh, and placed in Excel spreadsheets for project use. Another update of these tables is expected before publishing of the final experiment plan later this calendar year. In addition, updated aircraft and satellite sensor data plans were prepared and included in the draft BOREAS Experiment Plan.

HSTX programming staff successfully implemented the Display Management System (DMS) software on a Silicon Graphics workstation using X Windows. This initial capability will be expanded over the next few months to work on Sun workstations, and other Macintosh and IBM PC systems that are running X terminal software (see Significant Accomplishments).

310 Level-0 Data

Task personnel followed up on acquiring GOES imagery over the BOREAS region with Dr. E. Smith (Florida State University). Under a proposal submitted by Dr. Smith, his group would acquire the desired GOES imagery, perform derivation of insolation, net radiation, and Photosynthetically Active Radiation (PAR) fields, and map the imagery into the BOREAS grid. The task leader sent Dr. Smith the BOREAS grid coordinate software developed by task personnel for his use. Dr. Smith has collected some data from August 1993 and will be sending a prototype data set in the next month or so for BORIS review.

320 Level-1 Data

Programming personnel developed software to read and reformat the sample AVHRR-LAC data processed by CCRS through its GEOCOMP system. Several questions about the data product contents were directed to CCRS for its response. The software is functionally complete but will likely require some minor modifications to address any responses received from CCRS.

Task personnel are awaiting a sample SPOT tape to be sent by CCRS to start development of the SPOT reformatting software.

A thorough walkthrough of the Landsat TM and MSS data processing was started. To date, the process and steps of handling the TM data sent to GSFC from CCRS have been reviewed. Because the TM data received to date and the data planned to be received have some processing and format differences, some more thinking is needed on developing a consistent TM product for distribution to the BOREAS researchers. The reformatting software installed at the CCRS facility in Ottawa may require some modifications. The task leader sent M. Giovannetti and J. Cihlar (CCRS) a fax containing issues and concerns that need to be addressed along with proposed deadlines for reaching closure on the issues.

400 STAFF SCIENCE DEVELOPMENT AND PROCESSING

410 Upper Air and Meteorological Data

HSTX staff has had an ongoing dialog with B. Atkinson (AES) about the final design and implementation of the upper air network for BOREAS. AES has made cooperative arrangements with several Canadian agencies to release sondes for BOREAS from sites previously not in the proposed upper air network. The release of these additional sondes is contingent on increased funding for this part of the program. Discussions have also been held with scientists at Wallops (NASA) to obtain their assistance in launching sondes from Lynn Lake during the 5-day test period this summer (August 16–20).

HSTX staff has also contributed to the ongoing negotiations with AES, NASA, and the Saskatchewan Research Council (SRC) about the design of the surface meteorological network. All parties now appear to agree about which sensors are needed and where they will be placed, in consideration of the limited financial resources and logistic constraints.

When the design of both networks was completed, a fax was sent to K. Vaneck (AES), providing the latest information to Vaneck's group, so that they can provide station identification numbers for the sites. These station identification numbers will be used by the operational numerical weather modelers, for inclusion of these data streams into their initialization schemes.

Task personnel received a tape containing historical meteorological data from AES. The data consisted of hourly, daily, and monthly observations from existing AES meteorological stations in Canada and some radiosonde profiles. The tape was copied and reviewed to determine how to organize and process the data. A program was written in C to perform needed unit conversions, divide the data into meaningful groupings, and output the data into a form compatible with the FIFE CD-ROM ASCII file format. The three types of data were divided into separate files by data type and station identifiers. To allow initial access to the data, M. Garner (HSTX, Code 633) was contacted about placing the data in the PLDS anonymous ftp account.

420 Map, Digital Image, and GIS Data

HSTX personnel worked with the newly hired data manager to get the existing map information and sheets organized so that they can be inventoried as soon as the online data base is ready for operational data entry.

The inventory of in-house and available Landsat data is currently being updated. A number of scenes have already been acquired for the study areas; however, all but one TM scene of the SSA acquired to date include the expanded Nipawin/Narrow Hills area. The inventory needs to be updated, and priorities for data acquisition from CCRS need to be adjusted. Staff is working out details about the SPOT acquisition plan. However, many questions still need to be addressed by CCRS. Staff members have provided potential scene centers so that the satellite can be programmed to acquire data for the SSA and the NSA. These coordinates to acquire two SPOT scenes for the SSA and one (tower flux area) for the NSA are under a NASA agreement. These scenes will be acquired some time between the time the satellite is programmed (about 2–3 weeks) for these points until September 30, 1993.

HSTX personnel started a more detailed evaluation of in-house and other available digital map data over the BOREAS region. Staff is assessing what minimum set of data should still be acquired and the number of personnel and computer resources required to compile various products from the data and reformat the files into a common format for distribution by BORIS. Initial efforts to grid the 1:1,000,000 soils data from ARC/INFO files to raster images mapped to the BOREAS grid system were successful. Now that the processing steps have been streamlined, a more detailed review of the numerous soil properties available must be performed to determine which properties are essential to the investigators. This soil layer image will be a sample gridded GIS product for review at the October workshop. Other data layers will be converted in the same way once final decisions on gridded products are made and data acquisition is complete.

Information is being gathered for a presentation to BOREAS investigators at the workshop to help decide what data are necessary. Although a large amount of data has been collected, inquiries are still being made about obtaining elevation data, updated fire history for both Manitoba and Saskatchewan, small-scale land cover, and large-scale forest cover for Manitoba.

Task personnel have been in contact with S. Jensen (EDC) and D. Marks (PI - HYD, EPA) regarding the digital topographic data. Staff may be able to work out an agreement with EDC to grid the 1:250,000 scale vector contour data for all or a portion of the BOREAS grid area.

HSTX staff have been unable to contact B. Stocks (Forestry Canada) who is compiling the updated fire history data set for R. Zepp. The data set should be complete by now.

H. Rostad (Agriculture Canada) was contacted regarding 1:125,000 scale digital soils data for the task's southern study area. Rostad said the data existed, although, for some reason staff members were told by people maintaining the national soils data base (NSDB) in Ottawa, that digital soils data were unavailable at that scale for the task's area of interest. Rostad assured staff that the data would be acquired and sent to it.

F. Gruzka (Forestry Branch, Saskatchewan Natural Resources) was contacted about the distribution issue for the forest cover maps obtained from the Forestry Branch. Gruzka promised to discuss the matter with her supervisor and draft a letter formally stating the branch's position on distribution. Staff thinks the branch would like to maintain some control over data distribution. Gruzka is concerned about proper acknowledgments when the data are used. HSTX staff drafted a memo for the cognizant scientist to review, sign, and send to her addressing these points.

The hardcopy map data base file was updated. Two task members are now aware of the procedure for updating the data base file maintained on the Macintosh and porting this file to the LTPIRIS2 to serve as the data base file for the MAP program that plots the spatial location of maps in the data base. The forest cover maps of Manitoba do not show one of the two acceptable forms of coordinates for plotting by this program. The maps contain only township/range information. A fax was sent to the Manitoba Natural Resources Forestry Branch requesting either lat/long or UTM coordinates for the forest cover maps in the data base. A letter will be sent to the directory of the forestry branch to explore the possibility of acquiring the digital forest cover data at a reduced cost (currently, $350 a map sheet) and to inform them about the task's plans for data distribution.

The 1:1 million scale digital soils data for Manitoba and Saskatchewan were sent to L. Steyaert (USGS, in Reston, VA).

500 DATA BASE DEVELOPMENT AND OPERATIONS

The regular data base design meetings have resulted in a designed set of tables for tracking the basic data inventory information. The improved flexibility of the design should allow better coordination and tracking of incoming data, data processing activities, and data requests. Upcoming meetings will address incorporating text documentation and spatial coverage information into the base design.

600 INVESTIGATOR AND FIELD SUPPORT ACTIVITIES

The new July 1990 TM scene of Thompson (to replace the copy here that staff could no longer read) was received and reviewed. A new NSA was extracted from this scene that extends from the 1989 burn northwest of Nelson House to beyond the city of Thompson, and north to Orr Lake and south to Paint Lake. The subset is now 4,096 pixels x 2,560 lines.

The TM classification of the SSA was refined slightly with input gathered during the May field visit and the forest cover maps. A Colorfire negative was made of the pseudocolored classification along with a visible/IR scatterplot. Prints of the classification were made available for use in the field during the August visit. The classification of the NSA will be performed once again using the previous cluster mean statistics as seeds in the unsupervised process. A Colorfire negative of a false-color enhancement of the expanded NSA was made available for the August field visit, but the new classification will be unavailable.

HSTX staff made major contributions to the test field campaign from August 8 through August 30, 1993, by helping establish operations centers at the NSA and the SSA, being study area managers (SAM's), and providing general information and communication with investigators (see Significant Accomplishments).

At the northern study area, HSTX personnel helped with many aspects of setting up the infrastructure and participated in site auxiliary work. In addition, HSTX personnel aided the northern area manager (NAM) in matters such as answering the phones and coordinating the return of the two-way radios from the investigators.

900 OTHER SUPPORT ACTIVITIES

Task personnel worked to gather additional and up-to-date information from various sources to incorporate into the revised BOREAS Experiment Plan.

During the Winnipeg workshop, the U.S. counterparts at the BOREAS Canadian secretariat met with a contact at Emery Worldwide. The contact at Emery visited the workshop and dispersed shipping information. Emery has offered to handle brokerage and warehouse fees for BOREAS investigators using Emery's services. Although Emery's handling of shipping for the August test field campaign was less than perfect, the overall interactions were good and lessons were learned on both sides.

A concerned investigator recently inquired about his foreign graduate student in the U.S. on a special visa. Employment and Immigration Canada and the Canadian Embassy in Minneapolis were contacted about this issue. Employment and Immigration Canada is the agency that the BOREAS secretariat is currently working with to develop a plan for work permits during the IFC's. It is hoped that the permit/letter that Employment and Immigration and Energy, Mines, and Resources drafts will apply to foreigners as well, but until the agreement is worked out, staff will not know for sure.

HSTX task members were greatly involved in the revision of the BOREAS Experiment Plan, which was mailed to investigators in late July (see Significant Accomplishments).

SIGNIFICANT ACCOMPLISHMENTS

HSTX programming staff made a major contribution to the BORIS task and LTPCF effort by successfully implementing the DMS software through the LAS on a Silicon Graphics workstation running X Windows. This initial capability will be refined and expanded over the next few months to work on Sun workstations and other Macintosh and IBM PC systems using X terminal emulation software. This successful implementation will allow distributed display and manipulation of image data in the BORIS project and in other areas of Code 920. To date, this type of distributed image data display from LAS under a basic X Windows configuration was not possible.

HSTX staff, from the period of August 8 through August 30, 1993, played key roles in the BOREAS project at the northern and southern study areas, in several important ways. At the southern study area, HSTX personnel assumed the role of SAM from August 8 through August 28. The role of the SAM was to assist the mission manager in the coordination of activities at the southern site (which from August 20 to August 28 was the "hot site"). This work involved communicating with investigator teams in the field through two-way radios and obtaining telephone and technical information from them on the nature of their present work and of their planned activities for the next day. These data were recorded in a daily log and summarized in charts that were presented at the 8:00 p.m. nightly meetings, which were prepared by the SAM. In addition, HSTX personnel led the 8:00 p.m. meeting on several nights. The SAM also helped to orient newly incoming investigator teams by explaining procedures, handing out radios, and doing other tasks. HSTX personnel also assisted in obtaining supplies for investigators and providing general information about the Candle Lake/Prince Albert area. At the northern study area, HSTX personnel aided in many aspects of setting up the infrastructure and participated in site auxiliary work. In addition, HSTX personnel aided the NAM in matters such as answering the phones and coordinating the return of the two-way radios from the investigators.

HSTX task members were greatly involved in the revision of the BOREAS Experiment Plan, which was mailed to investigators in late July. The revisions included changes in science goals, changes in the planned infrastructure and core data collection, and updated information on customs, immigration procedures, and work permits. Staff also assisted with distribution of the experiment plan, by having the plan copied and bound in a timely manner at the HSTX Lanham office. This coordination ensured that investigators would receive the newly revised plan before they took part in the test-intensive field campaign (August 9–29).

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. The work activities will continue under contract NAS5-32350.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

The following activities are planned:

- Prepare a Work Control Plan to cover the period of October 1993 through September 1994.
- Perform a detailed review of Landsat TM, AVHRR, Landsat MSS, and SPOT data and anticipated processing plans.
- Develop a plan to improve the accuracy of the geographic location information on the existing systematically corrected Landsat data.
- Initiate development of software to perform geotagging and geocorrection of Landsat MSS and TM data.
- Complete development of software for reformatting CCRS AVHRR-LAC image data products.
- Implement high-level inventory and data-tracking tables in the online data base.
- If sample data arrive from CCRS, develop software for reformatting current CCRS SPOT image data products.

- Work on completing a new classification of the expanded NSA TM subset.
- Continue to pursue satellite acquisition plans for Landsat and SPOT data.
- Revisit and update digital map data inventory and review issues that the project must face in the near future.
- Compile digital map information for presentation at the October BOREAS workshop with a goal to come out of the workshop with some specific plans and ideas for gridded data product needs.
- Complete implementation of DMS under X Windows for use on multiple systems.

DELIVERABLES SUBMITTED

Documents: Updated materials for the BOREAS Experiment Plan
Originator: HSTX task staff

Software: Updated BOREAS coordinate transformation software utility
Originator: J. Newcomer

Software: Version 1.0 of the BOREAS data-formatting software for PC's
Originator: J. Lewthwaite

NONLOCAL TRAVEL

Five HSTX personnel traveled to Saskatchewan and Manitoba, Canada, from August 8 through 30, 1993, to participate in field data collection activities and to establish operations centers.

COMPUTER USE

Hours	Computer
1,200	LTPCF VAXcluster
800	Various LTPCF Workstations
1,600	Available Macintosh and PC's

NASA Task 22-110-14: Semivegetated Landscapes

GSFC ATR: ***A. Kerber***

Hughes STX Task Leader: ***J. Robinson***
Hughes STX Task Number: ***270***

This subtask analyzes the fractional subpixel land cover types using inverse modeling, simulation modeling, and analysis of aircraft and satellite multispectral data.

FINAL CONTRACT SUMMARY

This task was initiated in January 1993. One principal scientist has worked from 0 to 1.0 FTE periodically during the year. Several milestones were completed. These include:

- Revising and testing analysis programs previously developed by the ATR and producing graphical presentations of the output.
- Developing new models to relate vegetative cover to satellite radiance measures.
- Developing ground truth from aerial photographs and incorporating it into the analysis of the model's utility.
- Moving the LOWTRAN7 model from the VAX to the ATR's HP workstation.
- Generating atmospheric moisture profiles from radiosonde data.
- Using the moisture profiles and LOWTRAN7 program to estimate reflectance from satellite measured radiance.
- Developing multiple methods for calculating tau, the absorption of radiation by forest cover.
- Generating graphs and bullet charts for RTOP review and conference presentation.

SUMMARY FOR CURRENT REPORTING PERIOD

Atmospheric water profiles for the HAPEX Mobilhy and Beaver Creek, AZ, study sites were calculated from radiosonde data. These atmospheric water profiles were then used to model atmospheric transmittance using LOWTRAN7 for the red and NIR bands. The results from this modeling were used to estimate surface reflectance from satellite-measured reflectance. These values, in turn, were used to estimate tau, the radiation absorption of illuminated and shadowed vegetation cover. The frequency of NIR DN values and tau values for red DN=25 was fitted to truncated gamma distributions.

WORK PERFORMED

Task personnel used radiosonde data to estimate the atmospheric water distribution for the Beaver Creek, AZ, and the HAPEX Mobilhy sites. The results of this analysis were then used as input to the LOWTRAN7 model to estimate the atmospheric transmittance in the red and NIR bands. These values, in turn, were used to estimate the ground level reflectance of the two target sites and then calculate the radiation absorption of illuminated and shadowed vegetation. The NIR DN values and tau values for red DN=25 at the HAPEX site were used to generate frequency plots that were then fitted to gamma distributions with different cutoff points. The results of these analyses were prepared on spreadsheets and plotted and presented to the ATR.

Staff's analysis indicated that the NIR DN and tau values could not be reasonably fitted to a lognormal distribution.

SIGNIFICANT ACCOMPLISHMENTS

The ATR's analysis requests were carried out in a timely manner. The results of the analysis were clearly presented. Task personnel successfully moved LOWTRAN7 from the VAX to the HP workstation in 2 weeks and used it to model atmospheric effects on the radiation reflected from the ground to the satellite sensors. This activity compares favorably with a similar effort made by another party that was unsuccessful after 3 months of work.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

All work will be completed in the next period. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Spreadsheets and plots of efforts to fit the gamma distribution were submitted to the ATR along with the results of the radiosonde and LOWTRAN7 analysis. A shell program to facilitate running the LOWTRAN7 program on the HP workstation was delivered along with the LOWTRAN7 program that was converted from use on the VAX to use on the HP workstation.

COMPUTER USE

Minutes	Computer
21,600	PC and Workstation Usage

NASA Task 22-111-00: Gravity Field Analysis

GSFC ATR: *F. Lerch*

Hughes STX Task Leader: *G. Patel*
Hughes STX Task Number: *280*

This task provides analytical and computer support for gravity field analysis using two GSFC software systems, SOLVE and GEODYN, to compute and analyze refined gravity field models of Earth. These models are produced by using different kinds of satellite tracking data from 35 satellites plus surface gravimetric data and satellite altimetric data. Simulations are also performed for the analysis of the Mars Observer (MO) mission and the analysis of Seasat altimeter data.

FINAL CONTRACT SUMMARY

Over the lifetime of this task, one principal programmer/analyst, one junior programmer/analyst from, and one senior programmer/analyst worked to accomplish the production of GEM-T3, JGM-1, and JGM-2 gravity models for Earth. The JGM-2 gravity model will be used to compute precision orbits for the TOPEX/Poseidon satellite. The task member received the Group Achievement Award for the GEM-T3 and JGM-1 gravity models from NASA and GSFC. Also, a Mars gravity model, GMM-1, was produced and published.

SUMMARY FOR CURRENT REPORTING PERIOD

A paper titled "An Improved Gravity Model for Mars: Goddard Mars Model-1 (GMM-1)" was published as NASA Technical Memorandum 104584 with the task leader as coauthor in May 1993. A paper titled "Gravity Model Development for TOPEX/Poseidon" was presented at the Spring AGU in Baltimore, MD, May 24, 1993, with the task leader as coauthor.

WORK PERFORMED

100 CAMERA DATA PROCESSING

110 Data Cataloging and preprocessing

Since no new data were available, no catalogs were produced.

120 Data Reduction Through GEODYN

Twenty arcs of the ISAGEX laser satellites DI-D, DI-D, and PEOLE were processed through GEODYN for the reiteration of the JGM-2 gravity model.

130 Production of Normal Equations

Twenty normal equations were produced from the arcs processed in WBS-120.

200 GRAVITY FIELD PRODUCTION AND ANALYSIS

210 Production of Gravity Fields From Normal Equations

Twenty subsets of the satellite only gravity model, JGM-2S, were produced for calibration.

220 Analysis and Comparison of Gravity Field Models

The gravity models produced in WBS 210 were compared with JGM-2S using the GEOCMP program. They also were compared with SEASAT altimeter and surface gravity anomalies using the DGSTAT program. Global maps of geoid height errors caused by the gravity model covariances were produced to find areas of gravity error reduction on Earth.

300 SEASAT ALTIMETER DATA ANALYSIS

310 Production of Gravity Models With Altimeter Data

Eleven subset models of JGM-2 were produced for calibration. Seven models were produced by adding LAGEOS-2 data to the JGM-2 model.

320 Analysis of Gravity Models

The gravity models produced in WBS 310 were compared with JGM–2 using the GEOCMP program. They also were compared with SEASAT-altimeter and surface-gravity anomalies using the DGSTAT program. Orbit tests were also performed to see if these new model improve the fit on TOPEX data. The covariances from these models were projected onto the TOPEX satellite orbit to estimate the orbit error caused by gravity.

400 ANALYSIS OF MO MISSION

410 Simulation of Tracking Data

No new data were simulated for MO.

420 Production of Normal Equations

No new normal equations were generated.

430 Production of Mars Gravity Models

No new models were produced, but plots and graphs were generated for the GMM-1 model for publication.

500 UPDATING AND MAINTENANCE OF TAPES, DATA, AND PROGRAMS

Task personnel continued to perform general tape maintenance for all geopotential recovery analysis data sets.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
12,000	Cray Y-MP
360	IBM 3091

NASA Task 22-113-00: Analysis of Oceanic Normal Modes and Tides

GSFC ATR: ***B. Sanchez***

Hughes STX Task Leader: ***R. Ray***
Hughes STX Task Number: *282*

This task provides scientific analysis and computing support in the general area of ocean normal modes and tide studies.

FINAL CONTRACT SUMMARY

One full-time Principal Scientist has worked on this task.

Major accomplishments over the lifetime of the task are:

- Development of a new global ocean tide model based on GEOSAT altimetry. This model was adopted for use on TOPEX Geophysical Data Records.
- Development of a model of radial-displacement ocean-loading tides, which was also adopted for use on TOPEX GDR's.
- Computation of a special model of the M2 tide for the Mediterranean Sea.
- Publication of six papers in refereed scientific journals and three NASA Technical Memoranda.

SUMMARY

The task member initiated work on a new approach to tidal analysis of altimeter data, which merges the ATR's use of Proudman functions with the orthotide formalism of Cartwright and Ray (1990). This approach should be useful in obtaining reliable early results from the TOPEX altimeter. A short paper coauthored with the ATR was submitted for possible publication to the *Geophys. J. Int.* Plotting support was provided to the ATR.

WORK PERFORMED

100 ANALYSIS OF GEOSAT AND TOPEX/POSEIDON DATA

The task member began working with the recently released TOPEX/Poseidon data, which contains the GSFC-generated, high-precision orbits. Old GEOSAT software was modified to use the new online TOPEX data base constructed by B. Beckley; this included software for dumping data, computing 1/rev orbit adjustments (for quality control), and performing initial tidal studies. One early result: it appears that the Cartwright-Ray tide model, based on GEOSAT data, has a signal in it that mimics the behavior of orbit error; it is presumably the partial remnant of GEOSAT's relatively large orbit error. The error in M2 is approximately 5–7 cm in some regions.

The task member initiated work on a new approach to tidal analysis of altimeter data, which merges the ATR's use of Proudman functions with the orthotide formalism of Cartwright and Ray (1990). Essentially, the tidal orthoweights, which are determined by analysis of observed sea level, will be represented as a series of Proudman functions. In the C-R method, these weights were determined individually in each small bin area covering the globe. The mathematics for this new approach was worked out, and efforts began on writing software to implement the approach. The software will support data from both collinear altimeter data and pelagic bottom-pressure data.

The task member's short paper "Improved Smoothing of an Altimetric Tide Model With Global Proudman Functions," by R. Ray and B. Sanchez, was submitted for possible publication as a Research Note in the *Geophys. J. Int.*

The task member's review paper "Global Ocean Tide Models on the Eve of TOPEX/Poseidon" was published in *IEEE Trans. Geosct. and Rem. Sens.*

Software and data for the Cartwright-Ray tide model were provided to:

- T. Bennett, NAVOCEANO, Stennis Space Center.
- J. Candela, Woods Hole Oceanographic.
- L. Kantha and P. Pontius, Univ. of Colorado.

Some plotting support was provided to the ATR.

SIGNIFICANT ACCOMPLISHMENTS

The task member's invited review paper on global tidal models was published in a special TOPEX issue of *IEEE Trans. Geosct. Rem. Sens.*

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work will continue on the Proudman-function/orthotide merger. Initial tidal studies with TOPEX/Poseidon data will begin. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
60	IBM 9021
180	Cray Y-MP

200

NASA Task 22-114-00: Magnetometer Calibration

GSFC ATR's: ***Dr. R. Langel and Dr. C. Voorhies***

Hughes STX Task Leader: ***H.B. Iz***
Hughes STX Task Number: ***283***

This task will quantify the conditions under which instruments on board spacecraft will be able to measure the ambient magnetic field to specified accuracy, and will include the design and implementation of a calibration and data reduction procedure to obtain these results.

FINAL CONTRACT SUMMARY

One part-time analyst worked on this task. The objective was to investigate the feasibility of calibration of the proposed vector magnetometer onboard the EOS polar platform and to determine the ambient field, apart from any spacecraft fields in each component to within approximately 2nT. The task's study found that the ambient field can be determined to the desired accuracy and that the shortest possible boom length compatible with achieving the desired accuracy is 7 meters. A task modification required the investigation of the feasibility of calibration of the proposed magnetometer experiment for the ARISTOTELES mission. The objective of the modification was to formulate the inverse problem of finding the ambient field at the magnetometers in the presence of fields from the spacecraft and to perform a covariance analysis determining the probable accuracy of such determination. The results were analyzed to find the shortest workable boom length and to identify likely problems and their solutions.

A report analyzing the problem and calling attention to important considerations was prepared. The report contained a formulation that will permit design of the software necessary to calibrate the actual data. In all, three error analysis reports were prepared and submitted, together with an error analysis computer program (MAGANAL) and many graphics plots of results.

SUMMARY FOR CURRENT REPORTING PERIOD

This task is inactive.

WORK PERFORMED

No work was performed on this task.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

No work was performed on this task.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

COMPUTER USE

None.

NASA Task 22-116-00: Nimbus-7 TOMS Programming and Data Analysis

GSFC ATR: *L. Walter*

Hughes STX Task Leader: *I. Sprod*
Hughes STX Task Number: *285*

The objective of this task is to provide necessary computer-related technical assistance for the research being conducted by the ATR. This research is concerned with measuring, monitoring, and analyzing stratospheric sulfur dioxide clouds, which are emitted by volcanoes.

FINAL CONTRACT SUMMARY

Since this task started, one programmer/analyst has worked on it. A data processing and analysis software system was set up on a VAX to enable detailed examination of the TOMS SO_2 data. Papers were coauthored by task members on the eruptions of Mount Pinatubo and Cerro Hudson in 1991.

The present task member started working on the task in December 1992. A new Unix workstation was purchased to facilitate analysis of the TOMS data and enable an online data set of eruptions to be created. New software was written for the workstation, and more than 100 days of eruption data is currently online.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff took responsibility for the new Unix workstation. Software to display and analyze TOMS data on the workstation was written and worked; the transfer of TOMS data to the workstation is underway. The task member produced graphics for conferences, posters, and papers using software on the new workstation. The task member presented a short video of TOMS data at the Gordon Research Conference. Staff members produced TOMS images for presentation by the NASA Co-PI at various conferences. Task personnel coauthored a paper on "Explosive SO_2 Emission From the 1992 Mt. Spurr Eruptions."

WORK PERFORMED

100 SOFTWARE DEVELOPMENT

Task personnel continued development of "Tomsplot" software using IDL.

New functionality includes:

- Computer animation of TOMS data, which can be put on VHS videotape if required.
- Sulfur dioxide, ozone, and reflectivity (weather clouds) data on a single image.
- The cloud tonnage algorithm.
- "Point and click" data analysis.
- High-quality PostScript output for hardcopy prints.

200 PRODUCTION OF GRAPHICS AND DATA PRODUCTS

This task member wrote software used to create computer animations showing Mount Pinatubo and Mount Spurr SO_2 cloud dispersal. Staff demonstrated its ability to make VHS videos from computer graphics (thanks to the Scientific Visualization Studio at GSFC).

The task member produced TOMS images showing SO_2, reflectivity (weather clouds), and ozone for a talk by NASA Co-PI A. Krueger (Code 916) at the Gordon Research Conference.

HSTX staff made new images of the June 1991 Mount Pinatubo eruption cloud for publication in a forthcoming book on Remote Sensing Volcanology, for display at an international remote-sensing conference in Italy by Krueger and for an EOS Project Volcanology poster.

The task member reprocessed and sent electronically TOMS data from various eruptions to collaborators at Michigan Technological University. TOMS data will be compared with AVHRR data to show the behavior of gas and ash in volcanic plumes.

Staff processed and delivered TOMS data from the Mount Spurr and Mount Pinatubo eruptions to collaborators at the University of Arizona. These data will enable comparison of the TOMS SO_2 retrieval algorithm with radiative transfer model results.

300 ANALYSIS OF TOMS DATA

Staff chose data format and structure for the transfer of data from 1/2-inch tapes to the disk drive on the Unix workstation. A task member wrote software and documented procedures for ease of data transfer. Currently, more than 100 days of eruption data is online, including Mount Saint Helens, El Chichón, Mount Pinatubo, and Cerro Hudson.

The behavior of the prototype cloud tonnage algorithm was investigated to improve the current calculational route.

400 PAPER PREPARATION/DOCUMENTATION

A staff member assisted with preparation of a letter to *Nature* by G. Bluth (USRA).

A task member was coauthor with Bluth on the paper "Explosive SO_2 Emission From the 1992 Mt. Spurr Eruptions," to be included in the USGS bulletin on this eruption.

Staff wrote notes on data transfer from the HD-TOMS 1/2-inch tape archive to workstation and updated notes on the use of Tomsplot software.

500 GENERAL SUPPORT

Staff performed these tasks:

- Set up and installed the new Silicon Graphics IRIS Indigo workstation.
- Performed system administrator duties for the new workstation: installed software, ran backups, and configured peripheral devices.

- Presented a video poster on SO_2 cloud dispersion from Mount Pinatubo at the Gordon Research Conference, July 26–30, at New England College, Henniker, NH.
- Supervised a high school student in the National Space Club Scholar program (along with Bluth).
- Demonstrated use of the new Tomsplot software on the Macintosh computer to coworkers.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue analysis of TOMS SO_2 data from Nimbus–7 and Meteor–3 instruments. Development of workstation-based software will continue. Meteor–3 TOMS data will be analyzed for any new eruptions during this period and SO_2 cloud data for previous eruptions processed in a standardized manner. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
10,000	PACF VAXcluster
10,000	Unix Workstation

NASA Task 22-119-00: Scientific Activity Data Base and Liaison

GSFC ATR: ***Dr. J. Smith***

Hughes STX Task Leader: ***A. Nanan***
Hughes STX Task Number: ***288***

The task will provide development, data input, and maintenance of the data base to track descriptions of scientific activities. The data base will also serve as a reference system for responding to various queries. The task will also act as liaison for scientists in developing reports, responding to queries, and assisting with correct presentation of information.

FINAL CONTRACT SUMMARY

HSTX staff developed several data bases to log information about all manuscripts, reviewers, and associate editors received by the current editor since the task began 2 years ago. Staff created letters and reports for the editor as requested, assisted the editor in putting together 18 issues of scientific papers and forwarded them to the publication office on time, and maintained the data bases, updating old records and adding new records and information. Staff has also maintained daily contact with reviewers, authors, and associate editors by telephone, fax, and electronic mail over the past 2 years.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff assisted the editor in putting together the November and January issues and forwarded them to the publication office on time. Daily contact with scientists and other relevant personnel was made. Staff continued to work on a data base for logging all scientific reports and tracking all changes. Statistical reports and letters were generated from the data base for June–September. All new reports in this reporting period were logged into the data base, correspondence was prepared and mailed to authors and editors, and reports were filed. Staff continued to work on a new data base as requested by the ATR.

WORKED PERFORMED

HSTX staff helped the ATR with all contacts to associate editors, authors, and publication personnel and assembled all materials for the November and January issues.

Staff had daily contact with scientists, answering their questions and requests and ensuring that all materials were in place. The staff member prepared and mailed more than 200 letters to authors, reviewers, and publication personnel.

Data base development is continuing daily for logging all manuscripts and tracking all changes (dates, length, title, name and address of authors, name of reviewers, and number of revisions). Statistical reports and letters were generated from the data base for the monthly reports to associate editors. Staff has developed a new data base according to the ATR's specifications. Modifications will be made as needed.

All new reports received by staff were logged in the data base, correspondence was prepared and mailed to authors and editors, and reports were filed.

Old materials were rechecked, logged, and packed away for storage.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work on this task has been completed. Work will continue under new contract NAS5-32350.

WORKED PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan for this task will be updated for the next contract as needed to meet requirements for the new task.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh

NASA Task 22-120-00: NASA SeaWiFS Calibrations/ Validation Support

GSFC ATR: ***J. McLean***

Hughes STX Task Leader: ***J. Cooper***
Hughes STX Task Number: ***289***

This task will provide laboratory and field support for SeaWiFS calibration and in situ validation. Support will be in the form of technical, data processing, and documentary assistance.

FINAL CONTRACT SUMMARY

In June 1992, contract NAS5-30440 was assigned to this current task. Over the lifetime of this task, one senior science technician has worked from 0.75 to 1 FTE, and one instrument engineer has worked up to 0.25 FTE. Major milestones have been accomplished over the lifetime of the task. Timely and effective support was provided to the ATR during the preparation of papers and presentations. Regular calibrations of onsite radiometric sources at GSFC were provided as needed. New spectroradiometer equipment was tested, monitored, and used successfully to provide radiance calibrations for many radiometric sources. Technical support was provided during two SeaWiFS Intercalibration Round-Robin Experiments (SIRREX-1 and -2) at the Center for Hydro-Optics and Remote Sensing (CHORS) at San Diego State University (SDSU). Other calibration comparisons and cross-calibration checks were performed at the Hughes Santa Barbara Research Center (SBRC) in Santa Barbara, CA. Subsequent data analysis of the intercomparison data continued in a timely manner. Documentation and data files involved in the SeaWiFS trials were written, updated, and improved. Calibration support was provided to investigators involved in the Sulfate Cloud And Radiation-America (SCAR-A) experiment. MODIS Airborne Simulator (MAS) technicians were given knowledgeable instruction in calibration source operations and alignment.

The remaining objectives to be accomplished include the continuation of regular onsite calibrations and future SIRREX missions, including ongoing data archival and analysis.

SUMMARY FOR CURRENT REPORTING PERIOD

Work on this task involved intercomparisons of many radiometric sources and instruments being used by SeaWiFS and MODIS investigators, including cross-calibrations of integrating spheres and standard lamps from laboratories involved in SeaWiFS. A staff member traveled to Wallops Flight Facility, VA, to help investigators with preflight calibrations of instruments being used in the SCAR-A experiment. Work involved calibrating the GSFC 48-inch hemisphere. MAS technicians were instructed in hemisphere operations and alignment procedures.

WORK PERFORMED

100 SYSTEMS EVALUATIONS AND MAINTENANCE

110 Source Calibrations

Calibrations were performed on the GSFC 42-inch sphere and the GSFC 48-inch hemisphere using the 746 spectroradiometer system. Radiance values were computed from 350–2,500 nm and were compared to previous 746 monochromator data.

Calibrations for irradiance of two standard lamps (F315 and F227) were performed, using lamp F268 as a standard. Data for calibrations performed before, during, and after the SCAR-A mission were given to the ATR for further analysis.

220 Nonlocal Travel

A staff member traveled with the ATR to CHORS at SDSU to participate in the second SIRREX-2. The work involved intercomparisons and cross-calibration checks of the sources and instrumentation being used by SeaWiFS and MODIS investigators. GSFC's 42-inch sphere, the Optronic 746 spectroradiometer, and standard lamps f268, f269, f227, and f315 were sent to CHORS for use in the calibration comparison and cross-checks. Other sources calibrated at CHORS by this task were the CHORS/SeaWiFS sphere source, Bio-Spherical Instruments' 20-inch sphere, a 30-inch sphere source from NASA's Wallops Flight Facility, and a 20-inch sphere source from the Univ. of California in Santa Barbara. In addition, 26 standard FEL and DXW lamps from 7 laboratories involved in SIRREX-2 were calibrated with reference to a NIST-calibrated standard lamp. Data for the calibration activities were given to the ATR and other SeaWiFS investigators. The round-robin calibration plan is an effort to provide some traceability between data sets obtained by participating SeaWiFS laboratories performing in-situ optical measurements.

A staff member traveled to Wallops Flight Facility, VA, on two separate dates to help investigators with calibrations of high-altitude ER-2 aircraft instruments being used in the SCAR-A experiment. GSFC's 48-inch hemisphere, and 12-inch sphere, the Optronic 746 spectroradiometer, and standard lamps f227 and f315 were sent to Wallops for use in the SCAR-A calibrations. Two of the instruments to be calibrated—the Electro-Optical (EO) Camera and the Cloud Absorption Radiometer (CAR)—malfunctioned during the calibration period and, consequently, were not preflight calibrated. SCAR-A technicians were instructed in the operation of the hemisphere, and given advice on procedures for alignment of the hemisphere, a 45° angling mirror, and the MAS instrument for preflight calibrations. Calibrations for radiance and lamp-level ratios were performed on the GSFC 48-inch hemisphere using the 746 spectroradiometer system and lamp F315. Radiance values were computed from 350–2,500 nm. The calibration equipment was then packed for shipment back to GSFC.

500 GENERAL TASK SUPPORT

Archived radiance data for the 48-inch hemisphere from 1988 to current calibrations were collated into one spreadsheet and given to the ATR and P. Abel (Code 925) for inclusion in a study of changes in the hemisphere's output and the effects of humidity on the output of the hemisphere.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has ended. Work is proceeding as planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Routine calibrations of GSFC sources will continue. Staff will modify 746 software to allow more samples to be taken at each wavelength. A Work Control Plan will be completed for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	**Computer**
100	WIN 386SX
40	Compaq Portable II

NASA Task 22-121-00: Tether Magnetometer

GSFC ATR: *W. Webster*
Cognizant NASA Scientist: *Dr. F. Hall*

Hughes STX Task Leader: *L. Huynh*
Hughes STX Task Number: *290*

Task personnel will provide software development for the Small Expendable Deployer System flight project. This will include data reduction and scientific visualization of the SEDS data sets.

FINAL CONTRACT SUMMARY

Hughes STX has been supporting work activities for MAG since FY '92. The number of task personnel currently is two Full-time employees and sometimes has grown to three during summer or school break. The major work activities include developing software in support of the Small Expendable Deployer System (SEDS) and other-based flight and research projects; and participating in validation and verification of flight hardware and software, mission operations, the reduction and analysis of mission data sets, and the numerical simulation of missions in the planning stage. Accomplishments to date include:

- Developing and processing data reduction software for SEDS was completed successfully.
- Developing and processing data reduction software for PMG was completed successfully.
- Validating and verifying flight hardware and software, mission operations, the analysis of mission data set, and the numerical simulation of missions in the planning stage was fully participated in by staff.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff completed the Plasma Motor Generator (PMG) data reduction software and passed the GSFC project manager's final software review. The PMG Tether mission flight was launched successfully on a Delta rocket at 9:30 a.m. on June 24, 1993. HSTX staff were on duty at Cape Canaveral Air Force Station during the mission. Task personnel performed the preliminary data reduction on the real-time data available at the launch site so that the Investigators Working Group (IWG) could get a quick look at these data in order to determine the mission's success. After successfully completing the preliminary data reduction, HSTX staff then performed the final data reduction on the data tape, which was a combination of all data received for the entire mission. The PMG data reduction software produces a clean data set, which is then released to the scientists, engineers, and IWG so that they may begin analyzing, studying, and making plans for future flight missions.

During the work on the deployer data error analysis and recovery, HSTX staff assisted the network testing and training personnel in converting a stream of bits into real-time data. The staff members designed a program that strips the start and stop bits from a stream of bits. This program recovered more data than the network test and training personnel's program. This indicates that there were bugs in the network test and training personnel's program. After fixing the bugs, the network and training personnel's program produced the same result as staff members' bit stream program.

HSTX staff successfully completed the graphical interpretation of the magnetometer data. IDL was used to perform a Fast Fourier Transform, Gaussian curves, and frequency noise filtering.

HSTX staff finished cataloging all these data and project-related files that exist on the project's different workstations. A new program called Findfile was designed to locate the file and to update the data base.

WORK PERFORMED

100 SEDS 1 SOFTWARE DEVELOPMENT

110 SEDS 1 Data Reduction Software

HSTX staff successfully completed the deployer data error analysis and data recovery. The staff members designed a program that strips the start and stop bits from a stream of bits. This program recovered more data than the network test and training personnel's program. This indicates that there were bugs in the network test and training personnel's program. Also, staff members designed another program to invert the bitstream data before in putting it to the bitstream stripping program. The reason was that during the analog-digital conversion, the operator may invert the analog data to block some bad data sneaking through the process.

Task personnel also modified the SEDS deployer stripping program to enhance its functionalities, which includes being able to process any fragmented data because of the transmission link from the deployer to the ground tracking station.

HSTX staff successfully completed the interpretation of the magnetometer data by graphics. IDL was used in this process to perform a Fast Fourier Transform, Gaussian curves, and frequency noise filtering. Scientists will use these graphs to learn the behaviors of the deployer and subsatellite systems for verifying the space tether theories.

130 Plasma Motor Generator Data Reduction Software

HSTX staff completed the PMG data reduction software. The software passed the GSFC project manager's final review. The PMG mission launched on a Delta rocket at 9:30 a.m. on June 26, 1993, was a success. The data acquisition from the Delta second stage and PMG systems was successful. Two sources of data are: the real-time data available at the launch site and the final data stored on magnetic tape and transported to GSFC. HSTX staff performed data reduction on both data successfully and released the best data set to scientists, engineers, and the IWG for analyzing, studying, and making plan for future mission.

HSTX staff traveled to Cocoa Beach, FL, to support PMG launch operation. During the launch, HSTX staff members worked closely with the onboard software engineers to check and record any bad data acquisition. At the end of the mission, HSTX staff participated in the mission evaluating discussion and was told to process the available real-time data as soon as possible.

Task personnel were requested to develop a bitstream program for PMG data. After weighing the reliability of data recovery produced by the seds bitstream stripping program, the pmg bitstream stripping program, and the network test and training personnel's stripping program, the seds bitstream stripping program was chosen as a backup option whenever the network and training personnel's program fails to deliver a good quality data set.

150 Workstation Support and Maintenance

Task members continued to provide system administration support for the task's Unix workstations. Task members successfully set up the new SGI workstation, and the CD-ROM drive.

SIGNIFICANT ACCOMPLISHMENTS

The SEDS data acquisition and reduction were successfully competed as were the PMG data acquisition and reduction. The bitstream stripping software and the setting up of a new SGI workstation and CD-ROM drive were successfully completed.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work is proceeding as planned.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

100 SEDS 1 SOFTWARE DEVELOPMENT

Staff will prepare software development for SEDS 2 mission scheduled in March '94.

110 SEDS 1 Data Reduction Software

Task personnel will begin the animation software.

130 Plasma Motor Generator Data Reduction Software

Task personnel will continue developing animation software.

150 Workstation Support and Maintenance

Routine support will continue as needed. Task personnel plan to set up the routine backup automatically on the 8-mm tape drive, and to install the RISC-4000 processor and the 1.2 Gigabyte hard disk on Gojira.

CONFERENCES

HSTX staff traveled to Cocoa Beach, FL, to attend support the PMG launch operations.

DELIVERABLES

Software: PMG data reduction software, SEDS bitstream stripping software

Originator: L. Huyhn

COMPUTER USE

Minutes	Computer
8,520	VAX 11/780, 8250 (LTP)
12,000	VAXstation 2000 (LTP)
24,000	Iris Indigo (gojira)
24,000	Iris Indigo 2(gorgo)
18,000	Iris Indigo (godzilla)

NASA Task 22-122-00: Alaskan Geodetic Data

GSFC ATR: ***Dr. J. Sauber***

Hughes STX Task Leader: ***D. Caprette***
Hughes STX Task Number: ***291***

Hughes STX will provide support for the acquisition of geodetic data in Alaska. This will include field work in southern Alaska to acquire data.

FINAL CONTRACT SUMMARY

Over the lifetime of this task, one senior engineer has worked from 0.1 to 1 FTE. The principal goal of the task was met because GPS data that equaled or exceeded the planned quantity were obtained at all of the intended sites. Because of the transient nature of the required work, this task was terminated at the end of September.

SUMMARY FOR CURRENT REPORTING PERIOD

An HSTX task member traveled to Alaska to participate in the DOSE summer 1993 observing campaign in Southern Alaska, and assisted with other GPS observations on the Kenai Peninsula from June 4–30, inclusive. While there, the task member transported the GPS equipment, prepared sites for observation, secured the equipment onsite, and had primary responsibility for observations and data delogging at six sites where approximately 135 receiver-hours of data was obtained. Later, the same person traveled to Kodiak Island and performed recognizance for the Kodiak footprint sites. From June 23 through June 30, the task member made GPS observations in a campaign on the Kenai Peninsula obtaining a total of approximately 60 receiver-hours of data.

In July, the task member participated in wrap-up meetings held to coordinate the collection of data diskettes and logsheets.

WORK PERFORMED

A task member traveled to Alaska to take part in the DOSE summer 1993 observing campaign in Southern Alaska, and to assist with other GPS observations on the Kenai Peninsula from June 4 through June 30, inclusive.

The task member assisted in unpacking equipment in Anchorage and received training there. The task member then transported the equipment to field sites and set it up. Together with other team members, observations were made at 14 sites in Southern Alaska with a total of approximately 455 receiver-hours of data obtained. The task member had primary responsibility at six of these sites where approximately 135 receiver-hours of data was obtained. The equipment was then returned to Anchorage from the field, packed for shipment, and shipped to the next location.

On June 21, the task member then traveled to Kodiak Island and attempted to recover four stations as potential footprint sites. These stations were determined to be too remote for easy occupation by GPS.

The task member then returned to Anchorage on June 22 and from there drove to the Kenai Peninsula where he had primary responsibility for GPS observations at three sites acquiring a total of approximately 60 receiver-hours of data. Some routine maintenance was also performed on the antennas.

The GPS and ancillary equipment were returned to Anchorage for shipment back to the lower 48 States. Data diskettes were returned to GSFC. Wrap-up meetings were held coordinating the collection of data diskettes and logsheets.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

This task was terminated at the end of September.

COMPUTER USE

Laptop PC's were used in the field to delog the receivers, and backup diskettes were also made in the field. Approximately 20 hours of PC time was used. Other computer utilization was limited to the use of electronic mail for coordinating with the PI and other contractor personnel involved in the task.

NASA Task 32-161-00: ROSAT System Engineering

GSFC ATR: ***Dr. R. Pisarski***

Hughes STX Task Leader: ***P. Damon***
Hughes STX Task Number: ***350***

This task provides system analysis and system engineering support for the development of the U.S. ROSAT Science Data Center (USRSDC), which includes a mission planning system, a standard data processing system (SDPS), postreduction scientific analysis, a networking and communications system, and a data storage and management system. In addition, technical support for activities in the project management, distributed data analysis centers, and guest observer areas of the USRSDC will be provided.

FINAL CONTRACT SUMMARY

This task provides support to the U.S. ROSAT Science Data Center (USRSDC). The duration of this task was 5 years. The number and types of people working on this task increased during this time from 5 to 11. There are currently eight programmers (systems programmers, programmer/analysts, science programmers) and three data technicians assigned to this task

Major milestones accomplished during this task's performance period are:

- Integration of the SASS software into the USRSDC environment.
- Creation and end-to-end testing of USRSDC operations procedures.
- Design, development, and implementation of the ROSAT data bank.
- Integration of Cygnet jukebox, SCSI host adapter, SOAR software, and JIMS software as the mass data storage architecture to support the ROSAT data bank.
- Quadrupled throughput of ROSAT processing by adding SCSI disks, SPARCprinters, increased automation, a second processing shift, and migration of operations to a VAX 6440.
- Completion of Revision 0 processing for PCV, AO1, and AO2 phases, including the elimination of the backlog of ROSAT data due to early SASS software problems.
- Start of Revision 1 processing for AO3 and AO4 data.
- Development of ROSAT RDF (FITS) converters.
- Release of ROSAT Revision 0 data to the public archive.

Remaining objectives to be completed in this task under contract NAS5-32350 are:

- Implementation of the RDF converter in the production system.
- Revision 1 reprocessing of all Revision 0 data.
- Completion of AO4 data processing.
- Development of and RDF converter for ROSAT calibration data.
- Replacement of Revision 0 public data with Revision 1 public data in the RDF format.

SUMMARY FOR CURRENT REPORTING PERIOD

During the reporting period, HSTX staff continued Revision 1 processing of ROSAT data. Data observed from March 17, 1993, through August 9, 1993, were processed, distributed, and archived. Work continued on the development of the ROSAT Rationalized Data Format (RDF) FITS converter with final testing and verification underway. Extensive changes to the GSFC steering and SASS interface software have been made and are being tested. All public U.S. data have been released to NDADS, MPE, and the U.K.

WORK PERFORMED

100 STANDARD DATA PROCESSING SYSTEM (SDPS)

Staff continued ROSAT standard data processing, archiving, and distribution for Revision 1 data. U.S. PSPC and all HRI data for ROSAT days 1015-1182 (March 17, 1993, through August 9, 1993) were processed, converted to fits, verified, and archived. U.S. data for these days were distributed to the guest observers. The weekly mission timeline updates to the SASS data base were applied.

SASS releases 6.4.1, 6.4.2, 6.5, 6.5.1, 6.5.2, 6.5.3, 6.6, 6.6.0, and 6.6.1 were installed and tested, then implemented in the production system.

The interface software to the SASS was rewritten to support the RDF converter. The GSFC steering system that controls FITS conversion, ROSAT data bank updates, creation of the archive data set, and Validation and Verification (V&V) staging was completely rewritten and has provisions for future enhancements, such as automated submission of archive and retrieves of SASS and FITS data. A new routine to create a RDF FITS distribution tape with a table of contents was written and tested.

200 POSTREDUCTION SCIENTIFIC ANALYSIS SYSTEM (PRSAS)

Work continued on the development of the ROSAT RDF FITS converter. The format specifications provided by the OGIP for the RDF FITS files underwent large changes during the reporting period to support the requirements of PROS (for U.S. GO's) and EXSAS (for German GO's) and meet new OGIP standards for FITS. Implementing these specifications changes required major changes to the RDF converter software. The revised RDF FITS outputs have undergone extensive verification at SAO, MPE, and GSFC, resulting in many enhancements and bug fixes being implemented. Test versions of the converter were released to MPE for verification and integration in Germany. The final testing and verification of the RDF FITS converter and its outputs are underway.

300 NETWORKING/COMMUNICATIONS

HSTX staff maintained the local area network in ROSAT work areas.

400 DATA STORAGE/DATA MANAGEMENT

Staff created Public Contents Files (PCF's) for all public U.S. data. All public U.S. data were released to NDADS. Public data distribution tapes were created and sent to the MPE and U.K. archive site.

Public data distribution tapes for public German and U.K. data were ingested from MPE. Ingest of some of these data was delayed because MPE was late in supplying revised PCF's necessary for the ingest processing. The ingested German and U.K. data were released to NDADS.

Staff members supported operation of the ROSAT Cygnet 1803 optical jukebox, creating and closing platters as necessary, and troubleshooting archive and retrieval problems.

500 MISSION PLANNING SYSTEM (MIPS)

Staff provided MIPS with public data release updates. These updates inform the user community of ROSAT data distributions, and the expected date these data will enter into the public domain.

600 GUEST OBSERVER SUPPORT

The ROSAT guest observer facility was provided with reports on data processing, which showed how much time GO's received (based on the standard processing) as compared to their awarded times. These reports are used to reschedule targets that did not receive the required time.

800 PROJECT MANAGEMENT SUPPORT

HSTX staff assisted the ATR in writing the R&T report section on ROSAT processing and public data distribution.

PROBLEM AREAS

ROSAT public data received from MPE did not contain properly formatted public contents files (PCF's). These PCF's are descriptors of each ROSAT data set, and are provided to the public archive by the ROSAT Science Data Center. Ingest of some public German and U.K. data was delayed until corrected PCF files were received.

Delivery of the ROSAT RDF converter was delayed by additional changes to the specifications by SAO and the OGIP.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

Standard data processing was performed on schedule with no delays.

Upgrades to the GSFC interface to SASS and the GSFC steering software were completed on time.

The release of ROSAT public data received from MPE was delayed because of problems with the format of the PCF's.

The ROSAT RDF FITS converts were not completed on schedule because of the many format changes requested by the HEASARC, SAO, and MPE.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements of this task.

Operations will continue to ingest, process, distribute, and archive ROSAT data as they are received from GSOC.

The public data will continue to be distributed to NDADS, Germany, and the U.K. and will be ingested from Germany and the U.K. and distributed to NDADS.

Staff will develop the ROSAT RDF converter for calibration data.

Staff will begin revision 0 reprocessing by October 1, 1993. Task members will perform a complete setup of software and a new account for Revision 0 reprocessing. Testing and implementation of the RDF converter, new SASS interface, and GSFC steering software will be finished.

Staff will explore the alternatives to distributing the PostScript and text files to the GO's in hardcopy form, such as including them on the FITS tape. A recommendation will be made to the ATR.

A verification routine for RDF FITS files will be written.

A new section for the ROSAT Dataproducts Guide for the RDF FITS files will be written and a "Getting Started" guide for the ROSAT user will be created.

HSTX staff will make enhancements to the ROSAT data bank software and SASS archive interface software.

Task members will continue to work with MPE and SAO personnel to solve problems with SASS

CONFERENCES

Several task members attended an EXPO in Washington DC on Client/Server software – August 18 and 19.

COMPUTER USE

Minutes	Computer
Dedicated	VAX 6440/VAX 4000/VAXstation 3100
Dedicated	Sun 4 server/SPARCstation 1+/DECstation 3100
Dedicated	Macintosh IIcx

NASA Task 33-162-00: NCCS Technical Assistance Group

GSFC ATR: ***H. Mitchell***

Hughes STX Task Leader: ***F. Verdier***
Hughes STX Task Number: ***380***

This task provides the NASA Center for Computational Sciences (NCCS) with services and resources to enhance effective facility use. The Technical Assistance Group (TAG) assists NCCS users with programming and operational problems, examines general user software, and offers education and documentation support. Where applicable, suggestions are made to users who are having difficulties.

FINAL CONTRACT SUMMARY

Major support efforts for the TAG during the last 5 years have centered on support for the NCCS's migration from:

- CDC 205 --> Cray Y-MP --> Cray C98.
- IBM 3081 --> IBM 9021.
- MVS/SP --> MVS/XA --> MVS/ESA --> Unix.
- VM/SP --> VM/XA --> Unix.
- AIX.

These migrations required dynamic reallocation of support personnel to provide written information, classes, seminars, and tutorials for the various members of the NCCS user community.

An extensive Cray User's Guide was produced to support NCCS users. Special emphasis was given on meeting the educational and information requirements of NCCS users. Consult articles were written and edited to provide this information. The idea of providing most facility information online is now considered the standard for the industry. The TAG also provided education for the NCCS users. The TAG evolved its educational efforts to meet the requirements of the targeted class audience. Some classes were held in traditional lecture style. Smaller tutorials were used extensively to provide immediate startup information or specifically targeted information to small audiences. During periods of overload and rapid change, the TAG organized informal seminars to provide ad hoc information to a wide audience. These seminars required a minimum of preparation, and were presented by a panel of experts that could provide the required detailed information on demand.

All of these activities proceeded with the "normal" help desk effort and ad hoc special requirements. During this period, more than 56,600 requests for assistance were addressed.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff provided new phone mail consulting services for the NCCS user community, in addition to the task's E-mail, regular phone, and walk-in services. The TAG improved the handling of users' E-mail questions to assure prompt replies, provide better staff coverage, and easily utilize a common template for answers.

After approval by the ATR and the CUC, staff implemented changes to the IBM user support services to require less direct coverage yet maintain a good level of support.

Staff responded to approximately 1,960 user requests for assistance from May–August 1993.

Staff made significant progress on plans to convert the current online information system to Gopher and WAIS, more up-to-date client/server-based systems. A Gopher server and client were installed on the TAG's SGI machines, and plans for organizing information on the new NCCS Gopher were started.

Staff wrote comprehensive Consult articles describing the upgrade to the UNICOS 7.0 operating system, new Multilevel Security Features, the switch from the Cray Y-MP to the Cray C98, and the new Multitasking initiative.

Staff kept online information current by installing 39, updating 68, and editing 97 Consult articles from May–August 1993.

Upon user request, staff quickly enhanced the keyword pattern matching abilities of the Consult utility.

Staff wrote a new utility, utstat, that allows users to easily check UniTree availability, either interactively or from batch. The utility utstat was installed on the NCCS Cray and Convex machines. Staff also enhanced the netjump utility to take advantage of faster UltraNet pathways.

Staff quickly updated local utilities that used old Cray path naming conventions when new conventions were implemented with the upgrade to UNICOS 7.0.

Staff thoroughly tested ConvexAVS 5.0 beta software and wrote a report to the NCCS AVS contact person documenting its problems.

Staff worked extensively to correct problems with NCAR Graphics that occurred after the upgrade from UNICOS 6.0 to 7.0, and again after the switch from the Cray Y-MP to the Cray C98.

Staff wrote 11 NCAR Graphics programs to meet the needs of Operations staff.

Staff updated the "Introduction to the Cray" class and made it more modular by dividing it into two separate classes, "Introduction to Unix" and "Introduction to the Cray."

Staff organized a UniTree User Forum to provide users with information on the current status of UniTree and to hear their feedback.

Staff presented 5 classes and 13 tutorials from May–August 1993.

Staff developed new User Administration and Accounting data bases for an IBM-compatible 486 PC. Staff then used the new data bases to prepare all of the account renewal forms for FY '94. Staff members also produced mailing labels and the annual "Request for Science Information" packet.

Detailed information has been provided in formal monthly progress reports.

SCHEDULE CONFORMANCE

Work under this contract has been completed with the exception of certain milestones for which the ATR agreed that higher priority task work took precedence. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements of this task.

NASA Task 32-163-00: NCCS Applications Development

GSFC ATR: ***H. Mitchell***

Hughes STX Task Leader: ***J. Cavallo***
Hughes STX Task Number: ***381***

This task provides support and build user-interface tools to assist users (especially novice and remote users) in fully using the computers at the NASA Center for Computational Sciences (NCCS). The tools will include a generalized user interface for users accessing the NCCS via networks. In addition, this task will provide orientation for new remote users; assistance in graphics software support and development for scientific workstations and graphics packages on NCCS mainframes; vector algorithm, code porting, and optimization support for the NCCS supercomputers; the quarterly NCCS newsletter; and support for other NCCS documentation as specified by the ATR.

FINAL CONTRACT TASK SUMMARY

This task provided support to users of the computers at the NASA Centers for Computational Sciences (NCCS) in visualization of scientific data and the animation of the results. In addition, this task provided assistance in development and implementation of vector algorithms, code porting, and optimization support for the NCCS supercomputers. In particular:

- Staff provided algorithmic and optimization assistance to many GSFC staff, including reducing overall execution times by up to 50 percent using appropriate libraries and techniques, identifying and locating existing libraries that accomplish the user's tasks, and writing code to handle conversions and calculations.
- In support of visualization, staff developed a novel viewing technique and published a paper describing it, created custom software for visualizations and demonstrations, and control of the video equipment at the Scientific Visualization Studio. Staff also created more than 30 videos that were used for research, conferences, briefings, and television broadcasts.
- Staff researched, wrote, edited, and proofread articles that went into the publications of the NCCS. This included doing all phases of publishing the NCCS newsletter, *NewsBytes*, for over a year. Also, staff did the research, writing, and editing for the End of Year Reports for 1991, 1992, and the NCCS Science Document.
- Staff prepared and gave presentations to visitors, including visiting congressional staff, administrative staff, faculty and staff from several universities, and many student groups in NASA outreach programs.
- Task personnel coauthored several papers presented at scientific conferences, materially contributed to others, and created illustrations that were used in a major magazine, including:
  - A talk entitled "Parallelization of Lanczos' Method and Its Application to Ocean Modeling" at the Sixth SIAM Conference on Parallel Processing for Scientific Computing in Norfolk, VA.
  - A talk entitled "Visualization of a 3-Dimensional Ozone Data Set: Nimbus-7 SBUV," presented at the Spring 1993 AGU.
  - A visualization of the "November 1992 TOMS Ozone: Difference From Climatology" that was published in *SCIENCE*, Vol. 260, April 1993.
  - The video "Two and Three Dimensional Simulations of the MHD Vortex Street" for T. Stribling and E. Siregar (Code 692) that was presented at the Spring 1993 AGU, May 24–28, 1993.

- A video for Code 916 "Visualization of a 3-D Data Ozone Data Set: Nimbus-7 SBUV" that was presented at the Spring 1993 AGU, May 24-28, 1993. Staff also gave a demonstration of the AVS tools at the conference.

Staffing on this task has varied during this contract, but currently includes four senior analysts and one video editor.

SUMMARY FOR THE CURRENT REPORTING PERIOD

Staff wrote and tested software to convert Voyager Mag data summary records from IBM binary format to IEEE binary format. The software was intended to run on a DEC Alpha workstation, but was written and tested on an SGI workstation before the Alpha was installed. The software was then ported to the Alpha within 4 weeks of its delivery, in spite of the fact that the Alpha handled integer*4 and integer*2 data differently than the IBM mainframe and the SGI workstation. T. McClanahan (Code 694) and staff performed extensive testing of the software. The software has been shown to meet all requirements.

Staff made significant improvements to J. Zero's (Code 910.3) general circulation model resulting in an approximate 20 percent reduction in overall CPU time of the model on the Cray Y-MP.

A task member proofread all of the approximately 85 scientific reports submitted by NCCS users for the NCCS Science Document. The reports were proofread for consistency, grammar, and conformance to GPO style guidelines. The task member also met with C. Boquist (Code 932) and personnel from the GSFC publications group to discuss publication plans for the document. The task member also contacted more than 30 scientists by E-mail to clarify information or obtain missing information.

At the request of the ATR, the SVS task members helped collect, modify, and reprint many of the figures for the NCCS Science Document. Because of the need for dispatch, other work was delayed so that staff could contact an author from each of the 15 papers. In spite of the absence or departure of some of the primary authors, an author from each of the papers was contacted within a week, and replies were gleaned from all within 2 weeks. Many of the figures were modified to improve the quality of the printed version, some requiring several days of work. Where modifications were made, care had to be taken to avoid modifying the scientific content, and the author had to be contacted again to verify that content was the same. Work had been completed on most of the figures by the end of the month.

Detailed information has been provided in formal monthly progress reports.

NASA Task 33-166-00: Systems Programming, Communications, and Job Entry Systems Support

GSFC ATR: *T. Schardt*

Hughes STX Task Leader: *C. Lofton*
Hughes STX Task Number: *382*

This task provides systems programming support for the NASA Center for Computational Sciences (NCCS), including operating systems support, interactive terminal systems support and enhancement, job entry subsystem support and enhancement, system performance evaluation and tuning, and communications systems support.

FINAL CONTRACT SUMMARY

Task members played a key role in numerous system installations, upgrades, and conversions that required creative application of existing technical skills and rapid acquisition of new expertise in the installation, maintenance, generation, and troubleshooting of systems software. Among the most significant projects to which task members contributed were the conversion from the Cyber 205 supercomputer to the much more powerful Unix-based Cray Y-MP, followed by the migration from the Y-MP to the current state-of-the-art C98. Task members supported a rapid and smooth migration from IBM's MVS/SP operating system to MVS/XA and on to MVS/ESA, maintaining local modifications to the operating system, where possible, and assisting users with required conversions. Support for the VM operating system included a smooth transition from VM/SP running on an Amdahl V/6 to VM/HPO on an IBM 3081, followed by an upgrade of the IBM 3081 to the VM/XA operating system. When the VM operating system was retired, local utilities to preserve all user data were written and successfully implemented. Task members were deeply involved in support for Unix-compatible mass data storage software and in resolution of problems with this relatively new type of systems software. This support included the NCCS' relatively brief experience with the Data Library System and its ongoing work with the Convex/UniTree system. Task members were also instrumental in supporting IBM's AIX/ESA operating system and in maintaining Apple Macintosh software for NCCS personnel and users.

SUMMARY FOR CURRENT REPORTING PERIOD

Task members spent much afterhours time in an effort to resolve a series of problems with Convex hardware, Redundant Array of Inexpensive Disk (RAID) software, tape daemon, and Ethernet hangs. This effort ensured that a minimum of user's data was lost because of hardware problems, and contributed greatly to the timely resolution of several serious tape daemon problems and service interruptions because of Ethernet hangs. Staff also developed local software and documentation central to the timely implementation of UniTree vaulting, and increased the security of UniTree data through implementation of RAID.

A task member delivered a complete storage accounting system incorporating data collection, processing, and reporting of charges assessed for data storage on all NCCS systems. This system will allow the NCCS to manage a critical resource more effectively by charging for its use.

Staff continued timely support for installation/maintenance of MVS/ESA systems software and developed a full-screen interface for IBM/IEEE floating-point conversion subroutines.

Staff resolved numerous problems with Macintosh computers used by NCCS staff, allowing important work to continue with minimal interruption.

Detailed information has been provided in formal monthly progress reports.

NASA Task 32-169-00: MPP Computer Science Research

GSFC ATR: ***Dr. J. Dorband*** **Hughes STX Task Leader:** ***C. Packer***
Hughes STX Task Number: ***354***

The objective of this task is to develop and demonstrate the utility of the Massively Parallel Processor (MPP) for performing a variety of advanced computational functions; to provide consultative support to the MPP Working Group in using the MPP for research projects; to develop network-based software enabling transparent remote access to the MPP; and to maintain and enhance the MPP Pascal language system, including the MPP Pascal code generator and set of primitives.

FINAL CONTRACT SUMMARY

This task, dedicated to the support of massively parallel computing, has had varying numbers of people assigned to it over its lifetime. Currently, there are three full-time programmer/analysts assigned to this task working on projects in hydrodynamics, image processing, and architecture independent language development. Accomplishments include:

- Aid in the development of a Hausdorff distance measuring program used to provide a numerical evaluation of the similarity of digital images.
- Enhancement of stereo-matching software developed on the MPP to take advantage of the additional memory and subsequent processing capabilities available on the MasPar.
- Use of the expertise developed on the MPP to begin software development for the commercially produced MasPar MP-1 as soon as it was delivered, including a subroutine library of routines for image display, virtual processing, and random number generation.
- Support for the study of chaotic dynamical systems, particularly in the production of imagery for the visualization of the dependency of the chaotic phenomena upon system parameters, with results presented at a conference on the synthesis of artificial life systems.
- Support for parallel C compiler development by writing a subroutine library and performing benchmark tests on a Connection Machine. The tests measured the efficiency of routines developed for the compiler.
- A fine-grained parallel C simulator that allowed developers to write code to be run on a generic parallel machine.
- Support for research for using the MPP for the production of computer generated holograms, and development of software demonstrating the proof of concept.
- A cellular automaton-based model of hydrodynamics for the MPP that used the supercomputer performance of the MPP to evaluate fluid flow behavior at a high speed of computation.
- An adaptive mesh refinement algorithm for massively parallel computers.

SUMMARY FOR CURRENT REPORTING PERIOD

During this reporting period, staff successfully optimized a parallel adaptive mesh refinement program for modeling hydrodynamic phenomena and added the capability to handle boundary conditions. Furthermore, HSTX personnel implemented a translator called ViC to support architecture independent parallel programming and successfully tested it on a variety of high performance architectures. The translator supports a subset of the C* programming language and is based on the data parallel programming paradigm. Finally, work continued on the implementation of a diffusion based algorithm for the Hubble Space Telescope phase retrieval program. In particular, a phase unwrapping algorithm referencing Zernike analytical maps was developed and implemented.

WORK PERFORMED

The adaptive mesh refinement program for modeling hydrodynamic phenomena now runs faster because of several improvements such as:

- Faster interprocessor communications because of new customer-supplied versions of critical routing routines written in assembly language instead of MPL.
- More efficient transfer of graphic data to the workstation.
- Pruning of operations that were discovered to be redundant.

In addition, the algorithm now handles boundary conditions. That is, the simulation accounts for what happens when the fluid medium encounters a hard wall.

Finally, the part of the program that loads the initial data now generates information about element adjacencies at load time rather than expecting this information to be included in the data set.

Staff implemented a translator (called ViC) to support architecture independent parallel programming for NASA projects. The translator supports a subset of the C* programming language and is based on the data parallel programming paradigm. The ViC language is suitable for implementing computational fluid dynamics (CFD) applications that employ a finite-element or finite-volume type computational model. These algorithms contain element-wise parallel operations that are easy to parallelize. They also contain communications, input-output, and initialization operations. The ViC translator allows the element-wise parallel component of an application to be vendor independent. It also provides a set of library calls written in the native language of the target architecture to handle the remainder of the support functions needed by the application. A translator approach was chosen, avoiding any code rearrangement to remain compatible with the vendor's native compiler and debugger tools.

A preliminary version of the ViC translator has been implemented on a cache-based Silicon Graphics workstation, a MasPar MP-1, a vectorizing Cray Y-MP, and a TMC CM-5, and then a single source text of a prototype CFD application, written using ViC, was run on these target architectures and results were verified.

In collaboration with Dr. Dorband (Code 933), staff developed and implemented a diffusion based smoothing algorithm for the phase retrieval problem and a phase unwrapping algorithm with reference to the Zernike analytical maps. A task member presented a talk, "Wiener and Kalman Filtering for Signal Processing—A Tutorial," to the NCCS HPCC group on September 9, 1993. A paper entitled "An Algorithm for Forward and Inverse Problems," coauthored by Dr. Dorband, was submitted to the *Journal of the Acoustical Society of America*.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

NONLOCAL TRAVEL

Staff traveled to Portland, OR, to attend a summer intensive workshop on high performance compilers. Staff also traveled to Boston, MA, to attend "Fundamentals of Detection, Parameter Estimation, and Kalman Filtering With Applications in Tracking, Control, and Signal Processing."

CONFERENCES

Staff presented the paper "Steps Toward a Machine Independent Parallelization of the Sanders and Weiser Algorithm" at Parallel CFD '93, May 10–12, 1993.

COMPUTER USE

Minutes	Computer
Dedicated	SGI
Dedicated	MasPar

NASA Task 33-172-00: EOS Pathfinder Support

GSFC ATR: ***M. Goodman***

Hughes STX Task Leader: ***A. Ritchie***
Hughes STX Task Number: ***391***

This task provides procedures for creating data sets of level 1 and 2 microwave imagery products from the Defense Meteorological Satellite Program satellites, adapts research quality algorithms to run in the Distributed Active Archive Center (DAAC) environment, and verifies the integrity of the resulting products using advanced visualization techniques.

FINAL CONTRACT SUMMARY

During the task, April 1, 1993, through September 30, 1993, Hughes STX staff has completed certification of significant amounts of scientist-supplied software. HSTX staff developed, tested, and coded corrections for 21 error types; baselined software; and established quality control procedures and production schedules for data products. The level of effort consisted of two chief scientists, one senior scientist, and one senior programmer/analyst.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff developed, coded, and tested 21 recommendations to correct identified errors in the input data and to improve the utility of the Pathfinder data sets. The resulting software was baselined, and changes will be configuration controlled. The specific production schedule was developed and coordinated with the DAAC archive manager.

WORK PERFORMED

The methodology to identify gaps or missing data in the input data stream and to properly locate the scan line within the HDF arrays was developed. The method had to be modified because the scan start times are rounded for the first 2.5 months, and the rounding led to ambiguities in computing the scan number immediately following the gap. The solution was to use the revolution numbers that are part of the input data. Extensive testing verified the accuracy of the technique.

The original HDF objects were modified to reflect a more logical grouping of similar information, e.g., a calibration object and a spacecraft object. Also, a new object of spacecraft ephemeris data was created using the "two-line" element sets stored at MSFC and an orbital prediction model.

Staff obtained the surface-type software and files from the Fleet Numerical Oceanography Center and implemented the routines on the DAAC computers. This software is used to provide the surface type associated with each pixel location. Because the pixel latitudes and longitudes are being corrected as part of the Pathfinder processing, the original surface types are inconsistent with the corrected values. The new surface-type values will be consistent and correct.

SIGNIFICANT ACCOMPLISHMENTS

All recommendations on the transformation of the input data to the Pathfinder data sets have been coded and tested. Processing of the Pathfinder data is ready to begin. The quality control procedures have been developed, and are being evaluated.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under a separate contract with MSFC.

WORK PLANNED FOR NEXT PERIOD UNDER SEPARATE CONTRACT

Staff will process, quality control, and have certified the SSM/I Pathfinder antenna temperatures; geolocation; surface type; and calibration, spacecraft, and orbital information, starting with August 1987 data. Staff will begin the validation and verification of the four geophysical product algorithms. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

NONLOCAL TRAVEL

One person attended the Shared Processing Network DMSP SSM/I Algorithm Symposium at the Naval Post Graduate School in Monterey, CA, from June 7–10, 1993.

COMPUTER USE

None.

NASA Task 32-173-00: Library/Brochure Development and Technical Writing and Editing Support

GSFC ATR: *J. Hollis*

Hughes STX Task Leader: *R. B. Estes*
Hughes STX Task Number: *356*

This task provides coordination, design, production, and technical writing and editing support for the publications and communications needs of the Space Data and Computing Division (SDCD). The task also involves the establishment of a Division Technical Library/Resource Center—including setting up a reference system that allows online access; ordering new journals, books, and technical reference materials on a regular basis; and monitoring the daily borrowing and use of library materials by Code 930 staff.

FINAL CONTRACT TASK SUMMARY

HSTX personnel wrote and edited articles for internal and external publications, including *SIAM* journals, OSSA's *Information Systems Newsletter, Goddard Weekly Report, FY 92 Headquarters Annual Report, SDCD News, Professional Profiles, Monthly Technical Reports, SMI Reports,* and *TRC Newsletters*.

Staff provided Code 930 quarterly accomplishments for the Information through Systems *Newsletter*.

Staff provided desktop publishing and graphics in support of Code 930 in the form of four-color transparencies for Annual Peer Reviews, materials for HQ and directorate personnel visits, and schematics such as computer configurations and division organization.

Staff provided desktop publishing and/or graphics for printed materials such as a four-color promotional piece for MS^2QP, informational pieces about the Division, and a Coast Zone Color Scanner poster.

Staff supported Code 930 meetings, including MS^2QP meetings, Director's Seminars, technical meetings, and planning meetings.

Staff created logo concepts for SeaWiFS project.

Staff migrated the Library data base from IBM hardcopy to the Macintosh in Hypercard. Staff categorized and labeled media for TRC tracking and online access. A data base of TRC resources and procured media for the Technical Resource Library was maintained.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX personnel completed the MS^2QP booklet. Staff edited and produced 27 reports for the *Goddard Weekly Report* (through 9/1/93), and edited and produced four *Monthly Technical Reports* and four *SMI Reports*. Staff designed and produced 22 color viewgraphs and worked on Professional Profiles. Staff assisted in the procurement process for the Phaser II SDX color dye-sublimation printer. Task personnel provided editorial support on the NCCS Science Highlights and assisted Dr. Halem with two MS^{2}QP meetings. Staff assisted in securing a new maintenance contract with Canon for the CLC 100, and upgraded Macintosh hardware and had faulty hardware replaced. Task personnel provided other support as needed and performed routine library and publication functions.

WORK PERFORMED

Writing and Editing Support
Staff is assisting C. Boquist (Code 932) with the NCCS Science Highlights.

Staff coordinated, edited, and formatted the division reports for Code SMI at NASA Headquarters (*Information Systems Monthly*).

Staff submitted ISO Newsletter accomplishments and an article to S. Dueck (JPL).

Staff assisted K. Pecnick (Code 930) in securing a new maintenance contract with Canon for the CLC 100.

Staff upgraded Macintosh hardware from a IIcx to an IIfx, and acquired two magnetic disk drives (Ehman) and one optical disk drive for the TRC from J. Fischer (Code 931). A drawing tablet attachment for the Macintosh was acquired and set up. This is attached to the IIcx, which is now used as the frontend for the scanner.

Staff worked with Dr. M. Halem, R.B. Estes (HSTX), and S. Tweedie (HSTX) to facilitate publication of the MS^{2}QP booklet.

HSTX staff took the first 3 hours of an 8-hour video course in Writing Excellence offered by the GSFC Learning Center.

Staff attended strategic planning meetings, provided attendees with meeting notes and copious quantities of auxiliary material for the purpose of producing a strategic plan, a 5-year plan and a presentation to the Peer Review Committee. Staff also provided writing, editing, graphics, and coordination support for the plans and presentations, as needed.

Staff gathered information to compile and complete the Professional Profiles for Division personnel.

HSTX staff assisted A. Davis (McDonnell Douglas) and J. Boroumand (HSTX) in the acquisition process for the Phaser II SDX color dye-sublimation printer and acquired a demonstration model to help complete the ESS Annual Review viewgraphs

Staff created transparencies on the Macintosh for the ESS Annual Review at the request of Fischer and for Dr. V. Salmonson (Code 900) at the request of Dr. Halem.

Staff met with Dr. Y. Yesha (USRA) in support of the Digital Library Foundation meeting scheduled for December and worked on the related data base and letter.

Staff expanded and improved the library data base system and pursued overdue books.

Staff wrote letters to MS^2QP members and coordinated the MS^2QP meeting attendance.

HSTX staff coordinated the collection of Code 930 highlights for the *Goddard Weekly Report* and wrote or edited the articles listed below for publication in June–September. Staff distributed weekly reports to selected personnel at GSFC and NASA Headquarters.

- *Goddard Conference on Space Applications of Artificial Intelligence*—R. Cromp/Code 930.1.
- *Ten University Projects Initiated by CESDIS Under HPCC Basic Research Program*—T. Pratt/Code 930.5.
- *ITSO Interacts With NSF-Sponsored Minority Education Research Program*—R. Cromp/Code 930.1.
- *SVS Journal Cover Image*—R. Twiddy HSTX/Code 932 and L. Koert/HSTX Code 930.
- *NASA Science Information Systems Booth at AGU and Electronic Poster Session*—C. Boquist/Code 932.
- *1993 Visiting Student Enrichment Program Commences*—M. Mack/Code 932.
- *Code 934 Image on Cover of* Federal Computer Week—J. Dorband/Code 934 and L. Koert HSTX/Code 930.
- *1993 Visiting Student Enrichment Program Lecture Series Inaugurated*—M. Mack/Code 932.
- *Rain Presence and Rain Rate From Satellite Imagery*—C. Vermillion/Code 930.2.
- *Code 932 Poser Presentation at AAS*—R. White/Code 932.
- *GOES-NEXT Ground Station for Air Force Global Warning Center*—M. Comberiate/Code 930.2.
- *Survey of Interest for NASA Science at Thule Air Base*—M. Comberiate/Code 930.2.
- *MDSDS Recovers From PDU Failure*—N. Palm, H. Domchick/Code 931.
- *July Goddard Atrium Teas and Posters Series Schedule*—R. White/Code 932.
- *NICOLAS Approaching Retirement*—B. Lev HSTX/Code 933.
- *A Special Tea and Poster Session*—I. Eberstein/Code 932.
- *American Astronomical Society Meeting Retrospective Held at Atrium Teas and Poster Sessions*—R. White/Code 932.
- *August Tea and Poster Session*—R. White/Code 932.
- *Data Systems Technology Working Group Meeting*—J. Tilton/Code 930.1
- *Cray Y-MP C98 Installation*—T. Schardt/Code 931.
- *Convex/UniTree Expands Capacity via Vaulting to Free-Standing Tapes*—E. Salmon HSTX/Code 931 and A. Tarshish/Code 931.
- *1993 Visiting Student Enrichment Program Concludes*—M. Mack/Code 932.
- *Convex C3820 Arrives for Beta Test*—E. Salmon HSTX/Code 931 and A. Tarshish/Code 931.
- *CRAY C98 Delivered*—B. Pfaff/Code 931.
- *GSFC Participation in NASA/ARC CRA*—L. Hamet/Code 934.
- *Goddard Atrium Teas and Posters September Schedule*—R. White/Code 931.
- *IGARSS '93 and Seiken Symposium*—J.C. Tilton/Code 930.1

Resource Center Development

Task personnel filed borrowed materials and entered new and donated material into the TRC data base. The following publications were received in the TRC:

Books

Discrete -Time Signal Processing
JPEG Still Image Data Compression Standard

Publish Yourself on CD-ROM
Structured Document Image Analysis
Satellite Monitoring of the Earth
The C Programming Book
Starting FORTH

Catalogs

Black Box Catalog Connectivity for the Macintosh, Spring/Summer 1993
Comp USA, The Computer Superstore
ComputerVision CAD/CAM and Computer Supplies & Accessories for Engineers, Edition One
Data Comm Warehouse
DEC Digital's Customer Update Issue October 30, 1991–May 10, 1993
DEC Authorized ADP Schedule Price List FY 93
DEC Professional Annual Buyers Guide
DECnet Hardware 1993 Winter Catalog
Digi-key Corp May–June catalog
Government Computer News, GSA Schedule Sourcing Guide (FY 93) to Information Technology Products
UNIX Central
Visualizations

Periodicals

Algorithmica
Aviation Week & Space Technology
BIT
Communications Week
Computer Language
Concurrency Practice and Experience
Digital Systems Journal
digital news & review
Federal Computer Week
Government Computer News
High Performance Computing Review
Inverse Problems
International Journal of Modern Physics C
IRIS Universe
Journal of Applied Meteorology
Journal of Computational Physics
Journal of Numerical Analysis
Journal of Parallel and Distributed Computing
Journal on Optimization
MacWeek
Maryland Windows
NASA Magazine
Network World
Open System Today

Science News
SIAM Journal on Optimization
Silicon Graphics World
Space News
SunExpert
The Sun Observer
SunWorld
Ultracomputers
UNIX Review
Workstation News

Manuals

FORTRAN Compatibility Guide

Reports

International Geographic Information Systems (IGIS) Symposium: *The Research Agenda, Volume I, Overview of Research Needs and the Research Agenda*
International Geographic Information Systems (IGIS) Symposium: *The Research Agenda, Volume 11, Technical Issues and the Research Agenda*
International Geographic Information Systems (IGIS) Symposium: *The Research Agenda, Volume III, Applications and Implementation*
SRC Technical Report SRC-TR-92-058: *Parallel Recurrence Solvers for Vector and SIMD Supercomputers,* by Harold E. Conn and Louis J. Podrazik
SRC Technical Report SRC-TR-92-062: *An Introduction to Compilation Issues for Parallel Machines,* by Maya Gokhale and William Carlson
SRC Technical Report SRC-TR-92-066: *A Polynomial Time, Numerically Stable Integer Relation Algorithm,* by Helaman R.P. Ferguson and David H. Bailey
SRC Technical Report SRC-TR-92-066: *Parallel Bisection for Finding Eigenvalues on Vector and SIMD Architectures (U),* by John M. Conroy and Louis J. Podrazik
SRC Technical Report SRC-TR-92-067: *RES: A Simple System for Distributed Computing,* by William W. Carlson
SRC Technical Report SRC-TR-92-068: *DBC Reference Manual,* by Judith D. Schlesinger and Maya Gokhale
SRC Technical Report SRC-TR-92-069: *The Petasys Supercomputer and a Class of Pseudo-random Number Generations,* by Steven Arno and Ken Iobst
SRC Technical Report SRC-TR-92-070: *Fast Logarithm & Exponentiation Approximations with Applications,* by Anna M. Johnston
SRC Technical Report SRC-TR-92-072: *Sparse Lu Factorization on Massively Parallel SIMD Computers,* by Steven G. Kratzer
SRC Technical Report SRC-TR-92-076: *A Massively Parallel Processor-in-Memory Array and its Programming Environment,* by Maya Gokhale, Bill Holmes, Ken Iobst, Ken Murray, and Tom Turnbull
SRC Technical Report SRC-TR-92-077: *Congruential Sieves on FPGA Computers,* by Nathan D. Bronson and Duncan A. Buell
SRC Technical Report SRC-TR-92-078: *Sorting on SPLASH 2,* by Duncan A. Buell
SRC Technical Report SRC-TR-92-079: *On a Parameterized Family of Quadratic and Cubic Fields,* by

Duncan A. Buell and Veikko Ennola
SRC Technical Report SRC-TR-92-080: *Parallel Recurrence Solvers and Related Applications on PETASYS*, by Harold E. Conn and Louis J. Podrazik
SRC Technical Report SRC-TR-92-081: *A Procedure for Solving Certain Simultaneous Generalized Pell Equations*, by Kiran Kedlaya
SRC Technical Report SRC-TR-92-082: *Performance of Networks Using Deflection Routing* by David Smitley
SRC Technical Report SRC-TR-92-083: *On Denominators of Algebraic Numbers and Integer Polynomials*, by Steven Arno, M.L. Robinson and Ferrell S. Wheeler
SRC Technical Report SRC-TR-93-089: *Matrix Multiplication on PETASYS/TERASYS*, by Harold E. Conn and Louis J. Podrazik
SRC Technical Report SRC-TR-93-091: *A Parallel Implementation of the Invariant Subspace Decomposition Algorithm for Dense Symmetric Matrices*, by Steven Huss-Lederman, Anna Tsao, and Guodong Zhang
SRC Technical Report SRC-TR-93-092: *A Comparison of Algorithms for Banded Matrix Multiplication*, by A. Tsao and T. Turnbull
SRC Technical Report SRC-TR-93-094: *AC: A C Language and Compiler for the CM-5 Node Architecture*, by William W. Carlson and Judith D. Schlesinger

HSTX personnel helped Division staff create viewgraphs and copies on the color laser copier. As of this report, 100,750 copies were registered on the meter; 2,677 of these were made during the reporting period.

PROBLEM AREAS

The Mac IIfx internal hard drive crashed and considerable time was spent getting it reinitialized and set up; it subsequently crashed again and was replaced.

Distribution of the *SDCD News* was chronically held up in the review process, and because customer interest seems to be vague at best, it will no longer be produced unless it is requested by Government personnel.

SCHEDULE CONFORMANCE

Work on this task is completed; work will continue on a new task under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX staff will coordinate, write, and edit articles for the *Goddard Weekly Report*.

Staff will continue to support the SDCD CLC 100 color copier and the MicroTek Scanner, and will begin to support the TekTronix Phaser IISDX color printer.

HSTX staff will coordinate, collect, and edit submissions for the Space Data and Computing Division's Monthly Technical Report and for the *Information Systems Monthly*.

Staff will work on the November presentation to the Peer Review Committee, Professional Profiles, the Strategic Plan, and the Five-Year Plan.

Staff will function as Dr. Halem's MS^2QP assistant, per his request, writing letters to members and coordinating meeting attendance.

Staff will continue to maintain and acquire new books and periodicals for the TRC Library.

The Work Control Plan for this task will be updated for the new contract as needed to meet requirements of the new task assignment.

COMPUTER USE

Minutes	Computer
960	LAS and MPP VAXes
Dedicated	Macintosh IIfx
Dedicated	Macintosh IIx
Dedicated	Macintosh IIcx

NASA Task 32-174-00: Advanced Data Flow Technology Office

GSFC ATR: ***P. Gary***

Hughes STX Task Leader: ***P. Lang***
Hughes STX Task Number: ***357***

This task supports GSFC in the area of networking systems used to support the activities of the Roentgen Satellite (ROSAT) project, the Massively Parallel Processor (MPP) project, the Pilot Land Data System project, and other projects.

FINAL CONTRACT SUMMARY

This task has had from two to seven full-time positions.

The following lists most of the major milestones and accomplishments over the life of the task.

Online Help Services:

- Network Information Center Online Aid System (NICOLAS) was created.
- A new faster version of NICOLAS that allows easy login from any type of terminal was installed, regardless of protocol or hardware used. Also, staff developed several new automated NICOLAS utilities (including online phone directory and electronic delivery of GSFCMail or NASAMail session logfiles).
- NICOLAS Automated File Transfer Utility was rewritten to account for the new TCP/IP software, and a new utility was written and installed to allow users real-time access to GSFC LAN status information.
- Automated Electronic Mail Matrix utility in NICOLAS was installed.
- Gopher service was adapted from NSI-USO efforts. Staff began adding NICOLAS features, as well as many other data and links to the CNE Gopher.

Node/Rib Registrations:

- Unregistered Ethernet hardware addresses in buildings that were to be set up for filtering by Code 543 were begun to be resolved.
- Programs were created to process the raw SYBASE dumps and produce reports (e.g., number of machines in each code that are running a particular protocol).
- Version 1.0 of the Automated NETCOMMAND Updata Process Routine (ANUP) was completed.
- Node registration for TCP/IP nodes was streamlined and the backlog of TCP/IP requests was eliminated.

Protocol Management:

- Tests to experiment with ip subnetting on the Goddard LAN were run.
- Programs were created to monitor the use the DECnet addresses.
- All zeroes ip broadcast address were transitioned to all ones.
- Programs were created to assist in the recovery of unused DECnet addresses, which include automated mailings to Rib managers.

- Future CNE multi-network architecture was developed and proposed (HSTX and ADFTO staff) the GSFC Network Steering Committee.

Security and Troubleshooting:

- Staff responded to "WANK" DECnet worm and helped identify, cleanup, and developed a vaccine program.
- Violent packet storms were resolved, and a "Stormwatch" program was developed and installed to give updates and sound an alarm.
- By direct request of the GSFC Associate Center Director, staff began production and distribution of and antivirus tool kit (MacSecure) for Macintosh users at GSFC and Wallops.
- Major revisions were made to MacSecure, including two informational HyperCard stacks concerning viruses and system errors. Also, staff made MacSecure available via AppleTalk, DECnet, and TCP/IP protocols, as well as in diskette form.
- Staff worked with various GSFC system managers, staff from ARC, and the NSA's Computer Emergency Response Team (CERT) to handle a number of break-ins at Goddard. Also, staff complied a Unix computer security kit and made it available via anonymous FTP.

MultiNet:

- Staff installed beta test Version 2.2 of MultiNet, and after testing worked with TGV Inc., to arrange for a site license for Goddard.
- Procurement of a GSFC site license for MultiNet was completed (STX and ADFTO staff). Staff began administering the site license, registering participants, created installation guides, helped with numerous installations, and developed user help files.

X.500/ERS:

- Staff began working on a pilot X.500 White Pages project with Peter Yee (NASA Ames Research Center) and other GSFC contractor staff, making the entire GSFC telephone directory available online through an X Windows application on node wp.psi.com.
- A working prototype of an E-mail Reflector Service (ERS) was designed to make use of the GSFC portion of the NASA's X.500 White Pages, tested and installed.
- Major work was performed on the X.500 Sybase program and in EMIG meetings.
- Began ERS beta test.

USEnet News:

- Several new UNIX-based USEnet News reader packages were acquired and installed for general use. They were made available to other network users via anonymous FTP. Also, staff worked closely with task members from TGV, Inc. to modify the VNEWS USEnet News reader for VMS systems, installed it on the SISC cluster and made it available to all cluster users.
- Continued management of GSFC's USEnet News server.
- Posting of the Goddard Dateline was automated.

UltraNet:

- Network configuration assistance was provided for the installation of the 1000 Mbps UltraNet interfaces for the NCCS Cray Y-MP8, a frame buffer/color display unit, and a SGI IRIS 4D workstation staff configured and tested a new CISCO router for support of the installation of UltraNet interfaces on the NCCS IBM 3081, a Sun 3/260, and another IRIS workstation.
- Staff helped bring up UltraNet hubs in Bldgs. 1, 22, and 28.
- Staff helped bring up UltraNet hubs in Bldgs. 21 and 26.

COBE Private LAN:

- Operation of a private link within the CNE for the COBE project was begun which involved procurement, installation, configuration for both hardware and software, and presentations.
- DEC's Distributed File Service (DFS) package was installed on AMARNA, the DFS disks were released to COBE users, and an IDL program for graphical analysis of usage data was developed.

Other:

- A pilot BITNET II link was established to Univ. of Maryland.
- Staff worked HSTX and ADFTO staff with representatives of Cray Computer Inc., and Code 930.1 to bring up GSFC's new Cray Y-MP to the LAN.
- FDDI testing using a Sun, a DECstation, and different FDDI concentrators was begun.
- Staff prepared for and then assisted in the removal of the VAX 8820 (DFTNIC) and the move of the DFTNIC identify to NSINIC, which involved a lot of coordination.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX's technical support of the Computer Network Branch (CNB, Code 933) has continued at an outstanding level. Staff members continue to maintain their excellent technical and problem-solving reputation while continuing to take on new tasks and responsibilities. Highlights for this period include work on requirements gathering for the new CNE database, transition to the all ones ip broadcast address, the retirement of NICOLAS, and the move of DFTNIC to a different platform.

WORK PERFORMED

Staff handled numerous requests for help from users, processed more than 15 user rib applications, and registered more than 800 new nodes on the GSFC LAN.

Staff provided GSFC CNE protocol management support for a network of more than 5100 registered IP addresses, more than 840 registered DECnet addresses, and more than 580 registered LAT devices.

Staff provided support for 183 systems participating in GSFC's MultiNet Site License for TCP/IP software for VMS operating systems.

Staff participated in GSFC CNE Network Technical Advisory Committee's discussion of WAN and MAN configuration policy and its implementation.

Staff worked with the summer student to create scripts that monitor the use of ip broadcast addresses, and to send messages to those system managers who systems are using the wrong ip broadcast address. Also created some scripts to help identify which ribs would be affected by the transition to the all one's ip broadcast address.

Staff made considerable progress on installing, testing and documenting the dialup IP server (SLIP/PPP).

Staff made tool for accessing SYBASE, UALIST and DECnet database information available to the helpdesk account on sled and to the members of the NSG-SS.

Staff built the gox500gw Gopher-X500 gateway and continued to add more items to the CNE Gopher.

Set up ERS backup system, (lego doing the mail part, toybox doing the X.500 part).

Staff members reviewed new revision of the EMIG document.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements of this task.

Staff will perform the following tasks:

- Support of general duties for protocol management, node registration, helpdesk, system management, gophers and USEnet News maintenance will continue.
- Tools for use from the helpdesk account for assistance with troubleshooting problems will be generated.
- The Spectrum Network Management system will be set up to monitor routers and smart hubs and to set up logging and alarms to trigger notification of certain types of network problems.
- Draft procedures and guidelines files for the CNE Functional Area Descriptions (CFADS) for the main functional areas covered by the NSG-LS will be completed.
- Menu structure will be finalized and programming the backend procedures for the New CNE Network SYBASE database will begin.

DELIVERABLES SUBMITTED

Program: Registered over 800 new nodes into the CNE's Network database
Originator: A. Muppalla

Program: Registration and support of 33 new nodes for participation in GSFC's MultiNet Site License Originator: D. Stern

Program: Processed over 200 ers-request messages for adding/changing E-mail addresses in X.500.
Originator: K. Patraska-Veum

Program: Mapped the 933 LocalTalk segment from the 930 LocalTalk segment
Originator: B. Lev, S. Rogers, J. Husain

Program: Created a table of dialup networking software versus platforms.
Originator: C. Shenton

Program: Made a presentation on ERS as a beta-test product to the Goddard LAN Users' Group meeting.
Originator: K. Patraska-Veum

Program: Generated reports for two rib managers to help clean up a subnet that had no available addresses. This report identified nodes that were no properly registered or had been moved to other ribs and need to be re-addressed.
Originator: P. Lang

Program: Prepared cheat sheets on how to change the ip broadcast address to the all ones broadcast address on different systems, and then made that available via anonymous ftp.
Originator: P. Lang

Program: Made presentation on EMIG to GSFC LAN User Group Meeting. Originator: K. Patraska-Veum

Program: Made presentation on EMIG work at ICCN VITS. Originator: K. Patraska-Veum

Program: Made presentation to GSFC NSC about X.500/ERS and the EMIG.
Originator: K. Patraska-Veum

Program: Created draft CNE Functional Area Description (CFAD) for the Helpdesk. This includes a draft procedures file.
Originator: Task group participation.

Program: Transitioned NICOLAS functions to the CNE Gopher so that it could be retired.
Originator: B. Lev, C. Shenton

Program: Transitioned DFTNIC off of the 8820 and on to (what was NSINIC, a MicroVAX 3300). Did major clean up.
Originator: D. Stern

CONFERENCES

HSTX staff attended an InterOp tutorial.

COMPUTER USE

Minutes	Computer
Dedicated	VAX, Sun, Macintosh, and PC's

NASA Task 32-175-00: Science Processing Support Office

GSFC ATR: ***Dr. Y.-C. Lu***

Hughes STX Task Leader: ***H.D. Chang***
Hughes STX Task Number: ***358***

The purpose of the Science Processing Support Office (SPSO) task is to collect and analyze information on science data processing and data access needs for the Earth Observing System Data and Information System (EOSDIS) project; provide data set analysis support of the Distributed Active Archive Centers (DAAC's) and Facility Instrument (FI), Principal Investigator (PI), and Interdisciplinary Investigator (II) teams; and to acquire and distribute atmospheric spectroscopy data sets to support the development of science algorithms.

FINAL CONTRACT SUMMARY

During the contract period from 1988–1993, the Science Processing Support Office (SPSO) was the main focal point for science information and analysis of science requirements issues. The SPSO compiled, synthesized, and disseminated Earth Observing System (EOS) related science information. Its major accomplishments, during the past 5 years, include: Earth Observing System Data and Information System (EOSDIS) RFP support, characterization of EOS data products, sizing analysis of the EOSDIS, development of an interactive, online system, called the Science Processing Data Base (SPDB), and publication of two versions of report documents on EOS output data products and input requirements.

The SPSO team of Hughes STX, played a key role in preparing the requirements specifications for the ECS Phase C/D proposal by characterizing EOS data products, performing sizing analysis of the EOSDIS, and analyzing the inter-DAAC data traffic. Most of the information provided by the SPSO was adopted and included as key requirements in the Phase C/D specifications.

The SPSO also developed an interactive, online system called the SPDB. The SPDB is used to provide key science information to support the inhouse study teams, to design and size of the EOSDIS, and to provide the EOS science user community with EOS-related science information, such as output data products, input requirements, investigators, instruments, and platforms. The original character-based SPDB was further enhanced by implementing a Graphical User Interface (GUI) version to support the X-terminal users.

The SPSO also developed a multilevel sizing analysis model for the sizing analysis of the EOSDIS. The model, that was originally developed to support EOSDIS RFP preparation, was greatly improved and became an important sizing analysis tool for the EOSDIS.

The SPSO has published two versions of multivolume report documents, based on the information compiled and synthesized by the SPSO since March 1989. The SPSO report documents, that were published twice in August 1991 and August 1992, provide the latest information on EOS output data products and input requirements for 30 EOS instruments and 29 Interdisciplinary Science (IDS) Investigators. The documents contain information on characteristics of over 2,400 EOS output and input data products and 200 non-EOS data sets required by EOS investigators.

In addition, the SPSO has responded in an efficient and timely manner to numerous requests for science information from Government personnel at both GSFC and NASA HQ. High-quality outputs by the SPSO was greatly appreciated by the ATR and two of the SPSO staff received commendation letters for their outstanding performance from the ATR.

SUMMARY FOR CURRENT REPORTING PERIOD

The SPSO staff prepared data product survey forms that were sent to 18 EOS instrument teams and one interdisciplinary investigator in July. The survey forms were designed and prepared at the request of the EOS Senior Project Scientist, Dr. M. King, to obtain updated data product and parameter information.

The Master Data Product Data Base (MPDB) was extensively revised, based on updated data product and parameter information from instrument team surveys. Characteristics of the 223 data products consisting of 615 geophysical parameters were reviewed, updated, and incorporated into the data base. The updated data product information was used to identify the top priority data products and analyze the storage and processing requirements for the EOSDIS. The updated product lists and a new set of storage and processing requirements for the EOSDIS were prepared and delivered to the ATR and to the EOS project scientist.

The SPDB, that provides information on EOS platforms, instruments, investigators, data products, and algorithms, was modified to include the latest data product and parameter information which became available in a recent data product survey. In addition, the SPDB was expanded to provide additional information on test sites and field experiments in response to a request from Dr. Bruce Guenther of GSFC.

The Atmospheric Spectroscopy Data Base (ASDB) was greatly enhanced by developing a GUI version which was developed to support X-terminal users. The contents of the ASDB was also expanded by implementing additional ultraviolet (UV) and visible data obtained from various research institutions. A status report on the ASDB was prepared and submitted to the ATR. The report, which was prepared at the request of the ATR, summarizes the background, objectives, current, and future activities of the ASDB. The report also describes the UV and Visible Line Atlas that was compiled and archived by the SPSO.

WORK PERFORMED

100 SCIENCE DATA PRODUCT CHARACTERIZATION

120 Refine Existing Information

The SPSO quickly and efficiently incorporated the full set of updated data product information received from all EOS instrument teams in response to the product survey forms prepared by the SPSO during June 1993 at the request of the EOS project scientist. The EOS data product information was extensively revised, incorporating updated information received from 18 instrument teams. The Master Product Data Base (MPDB) was restructured to accommodate extensive product reorganizations made by the instrument teams. In many cases related data products were regrouped into single products containing multiple parameters. This restructuring better reflected the way geophysical parameters are to be produced by the various retrieval algorithms. The MPDB for instrument data products now consists of three related, linked spreadsheets, one containing the full set of information for products and parameters, analogous to the product survey form, a second containing the list of data products, one record per product, and a third containing complete information on all geophysical parameters. This restructuring greatly facilitates production of the many product and parameter reports and analyses which the SPSO routinely prepares for the EOS project office.

To facilitate preparation of the product and parameter lists, programs were written for automatic extraction of the individual product and parameter spreadsheets from the complete MPDB, with appropriate reformatting of the tables. Additional programs were written to separate relevant portions of both the product list and parameter list for printing. Information changes were marked in the MPDB using different colored fonts. The printing preparation routines automatically italicize every cell containing these marked changes so that changes can be recognized on standard black and white printed reports.

200 ANALYSIS OF SCIENCE DATA PRODUCTS

210 Data Dependencies

The SPSO prepared a report on data dependencies, based on the SPSO analysis of 157 retrieval algorithms planned by EOS instrument teams. The results were presented by the ATR at the Third Data Processing Focus Team (DPFT) meeting in New Carrollton, MD in June. More recent data dependency information provided by instrument teams, in the July 1993 data product survey, was incorporated into the MPDB and a preliminary analysis to identify interinstrument relationships was performed.

250 System Sizing Analysis

A preliminary analysis of storage and processing requirements for the EOSDIS was performed, based on updated data product information provided by instrument teams in a recent data product survey. A set of new requirements, including data volumes and processing load estimates by platform and processing level, were prepared and delivered to the ATR and EOS Senior Project Scientist, Dr. King.

Programs were developed for an automatic sizing analysis of the EOSDIS. The programs, based on EXCEL Macros, were developed to perform various customized sizing analyses of the EOSDIS and were capable of generating many different types of tables for storage and processing requirements. These automated procedures have saved many hours of manual work and allow the SPSO to respond quickly to requests for information from the Earth Science Project Office (ESDIS) and EOS project scientist.

300 INFORMATION DISSEMINATION AND REVIEW

330 Online Science Processing Data Base

The SPDB was expanded to include additional data base, called Test site/Field experiment Data Base (TFDB) that was designed and developed in response to a request from Dr. Guenther of GSFC. The objectives of the TFDB are: 1) to serve as the central repository for the collection, archival, and distribution of the test site and field experiment information relevant to the EOS Program; 2) to support the EOS calibration and validation activities by providing a mechanism to share the most up-to-date test site and field experiment information among EOS science users; and 3) to act as a source of EOS scientific information that is complementary to the EOSDIS SPDB that provides comprehensive information on EOS instruments, platforms, data products, algorithms, and investigators. In addition, a proposal for the TFDB was prepared and delivered to the ATR.

400 ATMOSPHERIC SPECTROSCOPY DATA BASE SUPPORT

420 Data Acquisition

UV and visible line for light elements, H, He, Li, Be, B, C, N, O, F, and Ne was compiled in cooperation with the NIST. Total data size of these line lists are several megabytes. C2H2 photo absorption cross section data were obtained from Dr. J. R. Esmond of Harvard-Smithsonian Center for Astrophysics, Cambridge, MA. The data includes strong absorption features in the wavelength range 1,470–2,010. The cross sections were measured at 195 K and 295 K. The size of this data is about 800 KB. Three new UV and visible line lists for SH, CO+, and H2O+ were implemented in the ASDB. The new data sets contain line positions, Einstein A coefficients, vibrational and rotational quantum numbers. Two old UV and visible data, CO and S2, were updated, and implemented in the ASDB. Dr. P. Brekke (Inst. Theoretical Astrophysics, University of Oslo, Norway) provided solar spectra covering the 1,190–1,730 range. The data consist of solar spectra of active region, quiet region, sun spot, lightbridge in sun spot, etc. These data, of which size is about 3 MB, were obtained with the High Resolution Telescope and Spectrograph (HRTS) during a rocket flight in 1978. The spectral resolution of the instrument was 0.05 at a spatial resolution of 1.8 in.

430 Development of Online System

The prototype ASDB was substantially improved. The most significant improvement is the development of the GUI version of the ASDB to support the X-terminal users. The GUI version was extensively tested by the SPSO, and demonstrated to the ATR.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Updated data product information will be uploaded into the SPDB. Algorithm data base will be revised to reflect updated data product information. Final analysis of storage and processing requirements for EOSDIS will be performed. Staff will attend MODIS Science Team meeting at GSFC and the EOSDIS V0 User Services and Data workshop in Saginaw, MI.

CONFERENCES

Staff members attended the third and fourth Data Processing Focus Team meetings in New Carrollton and College Park, MD. A staff member also attended the first EOSDIS Data Organization and Access Focus Team meeting in College Park, MD.

DELIVERABLES SUBMITTED

Table:	High-Priority EOS Standard Product List: A set of 3 tables which contains the top priority, at-launch standard data products for 3 EOS satellites (AM, PM, and flights of opportunity)
Originator:	H. D. Chang
Document:	EOS Data Product Lists of at-launch and post-launch data products and parameters to be generated by 18 EOS instruments
Originators:	H. D. Chang, L. Cheng, B. Krupp, A. Swaroop, and L. Wanchoo
Proposal for the TFDB:	A report which describes a Test Site/Field Experiment Data Base (TFDB) designed and developed by the SPSO
Originators:	H. D. Chang and L. Wanchoo
Document:	A Status Report on the ASDB A summary report which describe the background, objectives, and current and future activities of the Atmospheric Spectroscopy Data Base (ASDB)
Originators:	H. D. Chang and S. Kim
Document:	Volume and Storage Requirements for EOSDIS storage and processing requirements, based on the new EOS data product information
Originators:	H. D. Chang, L. Cheng, B. Krupp, A. Swaroop, and L. Wanchoo

COMPUTER USE

None.

250

NASA Task 32-177-00: MHD Coding

GSFC ATR: *Dr. S. Zalesak*

Hughes STX Task Leader: *Dr. P. MacNeice*
Hughes STX Task Number: *361*

The objective of this task is to develop and implement techniques for numerically modeling plasmas, with particular attention toward porting the new algorithms to the Cray Y-MP and to massively parallel architecture SIMD machines. The techniques should encompass fluid, particle, and hybrid codes suitable for multidimensional, time-dependent problems in space and astrophysical plasmas.

FINAL CONTRACT SUMMARY

This task began in February 1989 and was supported by one senior scientist. Hughes STX staff coauthored an article on Non-Maxwellian Electron Velocity Distributions in Models of the Solar Atmosphere that was published in the *Ap. J.*

Staff members delivered an invited review on Transport Processes in the Solar Atmosphere at the OSL workshop. A paper based on this talk was published in the workshop proceedings.

Staff edited the OSL workshop proceedings, which were published by the American Institute of Physics in its Conference Proceedings series. Task personnel ported a 2-D finite element hydro code to the MasPar. Staff completed the final draft of an invited contribution to a monograph on Solar Physics that is being prepared.

HSTX personnel completed development work on a 3-D electromagnetic particle code. Upgrades were made to both Cray and MasPar versions of the code. Task members delivered a talk on this work at the Sixth Society for Industrial and Applied Mathematics (SIAM) conference on parallel processing for scientific computing. An article describing this work appeared in the conference proceedings. The text of the article published in the conference proceedings was expanded for circulation as a NASA technical report.

Task members completed preparation of a set of lectures on particle codes and delivered them at the NASA High Performance Scientific Computation Summer School.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff completed preparation of a set of lectures on particle codes and delivered them at the NASA High Performance Scientific Computation Summer School. Staff began preliminary work on porting the 3-D PIC code to the CM-5. Staff also began exploring the Cray T3D by using the T3D emulator program running on the Cray YMP-EL. Staff also began work on an algorithm for anisotropic thermal conductivity in plasmas with strong magnetic fields.

WORK PERFORMED

Detailed information on this task is provided in the regular monthly reports.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be prepared to meet the requirements of this task.

COMPUTER USE

Detailed information on this task is provided in the regular monthly reports.

NASA Task 32-178-00: Data Compression

GSFC ATR: *Dr. J. Tilton*

Hughes STX Task Leader: *E. Seiler*
Hughes STX Task Number: *362*

This task develops data compression algorithms and techniques to be used to reduce the volume of space science data produced by NASA with the goal of maximizing data storage and transmission capabilities.

FINAL CONTRACT SUMMARY

The work for this 5-year task was performed by a single task member. The task was successful in developing a portable lossless compression application that was distributed throughout the NASA science community. Research on lossless data compression techniques was also performed and reported. The data compression expertise developed for the task was used to evaluate data compression techniques for the GSFC's Distributed Active Archive Center (DAAC) and to recommend a processing strategy for reducing the storage requirements of the DAAC.

Initially developed to meet the requirements of the Data Systems User's Working Group of the National Space Sciences Data Center, the CRUSH package evolved to become a highly portable and extensible data compression application that was distributed through the NASA Science Internet. Development of CRUSH continued throughout most of the duration of the task. CRUSH provides a collection of lossless compression algorithms, applicable to both general and image classes of data. Included is the ability to automatically select the algorithm that produces the best compression performance for a given data set from the set of algorithms provided. Another important feature is that compressed files produced by CRUSH are portable between VMS and Unix operating systems.

SUMMARY FOR CURRENT REPORTING PERIOD

Compression and throughput measurements were performed for data files to be archived at the DAAC. A final set of recommendations for the implementation of the DAAC data compression processing was delivered.

WORK PERFORMED

Assistance was provided to a summer faculty research fellow to investigate methods for improved lossless compression of images, and the results of the research were presented by the research fellow at a data compression conference.

The CRUSH package was used to measure both compression and throughput for a sampling of files to be archived at the DAAC. The results showed that a significant benefit in reduced storage requirements and reduced network load could be obtained by using data compression. The results were reported, and recommendations were made, for the development of the DAAC compression processing.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

This task was terminated during this reporting period. All work under this contract has been completed.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

COMPUTER USE

Minutes	Computer
240 (wall clock)	SGI

NASA Task 32-187-00: EOSDIS Data Archival and Distribution System Study

GSFC ATR: ***J. Berbert***

Hughes STX Task Leader: ***A. Dwyer***
Hughes STX Task Number: ***368***

This subtask studies the functional and performance requirements of the Data Archival Distribution System (DADS) within the EOSDIS project. The DADS is responsible for the archiving, retrieval, distribution, and management of all data and information acquired by EOSDIS.

FINAL CONTRACT SUMMARY

This task began during the Phase B period of the EOSDIS project in 1989 and came to a formal close on August 31, 1993. Throughout this period, the DADS task provided the ATR with advice and expertise about the status and evolutionary trends of technology related to mass storage systems, peripherals, and media.

The task supported the ATR in evaluating requirements, and optimal hardware and software configurations for the EOSDIS DADS. It contributed articles to the *EOSDIS Science Data Processor Newsletter* on technical matters. It wrote a comprehensive magnetic media document, which has become a useful reference. It has presented technical information to such audiences as IEEE, National Research Council, GSFC Data Compression Workshops, THIC, and many others. The DADS task's simulation studies were the first of their kind for the DAAC's, and one ATR stated that they benefitted them by providing clear and unequivocal answers to their sizing problems.

Another task initiative that will live on for many years is the GSFC Mass Storage and Technologies (MSST) conference, which has developed into a much-anticipated annual affair. MSST has provided the opportunity since 1991 for GSFC audiences to listen to and meet top experts in their fields, and MSST publications have now become standard reference materials in many Government agencies.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff completed and made copies for distribution of the Magnetic Media Document. Staff also completed a simulation document that presented the results of simulating the STK 4400 automated cartridge system. Plans and preparations were made for the 1993 NASA conference on MSS including a paper to be presented by this task's staff, and additional technical presentations were prepared for THIC and National Research Council meetings.

WORK PERFORMED

Reference Documents

Staff reviewed and delivered the final version of the Magnetic Media Document. Copies have been made, and these were sent out according to an ATR-prepared distribution list.

Staff reviewed and delivered the final version of the report entitled "Performance Simulations for Selected Storage Devices."

V0 GSFC DAAC Engineering Support

Staff prepared and delivered a report describing the architectural model of the GSFC V0 DADS.

Staff prepared a series of tests to evaluate the V0 DADS. The purpose of these tests was to determine the amount of data that can realistically be ingested and distributed at the V0 DADS. These tests also were used to validate the simulation model of the DADS.

1993 Mass Storage Systems and Technologies Conference (MSST '93)

Staff worked on planning and organizing this October 1993 conference. In addition, staff prepared a paper entitled "Simulation of a Data Archival and Distribution System at GSFC," which will be presented at MSST '93.

Vendor Meetings

Staff attended a meeting with OpenVision on July 29 to discuss performance issues and the future of the UniTree products.

Staff attended a presentation by Asaca Corp., on June 9. Asaca developed a robotic media autochanger that holds up to 2,400 disk cartridges for a total capacity of 2.88 TB. This magneto-optical disk drive has a sustained read rate of 10 MB/s.

Staff attended a presentation by Optivision on compression on June 10. Optivision discussed their compression algorithms (recursive, block coding, wavelets, and MPEG), compression hardware (Optipac), and compression chip hardware (fully programmable).

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

This task ended on August 31, 1993.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None. This task ended on August 31, 1993.

CONFERENCES

Staff prepared a presentation to be given at the October 1993 THIC conference in Annapolis. This will focus on describing the discrete event model developed to simulate the DADS, and in presenting the results obtained under varying conditions.

Staff gave an invited talk to the National Research Council on July 7 at its offices in Irvine, CA, on long-term data storage and retention technologies.

COMPUTER USE

None.

NASA Task 32-188-00: NSI User Support Services

GSFC ATR: ***P. Gary***

Hughes STX Task Leader: ***B. Lev***
Hughes STX Task Number: ***369***

This task provides advanced technical support services in the area of user support services, network applications development, and network operations to extend and enhance the NASA Science Internet (NSI) and to meet Advanced Data Flow Technology Office (ADFTO) responsibilities to the NSI Project Office (NSIPO).

FINAL CONTRACT SUMMARY

Over the life of this task, the NSI User Support Office (USO) staff delivered work of extremely high quality in a timely manner, despite several major changes in the NSI Project itself. In addition to garnering much appreciation from the user community, the staff's work was of such high quality that the NSI Network Information Center (NIC) won (and held) categorization by the Chair of the IETF User Services Working Group as a "Notable NIC," an honor reserved for only a dozen NIC's worldwide, within the first 18 months of its operation. This was despite the fact that, from September 1992 through the beginning of March 1993, staff worked without guidance concerning budget or feedback of any kind concerning the Transition Plan delivered to NSI Project Management at NASA Ames at the end of September, in spite of the ATR's and staff's best efforts at acquiring such input. Other highlights of the work performed over the life of this task are listed below.

A Help Desk function was created as part of the NSI NIC; the Help Desk consistently resolved over 90 percent of the several thousand user requests it received (via E-mail, telephone, fax, and personal contact) within 24 hours. Staff developed and maintained a number of online services: the NSI Online Network Aide (NONA), a menu-driven information server running under VMS and accessible through DECnet, TCP/IP, and dial-up links, which was used by NASA researchers and affiliated institutions around the world (work was underway to port NONA to a Unix environment when funding to GSFC was stopped); the NSI File Cabinet, an information and software repository available via both Anonymous FTP and DECnet "copy," which comprised over 70 directories containing approximately 2,000 files and which averaged several hundred accesses each week; the NSI_DB service, which replaced the out-of-date SPAN_NIC node data base lookup utility with a faster, more easily maintained interactive system; the NSI Passthru Account, which allowed users with limited systems access connectivity to the entire NSI; and the NSIrelay and NSI Electronic Postal Facility (EPF)/POBOX systems, which supported the International Forum on the Scientific Uses of Space Station (IFSUSS) program, AAS High Energy Astrophysics Division (HEAD), and Applied Information Systems Research Program (AISRP). Other automated systems NSI USO staff worked on included the IKI-NASA gateway, which was shut down after a short period because of the political and financial situation in the then-dissolving Soviet Union, and automated access to the ESA's Columbus Utilization Information System (CUIS), which involved only a small number of users at NASA HQ. Staff also laid the foundation for GSFC's current Gopher/WAIS server by bringing up a pilot system under the auspices of the NSI, and brought up a Unix-based BITNET-style LISTSERV system for a planned NSI "online forum" that was abandoned when the project was restructured.

In other work, HSTX personnel delivered presentations and helped staff NSI booths at numerous groups' conferences around the country, including the AAS, AGU, the Internet Engineering Task Force (where staff cochaired the User Documentation Working Group meeting), and SURAnet. Staff had similar involvement with such NASA groups and projects as JOVE, MU-SPIN, AISRP, the Lunar and Planetary Science Conference, and the EOSDIS DAAC User Services Working Group. The NSI USO also arranged, hosted, and published proceedings of the highly successful 3rd Annual NSI User Working Group meeting in April 1992, created numerous user-oriented guides on aspects of networking and the NSI, delivered several updates of the "MacSecure" antiviral tool kit, and published articles on NSI user support services in a variety of NASA journals and publications.

SUMMARY FOR CURRENT REPORTING PERIOD

During this reporting period, the NSI USO staff completed the phaseout of all operations—the NSI NIC, online information servers, network applications development, et al.—in accordance with orders of NSI project management. Files requested by the NSI management or operations staff were sent on tape and/or electronically to NSI systems at NASA Ames, and the online systems maintained by the NSI USO were either shut down or handed over to users, as appropriate.

WORK PERFORMED

The NSI USO staff has completed closing down operations in accordance with NSI management's instructions; after providing the NSI USO with no feedback on a proposed Transition Plan delivered at the end of September 1992, NSI management notified the NSI USO on March 2 that the project was changing over to a new "distributed NIC" structure and that the NSI NIC at GSFC was to shut down at close of business March 31. During this reporting period, the last remaining network configuration files for NSI-DECnet were updated and transferred to an NSI system at NASA Ames; online system login banners and the Help Desk phonemail greeting were changed to notify users of the change in operations; the NSI Online Network Aide, the NSI Passthru Account, and the NSI_DB account were shut down permanently, with copies of any requested files forwarded to NSI Operations staff; management and operation of the NSI USO's Help Desk phones, Gopher server, LISTSERV, and the NSI File Cabinet were moved into GSFC's Network Support Group for Large Systems to become GSFC-local support functions; and work done on the POBOX and NSIrelay systems was either terminated or handed off to users as appropriate. Work was begun to more smoothly integrate the Gopher server and NSI File Cabinet into GSFC-local support roles, and preparations were begun to rename and reassign all NSI hardware left with the NSI USO.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue as directed by the ATR under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work will proceed as directed by the ATR. A Work Control Plan will be prepared to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh

NASA Task 32-191-00: EOSDIS Version 0 System Engineering Support

GSFC ATR: ***K. McDonald***

Hughes STX Task Leader: ***T. Johnson***
Hughes STX Task Number: ***371***

This task supports the EOSDIS Ground Systems and Operations Project (GSOP) Systems Manager in the development and implementation of EOSDIS Version 0 (V0).

FINAL CONTRACT SUMMARY

Staff conducted studies to examine Earth Observing System Data and Information System (EOSDIS) Version 0 (V0) technical issues.

Task personnel completed an indepth comparison of the Version 0 Distributed Active Archive Center's (DAAC's) software and hardware plans. This study resulted in recommendations for a compatible and consistent Information Management System (IMS).

Staff analyzed requirements for porting TAE+ to a Silicon Graphics machine and provide resource and cost estimates.

Task personnel analyzed issues concerning an end-to-end performance monitoring system and made recommendations for this component of the EOSDIS Version 0 system. A performance monitoring scheme was developed in outline form.

Staff specified, designed, and implemented the message passing software as a key component of the EOSDIS Version 0 system. The performance monitoring software was added as an enhancement to collect data for performance monitoring during the message passing process.

SUMMARY FOR CURRENT REPORTING PERIOD

No work was requested on this task by the ATR for this reporting period.

WORK PERFORMED

No work was performed on this task.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Work will proceed on this task at the request of the ATR.

COMPUTER USE

None.

NASA Task 32-192-00: EOSDIS IMS Version 0 Support

GSFC ATR: ***K. McDonald***

Hughes STX Task Leader: ***T. Johnson***
Hughes STX Task Number: ***372***

This task supports the early development of an Earth Observing System Data Information System (EOSDIS) Information Management System (IMS) capability, with the primary goal of providing the science research community with improved access to existing Earth science data, information, and data system services. The Version 0 (V0) IMS will be developed as a collaborative effort by representatives of the Distributed Active Archive Centers (DAAC's) and the GSFC IMS team, supported by Hughes STX personnel. In addition to developing the system-level capabilities, the IMS team will coordinate the information management tasks that are performed at each of the DAAC sites.

FINAL CONTRACT SUMMARY

In fiscal year 1991, staff led the development of the Version 0 IMS proof-of-concept prototype. This client/server prototype displayed the capability to search distributed, heterogeneous data system inventories and merge the results at the client. An interoperability model for the development of the prototype was selected, and four DAAC's were identified to design and implement IMS servers. The system-level team and the DAAC's agreed upon the client/server protocol, inventory search parameters, and inventory result attributes. Staff personnel established definitions of standard communication messages for interoperability and Dependent Valids list for the user interface. Staff personnel completed the development of an Character User Interface (ChUI), and the system was successfully demonstrated to the IMS Science Advisors.

During the next year, staff completed the development of Release 2 of the IMS prototype. This release was developed based on user feedback captured from the proof-of-concept prototype and additional system requirements. Both a ChUI and a Graphical User Interface (GUI) were developed for this release. These interfaces featured Inventory Search, Dependent Valids, Results Integration, Directory Search and Results, Product Request, and Inventory Details. In addition, the Visual Aids subsystem was developed and integrated with the GUI. This subsystem featured the Geographical Coverage Selection Map, Coverage Map, and Image Display functions. The message passing syntax was revised to support the Object Definition Language (ODL), and the message passing software was redesigned to support the new client/server protocol. Interoperability also was extended to the three remaining DAAC's. The demonstration of this release to NASA HQ was extremely successful, and all were impressed with the amount of work completed during this short development phase.

The Data Dictionary and Guide subsystem development activities began as the implementation Release 2 was in progress. The requirements for the data dictionary and database schema were developed and reviewed by the IMS system level and DAAC development teams. The construction of the data dictionary began. In addition, the first draft of the IMS Lexicon was completed. Staff personnel began to gather requirements for the Guide system. An initial study of existing Guide systems was completed, and a set of high-level requirements were developed and presented to the IMS Science Advisors for review.

In fiscal year 1993, the design and implementation of the Version 0 IMS Alpha-1 release (release 3) was completed. As in earlier releases, the requirements were based on feedback from the IMS science users. This release provides users with an enhanced user interface and new functions that allow users to save and restore search parameters and to store granules of interest on a selection list. In addition, the Directory function was extended to link to the GCMD ChUI.

The Data Dictionary team completed the construction of a systemwide data dictionary. A report was published and made available to the IMS development team and to the EOS Core System (ECS) contractor for review.

Staff led the development of the initial Guide prototype. A high-level plan was completed, and user requirements, an operational scenario, a tool evaluation report, document standards and instructions, and a design document were prepared. Staff led the development work at the GSFC and NSIDC DAAC's and the prototype was successfully demonstrated to the EOSDIS Version 0 Project office.

Staff began extending interoperability to the International information systems as part of the CEOS Inventory Interoperability Experiment (CINTEX). Staff provided technical support to Germany (DLR) and the United Kingdom (DRA) in the development of IMS servers. These servers were completed and demonstrated to the CEOS Catalog subgroup meeting. Staff also has completed the design of the IMS Bridge, which will support access to the DAAC archives from the User Interface Terminal (UIT) that was developed for ESA.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff completed the redesign and implementation of the IMS GUI for the Alpha-1 release. The complete user interface layer was enhanced based on user feedback and requirements modifications. In addition, several new functions were added to improve system usability and flexibility.

Staff completed several major modifications to the IMS core software. The Mark and Scroll software was redesigned to improve system performance and consistency. The Data Manager and Network manager were enhanced to provide performance data and user statistics. In addition, a new version of the network manager was released. This version provides the capability to detect server failures during a search request.

Staff completed the enhancements to the Visual Aids subsystem. The Geographical Coordinate Selection Map now supports north and south polar projections. The Coverage map was enhanced to display the coverages of multiple granules. The Image Display software now supports the decompression of images at the client.

Staff completed the initial Guide subsystem prototype. This system was successfully demonstrated to the EOSDIS Version 0 project staff, and all were impressed with this new IMS capability.

Staff assisted the CINTEX partners in Germany and the United Kingdom in the development of IMS servers. The servers were successfully implemented and interoperability with the IMS was demonstrated to EOSDIS Version 0 project staff and at the CEOS Catalog Subgroup meeting.

Staff provided a high level of support to the IMS Science Advisors and Univ. of Virginia testers. In addition, staff continued to provide science requirements and direction for the continued evolution of the IMS.

The IMS system administration staff continued to support the IMS, SPSO, and GCMD projects. This work has been extremely valuable as the software development activities of these projects continued with out interruption.

WORK PERFORMED

100 IMS DESIGN STUDIES AND PROTOTYPES

Staff installed the Kerberos security system to allow further testing and evaluation of its capabilities for eventual support of IMS user access control.

200 LEVEL-3 INVENTORY INTEROPERABILITY PROTOTYPE

Staff completed the design and implementation of the IMS Version 0 Alpha-1 prototype. This system contains enhancements to all IMS subsystems and features, new color defaults, redesigned screens and menu bar, and a new capability that allows users to store granules on a selection list.

Staff redesigned and reimplemented the complete user interface layer of the IMS system. Inventory Search, Inventory Results, Product Request, User Profile, and Inventory Details were enhanced based on feedback from the IMS user community.

Staff redesigned the Granule Scrolling and Marking subsystem to provide more robust service to the User Interface routines. The new system tracks all granule marks in memory to allow multiple changes without requiring disk I/O. It provides a read/free service that assures granules have the proper marks attached when read and ensures disk copies are updated as a side effect of freeing the buffer.

Staff completed color analysis and guidelines for the IMS GUI. The default colors selected were reviewed by the IMS Science Advisors and DAAC IMS developers. Both groups were very pleased by the new interface colors.

Staff designed and implemented the GUI screen management software that allows for multiple windows to be visible during a session.

Staff designed, coded, and distributed a new version (0.4) of the message passing software. This version implements "heartbeat" messages that allow the client to detect server failure. Installation of the new software is completed at the DAAC's.

Staff designed, coded, and tested a new version (0.4) of the network manager. This enhanced version provides additional robustness and resolved several memory leak problems.

Staff designed, coded, and tested routines to extract time stamps for major network messages to a separate log. This involved changes in the message passing code, as well as an additional routine to extract and reformat time stamp information from the system log. The log files are delivered monthly to the EOSDIS Network group.

Staff developed the new common layer software to support the new interactive/ftp browse requirements.

Staff modified code in the network manager, product request, data manager, and browse subsystems for output of performance/usage statistics information. Staff also provided information to the user interface development staff on logging the image display times.

Staff developed a new technique of displaying the IMS client/server communication status. This enhance version provides the capability for users to track the progress of the requests at each DAAC.

Staff completed the analysis, design, and coding of software that provides the capability to save and restore search criteria.

Staff updated the message passing data dictionary to reflect changes that are required for the Alpha-1 release. Copies were distributed to the DAAC's as well as the IMS team.

Staff presented the Alpha-1 systems design to the IMS Science Advisors and DAAC representatives in a July meeting held at GSFC. The meeting was very successful, and as a result requirements were finalized so that implementation of the Alpha-1 system could get underway.

Staff developed screen mockups of the Alpha-1 GUI. The screens were made available for testing to the IMS Science Advisors and DAAC technical staffs.

Staff refined the set of coding standards and procedures for development, testing, and review of GUI software in preparation for the Alpha-1 V0 IMS release.

Staff prepared draft versions of the Software Configuration Management Procedure and the Software Code Review Procedure.

Staff collected information for the analysis of automated software test tools.

Staff played key roles in the IMS team meeting held in Charlottesville, VA. Staff led several discussions and also developed a list of key work activities to be completed through July 1994.

300 IMS DIRECTORY SUBSYSTEM DEVELOPMENT

Staff completed the redesign and implementation of the IMS Directory subsystem. The directory function has been expanded to display Directory entries ordered by DAAC, and the interface screens were enhanced to improve usability.

The Global Change Master Directory client is now available through the IMS interface. This new capability provides users access to all GCMD directory entries.

400 IMS VISUAL AIDS DEVELOPMENT

Staff continued to lead and coordinate the development of the Visual Aids subsystem. In addition, staff organized and led weekly IMS Visual Aids teleconferences. These teleconferences were key in the continued successful development of the Visual Aids software.

Staff led development of a new Geographical Selection Coverage Map. This software was extended to provide the capability to select coverage in the north and south polar projections.

Staff led the development and integration of software that provides the capability to decompress images at the IMS client. The software supports JPEG, RLE, and Unix compressed HDF files. This capability will greatly improve the interactive browse network performance.

Staff enhanced the FTP Browse function to pack multiple FTP requests in one message. In addition, the Contact Information screen was modified to reflect the changes in the user profile information.

Staff has worked closely with the NSIDC and LaRC DAAC's to add the Integrated Browse function.

Staff integrated the new Coverage Map software that was developed at EDC. The new Coverage map supports many new features including the display of coverage for multiple granules.

Staff presented Visual Aids issues and future work proposals at the IMS Development Team meeting held at Charlottesville, VA.

500 IMS GUIDE SUBSYSTEM DEVELOPMENT

Staff continued to lead NSIDC and GSFC DAAC's in the development of the IMS Guide subsystem. The IMS Guide Team completed the development of the initial prototype of the IMS Guide subsystem. The functionality implemented includes the "More Info" capability, Guide search and results, hyperlinks to supporting documents through indexed terms, and access to guide documents from X-Mosaic, WWW, and WAIS clients.

Staff demonstrated the Guide prototype to the EOSDIS Version 0 project staff from GSFC. The demonstration was very successful, and the project staff was impressed with the this new capability and the innovative design.

Staff presented the Guide subsystem design and implementation plan to the IMS Science Advisors and DAAC representatives at the IMS Development Team Meeting held in Charlottesville, VA. Following the meeting, staff led an extremely productive Guide Team meeting that focused on design and implementation issues.

Staff set up and led weekly Guide team teleconferences. Participants included staff members from IMS, NSIDC, and GSFC.

Staff implemented a test version of the IMS client software that was extended to include a prototype version of the Guide subsystem. The user interface was enhanced to provide hooks for the Guide software and the underlying message structure was upgraded to support the new search parameters.

Staff completed and distributed the first draft of the Guide Design Document.

Staff completed the document "How to Create Version 0 Guide Documents" and distributed this to the DAAC's. These instructions will ensure that the DAAC's can begin writing Guide Documents as development of the subsystem progresses.

Staff completed the Requirements Specification, High-Level Plan, and Tool Evaluation documents.

600 IMS INTEROPERABILITY EXTENSIONS

Staff provided technical assistance to German (DLR) and UK's (DRA) CINTEX representatives in developing IMS servers. Both IMS servers are up and functioning. This system was demonstrated at the CEOS meeting.

Staff developed a joint document, "UIT Search Objects," with the German CINTEX team that details the format of the UIT Search Request files. Staff distributed the document to the CINTEX partners for review and comments.

Staff drafted a document, "UIT Workstation/Search Server Transfer Process," that details the configuration information necessary to use the UIT transfer agents.

Staff drafted a document, "Configuration Requirements of the Bridge," that details the configuration requirements of the IMS Bridge. The document also outlines how the Bridge will be accessed by the UIT workstations and the minimal configuration requirements for the process.

Staff drafted a document, "Analysis of the IMS Bridge Implementation Options," that analyzes the two options for the UIT-IMS Bridge software to be built for the ESA UIT—NASA EOSDIS IMS inventory interoperability.

Staff completed the high-level design of the IMS Bridge software that will support interoperability between the UIT and IMS system.

Staff met with representatives from NASDA (Japan's space agency) to discuss IMS interoperability with their EOS system currently being developed.

Staff attended the IMS Development Team meeting in Charlottesville, VA, and presented the status and plans for the CEOS Inventory Interoperability Experiment (CINTEX). Staff also met with NOAA, CIESIN, and Oak Ridge representatives to discuss extending interoperability to their sites.

Staff organized, coordinated, and participated in monthly CINTEX teleconferences.

Staff completed the first draft of the IMS Server Development guide. This document is available online and was distributed to the CINTEX partners at DLR, ESA/ESRIN, and NASDA. Staff started IMS-NOAA interoperability discussions with NOAA representatives.

Staff set up test accounts for CIESIN and Oak Ridge and provided information on how to access IMS information and how to run the clients. They also received hardcopies of the user's guides.

700 METADATA STANDARDS

Staff continued to attend GCDIS meetings to participate in the Thesaurus prototyping project that will improve the development and maintenance of IMS keywords.

Staff conducted monthly data dictionary teleconferences to address revisions to the DAAC data dictionary schema. Both the logical and data base schemes have been revised to improve the organization and quality of dictionary content.

Staff began work on preparing designs for new reports and views of data dictionary information from the DAAC's. These revisions will reflect the schema modifications and lessons learned in Phase-I development.

Staff started to collect requirements for the ESDIS data dictionary. These requirements are being collected for documentation, planning, and design of the data dictionary supporting the science team and IMS interface.

Staff completed a new draft of the IMS Version 0 Development Lexicon. Copies of the document were distributed to the EOSDIS Version 0 project staff.

Staff created definitions for all the IMS keywords and distributed this information to the DAAC's for review.

Staff collected requests for minor changes to several lexicon terms. In addition, a copy of the Lexicon was prepared for use in the Guide subsystem as a source of information for a Guide glossary.

800 IMS SCIENCE AND OPERATIONS

Staff continued to support the IMS Science Advisors and UVA testers. User comments from theses groups were captured and folded into the user comments data base to be tracked and analyzed. In addition, staff assisted several new users with accessing the system and provided them user accounts and the IMS getting started Guide.

Staff continued to provide science requirements and assist in the user interface design of the IMS prototype. This input is extremely valuable as it ensures the continued smooth evolution of the Version 0 IMS.

Staff worked on the Style Guide to improve the look and feel of the ChUI and GUI systems. This included reviewing numerous interface screens and working on improving the user friendliness of the IMS interface. Many suggested enhancements were based on user feedback and preferences.

Staff continued to review and revise the IMS Getting Started Document. The Data Set Availability matrix was updated to include anticipated data through July '94.

Staff organized, planned, prepared for and presented information at the IMS Design Team Meeting in Charlottesville, VA. In addition, staff provided support for network and equipment setup during the meeting. Staff also worked with the UVA testers in setting up and running the IMS in their native environment.

Staff completed modifications to both screen and context sensitive help text for the GUI and ChUI systems.

Staff continued to support and participate in several successful IMS demonstrations. The IMS GUI was demonstrated for Congressional staffers who were very enthusiastic about the systems progress and results. In addition, the system was demonstrated for a group of representatives from a South Dakota Native American Teachers Association.

Staff attended the Pecora Conference in Sioux Falls, SD, to assist the EOS Project support office with an EOS exhibit booth, to provide assistance in demonstrating the ESDIS IMS GUI interface and to attend presentations related to Earth science.

Staff completed revisions to and distribution of the Data Set Availability Matrix, the Keywords Valids Matrix, and the IMS Project Document Package. Staff began review and revisions to the IMS Getting Started Guide, the Guide Design Document, and the IMS System Quick Reference Guide. Staff made copies of the ChUI and GUI screens to be used in various IMS documents.

Staff continued to provide an excellent level of system administration support to the IMS, GCMD, and SPSO Version 0 projects. Staff performed routine maintenance on computer systems that included monitoring network traffic, setting up user accounts, performing backups, monitoring disk space usage, troubleshooting system problems, and reconfiguring system hardware and software to enhance performance.

Staff evaluated and tested color printers that would be useful for IMS demonstrations and documentation. A dye sublimation color PostScript printer was selected based on quality requirements.

Staff installed a version of the IMS system on the IMS operational workstation, Harp. This will improve the performance of demonstrations and enhance the productivity on the IMS development team.

Staff upgraded HP workstation operating system from 8.0.5 to 9.0.1.

Staff set up and installed a new IMS Sparc 10 workstation. Software installed include X11R5, FrameMaker, elm, and emacs.

Staff reformatted the SPSO data disk to eliminate read/write error messages. The disk was reformatted and reloaded. The 32-MB memory board was installed and verified.

900 PROFESSIONAL DEVELOPMENT

Staff developed a beginners Unix course that provides an excellent foundation for those users that are migrating work activities from VMS to Unix. Staff presented the class to IMS internal staff, Government staff, and other interested HSTX staff members.

Staff coordinated a hands-on, X-Windows programming course held at GSFC. This Learning Tree course prepared software developers for designing and implementing GUI's with Xlib and Motif. Attenders included several HSTX employees and Government staff members. All were impressed with the instructor and hands-on exercises.

System contact staff attended a Communications course.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will prepare a Work Control Plan that meets the requirements of contract NAS5-32350.

100 IMS DESIGN STUDIES AND PROTOTYPES

Staff will continue to perform design studies and develop prototypes as required.

200 LEVEL 3 INVENTORY INTEROPERABILITY PROTOTYPE

Staff will continue to enhance the IMS prototype and fold user feedback into the development process; reevaluate requirements for user access and user accounts; develop software to support this capability at the DAAC's and user workstations; reevaluate the Product Request subsystem and enhance this software as required; investigate multitasking and multitheading to improve performance; and upgrade the IMS alpha-numeric user interface.

300 IMS DIRECTORY SUBSYSTEM DEVELOPMENT

Staff will provide access to the GCMD GUI client from the IMS interface, and continue to improve the usability of the interface.

400 IMS VISUAL AIDS DEVELOPMENT

Staff will continue to enhance and provide new capabilities to the IMS Visual Aids subsystem.

500 IMS GUIDE SUBSYSTEM DEVELOPMENT

Staff will continue to lead Guide subsystem development activities.

The Guide subsystem will be integrated with the current release of the IMS prototype. In addition, the software will be extended to provide a full suite of guide services.

Staff will continue to set up and lead weekly telecons to discuss guide development.

600 IMS INTEROPERABILITY EXTENSIONS

Staff will begin the development of the IMS bridge software that will support access to the IMS DAAC's from the UIT system in the UK, Italy, and Germany; continue to work with the CINTEX partners in the development and testing of IMS servers; continue to coordinate extending interoperability to NOAA, Oak Ridge, and CIESIN; and meet with representatives from Russia to discuss development of a catalog system and interoperability with the IMS.

700 METADATA STANDARDS

Staff will continue to lead and coordinate the activities of the IMS Data Dictionary Team; work with the DAAC's to fine tune IMS standard keywords and keyword definitions; and will update the IMS Lexicon as required.

800 IMS SCIENCE AND OPERATIONS

Staff will continue to provide science requirements and assist in the design of the IMS system; support the IMS user community and coordinate and track user feedback; and develop and maintain IMS documentation.

DELIVERABLES SUBMITTED

IMS Guide Subsystem: Guide Subsystem Prototype
Originator: R. Pfister, H. Friedemen, and G. Sylvain

Interoperability Prototype: Alpha-1 Release
Originator: T. Johnson, R. Harberts, R. Pfister, and W. Barth

NONLOCAL TRAVEL

Staff attended USENIX conference in Cincinnati, OH.

Staff attended the American Geophysical Union Conference in Baltimore, MD.

Staff attended the User Services Working Group meeting in Boulder, CO.

Staff attended the IMS Development Team meeting held in Charlottesville, VA.

Staff attended the Pecora 12 Symposium held in Sioux Falls, SD.

COMPUTER USE

Minutes	Computer
Dedicated	IMS SGI
Dedicated	IMS SPARC 2
Dedicated	IMS Personal Iris
Dedicated	IMS HP
Dedicated	IMS SPARC 10

NASA Task 32-193-00: Astro-D

GSFC ATR: *Dr. R. Pisarski*

Hughes STX Task Leader: *M. Good*
Hughes STX Task Number: *373*

The objective of this task is to provide support for the high-energy astrophysics mission called Astro-D in the following areas: assists the ATR in planning the data processing system, plan and develop archiving and data distribution systems, produce working and tested modules of the system, and assist in integrating the whole data processing system.

FINAL CONTRACT SUMMARY

This task has supported the ASCA Science Data Center (ASDC) for 2 years. There are currently four programmers (systems programmers and programmer/analysts) assigned to this task.

Major milestones accomplished during this task's assignment period are:

- Design and development of the ASCA Processing System (APS), including data base design, Graphical User Interface (GUI), and a work control and planning subsystem.
- Design of the ASCA archiving system.
- Selection, integration, and test of hardware systems for the ASCA processing, distribution, and mass data storage system.
- Integration and test of the device driver for the ASCA jukebox.
- Processing (and reprocessing) of ASCA PV phase data.
- Writing of APS Programmer's Guide and User's Guide documentation.

The remaining objectives to be completed in this task under contract NAS5-32350 follow:

- Development and testing of operations procedures for AO data processing.
- Processing, distribution, and archiving of all ASCA U.S.-pointed observations.
- Delivery of public-domain ASCA data to the HEASARC.
- Upgrade of APS, with the XTE mission, to support multimission data processing and distribution.
- Upgrade of the ASCA archiving system, with the XTE mission, to support multimission data archiving.

SUMMARY FOR CURRENT REPORTING PERIOD

The focus for the current reporting period has been to develop Korn shell scripts and C programs to ingest, process, archive, and distribute ASCA PV phase data. Data tapes are being received on a weekly basis, with more than 12 GB having been received, ingested, and processed in this period. The team has also been working on redesigning the APS to allow data technicians to process the AO data.

WORK PERFORMED

100 SOFTWARE DEVELOPMENT

Software development for this period has been of two types. The first type is designed to ingest, process, archive, and make available PV phase data. The second type is designed to adapt the data base and GUI for AO phase data processing based on the lessons learned from the PV phase processing.

ASCA data processing has started, and many software adjustments have been made. Some raw data that the processing software expected are unavailable (e.g., as-flown timeline), and more data are needed by the FTOOLS than were originally planned (e.g., Euler angles); therefore, the software had to be modified to meet these new requirements. The team wrote C programs and Korn shell scripts to insert keywords in telemetry FITS files using FTOOLS, extract Euler angles from the PostScript file of the daily operations report, write processing products to the Building 2 jukebox, read and ingest raw telemetry from tar tape, and recover from hardware failures.

Using the PV phase as a model, staff modified the GUI to be used for the AO phase to ingest tar tapes, process the files for consistency checks (e.g., the operating system file name is identical to the internal file name in FITS keyword, and reflects the correct time for the observation), and properly catalog them to a data base.

200 SYSTEMS/NETWORKING/COMMUNICATIONS

The ASCA optical disk jukebox is now in use for archiving the telemetry data and the results of processing. The team worked closely with USDesign to eliminate bugs and test the software to support the Cygnet 1802 optical disk jukebox. Several enhancements to the software were requested by Hughes STX staff and included by USDesign.

300 DATA STORAGE/DATA MANAGEMENT

To date, 20 raw telemetry tapes and 3 replacement tapes have been received from Japan. The 20 tapes are for PV phase observations, and they have been processed through 4 different processing cycles. These cycles used newer versions of tools and scripts and added newly received data to the processing. In the first cycle, the team processed 51 sequences (approximately 4.6 GB); in the second cycle, staff processed 98 sequences (8.8 GB); in the third cycle, the team processed 174 sequences (15.7 GB); and in the last cycle, staff processed 199 sequences (approximately 18 GB). The products resulting from the processing have been copied to the optical jukebox in Building 2 to make the data accessible to the ASCA science team.

The raw telemetry tapes have also been duplicated and sent to ASCA team members at MIT and Penn State University.

PROBLEM AREAS

Lack of raw input data from ISAS has slowed processing of the PV phase and required several modifications to the processing software. It is hoped that this problem will be resolved when HSTX staff meets with ISAS team members in Japan. Staff plans to make the Japanese team aware of the needs of the GSFC processing team and to suggest ideas and procedures on the data transfer.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will perform these tasks:

- Prepare a Work Control Plan for the new contract to meet the requirements of this task.
- Reprocess PV phase data with the best release of FTOOLS and archive it to the local jukebox.
- Begin processing, archiving, and distribution operations for ASCA AO data.
- Modify scripts and GUI, as required, to allow a data technician to process ASCA data using a reliable, consistent interface.

NONLOCAL TRAVEL

One HSTX staff member traveled to ISAS in Tokyo to discuss data processing and ways to establish an ongoing, reliable interface between ISAS and GSFC to process AO data.

TRAINING

A series of training sessions on ASCA provided to all task members included the following topics: the ASCA mission, FITS, FITSIO, and FTOOLS. This training was developed by Code 631 civil servants and HSTX staff.

COMPUTER USE

Minutes	Computer
15,000	Sun 4/380
Dedicated	Sun SPARCstation 1+
Dedicated	DECstation 3100
Dedicated	DEC System 5000/240
Dedicated	DEC System 5000/240

275

NASA Task 32-196-00: Science Processing Library

GSFC ATR: *Dr. Y. Lu*

Hughes STX Task Leader: *H.D. Chang*
Hughes STX Task Number: *365*

The Science Processing Library (SPL) task compiles and analyzes information on requirements for shareable software necessary to support the development of science algorithms; identifies and collects public-domain science software, tools, and utilities that are of value to the Earth Observing System (EOS) science community; and provides the mechanism to share this software.

FINAL CONTRACT SUMMARY

Work has been performed on this task for approximately 15 months, October 1991 through December 1992. The primary objective of the V0 SPL task was to identify scientific users' software needs and to provide a mechanism to share public-domain software necessary to support EOS investigators.

Based on experience gained from one of the existing data analysis systems, the Landsat Analysis System (LAS), the SPSO prepared the functional and operational requirements of the SPL. A representative sample of science algorithms, analysis packages, and product generation systems was reviewed, and each type of software was categorized according to its functionality. Based on these functional requirements, a prototype SPL was developed. The SPSO developed SPL serve as an online central repository for the collection, archival, and distribution of contributed, shareable software. It provides menu-based interface options for users to search, query, view, and download software that has been contributed. The SPL also provides information on software that is referenced by the SPL and the source of availability. Online help, a software upload facility, and an online comment capability are also available.

Since it was first released in April 1992, the prototype SPL has been extensively tested and evaluated by the representatives of the Distributed Active Archive Centers (DAAC's) and the V0 Data Panel members. It was also demonstrated at several workshops and conferences. Even though the development of the SPL has been successful, the task has been deactivated since January 1993 to avoid a possible duplicated effort by the ECS contractor.

SUMMARY FOR CURRENT REPORTING PERIOD

In response to the request from the ATR, no work has been performed since January 1993.

WORK PERFORMED

None.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

None.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

This task will not continue on contract NAS5-32350.

COMPUTER USE

None.

NASA Task 32-197-00: V0 DAAC Support

GSFC ATR: ***Dr. P. Chan***

Hughes STX Task Leader: ***L. Bodden***
Hughes STX Task Number: ***366***

The purpose of the GSFC V0 DAAC task is to improve science productivity by consolidating access to climate and related data in the pre-EOS Phase C/D timeframe, i.e., by 1994. In cooperation with science partners from the science laboratories at GSFC, universities, and other Government agencies, the DAAC will support data acquisition, validation, archiving, and distribution. The V0 DAAC is being developed in response to EOSDIS Project Functional Requirements as well as science project requirements, including SeaWiFS, TOMS, and UARS. The GSFC V0 DAAC will incorporate the data, services, and functions of the Coastal Zone Color Scanner (CZCS) System and the NASA Climate Data System (NCDS). The GSFC V0 DAAC will also support the transition of Pilot Land Data System (PLDS) data, services, and functions to other support centers.

FINAL CONTRACT SUMMARY

The work performed by HSTX staff in support of the GSFC V0 Distributed Active Archive Center (DAAC) through NASA Task 32-197-00 has been significant and profound. When this work began, only the concept of a DAAC to support online global change data sets and other Earth science data existed. Staff supported NASA in the definition of the requirements for the DAAC and helped establish a plan for creating the DAAC. There were many technical problems and political obstacles in the NASA environment that had to be overcome in bringing the DAAC into existence. HSTX management worked closely with NASA to identify solutions to these problems. A first major achievement resulting from the planning was the merging of the Pilot Land Data System (PLDS) and the NASA Climate Data System (NCDS) in FY '91 to form the foundation of the DAAC. The successful merging of these two systems provided GSFC with its first semblance of a DAAC with the PLDS and NCDS data holdings as the first data sets that were made available by the DAAC. The DAAC has continued to serve users of these "heritage" data systems.

HSTX staff conducted cost analyses and trade-off studies in FY '91 and FY '92 for all the hardware procurements made by NASA for the DAAC. The studies were exhaustive and involved vendors from all over the world. The highest quality equipment meeting requirements and cost objectives was selected, procured, and installed. The UniTree File Management System was then selected to manage the data. Ethernet and FDDI networking capabilities were also designed and installed. A build methodology for doing the software development was introduced and the requirements were separated into builds depending on when capabilities were needed for operational support. Builds through 3.0 have been delivered to NASA for Operations. The final build (Build 4.0) will be delivered in July 1994. Support for the ESDIS Information Management System (IMS) development effort was also defined, and a server has been developed and installed.

The CZCS system data holdings were then added to the DAAC in early FY '93 bringing the DAAC's data holdings to over 2 TB of data. In April 1993, the DAAC began supporting new EOS-related data sets. AVHRR Pathfinder was the first data set to be supported by the new DAAC system. In July 1993, operational support for TOVS Pathfinder data also began. The DAAC began taking UARS data in September 1993. All data are being transferred into the DAAC electronically and are being staged on line for ready retrieval and distribution to researchers. These first three data sets could produce 5–10 TB of data that will need to be ingested and staged by the DAAC. The DAAC is now in preparation to support its highest priority data, the SeaWiFS data set. The DAAC is also preparing to support TOGA-COARE and 4-D Assimilated Data, with support for these data sets scheduled to begin in FY '94.

Working together with NASA staff from GSFC and other centers, HSTX task members have provided the expertise and vision to develop the concept of a DAAC. HSTX staff has provided the resources and technical capabilities to NASA to help make this vision a reality by establishing the DAAC and servicing researchers with scientific data and information.

SUMMARY FOR CURRENT REPORTING PERIOD

Build 2.0 was promoted to Operations on June 8, 1993, following the successful completion of acceptance testing. This build provides Guide, FTP file transfer, tutorial screens, document and software ordering, and data-product-specific granule displays enhancements to the IMS user interface. Network transfer, ingest processing, and data archiving became fully automated with this build. This build also increases the distribution capacity of the DADS through the introduction of additional file copy utilities and provides support for the network transfer of SeaWiFS data, but does not have the full functionality to support the SeaWiFS end-to-end testing now scheduled to begin September 1. Full support of the SeaWiFS end-to-end tests will require modifications to the SeaWiFS data and metadata ingest programs because of changes in the data formats, which are currently undergoing modification and have not yet been made available to the DAAC. The readiness of the DAAC to support the SeaWiFS end-to-end tests is contingent upon the timely receipt of the new data formats by the DAAC.

The GSFC V0 DAAC prepared a special Build 2.1 to support the ingest, archival, and distribution of TOVS Pathfinder Level 3 data, which began arriving at the DAAC about July 15, 1993. Build 2.1 also contained needed enhancements to the staff user interface that are required for operational use. This build was integrated in the system testing environment. Build 2.1 was delivered to Acceptance Testing on July 13, 1993. Build 2.1 of the GSFC V0 DAAC system was promoted from Acceptance Testing to Operations on August 16, 1993, to support the FTP transfer, ingest, archival, and distribution of TOVS Pathfinder Level 3 data. Build 2.1 was planned, scheduled, and delivered in response to evolving TOVS Pathfinder requirements and has already been used to successfully ingest and archive data transferred via FTP from the TOVS Pathfinder Path A Group.

The GSFC V0 DAAC also prepared Build 3.0, which introduces additional support capabilities for SeaWiFS data processing and provides support for the transfer, ingest, archive, ordering, and distribution of UARS Level 3 data scheduled to begin arriving on September 15, 1993. The GSFC V0 DAAC staff presented an Internal Design Review (IDR) on June 4 primarily focused on the design of the IMS and DADS for Build 3.0. The IDR was attended by EOSDIS project personnel, members from the supported data projects, EOSDIS core system personnel, and DAAC staff. The delivery of Build 3.0 to Acceptance Testing on July 31, 1993, was shifted 2 weeks to August 15 because efforts were diverted to support a special Build 2.1 and there was a staffing shortage in the DADS and IMS areas. Both areas have continued to staff up, but remain one person short for Build 3.0. Action was being taken to complete the necessary staffing. The GSFC V0 DAAC completed the software development, integration, and system testing of Build 3.0 and promoted it to Acceptance Testing on August 24, 1993. Acceptance testing was completed, and the system was promoted to Operations on September 21, 1993, when support for the UARS project is scheduled to begin. The operations, systems, and software development and system testing staff provided additional support to meet this objective.

The GSFC V0 DAAC continued operational support for the AVHRR Pathfinder Project initially using Build 2.0 (June 8, 1993), and later with Build 2.1 (August 16, 1993), and has successfully ingested and archived all data transferred to the DAAC. The archival of the AVHRR Pathfinder Level 3 data to the Metrum has continued without any significant problems during this initial operational period. Standing orders for data being distributed on low-density 8-mm tapes to researchers at the University of Maryland (UM) using Sun workstations were encountering read difficulties. Investigation into device driver and blocking characteristics for the Sun and SGI computers (including a trip to UM) led to the discovery that 8-mm tapes intended for Sun computers cannot exceed a 64K-2 blocking factor. Tapes were successfully read after adjustment of the blocking factor. A possible problem in the archival of the AVHRR Pathfinder Level 3 data to the Metrum has been detected and may have been caused by the UniTree File Management System. Analysis to determine which files are affected is underway. Files that have been altered will be replaced from 8-mm backup tapes.

DAAC personnel met with ECS DADS personnel to exchange information on design approaches and hardware technology for the DADS. Discussions also focused on file management systems for the DADS such as UniTree. The DAAC offered several lessons learned on selecting and procuring hardware.

The GSFC V0 DAAC personnel attended a UARS support review presented by the UARS project and attended by their Project Scientist, the Global Change Data Center Head, and UARS project personnel. Details of the DAAC/UARS interface were discussed, and UARS data selection programs to be used by the DAAC were presented. Science and data support issues concerning the type, volume, and media for data distribution were also discussed. The DAAC is also preparing a client to be used by the UARS CDHF facility's VAX (VMS) computers to transfer the data to the DAAC's SGI (Unix) computers.

Several interface testing meetings have been held with UARS project personnel to define the interface tests and establish a testing schedule. A special test team was formed to document, set up, and conduct the tests. It was determined that several tests of the TRANSL8 utility and its VMS-to-Unix file conversion capabilities have already been completed and will be documented. Tests with the automated data transfer program began on August 31. Testing was completed by September 17.

GSFC V0 DAAC personnel presented details to UARS scientists and other personnel of the intended user interface and data distribution support for the UARS data sets. The presentation included a demonstration of the IMS that researchers will use to access the data. Schedules for interface testing and operational data transfers were also discussed.

The GSFC V0 DAAC held two Internal Staff Reviews (ISR's) during June to clarify the requirements and design for several areas of the DAAC and to reach a consensus on approach among DAAC personnel. The ISR's were "IMS Browse Requirements and Design," held June 2, and "ESDIS IMS Requirements and Design," held June 28.

GSFC V0 DAAC personnel presented an IDR on the Science Data Plan for the DAAC. Proposals for new data sets such as TOGA-COARE and 4-D Assimilated Data were discussed. Progress was reported on the final two FIFE CD's and the planning of three DAAC/Climate CD's.

WORK PERFORMED

100 SYSTEMS ENGINEERING

The integration of Version 1.7.1 of the UniTree File Management System was completed on June 4, 1993. The integration of UniTree 1.7.1 is of particular importance because it contains the functionality necessary to interface with the Cygnet 12-in. WORM optical jukebox, which the previous version of UniTree (1.6.2) did not have. UniTree 1.7.1 was subjected to acceptance testing by both the integrator (Titan) and the DAAC's system engineers and Acceptance Testing team. The interfaces to the Metrum and the Cygnet jukebox were demonstrated to be functional during this testing. UniTree 1.7.1 also introduced the family of files capability, which permits the DAAC's system administrators to direct data to a specific mass storage device depending on data type (e.g., SeaWIFS, UARS) and level and allows for the segregation of the data type and level within the mass storage device. This capability will greatly increase the ability of the DAAC to efficiently manage and distribute data for the various data projects supported. UniTree 1.7.1 will require the complete installation of an asynchronous I/O functionality before optimal performance can be achieved, although the performance through the Metrum is already better than expected. DAAC staff attended a presentation by Titan on the future of UniTree under Open Vision.

The FDDI component of the DAAC's network has been installed and is now operational to the GSFC FDDI ring in Bldg. 1. Any computers on the GSFC network that have FDDI connectivity to Bldg. 1 will be able to transmit data to the DAAC via FDDI.

Systems personnel participated in FY '94 planning activities. Comparative analyses of different SGI upgrade paths are being made with the purchase of an SGI Challenger L with a tall rack considered as the most cost-efficient approach. Additional disk drives, 8-mm and 4-mm drives with stackers, are also being planned.

Systems personnel made enhancements to the DTP program in support of transferring UARS data. These enhancements included incorporating the TRANSL8 VMS-to-Unix conversion utility into DTP. Analysis began on developing a version of DTP for the CONVEX in support of the TOVS Pathfinder Path A Group.

Performance and capacity analysis for the DADS was completed. Results indicated that additional disk space will be needed for FY '94. The results also showed that operator response time is critical, thus indicating that 8-mm and 4-mm stackers will also be needed to meet data distribution volume objectives.

200 DADS SOFTWARE DEVELOPMENT

Implementation and system testing of Build 2.1 were completed. Separate Build 2.1 development directories were created for some components of the DADS to avoid affecting ongoing Build 3 implementation.

Detailed design of Build 3.0 enhancements to the archiving and retrieval utilities was completed, and enhancements to the staff interface continued. Detailed design of the resource manager server and an operator interface for the DADS servers began. Detailed design of status monitoring in the staff interface based on standard log files and enhancements to the DADS manager began. Work continued on the design of an operator certification program. An online scheduling and reporting system was designed and implemented for request distribution and data ingest activities.

Implementation of Build 3.0 was completed and included additional functionality for the resource manager, standardized message logging routines, and new functionality for the DADS distribution processor.

Implementation continued for the following:

- Prototype operator interface for the DADS servers.
- Enhancements to the staff interface.
- The scheduler.
- Automated data distribution functions.

The standardized message logging routines were tested in conjunction with the Build 3 Archiver/Retriever. Additional testing by developers took place on the Build 3.0 versions of the staff interface, distribution processor, resource manager, and scheduler.

As part of the investigation of a commercial scheduler software for planning and scheduling, including Kronos, a formal list of requirements for the DADS scheduler was drafted. J. Bay (Code 902.2) continued implementing a prototype scheduler reservation interface using the Tcl/Tk package. Experience gained in this exercise indicates that Tcl/Tk is a suitable package for this application, and its continued use is planned. J. Bedet (Code 902.2) continued investigating existing software for planning and scheduling and prepared materials for a meeting to be held with Honeywell personnel to discuss their Kronos product. Staff continued investigating existing software for planning and scheduling and met with Honeywell personnel on August 30 to discuss their Kronos product.

Several software modification requests (SMR's) were corrected, including:

- SMR 515—Carry *quick order confirm* to update order screen in staff interface.
- SMR 517—Allow *commit* from any screen in staff interface.
- SMR 625—Correct *quit* option in data base-user-person screen in staff interface.

Several SMR's were corrected, including:

- SMR 709—Resource manager abort.
- SMR 715—Staff interface XJam problem.
- SMR 727—Reqproc abort.
- SMR 760—Resource manager abort.
- SMR 762S—Scheduler parse error handling.

300 IMS SOFTWARE DEVELOPMENT

During June, detailed designs were developed and revised for some IMS elements for Build 3.0, such as the granule validator. Parts of the automatic order generator and granule validator were implemented. The alphanumeric interface was enhanced to include user login, usage tracking, a user comments facility, ability to select and deselect all granules, and improved list selection. Several functions were written to update the request tracking data base, to be used by the ESDIS IMS server in the next month. Several minor bugs in the IMS user interface were fixed: SMR's 496, 589, 591, 595, and 602.

During July, the IMS Software Development Group implemented additional components of the Build 3.0 software. FTP transfer of data files in the alphanumeric interface was partially implemented. The baseline end-to-end capabilities of the browser were implemented: display image, display metadata, select for ordering, and submit order to server. Automatic request tracking within the ESDIS IMS server was partially implemented, using functions from a common library. Several inventory maintenance utilities (granule validation, granule exposer, and standing order generator) were implemented. The Guide subgroup worked with the ESDIS IMS group to produce a version of the client for development of the Guide search capability.

During August and September, the IMS Software Development Group finished and delivered the Build 3.0 software to Acceptance Testing, including an improved granule query, shortcut function keys, and FTP transfer of data files in the alphanumeric interface; a gridline overlay capability in the browser; automatic request tracking within the ESDIS IMS server; and several inventory maintenance utilities (granule validation, granule exposer, and standing order generator). The Guide subgroup developed Guide search capability and demonstrated the Guide subsystem to the project. The implementation of the Guide search capability for the ESDIS IMS client was completed as part of Build 3.0.

The product request part of the browser was designed and implemented, including socket communication with the ESDIS IMS server. Product request screens for the browser were developed, as were the capabilities to aave and restore user profile information and create ODL trees from that information. The product request function of the browser was integrated with the ESDIS IMS communications and ODL libraries; message passing to the ESDIS IMS server was tested.

Data base modifications for Build 3.0 applications were proposed to the CCB. Data base utility library functions were developed to select multiple columns of data and insert them into request tracking tables.

System-Level Activities
For the ESDIS IMS Guide see subsystem, the design for the client-side was documented and supplied to the ESDIS IMS. A "More Info" scenario for the ESDIS IMS Guide subsystem was implemented and integrated into the Guide client.

The More Info scenario (from the valids list) was implemented and integrated into the ESDIS IMS client, including interfaces to both WAIS and WWW servers. The joinless granule query was integrated into the ESDIS IMS server along with new communications libraries.

400 SCIENCE SUPPORT

SeaWiFS:
SSG staff met with ESDIS IMS staff to determine browse product requirements, particularly with respect to SeaWiFS products. Modifications were made to SeaWiFS data product ingest software to accommodate Build 2.1 of the DAAC. The design and coding of the ingest software for CZCS L1 data products commenced. DAAC staff members met with SeaWiFS personnel to discuss their plans to adopt a proposed standard metadata implementation in HDF for SeaWiFS data and browse products.

AVHRR Pathfinder:
Changes were made to the DADS software and AVHRR Pathfinder Land ingest software for Build 2.1 of the DAAC. A listing utility for HDF files that accommodates Unix standard input was completed. Continental subsetting software for global images was completed. The software will work on any Unix 32-bit-word machine with future support of 64-bit machines planned. Version 1 of the AVHRR Pathfinder Land Data Product User's Guide was completed and shipped with the first shipment of PAL standing orders. Work commenced on preparing this User's Guide as a NASA Technical Memorandum. SSG staff met with AVHRR Pathfinder Atmosphere representatives to discuss data set specifications and requirements. A target date of July 1994 was given for initial data receipt at the GSFC DAAC. DAAC staff documented the installation procedures for the continental and parameter subsetting routines provided by the DAAC for AVHRR data products. DAAC personnel gave software to AVHRR Pathfinder staff to help them QC their metadata. SSG staff worked with Pathfinder personnel to correct inaccuracies in previously produced PAL files. The AVHRR Pathfinder Data Product User's Guide was reworked to address review comments obtained from the Land Science Working Group (SWG) Chair. Operational ingest of PAL data products continued. The AVHRR Pathfinder Data Product User's Guide was revised and released to selected members of the user community.

TOVS Pathfinder:
The analysis of the algorithm for computing tables of coefficients for a rapid transmittance code that provides a fit to detailed line-by-line computations of spectral radiances for the Stratospheric Sounding Unit (SSU) continues. DAAC personnel began testing TOVS Level 3 ingest software. Operational ingest of Level 3 data products from Path A commenced. Further Unix scripts were developed on the NCCS Cray to drive the Genln2 package obtained from NCAR to perform the computation of accurate transmittances though 19 prototype atmospheres and through the SSU instrument cell. These scripts have been used to generate some of the transmittances for the 19 atmospheres and graphical postprocessing. Once obtained, these transmittances will be used as input for code that fits coefficients for calculation of rapid transmittances. Documentation for the algorithms and code described in 411 continues in parallel with the above adaptation of the Genln2 package. Parts of the GEOS 4-D time series assimilation data set were accessed, and the Grads package was installed for data browsing. DAAC staff provided HDF and IDL utilities to Susskind's TOVS group (Code 911) for reading Level 3 raw data files and HDF files.

UARS:
A regular monthly meeting was held between the UARS/CDHF staff and DAAC staff. Several items were discussed including setting up a demo of the CDHF menu interface for DAAC management on July 12. The UARS quality indicators will appear in the metadata for each file rather than on the menu screen as originally proposed. Most of the Level 3A metadata have been submitted to the UARS project and are undergoing review before being registered. The Level 3B metadata have been delivered and registered with the CDHF. August 1 was the date full testing of the UARS-DAAC transfer began. CDHF and DAAC security was discussed. The Level 3B metadata were received, including FORTRAN source code to read the data. All of the instruments that produce Level 3B use the same format. The TRANSL8 software was transferred to the CDHF2 node (VAX 6440) as CDHF1 was shut down. New key codes were obtained from ACCLR8 to install the software. There were no problems during installation. The DPID and supporting documents have been modified and updated with the latest information. DIF's for the GCMD have been written for all of the UARS data sets expected in September. Data set level or product level metadata have been written for each of the UARS data sets. A first draft of the UARS science catalog (one for each UARS instrument) was written. Unit testing of UARS data ingest software was completed. Integrated and end-to-end testing of the UARS/DAAC interface were planned in coordination with

representatives from the UARS CDHF. The UARS ingest program has been updated (only one program is needed to extract metadata from all five different data types). Four programs are available to create VAX/Unix FSF's and filename/FSF's matching tables for UARS 3al, 3lp, 3tp, and 3at files. Twenty-four UARS data/meta files have been transferred from CDHF2 to DAAC successfully; four of them were transferred back to CDHF2 to verify that there was no loss of data accuracy.

TOGA-COARE:
T-C PI's were queried to determine projected data volume and format for the data sets to be archived at the GSFC DAAC as part of the overall effort to prepare an estimate of required resources for supporting T-C in the DAAC. Staff attended (as data manager) the NASA/TOGA-COARE Data Management meeting and the follow-on NASA/TOGA-COARE SWG meeting. Both meetings scheduled presentations on the proposed GSFC DAAC support of the TOGA-COARE data sets and interactive sessions with TOGA-COARE PI's to obtain their responses to the DAAC proposal and to solicit their input. An implementation plan for archival of TOGA-COARE data sets has been drafted and is under review. NASA/TOGA-COARE data were slated to begin arriving at the archive in October 1993. At the San Diego data management meeting, it was determined by polling PI's that the bulk of the data sets will not be ready to archive before January 1994.

DAAC/Climate:
A preliminary resource estimate was provided for support of selected NCDS data sets within the GSFC DAAC. Six ASTEX detail catalogs were written and submitted to the ATR for review. They are currently being revised. Formatting documentation for data sets of the FIRE CIRRUS 1 IFO was delivered to the User Support Office at Langley Research Center in accordance with Phase 1 of the FIRE Central Archive transition plan. The FIRE Central Archive transition did not meet the June 30 deadline for completion of Phase 1 because Langley Research Center personnel could not validate the offline data they received. They were unable to read the tapes on their IBM computer and requested a deferral until August to validate the tapes. The following FIRE-ASTEX data sets were acquired via FTP from Colorado State University's Department of Atmospheric Science and placed in anonymous FTP on EOSDATA:

FIRE_ASTEX_CSU_PRT6
FIRE_ASTEX_CSU_SND
FIRE_ASTEX_CSU_CEIL
FIRE_ASTEX_CSU_SFMET
FIRE_ASTEX_CSU_PSWND

CZCS:
Work continues on the design and coding of ingest software for CZCS Level 1 data products. Inadequate documentation and support have provided a challenge in determining the precise structure and interpretation of CZCS data products. Software to ingest CZCS Level 1A data files was written and tested. Software to invoke the ingest, archive, compress, and copy to tape of CZCS data files was written and tested.

Data Assimilation Office:
Staff completed part of an initial plan for the GEOS 4-D time series titled "Appendix A: Description of 4-D Assimilation TimeSeries Data Set." Consultation with data producers is underway.

ATLAS:
Contact was initiated by L. Lowes, ATMOS data representative from JPL. The ATMOS data may be ready soon for delivery to the DAAC. Staff provided information on the mission of the GSFC DAAC and general data submission procedures to ATLAS Data Management representatives.

DAAC staff attended ESDIS IMS visual aids teleconferences and generally provided information in both directions between the DAAC and the ESDIS IMS with respect to browse-related activities.

DAAC staff performed modification to ingest software for TOVS and AVHRR to conform with the Build 3.0 system.

SSG staff wrote a software utility to perform parameter subsetting of HDF files.

500 USER SERVICES

Staff members' June activities included:

Total User Correspondence:	178
Total Number of Distinct Researchers Serviced:	149
Total Number of Data Requests:	71
Noteworthy Requests:	Staff arranged to process a request for the entire CZCS Level 1A archive as part of a data exchange program for OCTS data between NASA and NASDA of Japan.

Staff's July activities included:

Total User Correspondence:	130
Total Number of Distinct Researchers Serviced:	98
Total Number of Data Requests:	131
Noteworthy Requests:	24 ISCCP-C1 subsets were created and converted to ASCII for D. Cavalieri and M. Martino (Code 971).

Staff's August activities included:

Total Number of Data Requests:	52
Total User Correspondence:	133
Total Number of Distinct Researchers Serviced:	89
Noteworthy Requests:	A schedule was set for completing data delivery for the NASA/NASDA CZCS Level 1B data exchange agreement.

Staff attended the HSTX-sponsored User Satisfaction Metrics Panel meeting with the EOSDIS Core System (ECS) development team. Staff contributed to the panel by presenting an overview of EOS User Services Working Group (USWG) activities. Staff assisted ECS personnel in the installation of a Sparcstation in the DAAC Browse Facility for demonstrating ECS functions.

Staff coordinated system testing for the GSFC V0 DAAC Build 2.1 system and participated in testing the local ESDIS IMS and staff interface software. Staff organized and conducted system testing for Build 3.0 of the GSFC V0 DAAC system. Staff prepared a draft version of an operational procedures manual for the staff interface in preparation for Build 2.1 system testing.

Staff members obtained and installed a PC version of the CZCS Browse software to allow order processing on IBM-compatible PC's. Task personnel finalized the data delivery procedures for CZCS Level 1A data as part of the NASA-NASDA data exchange program.

Staff assisted in preparing a draft version of the NCDS Transition Plan highlighting NCDS data sets to be written onto CD-ROM. Staff continued to investigate options for regridding data from higher resolution to lower and vice-versa in preparation for ISLSCP CD-ROM publication activities. Staff attended a followup meeting with project scientists and NASA HQ staff to present updated information on data set availability, acquisition status, and storage requirement estimates for the ISLSCP CD-ROM publication. Staff updated data set information and volume requirements for GEWEX CD-ROM and presented the information to project scientist and NASA HQ personnel.

Task members distributed the Data Compression document to several interested recipients and staff members at other DAAC's. Staff assumed FIFE user support duties, arranging for phone line and E-mail transfer, supporting the FIFE reference library, and providing USO staff training. Staff reviewed FTP logs on the EOSDATA computer for SeaWiFS simulated data access activity. Staff investigated options for recording and tracking data problems reported by users.

Revisions were made to a preliminary draft of the Goddard DAAC User's Guide and table of contents. The document was recirculated to various project staff for comments. USO personnel are compiling a user's manual for the ESDIS IMS and are investigating the applicability of HyperCard software to log user service phone calls and other offline user support contacts. A draft of the Goddard DAAC flyer was completed showing information on the charter, supported data sets, and access instructions for the DAAC system. Staff submitted a proposal for a multi-DAAC brochure to the EOS Project Office as part of an EOSDIS USWG effort.

Staff modified the valid list for organizations to include the organizations of all "tire-kickers" from the GSFC UWG. Staff prepared data set executive summaries for the GSFC top-10 data sets to be included in the USWG User and Data Services Handbook and for inclusion in Master Directory DIF's. DAAC staff participated in the EOSDIS USWG-sponsored Inter-DAAC request referral exercises. The Goddard DAAC was designated as DAAC-of-the-week July 12-16.

600 DATA OPERATIONS

The DAAC distributed 60.5 GB of data in June, 59.53 GB of data in July, and 123.546 GB of data in August.

The DAAC ingested and archived 11.99 GB of data in June, 19.02 GB of data in July, and 26.103 GB of data in August.

NCDS transition processed 5.130 GB of data.

Tape incompatibility problems between the DAAC (SGI) and UMD users (Sun) were resolved regarding use of the PAL data. A small backlog of standing orders for these data was filled.

The transition of FIRE data to the LaRC DAAC continued.

Preparation for the receipt of UARS data was initiated.

Work began on a draft of an operations procedures manual.

PROBLEM AREAS

A possible problem in the archival of the AVHRR Pathfinder Level 3 data to the Metrum has been detected and may have been caused by the UniTree File Management System. Analysis to determine which files are affected is underway. Files that have been altered will be replaced from 8-mm backup tapes.

Several staffing vacancies need to be filled as soon as possible.

SCHEDULE CONFORMANCE

The DAAC is currently on schedule. Build 3.0 implementation was delayed 2 weeks because of a staffing shortage and support needed for a special Build 2.1. However, 2 weeks were recovered during an intensified testing period.

Work on this task will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

NONLOCAL TRAVEL

Systems personnel were sent to Honeywell in Minnesota to define the initial requirements for a scheduler for the DADS system.

CONFERENCES

Staff attended a 2-day meeting at EDC to gather information on AVHRR Pathfinder Land data products.

Staff attended a PAL SWG meeting. Staff also participated in the revision of the PAL Data Set Documentation and User's Guide. Revised documentation was mailed to all members of the PAL SWG.

Staff responded to a request from the University Affairs office to participate in the NEWMAST education program. A group of JOVE participants (area school teachers) was given a formal presentation on the acquisition and interpretation of Landsat imagery. An initial draft for a Goddard DAAC exhibit poster was created.

Planning continued for a multi-DAAC exhibit at the December American Geophysical Union meeting. GSFC is assisting in coordinating the exhibits of the ESDIS IMS, the Science Support Office, and the participating DAAC's.

TRAINING

DAAC staff attended a 3-day class on IDL sponsored through NASA at GSFC.

DAAC staff attended a 3-day course on X-Windows programming sponsored by NASA at GSFC.

Procedural and Unix training was provided to NYMA personnel.

DELIVERABLES SUBMITTED

Software Builds: GSFC V0 DAAC Builds 2.0, 2.1, and 3.0, designed, implemented, tested, and delivered to NASA for Operations
Originators: HSTX task personnel

Documentation: Build release notes, updates to the system Analysis document, updates to the system design document, and updates to the users guide document; each item was included with each Build
Originators: HSTX task personnel

COMPUTER USE

Minutes	Computer
Dedicated	SGI 4D/440 VGX-eosdata
Dedicated	SGI 4D/440 S-eosdads
Dedicated	SGI 4D/35 VGX-eosdev1
Dedicated	HP 730 VGX-daacdev1
Dedicated	Sun Workstations
Dedicated	PC's
Dedicated	Macintoshes
Dedicated	X-Terminals

NASA Task 32-198-00: Solar Flare Research

GSFC ATR: *D. Spicer*

Hughes STX Task Leader: *T. Opsahl*
Hughes STX Task Number: *355*

The purpose of this task is to perform research to identify potential coherent radiation mechanisms that may play a role in solar flares. In particular, the research will cover both weak and strong coherent mechanisms.

FINAL CONTRACT SUMMARY

Work on this task has been performed by a subcontractor, Mako and Associates. Support was provided in the general area of solar flare research and involved the study of electron and ion acceleration by lower hybrid waves. The major accomplishment is the development of an analytical model for the particle acceleration by lower hybrid waves (LHW).

SUMMARY FOR CURRENT REPORTING PERIOD

Staff quickly initiated and coordinated a subcontracting arrangement with a vendor possessing unique research expertise to ensure timely research support to GSFC in the area of coherent radiation mechanisms. The subcontractor performed research involving the study of electron and ion acceleration by lower hybrid waves (LHW). In particular, an analytical model of particle acceleration by LHW's was developed. Numerical work designed to model particle acceleration by LHW's was initiated.

WORK PERFORMED

Research involved the study of electron and ion acceleration by lower hybrid waves (LHW). In particular, work was directed at developing an analytical model of particle acceleration by LHW's excited by the Modified Two Stream Instability (MTSI). The model assumes marginal stability and exploits the well-known relationship between shock thickness and collision frequency. The analytical expressions of the model were coded and various parameter regimes were studied. Numerical work designed to model particle acceleration by LHW's also was initiated. Efforts were directed at "tuning" the code to achieve only MTSI growth.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

None.

NASA Task 32-199-00: HPCC/ESS Network Support

GSFC ATR: ***P. Gary***

Hughes STX Task Leader: ***J. Boroumand***
Hughes STX Task Number: ***360***

This task provides a range of network management and technical services to meet the high-speed networking requirements of the HPCC/ESS project. In particular, the task requires the integration of new and existing high-performance computers with Ethernet-, FDDI-, and UltraNet-based network technologies. The range of activities includes the design and development of high-speed network architectures, network system administration, and network-related user help desk support for the HPCC/ESS project.

FINAL CONTRACT SUMMARY

This task began in June 1992 and will continue under the new contract. For the first 8 months, one systems engineer worked on this task. For next 8 months, one systems engineer and a half-time systems programmer worked on this task. Major accomplishments include planning for deployment of ATM technology at GSFC through establishment of ATM testbeds and participation in DoD's ATDNet project, and installation and management of an FDDI network for the HPCC/ESS project.

SUMMARY FOR CURRENT REPORTING PERIOD

Work in the areas of detailed planning for HPCC ATM Testbed and ATDNet participation were completed and the procurement process for all required equipment was managed. ATM products assessment was performed through a series of nondisclosure meetings with and written information requests from major ATM vendors. Work on video conferencing and other multimedia applications for use as ATM demonstration applications was initiated. Active participation in the ATM Forum and the Enterprise Network Roundtable continued. Technical and coordination assistance to the HPCC K-12 project was provided. Management and maintenance of Internet information services and general network support for the HPCC/ESS project were provided.

WORK PERFORMED

Staff completed planning for the creation of an HPCC ATM Testbed and participation in ATDNet. Work included detailed network design and product evaluation and specifications. Staff also managed the procurement process for all equipment required by both the HPCC ATM Testbed and ATDNet participation, initiated planning for desktop video conferencing and other multimedia applications demonstrations over existing networks and upcoming ATM networks, and provided technical support for the GSFC ATM over ACTS satellite project proposal.

The task leader continued GSFC's active participation in the ATM Forum and its user organization, the Enterprise Network Roundtable, while currently holding the chair of the High Performance Computing Focus Group.

Staff provided technical and coordination assistance to the HPCC K-12 project-funded schools. Work included school equipment specification and dedicated Internet access connectivity facilitation.

A task member continued managing a dedicated host to provide online HPCC-related services including anonymous ftp, the gopher network navigation tool, and a mail server. Staff continued providing general network support for the HPCC/ESS project.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed and will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

NONLOCAL TRAVEL

Staff traveled to Cleveland, OH, June 14–17 to attend NASA's ICCN/S meeting.

Staff traveled to San Francisco August 24–27 for the Interop conference and a meeting of the ATM Forum and Enterprise Network Roundtable.

CONFERENCES

Staff attended the AFCEA/TechNet exhibits in Washington, DC June 2–3 and the Interop exhibits in San Francisco, CA, August 24–27, 1993.

COMPUTER USE

Minutes	Computer
Dedicated	Sun SPARCstation
Dedicated	Macintosh

NASA Task 33-200-01: Applied Research in IDM

GSFC ATR: *R. Cromp*

Hughes STX Task Leader: *S. Chettri*
Hughes STX Task Number: *383*

This task will support the application of artificial intelligence techniques in the development of a prototype end-to-end system for the automated ingest, characterization, and cataloging of remotely sensed data. This support will include the investigation of artificial neural network and expert system techniques for image characterization, object-oriented data base techniques for metadata modeling, and natural-language understanding techniques for constructing intelligent user interfaces.

FINAL CONTRACT SUMMARY

Over the life of the IDM task, many people have individually and collectively contributed, including R. Lovell, May 1992–present; S. Chettri, January 1992–May 1993; C. Horgan; G. Feketa; and S. Hill.

The primary goal of the IDM task has been to research new ways of managing large remote sensing data sets. The task has drawn upon many computer science fields to accomplish this goal, including natural-language processing, data base theory, neural networks, computer graphics, image processing, planning and scheduling, genetic algorithms, and other artificial intelligence techniques.

SUMMARY FOR CURRENT REPORTING PERIOD

This period, work focused on five areas: 1) the data base was tested to evaluate the performance of hierarchical indices, special structures, and quadtrees; 2) development of a schema generator began that will be used to design and implement object-oriented data bases without having to compile new code; 3) a new search mechanism was added to the quadtree structure that handles an unusual special case; 4) some detail work maintaining the user interface and network interface for the Intelligent Information Fusion System (IIFS) was completed; and 5) a preliminary design and implementation of an object-oriented data base were developed for the TIROS Operational Vertical Sounder (TOVS) scientists.

WORK PERFORMED

The IIFS as a whole consists of many concepts and ideas all working cooperatively. As such, many parts are still under development. These pieces include classification schemes, a user interface, an object-oriented data base, network communication between modules (s-expression language, rpc interface), a geologic information system, a planner/scheduler, image processing routines, and a raw data storage area. In the last 4 months, work has concentrated in the object-oriented data base, user interface, and network communications areas.

Testing of the data base was carried out by inserting code that times each query individually and stores records of the timings in the data base. Later a program reads back the times and calculates statistics based on the timings. In the first run of the evaluation, two data bases of different sizes were tested, one of 1,000 records and another of 75,000. Standard indexed queries were compared, and staff found that the hierarchical queries outperformed the traditional indexing by substantial amounts with the large data base.

To improve the flexibility of the data base, a schema generator was designed. The idea behind this is to create a data base system that, like relational data bases, can be dictionary driven. This makes the task of designing a data base less time-consuming by eliminating the tasks of debugging and compiling the code. The goal is to provide a kind of "flexible manufacturing line" for remote sensing metadata data bases.

During the last period it was determined that the quadtree structure did not work in specific instances where the query region was aligned in a certain arrangement with respect to the trixels. The problem was fixed by providing an extra test during the search phase of the quadtree; this fix paves the way for continued testing and eventual publication.

User interface work consisted of supporting N. Short's (Code) ADCC demo and improving the message passing format between the interface and the data base. Also, the IIFS display program was integrated into the user interface at Short's request. During this integration process, it was found that the results of a query needed to be passed back as an s-expression to enable the user interface to interpret the information being received. The user interface needed to know the location and shape of the images so that they could be displayed.

Finally, a new data base was added to the IDM demos consisting of a metadata data base about the TOVS gridded data set. This new demo consists of a different version of the user interface that provides the ability to query by TOVS parameter and elevation.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Documentation of work accomplished on quadtrees will be published, and a program that demonstrates the performance and reliability of quadtrees will be developed.

The schema generator will be completed.

The 3-D location selection mechanism will be added to the user interface, and the method will be published in a graphics journal.

Work on new query mechanisms related to the TOVS data will continue.

A connection between a GIS and the IIFS will be added.

A Work Control Plan will be prepared to meet the requirements of this task.

COMPUTER USE

Time	Computer
100%	HP 710 (tucson)
100%	Macintosh (tempe)
100%	HP 735 (sauquoit)
100%	HP 710 (bombay)
100%	HP 710 (dunloggin)
100%	Sun 3 (nails)

NASA Task 33-200-02: Transfer of IDM Research Results

GSFC ATR: ***R. Cromp***

Hughes STX Task Leader: ***R. Lovell***
Hughes STX Task Number: 384

To show the feasibility of the IDM research, this task will support applicable NASA projects, especially in the areas of the management of large, complex spatial data bases, the design of intelligent user interfaces, and the use of expert systems.

FINAL CONTRACT SUMMARY

At the request of the ATR, no work was performed on this task during this contract.

SUMMARY FOR CURRENT REPORTING PERIOD

At the request of the ATR, no work was performed on this task during this reporting period.

WORK PERFORMED

No work was performed on this task.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

No work was performed on this task.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work on this task is completed.

COMPUTER USE

None.

NASA Task 33-200-03: IDM Applied to High Performance Computing and Communications

GSFC ATR: ***R. Cromp***

Hughes STX Task Leader: ***R. Lovell***
Hughes STX Task Number: ***385***

This task will develop domain-independent data management techniques and software that will allow massive amounts of collected data to be automatically and efficiently cataloged, characterized, managed, and made available interactively and in near real-time to the science user community.

FINAL CONTRACT SUMMARY

At the request of the ATR, no work was performed on this task during this contract.

SUMMARY FOR CURRENT REPORTING PERIOD

At the request of the ATR, no work was performed on this task during this reporting period.

WORK PERFORMED

No work was performed on this task.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

No work was performed on this task.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work on this task is completed.

COMPUTER USE

None.

NASA Task 33-203-00: VR System Development/Integration

GSFC ATR: ***H. Mitchell***

Hughes STX Task Leader: ***T. Opsahl***
Hughes STX Task Number: ***387***

The purpose of this task is to integrate an advanced set of software and hardware for the GSFC NASA Center for Computational Science (NCCS), which will provide new visualization capabilities to complement the scientific computational approaches being applied at the NCCS. The new capabilities will provide fast interactive workstation graphical analysis for both structured and unstructured numerical modeling that is done at NCCS. Included will be a multi-user, interactive, 3-D, head-mounted, virtual reality environment display and a videotape movie recording facility. The work will utilize technologies and components currently under development at Ames, GSFC, and Hughes STX/Sterling. Furthermore, the task will customize and augment FAST consistent with a set of initial requirements specified by NCCS.

FINAL CONTRACT SUMMARY

Work under this task was performed by one Hughes STX principal analyst programmer and subcontractor staff from Sterling Software. Accomplishments include the following:

- Integration of a basic tracking system into FAST.
- Implementation of posture recognition.
- Implementation of object grabbing with thumb and any opposed finger.
- Integration of speech input with utterance recognition.
- Modification of FAST for full scene Anti-Aliassing.
- Development of software to read files in DF format.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff developed a documented set of C routines to read files in DF format. These routines were incorporated into independent, portable DF file utilities for data distribution purposes. The subcontractor continued to successfully develop the VR system to be used in conjunction with the FAST visualization system. In particular, the subcontractor accomplished these important milestones:

- Implementation of posture recognition.
- Implementation of object grabbing with thumb and any opposed finger.
- Integration of speech input with utterance recognition.
- Modification of FAST for full scene anti-aliassing.

WORK PERFORMED

DF Reader Development

A documented set of C routines was written to read files in the DF format. These routines were incorporated into independent, portable DF file utilities for the data distribution purposes of Codes 916 and 910.3. These routines were also incorporated into modules used by FAST and Explorer for reading DF files into internal data structures used for scientific data visualization. The task succeeded in providing a critical data handling capability to the Scientific Visualization Studio as well as significantly broadening the distribution channel for DF formatted data sets.

Posture and Gesture Interaction

Gesture recognition is currently under development as an extension to the posture recognition and interaction/control capability already implemented. Gestures are dynamic expressions as compared to the static postures. Gesture/posture examples are the gesture "wave"- where a flat hand oscillates between pointing up and pointing down and the posture "stop"- a steady hand up, fingers flat, palm out.

Work continued on refinement of the calibration procedure for the glove and a foam-core prototype of a calibration fixture was started.

A recurring problem with a glove-finger sensor was corrected by the vendor.

Object Interaction

Object "grabbing" with thumb and any opposed finger was implemented by extending the finger-ray approach developed earlier. The grabbing rays are orthogonal to the pads of the fingers (and thumb) and a loose criterion is used for intersection detection with the object boundary. The technique is being evaluated for "quality" of feel to see how much complexity will be required in the grabbing mechanics.

Speech Input

Speech input with utterance recognition was effected by two approaches to date. In one approach, a low cost peripheral for Macintosh computers was used with a serial link between Mac and SGI. Utterances decoded on the Mac are sent as single word text to the SGI where they are input directly into the FAST VR module. In the other approach, an SGI Indigo was used, networked to the Reality Engine running. An alpha release of SPanel was used to generate an "event" that is converted to a word by a separate application (custom code). The word is "piped" into FAST where it is compared to a list of words with associated commands. The first approach worked well and allowed limited speech control for "flying". The second version included support for any FAST script command to be executed. Latency without optimization was about the same for both approaches. Task personnel are looking into third party products for audio processing on SGI's that can be integrated directly into the Reality Engine.

Position and Orientation Tracking

Tracker performance for the wrist and Head-Mounted display continued to be less than satisfactory with multiple monitors turned on. A new version of the tracker firmware was installed and is being evaluated. Filter performance may have been improved relative to the earlier versions.

Displays

Project staff tried new HMD products from Kaiser Electro-Optics. Generally speaking, the performance of their high-end system did not support the asking price and the new VIM viewer was less impressive than the Flight Helmet that staff are already using on the project.

Polhemus Laboratories Inc. has forwarded a report on developments in the fiber optic-based display area. The report indicates good progress in improving the image quality.

Software for supporting the Fake Space 2C and 3C was added to FAST. The support was directly added to the viewer module instead of the VR module for increased speed and simplicity. The BOOM panel supports user specification of the device port, the boom model, the Inter-Papillary Distance (IPD), the horizontal offset and the vertical offset. The panel also allows use of the Fake Space BOOM software even if a BOOM is not attached to the system. This panel is useful for testing. The BOOM tracking system may also be "zeroed" via the BOOM panel.

Graphics/Computer/Architecture

FAST was modified for full scene anti-aliassing using the RealityEngine Multisample option on machines that support it. This panel is supported within the FAST BOOM software as well.

Recommendations for upgrades to the existing SGI Reality Engine were forwarded to GSFC. The recommended upgrades would replace the existing RISC 3,000 processors with 4,400s and replace the existing graphics engines with Onyx series hardware. Rendering performance improvements on the order of 2X are expected with the upgrades. A raw processing power improvement of roughly 20X is expected for four processor system.

The current level software was loaded and successfully tested on an SGI Onyx eight processor RealityEngine II with 512 MB of RAM. During the test, a problem was encountered with the glove interface relating to Version 5 of the operating system (the glove worked fine under Version 4). The problem was eliminated by a minor modification to the code.

PROBLEM AREAS

Tracker performance for the wrist and head-mounted display continued to be less than satisfactory with multiple monitors turned on. A new version of the tracker firmware was installed and is being evaluated.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. The capability of the C routines to read files in DF format will be expanded and this component of the task will be completed. The development of map projection software that can be used with FAST will be initiated. The capabilities of the VR system will be further enhanced and expanded to include improved position and orientation tracking, audio processing on the SGI's, improved calibration for the glove and foam-core prototype, and increased grabbing mechanics complexity.

COMPUTER USE

Minutes	Computer
Dedicated	SGI

NASA Task 33-206-00: XTE Science GOF Support

GSFC ATR: ***R. Pisarski***

Hughes STX Task Leader: ***P. Damon***
Hughes STX Task Number: ***392***

This task provides support for the high-energy astrophysics mission called XTE in the following areas: assist the ATR in planning the data processing system, plan and develop archiving and data distribution systems, produce working and tested modules of the system, and assist in integrating the whole data processing system.

FINAL CONTRACT SUMMARY

Staff performed the initial design of the XTE data processing, archiving, and distribution subsystems, and provided support of the XTE Critical Design Review.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff performed the initial design of the XTE data processing, archiving, and distribution subsystems, and provided support of the XTE Critical Design Review.

WORK PERFORMED

100 SYSTEM ENGINEERING/SOFTWARE DEVELOPMENT

Hughes STX personnel developed initial software design for the XTE mission. The design uses three major subsystems: processing, distribution, and archiving. Each of these subsystems is being designed with a multimission approach that will facilitate the reuse of code on future and existing missions (e.g., the ASCA mission will likely use the same archiving system developed for XTE).

200 SYSTEMS/NETWORKING/COMMUNICATIONS

HSTX staff analyzed data volume and network throughput requirements for moving data between the XTE SOF and GOF and Code 631. This investigation led to a decision to put the production ingest portion of the SOF into Code 631 space in Building 28 to reduce the total network traffic.

FDDI networks were investigated as a possible solution for the high data volume required for network transfer between Code 631 and the GOF.

300 DATA STORAGE/DATA MANAGEMENT

HSTX staff investigated various mass storage devices, media, and software packages for possible use as the XTE proprietary data archive.

400 DOCUMENTATION

HSTX staff documented the preliminary software build plan to be followed for the schedule of Code 631 XTE software development.

500 PROJECT MANAGEMENT SUPPORT

Staff worked with the ATR to plan manpower allocations.

Staff supported the XTE Critical Design Review by preparing and delivering the approach to design and development of the subsystems for which Code 631 is responsible.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will complete detailed design of the XTE processing, archiving, and distribution subsystems and prepare software design document; complete a software build plan; continue to identify potential hardware platforms for processing system and mass data storage system, and select processing platform; and prepare a Work Control Plan for this task.

DELIVERABLES SUBMITTED

Document: Preliminary software build schedule
Originator: P. Damon

Viewgraphs: Used for the XTE Critical Design Review presentation
Originator: S. Karpovich

COMPUTER USE

Minutes	Computer
5,000	Sun Sparcserver
Dedicated	Sun Sparcstation

NASA Tasks 62-232-01-07: Cosmic Ray Support

GSFC ATR: ***E. Eng***

Hughes STX Task Leader: ***Dr. N. Nath***
Hughes STX Task Numbers: ***650–656***

This task provides production data processing and analysis support for the GSFC Laboratory for High Energy Astrophysics (LHEA) cosmic ray experiment aboard the Helios-1 spacecraft. In addition, it provides analytic support, program maintenance, documentation, and data base management support for the LHEA cosmic ray experiments aboard the Interplanetary Monitoring Platform (IMP)-6, -7 and -8; Pioneer-10 and -11; Helios-1 and -2; the International Sun-Earth Explorer (ISEE)-3; and Voyager-1 and -2 spacecraft.

FINAL CONTRACT SUMMARY

Subtasks 1–7 are follow-on tasks from a previous contract with SAR. Subtask 8 began in March 1993.

The subtasks provide support for 10 satellite missions, 5 of which are still actively receiving data (see Table 1). These missions have software system development times that range from 1969–1978 for the major mainframe production and analysis programs. IBM PC-based analysis software was implemented in part of the Low Energy Cosmic Ray (LECR) Group, and continues to develop. The mainframe software systems are large, totaling about 200,000 lines of FORTRAN code, 72,000 lines of IBM Assembly code, and > 50,000 lines of JCL/CLIST procedures. Pioneer-10 was the first satellite mission to Jupiter, and also the first to leave our solar system. The Voyager missions have sent back wonderful photographs of the giant planets in our solar system. None of these missions was projected to be in operation as long as they have lasted, and they continue to provide excellent scientific data. The combined data base size is of the order of 150 GB, residing on 9-track reels and square cartridges in the NCCS.

At the contract start, the combined subtasks had four senior-level and one junior-level programmers. Shortly after the contract start, one programmer moved to Maryland, and in November 1989, a new programmer was hired with a dual job of Pioneer-Voyager (PV) data technician and junior-level programmer. All production and standard analysis was performed one in the mainframe environment. The ISEE-3 group had moved the analysis functions to an IBM PC and was continuing software development on the PC. A new programmer joined this activity in April 1989. In 1991, the NCCS announced it would be replacing the MVS operating system with a Unix system, 'AIX', and urged all users to port their software to the Cray or AIX. IBM's AIX version was not ready for a long time. Their port method turned out to be unfeasible, so the plan to drop MVS was abandoned. However, in the interim period our group decided to move mainframe production and analysis to the local Sun workstations, although the projected time and cost were very great. In October 1992, two additional programmers were hired to help with the Pioneer and Voyager conversion work. One task member ported basic versions of the main Pioneer production system but left within 6 months. The task worker is developing portions of a plot package and data request analysis tool for the local systems. The ISEE-3 mainframe subtask was mainly a maintenance task for the contract duration, and funding for that task has stopped.

Table 1. Timeline of Related Missions

Satellite	Launch Date	Location of Study	Special Events
IMP-6 *	03/71	Earth Orbiting }	Baseline Solar Cycle and 1 AU Cosmic Ray Flux Measurements
IMP-7 *	09/72	Earth Orbiting }	
IMP-8	10/73	Earth Orbiting }	
Pioneer-10	03/72	Solar System (and beyond toward Sun's magnetotail)	Jupiter Encounter (12/73)
Pioneer-11	04/73	Solar System (into Sun's magnetosphere bow shock)	Jupiter Encounter (12/74) Saturn Encounter (8/79)
Helios-1 *	12/74	Sun-Earth }	Measurements of the Sun-Earth Interplanetary Space Medium
Helios-2 *	01/76	Orbiting }	
Voyager-1	09/77	Solar System (and above ecliptic)	Jupiter Encounter (3/79) Saturn Encounter (11/80)
Voyager-2	08/77	Solar System (and below ecliptic)	Jupiter Encounter (7/79) Saturn Encounter (8/81) Uranus Encounter (1/86) Neptune Encounter (8/89)
ISEE-3	08/78	Libration Point and Near-Earth Trajectory	As ICE, Comet Giacobinni-Zinner Encounter (9/85)

* This satellite is no longer giving data

Subtask 1: Pioneer/Helios Programming and Maintenance

The Pioneer programming task continued in October 1988, with the HSTX (/SAR) contract rebid win. At that time, the task had two senior-level programmers and one junior-level programmer. Work was in progress developing the PL3810 and DISTN programs (see Subtask 5), which became vital to our mainframe analysis. In August 1989, the RMS Pioneer data technician left that work, and HSTX staff was given responsibility for Pioneer production data processing. A data technician/junior programmer position was established. Then, one of the senior programmers moved to the Univ. of Maryland to work with Dr. F. McDonald. Later, the junior-level programmer moved to the Energetic Particles Acceleration, Composition, and Transport (EPACT) subtask.

During the whole contract period, staff worked with Dr. McDonald on Pioneer-10, -11 and Voyagers-1, -2 data analysis in a variety of scientific support activities. These included modulation and gradient calculations, flux ratio and flux fitting calculations in momentum, rigidity, and total energy coordinates. Task members also obtained and manipulated data of other projects for comparisons, such as Pioneer solar wind plasma velocity and pressure, UCSD high-energy plasma data of Pioneer-10 and 1.236 GEV electrons of the ISEE-3 MEH experiment, IMP OMNI data base solar wind parameters, and Voyager solar wind and magnetic field data. All of this work involved developing needed software solutions and high use of the mainframe CLIST capability to handle the large volume of work involved. HSTX staff produced data for scientists at other facilities. Publication-quality PostScript plots are now made on the workstation using the no-cost ACE/grplot program. Data plots were previously drafted and then photographed for publications.

Near the end of September 1990, Pioneer-10 passed the 50 AU distance mark in its trajectory toward the tail of the Sun's magnetosphere. It is in a power conservation mode at present, and at its life's end will have provided over two full solar cycle's worth of data for analysis.

After the decision to port the production and analysis software to local workstations, two new staff members were hired (see Summary and Subtask 5 sections), and one converted basic versions of the IBM Pioneer production programs EDRLST, PIODRP, PFRTPL, PRNPHA, FLXDBG, FLXLST to the Sun workstation environment. Programs are in the initial stages of testing, so far successfully. Further, a task member ported two trajectory data base programs. One program generates files as part of the Pioneer trajectory data base. The other program lists select data from the Pioneer trajectory data base.

Task members have maintained Pioneer production software in accordance with contractual obligations. Difficulties resulting from changes in systems software were dealt with in an efficient manner, where applicable.

Subtask 2: Pioneer/Helios Production Data Processing

This task began in October 1988. In August 1989, HSTX assumed the responsibility of the RMS data technician.

Pioneer production data processing is the process of extracting data from raw data tape and placing these data into a data base. The process involves some data base management and tape management. Analysis was performed by staff on a regular monthly basis, as well as by investigator request. Data were extracted from the relevant data base and analyzed by our major analysis software providing listings, matrixes, and plots.

Pioneer production was kept up to date to provide requesting scientists with the most timely data available. Analysis was achieved in a timely fashion. Efforts to satisfy investigator requests were met with as much flexibility as resources would allow.

Subtask 3: ISEE-3 Programming and Maintenance

The ISEE-3 programming task continued in October 1988, with the HSTX contract rebid win. At that time, the task had one senior-level programmer and one junior-level programmer. The junior-level programmer later moved to the EPACT subtask, and the mainframe subtask was mostly a maintenance task for the contract duration.

Subtask 4: IMP Programming and Maintenance

The IMP programming task continued in October 1988, with the HSTX contract rebid win. At that time, this subtask had two senior-level programmers and one junior-level programmer (who later moved to EPACT). IMP-8 standard production was handled by one GSFC data technician.

Highlights of the contract work are presented next, in rough time order: Five programs (TPFORV, SPECTR, STRIP, FLXWRN, and FOURER) originally residing on the PDP-11/70 were transferred successfully to MicroVAX VMS operating system when the 11/70 was excessed.

Staff accomplished the conversions of IMP-8 production, analysis, and utility programs from IBM 3081 MVS/SP operating system to IBM 9021 MVS/ESA operating system and the conversion of FORTRAN-H source routines to VS-FORTRAN for five IMP-8 production and one analysis programs. Two programs (RATEPLOT and FOURIER) were modified to produce PC RATE verses, and two new programs (RESPONSE TABLE and VLET PC-PHA) were designed and coded to support the IMP-8 PC analysis work. The IMP-8 analysis has been automated by staff for annual requests.

An IMP-8 Tri-axis magnetometer data base was created. Staff oversaw the data gap recovery of IMP-7, IMP-8 compressed data bases, and backups. Also the IMP-6, IMP-7, and IMP-8 data bases were moved completely from reel tapes to cartridges.

Staff worked hard to complete the conversion of two major IMP-8 production programs (Data Processing System and Data Base Generator) Assembler routines to IBM VS-FORTRAN, and ported the two programs from IBM 9021 MVS/ESA operating system to local Sun SPARCstation Unix operating system. Recently, the IMP-8 Data Base Generator program was tested on the Sun SPARCstation Unix operating system. Staff also created mainframe file-oriented versions of the IMP8DPS and LSTA32 programs in preparation for Unix local workstation porting.

Subtask 5: Voyager Programming and Maintenance

The Voyager programming task continued in October 1988, with the HSTX contract rebid win. At that time, the task had two senior-level programmers and one junior-level programmer (who later moved to EPACT) and work was in progress in the preparation for the (then) upcoming Voyager-2 ENCOUNTER with Neptune, which occurred in August 1989. Staff readied and updated the PC software used for Uranus, were responsible for equipment transfer to JPL and back, and processed data during the encounter. Staff later received the Neptune Group Achievement Award from NASA.

Just at the time of the ENCOUNTER, the RMS Voyager data technician left that work, and HSTX staff was given responsibility for Voyager production data processing. A data technician/junior programmer position was established. One of the senior programmers moved to the Univ. of Maryland to work with Dr. McDonald. During this general timeframe, staff developed the mainframe spectrum plot program PL3810, and the trajectory distance plot program, DISTN. These programs became the cornerstones used in mainframe plotting, especially in the multisatellite data comparison requests of Dr. McDonald.

Staff then developed the EDITSCAN program, an EDR preprocessor program, to aid in necessary EDR data cleanup. The program also was used to establish correct onboard telemetry buffer delay times for three new data modes used since the Voyager-2 Neptune encounter.

During the whole contract period, a very large body of work was done with Dr. McDonald. (See Subtask 1). His work routinely involves both Voyagers and both Pioneer satellites.

Another large body of work highlighted is preparation of whole Saturn encounter data for an NSSDC requestor for Voyagers-1 and -2. Staff were required to get an even more indepth knowledge of these telemetry systems because of the non-nominal instrument status conditions used in the encounters. In the past 2 years of the contract, staff also prepared data for the project for NSSDC's submission of cruise portions of the Voyager-1 and -2 missions. Header information for the cruise submissions will be completed in the follow-on contract.

With the decision to move production and analysis off the mainframe to local Sun/Unix workstations, two additional staff members were hired in late fall of 1992 to work with Pioneer and Voyager tasks. These workers investigated cosmic-ray data analysis processes and requirements for some of the analysis tools on local workstations. They looked at various software like KHOROS (CASE Tool), Motif, Xrt/Graph, and XPlot to test the usability of it in building a graphical user interface. Having found some advantages in using Motif over others, it was chosen to be used to build the graphical user interface. After about 6 months, one of the new workers left. The other successfully designed and developed a graphical user successfully, for creating and maintaining the bincard sets, using X Windows/Motif toolkit. He investigated various plotting tools (ACE/Xvgr and AthenaPlotter Widget toolkit) for plot purposes. The AthenaTools Plotter widget set was successfully modified and upgraded to meet all the requirements for plotting purposes. HSTX staff designed and developed a plotting package for the bincard data using this new widget set. Task members also developed an interface between data base query and this plotting package.

Task members maintained the production/analysis software for the life of the contract. A version of the LSELECT program was ported to the local Unix workstation and is being tested.

Subtask 6: Voyager-1 and -2 Data Processing and Analysis

In August of 1989, HSTX staff became responsible for this subtask when the RMS data technician left that work. Voyager data processing and analysis is the process of extracting raw data from tapes, merging data into an existing data base and providing various analyses of the resulting data base. Tasks involved in this process include elements of data base management and tape management. Standard analysis is performed on a monthly basis, as well as upon investigator request. Results are provided in the form of data listings, matrixes, time history plots, and spectrum plots. Every effort has been made to provide investigators with the maximum timeliness in meeting requests. This timeliness has been bounded only by the availability of staffing resources. Production and analysis were accomplished in accordance with contractual obligation with minimal delays. All delays were resolved as quickly as possible, with a minimum of inconvenience to the investigator requests.

Subtask 7: EPACT Software Support

The EPACT experiment, to be flown on the WIND spacecraft scheduled for launch in February 1994, will measure abundances, spectra, and angular distributions of particles from 20 keV/amu-500 MeV/amu. EPACT is a multitelescope system involving eight individual telescopes housed in three separate groups.

The EPACT systems and software support involved design and development of real-time software for graphic analysis of the telemetry from Ground Support Equipment (GSE). It also required integration with GSE software that commanded and controlled the experiments on bench. The GSE included software for simulating the spacecraft and the receiver boards.

The systems and software support began in October 1988. Initial requirements and preliminary design of the analysis software was completed by the end of 1989. In May 1990, critical design review was conducted and the requirements for the analysis software, MACRO, were reviewed.

The software provides a flexible means for studying multidimensional scientific data sets by generating multiple two-dimensional graphic plots and/or ASCII output listing files. The options by the program include the ability to interface with EPACT's Ground Support Equipment Software so that instrument calibrations and hardware testing can be conducted in real time. In this configuration, the program can switch between analysis and GSE modes interactively and can perform all the analysis and GSE functions, which include commanding and controlling the experiments in bench configuration.

The software has a number of built-in features that make it very flexible. The software can be run on any PC 386/486 clone with a PGA or VGA video interface. Plots can be generated on CANON printers or in PostScript format.

Postlaunch data processing software development was started in June 1993. This software will process the telemetry and orbit/attitude data into the ENCY format and monitor the health and safety of the instrument.

Subtask 8: SAMPEX Data Analysis

The Solar, Anomalous, and Magnetospheric Particle Explorer (SAMPEX) mission was launched in July 1992. The mission carries four instruments to measure the elemental and isotopic composition of energetic particles from solar and galactic sources. Two of these instruments, the Mass Spectrometer Telescope (MAST) and the Proton Electron Telescope (PET), were assigned to HSTX staff for data analysis, beginning in May 1993. One part-time programmer has been supporting this task.

The hardware and software requirements were determined and purchased to set up a data processing system. The data processing software for the MAST telemetry data was completed, and data base development is proceeding.

SUMMARY FOR CURRENT REPORTING PERIOD

Subtask 1: Pioneer/Helios Programming and Maintenance

As a result of missing Pioneer data sets, staff downloaded most major project software for the SB#HP general project Userid to the Sun SPARC1+ workstation, and backed up the sources locally. Staff performed the following tasks:

- Produced flux data and rigidity plots for Dr. McDonald.
- Made 24 fits of hydrogen and helium data in rigidity and total energy.
- Made hydrogen/helium flux ratio calculations for Dr. McDonald, for paper and meeting preparation.
- Reviewed the AWK and PERL shell languages in preparation for creating Unix versions of common analysis tasks done on the mainframe.
- Reviewed certain portions of the ACE program fit capability, command line execution from batch files, and use of the altxaxis and zeroxaxis concepts for trajectory distances.

- Downloaded most major project software for the SB#HL project Userid to the Sun SPARC1+ workstation, and backed up the sources locally when some mainframe data sets disappeared, and systems staff could not explain what had happened.
- Ported programs for the Pioneer trajectory data base to the Sun/Unix environment.
- Reviewed work done in porting EDRLST, FLXLST, PRNPHA, PFRTPL, and FLXDBG (in progress) to the Sun/Unix workstation in preparation for enhancing and continuing that work.

Subtask 2: Pioneer/Helios Production Data Processing

Staff maintained data production and analysis in a timely manner; and provided plots, matrixes, and listings on a monthly basis, as well as on demand. Staff is currently reviewing reel tapes for a tape cleanup effort.

Subtask 3: ISEE-3 Programming and Maintenance

Staff downloaded most major project software for ISEE-3 and the Data Pool systems to the Sun SPARC1+ workstation, and backed up the sources locally, as mentioned under Subtask 1.

Subtask 4: IMP Programming and Maintenance

Staff performed the following tasks:

- Held discussions relating to the IMP software conversion to Unix planning task.
- Wrote a program to extract the MED gain factors from the IMP-8 gain tables, and plotted them with the ACE/gr program.
- Modified the READCAT1 program to calculate the total records and megabyte storage requirement for the IMP-7 and IMP-8 tape types.
- Completed a draft task plan report to convert the IMP-8 software to the Sun SPARCstation Unix operating system.
- Generated IMP-8 "all types" rate plots using the ACE/gr program on the Sun SPARCstation.
- Completed the new program that analyzes the difference of two IMP-8 DECOM tapes generated from different programs at IPD.
- Completed the conversion of the IMP-8 Data Processing System Assembler routines to FORTRAN.
- Completed the testing of converted the IMP-8 Data Processing System version on IBM 9021/ESA operating system. Updated the IMP-8 main gain table for intervals 1822-1859.
- Completed the DBTIME's runs for IMP-8 CNTS/PHA reel sequence number 362 to 369.
- Produced data for Dr. J. Lockwood (University of New Hampshire) and Dr. Z. Fujii (University of Maryland).
- Produced high-quality PostScript plots requested by Dr. McDonald for paper presentation work.
- Added IMP-8 26-day average analysis for H and He to the annual data requests of Dr. McDonald.
- Downloaded most major project software for IMP-6, -7, and -8 systems to the Sun SPARC1+ workstation, and backed up the sources locally, as mentioned under Subtask 1.

Subtask 5: Voyager Programming and Maintenance

Staff performed the following tasks:

- Produced 26 high-quality PostScript plots requested by Dr. McDonald for paper presentation work. These plots compared one to four frames of data per plot of Voyager-1, -2, and /or Pioneer-10.
- Produced 42 other mainframe plots of various data.
- Wrote specialized software to do least squares fits and to put data and fit, with fit parameters, to plots.
- Produced 145 data fits and plots (IBM 3800 laser printer) of standard flux data in rigidity and momentum coordinates, and total energy coordinates for H and He (all Voyager-2 data). At Dr. McDonald's request, produced similar fits and plots for additional times for Voyager-1 and Voyager-2, 24 fits in all. Also produced H and He flux ratios for these time periods.
- Wrote a program to extract fit parameters from 84 of the above fits for the total energy and rigidity fits for H and He.
- Plotted these data with ACE/gr along with the H and He flux ratio for the 1.8-2.6 MeV bin.
- Produced data for the Voyager-2 NSSDC cruise submission.
- Produced first draft of the header information to be included with the submission, which included Dr. Cummings' information.
- Produced data for Dr. J. Belcher (Massachusetts Institute of Technology) and Dr. Fujii.
- Downloaded most major project software for the Voyager systems to the Sun SPARC1+ workstation, and backed up the sources locally, as mentioned in Subtask 1.
- Ported the LSELECT software to the Sun/Unix environment.
- Modified and upgraded the plotter widget set to meet all the plotting requirements. Used this modified version of widget set to build the plotting package.
- Tested the plotting package with real data and developed an interface between data base query and this plotting package.
- Upgraded the bincard inputs interface to accommodate new parameters.

Subtask 6: Voyager-1 and -2 Data Processing and Analysis

Staff maintained data production and analysis in a timely manner, and provided plots and listings on a monthly basis, as well as on demand. Staff is reviewing reel tapes for a tape cleanup effort.

Subtask 7: EPACT Software Support

Staff performed the following tasks:

- Designed, coded, and tested three class libraries to produce the EPACT ENCY format.
- Delivered the MACRO analysis software to access the EPACT postlaunch ENCY data bases.
- Acquired and reviewed PC CDHF software for accessing the Common Data Format to process key parameter and orbit/attitude data.
- Performed extensive testing on CDHF Level-0 and calibration test telemetry data for correct byte allocation tables and contents for EPACT instruments, LEMT, and ELITE.
- Isolated, prepared, and delivered to the Data Capture Facility test cases of telemetry data discrepancies.
- Installed Visual C++ and MS-DOS 6.0 software and CD-ROM hardware on PC.

- Prepared and presented 8 hours of lectures on the C++ programming language and object-oriented principles to NASA personnel and coworker.
- Attended two weeks of training in windows programming with MOTIF and Windows NT.

- Updated the MACRO Requirements and the PDL documents.
- Researched and recommended new hardware and software products to NASA.
- Coded a new program for use as a debugging tool in testing telemetry files.

Subtask 8: SAMPEX Data Analysis

Staff installed software and performed system administration on the workstation; learned SunOS, Openwindows, SPARCworks software; reviewed and used the California Institute of Technology's software routines to access SAMPEX's MDF tennis format; and designed, coded, and tested data processing software for the MAST instrument.

WORK PERFORMED

Subtask 1: Pioneer/Helios Programming and Maintenance

Staff performed Pioneer-10, Voyager-1, and Voyager-2 fits in rigidity and total energy and H and He flux ratio calculations. As a result of this work, a check of the LP2 H track of Pioneer-10 has begun. Dr. McDonald redefined the track, and it was installed into a test FLUX catalog. New fluxes were generated and data were plotted for three times of interest for two bincard sets. Later, these data were refit. Further work will be done when Dr. McDonald returns from Italy. The INSTALLH program needs to be hard coded to recognize the LP2 MODE name. It should be treated as part 'penetrating' mode and part two-dimentional stopping mode. Dr. N. Lal (Code 664) was consulted to clarify the new LP2 track installation.

Dr. McDonald requested plots of hydrogen and helium detailed spectrum bins in rigidity coordinates. Three sets of three times were compared for Pioneer-10, Voyager-1, and -2. Three plots were prepared containing six curves each, and then two plots were prepared of the third comparison set, where only hydrogen and only helium were plotted. Dr. McDonald requested additional flux values for the three satellites, for Voyager-2 (four times), Voyager-1 (three times), Pioneer-10 (three times), and 3.6-5.2 MeV H and He, with bins matched as closely as possible, which required checking response tables. Dr. McDonald also requested daily listings in 1991 of other bins and solar wind data already available. Staff produced rigidity plots comparing Pioneer-10, Voyager-1, and -2 H and He with added AU distances in the title boxes. Dr. Fujii requested P-10 yearly quiet time spectra from 1977-1992, with bins matched as closely to standard Voyager-1, -2 bins as possible. Listings were delivered as enumerated in the Deliverables section.

The Pioneer trajectory data sets turned up missing when needed for an update Dr. McDonald requested. Copies were uploaded from the workstation and updated. Subsequently, staff discovered that many load modules and other data sets were missing, and not in HSM anymore, most notably the major VSFORTRAN version of the Multisat Fourier Program. N. Laubenthal also reported missing data sets. The download work of other project software was undertaken to safeguard the major software from loss. Source backups have not been systematically done since about the time of the ESA upgrade. At that time, tape backups had been sent back to HSTX staff because of the TLS system reorganization.

Staff set up a CLIST system on the mainframe that FTP's all the project software, one partitioned data set for each FTP cycle. The CLIST creates an input file for FTP, which logs onto VOYCRS, creates a local workstation directory based on an algorithm relating to the middle qualifier of each partitioned data set, and does an mput command. Lists of data sets to be processed are created from LC command output, which is subsequently edited slightly to become the CLIST driver for the work. Initial FTP work was started from the workstation side, but FTP seemed to have trouble downloading all data set members, especially for large data sets (> 200 members), but also smaller ones, and in a nonreproducible way. The problem was reported to the HSTX TAG. One other user had reported a similar problem. TAG made some changes, but task members have not yet tested it from the local side. No mass FTP's initiated from the mainframe CLIST system ever failed in the above way.

Staff began reviewing the AWK and PERL shell languages in preparation for creating Unix versions of common analysis tasks done on the mainframe. A small utility was written using PERL to help with space maintenance of userids on the VOY386 SPARCstation 2 when the program disk became 100 percent full. Staff did some testing with AWK in which the Pioneer Unix software program source code (that was all in one directory) was separated back into individual directories for each program. The 'commonsource' directory holds routines shared by more than one program.

Staff did some testing of the ACE/gr program in its option of executing from the command line. Staff also experimented with spectrum data plotting. Staff uploaded the source members of ACE into a mainframe partitioned data set for listing. Task members reviewed and tested the ACE program fit capability and use of the altxaxis and zeroxaxis concepts for trajectory distances.

Staff began to review work done by a former task member in the software conversion of Pioneer to the Sun workstation. Code from the EDRLST, FLXLST, PRNPHA, and PFRTPL programs was checked. FLXDBG review is still underway. This is preparation to continue/enhance the Pioneer Unix conversion effort.

Two other programs were ported to the Sun computers Unix system. The programs are written in FORTRAN and are used for Pioneer trajectory data base generation and listing. The listing program was modified to detect source data files created on the IBM mainframe. When these files are detected, the EBCDIC characters and floating point numbers are converted to ASCII standard. Raw data files and source data files were downloaded via FTP for testing of the programs. The trajectory data base generator was used to produce a data source file on the Sun. Data derived from this file were compared to data listed from an IBM generated data source file. All programs and data files were placed under the Pioneer subdirectory in the Trajectory directory. A makefile and Directory file were created for this directory. Documentation for the programs was created and placed in the directory with the dot extension of doc.

HELIOS maintenance staff downloaded most major project software for the SB#HL project Userid to the Sun SPARC1+ workstation, and backed up the sources locally.

Subtask 2: Pioneer/Helios Production Data Processing

Eleven EDR tapes arrived for processing. Nine PHA cartridges, nine RATE cartridges, and one FLUX cartridge were reassigned for Pioneer F production. Two EDR tapes arrived with data for the same time period. One tape was produced under the standard SIGMA-5 system and the other was produced under the new SIGMA-9 system.

The production system was completed up to the test data time period. After backing up the catalogs, the new SIGMA-9 tape was processed. The catalogs were restored, and the PHA, RATE, and FLUX tape cartridges were pulled from the tape library. New tape cartridges were assigned to replace the pulled cartridges. After label jobs had been run on the replacement cartridges, production resumed with the SIGMA-5 data. The printouts from the production runs were collected for comparison. Scans of the various tapes and tape cartridges for the test time period were done. It was found that the differences between the SIGMA-5 and SIGMA-9 data would not adversely affect production.

The end of data for Pioneer F is currently August 1, 1993. End of data for Pioneer G remains October 1, 1992. Monthly plots, listings, and matrixes were completed for Dr. McDonald. Various plots were faxed to Dr. McDonald at the Univ. of Maryland.

Approximately 891 SB#PR project data sets were removed from the system and HSM. TAG task members were contacted about the disappearance of these data sets. At the request of TAG task members, the list of lost data sets was reduced to include only those data sets critical to the project. The list was then passed to Operations personnel. Operations personnel informed task members that they could not help. The majority of the data sets were migrated.

During a recent tape library compression, several tapes arrived from the tape library. These tapes, along with tape stored in Bldg. 2, Rm. W-20 are to be scanned. If the tapes are to be kept, they will be either copied to cartridge and stored in the TSS facility or rehung in the tape library. The Libman tapes were assigned new tape slot numbers and hung in the tape library. Two tapes appear to be missing, and several have tape scan errors. The tape scan errors are to be ignored, and the tapes are to be hung in the tape library.

Subtask 3: ISEE-3 Programming and Maintenance

Staff downloaded most major project software for ISEE-3 and the Data Pool systems to the Sun SPARC1+ workstation, and backed up the sources locally.

Staff made a list of missing or non-HSM recallable ISEE-3 software on the mainframe to include with other lost/missing data sets, which the TAG was to attempt to restore (see Subtask 2).

Subtask 4: IMP Programming and Maintenance

Staff wrote a program that analyzes the difference between two IMP-8 DECOM data (same timespans) generated from convolutional decoder unit and new convolutional decoder software at IPD, and also produces a summary report. Staff compared and found two IMP-8 DECOM tapes (same timespans) generated from convolutional decoder unit (CDU) and the new convolutional decoder software at the Information Processing Division (IPD) are different. Staff generated a test IMP-8 ENCY, CNTS, PHA, and SMCT data base that read the IMP-8 test DECOM data (November 30, 1992-December 10, 1992) provided from IPD.

The IMP-8 ENCY, CNTS, and PHA production data base for November 30, 1992 to December 10, 1992, was accidently generated by using IMP-8 test DECOM data provided from IPD by GSFC's data technician. Staff regenerated the IMP-8 ENCY, CNTS, and PHA production data base for November 30, 1992 to December 10, 1992, by using the IMP-8 old DECOM data.

Staff discussed the conversion of IMP software from IBM 9021/ESA operating system to Sun SPARCstation Unix operating system. Staff wrote a draft task plan report to convert the IMP-8 software from IBM 9021/ESA operating system to Sun SPARCstation Unix operating system. Staff modified the READCAT1 program to calculate the total records and megabyte storage requirement for the IMP-7 and IMP-8 tape types.

Staff converted the IMP-8 Data Processing System routines UNPACK, BTNMP, and LOGDEC from Assembler to FORTRAN and tested each individual routine completely.

Staff built a test load module of the IMP-8 Data Processing System program from all the routines coded in FORTRAN language, and the load module is under testing in two time periods on the IBM 9021/ESA operating system.

Staff ran the programs (RATEPLOT, READFT41, and PL3800) to generate an IMP-8 type-2 rate plot covering time range November 1, 1992 to February 1, 1993, this rate plot will be applied to analyze the IMP-8 gain factors. Staff ran the IMP-8 High Gain Plot program for interval 1822 to 1859 33 times to determine the IMP-8 gain factors (D, E, and F detector elements). The IMP-8 main gain table also was updated. Staff wrote a program to extract the MED gain factors from the IMP-8 gain tables and plotted them with the ACE/gr program. After gain factors were available, staff generated the IMP-8 FLUX and FLEX data base for interval 1822 to 1859. Staff ran the programs (RATEPLOT, READFT41, and FRACYR) to generate the 5-minute and 15-minute average IMP-8 rates plot data sets from the IMP-8 production data base and test IMP-8 data base on IBM 9021/ESA operating system, then downloaded all the IMP-8 rates plot data sets to Sun SPARCstation. A plotting program ACE/gr on Sun SPARCstation was applied to generate the IMP-8 type 1A, 1, 2, 3, and 7 rate plots. All the rate plots were delivered to GSFC's scientist to review.

Staff downloaded most major project software for IMP-6, -7, and -8 systems to the Sun SPARC1+ workstation, and backed up the sources locally.

Staff produced a high-quality PostScript plot requested by Dr. McDonald for paper presentation work of IMP-8 LED and MED data, 6-hr averages. Staff produced data for Dr. Lockwood. The data (24 data sets, 5- and 15-min. and hourly data) were e-mailed to Dr. Lockwood. Staff e-mailed Dr. Fujii the 26-day average data prepared with the special FLUXPLOT program version for the standard galactic bins from 1977 EOD.

Staff assisted GSFC's data technician to validate a new requested IMP-8 DECOM tape (previously requested IMP-8 DECOM tape has bad data), staff compared and found both tapes are identical. Staff informed the GSFC's data technician to request another one from IPD. The member READCAT in the CLIST data set SB#IM.LIB.CLIST was modified to comply with the IBM 9021 ESA operating system. Staff completed runs of DBTIME for IMP-8 CNTS/PHA reel sequence number 362-369; and compared the data time gaps on the run's listings with IMP-8 DECOM shipping letter, finding no difference. The executable module XRPAS.FLUXPLOT.LOAD(FLEXPLOT) was relinked with system library DAIO routines.

Dr. McDonald requested plots and listings for IMP-8: 24.25-229.5 MeV protons and 24.16-250 MeV alphas for seven time periods. He also requested plots and listings of daily and 6-hr averages for data from 1991.0-1992.0 and 1991.0-1991.9, 4.1-5.96 MeV and 28.74-81.00 Proton. See the Deliverables section.

Dr. McDonald requested that standard 26-day averages of IMP-8 data be added to the monthly listings and plots requests. JCL was updated to do the fluxplot jobs and plot jobs. CLIST's were modified to automatically submit the fluxplot and plot jobs. The standard data sets for the particle-energy range bins were brought up to date. The first series of plots and listings were presented to Dr. McDonald in the August monthly batch.

Subtask 5: Voyager Programming and Maintenance

Staff produced data for the NSSDC submission of Voyager-2. Three basic time segments were done, because of changes in instrument status. A first draft header file was prepared for Voyager-2. Dr. A. Cummings' information was added to the Voyager-1, and Voyager-2 headers. Some refinement of the headers is still needed.

Dr. McDonald requested least squares fits of data, for 21 time periods, for Voyager-2 low-energy spectrum bins. Fits were requested in momentum and rigidity for H and He separately. Staff incorporated the GLSWS fit program into the program written in June to read data and do coordinate transformations into rigidity and momentum. Later, fits in total energy were also requested. Staff made additional program changes to handle the total energy conversion and to put fit parameters into the comment lines of the output data sets used for later plotting. One hundred and forty-five fits were done as listed in the Deliverables section (all Voyager-2 data). Staff modified the mainframe spectrum plot program GOGO to print the fit parameter results (= the second title line) on the plots.

Staff produced 145 plots (IBM 3800 laser printer) of data with fit and final parameter values for rigidity, momentum, and total energy. Staff also produced 116 plots for use in fitting work, of the data prior to fitting, for initial guess parameter estimating (all Voyager-2 data).

Later, Dr. McDonald asked for similar fits for additional times for Pioneer-10, Voyager-1, and Voyager-2. Forty-eight fits in all were done, with two bin sets for Pioneer. These also were plotted. Dr. McDonald also asked for H and He flux ratios for these time periods. Fit data were plotted in energy and fit transformed coordinates. See the Deliverables section.

Staff wrote a program to extract fit parameters from 84 of the above fits for the total energy and rigidity fits for H and He. These data were then plotted with ACE/gr along with the earlier H and He flux ratios for the 1.8-2.6 MeV bin.

Staff modified a subroutine that already existed and reads the V B A FT07F001 output of FLUXPLOT so that it could read V B output when FT07 data sets were copied into a partitioned data set. Staff added to this subroutine, code that separated the proton and helium fluxes into particle names by event type. This allowed staff to extract the individual flux components of the final mean fluxes and plot them all with separate symbols. The general agreement or lack of agreement among individual LET's and HET fluxes for the fit work could be checked. Some periods had LET discrepancies, and further evaluation is being done.

Dr. McDonald requested matrixes of the A-Stopping data for Voyager-2 for two periods and response table listings and plots for that data. Dr. McDonald also requested a summary of the older LET geometry factors, which staff had replaced in fall 1990. Staff restored a FLUX CATALOG from prior to the geometry replacement work, and obtained the older numbers. He is working on a LET/HET flux discrepancy, possibly rooted in A-Stopping table tracks, which are too narrow for quiet time.

Staff made a modification to the RANGES program to list out the Channel 0 and Channel 1 portions of the flux catalog response tables. This was done to clarify the onset of three-parameter analysis in the LET's, as part of follow up work related to the LET and HET flux discrepancies mentioned above.

Staff produced high-quality PostScript plots requested by Dr. McDonald for paper presentation work. One stack of four graphs, and one stack of three were made of Voyager-2 data. Staff obtained Voyager-2 Magnetic Field data from Dr. L. Burlaga's group (Code 692), and prepared another plot comparing that data with solar wind velocity data. One set of new data was added to a stack of five graphs prepared previously. Staff also produced these high-quality PostScript plots for Dr. McDonald: A stack of three graphs, eight in the series comparing Voyager-2 hourly LET data with Magnetic Field data from Dr. L. Burlaga's group, and solar wind data; 1 Voyager-1/Voyager-2 penetrating rates data comparison with AU distances, 5 plots of 14 HET and LET low-energy bins during mid-1991.

Additional ACE plots were prepared or modified as requested by Dr. McDonald. See the Deliverables section. Staff produced data for Dr. Belcher and E-mailed him the results. Staff produced yearly spectra for Dr. Fujii in mainframe data sets. See the Deliverables section.

Staff used the FT07 output data sets mentioned above month in testing the spectrum plot capability of ACE. The input was segmented into groupings by 'particle' type (and variations). The different segments were properly recognized as different curves, but each curve still had to be processed by the interactive window system to get symbols line types, and legend information to the final plot. See also Subtask 1, ACE testing.

See Subtask 1, rigidity plots with added AU distances. See also Subtask 1, rigidity plots and flux listings. See Subtask 1, reviewing the AWK and PERL shell languages in preparation for creating Unix versions of common analysis tasks done on the mainframe.

Staff downloaded most major project software for the Voyager systems to the Sun SPARC1+ workstation, and backed up the sources locally. Software not present under HSM is deferred until after the TLS reorganization, when our mainframe backup tapes will again be available.

Work has begun on the porting of the LSELECT program to the Sun computer system. One Assembly language program, (BITS), was transcribed to the FORTRAN language. A driver was written to test BITS along with a routine to list the bits in an integer word. A makefile has been created to compile LSELECT. The listing feature of LSELECT has been tested on data from Voyager-2. The range of volumes, (449,000-449,994) were listed. A comparison of listings is underway between the IBM and Sun software products. The comparison has revealed a difference in the data quality acceptance offmask. This difference is being investigated by Dr. Lal. The LSELECT software has been installed under the directory LSELECT in the voyager directory. A makefile has been set up to work as the build module. Information files have been moved into the directory from the IBM and modified to reflect the Unix environment. An optional shell script file has been set up to run the LSELECT program.

Staff worked with AthenaTools Plotter Widget set to test the feasibility of using it for developing a plotting package. Some modifications were made on the widget set source code to remove the deficiencies. Then, staff developed a plotting package with minimal capabilities like reading multiple data sets, creating multiple graphs, setting graph and plot properties, and printing capability. This prototype plotting package was tested using some sample data.

Having found some deficiencies in the plotting package, staff went back to work with the widget set to enhance its capabilities. New resources have been added for changing the size of the symbol, filling in a symbol, setting the width of a line, setting error bars on or off. Staff also added a capability of attaching tic labels at arbitrary intervals and also specifying major and minor tics at arbitrary intervals. The time-axis was implemented, using this newly introduced capability. The printing capability was updated to reflect all these new resources.

Apart from this, staff also worked on upgrading the bincard inputs interface to accommodate rates.

At present, staff is involved in giving finishing touches to the plotting package and also building an interface between data base query and the plotting package.

Subtask 6: Voyager Data Processing and Analysis

Thirty-five EDR tapes have arrived for production. Two EDR's have been copied to a scratch tape because of tape label conflicts in the Tape Library System. Three EDR tapes have been edited for Voyager-2 because of time/line count problems. One EDR tape had data from another project on it and a regeneration was ordered and received. A Voyager-2 library cartridge was misplaced in the tape library and later found. This occurrence did not adversely affect production. One tape cartridge was added to the Voyager-1 Library. The cartridge was hung in TLS, labeled, and assigned to the library control block. End of data for Voyager-1 spacecraft (CIT end of data is February 7, 1993) and Voyager-2 is July 25, 1993 (CIT end of data is January 28, 1993).

The catalogs were modified to accommodate a Tape Library compression that recently took place. Monthly plots, listings, and matrixes were generated for Dr. McDonald. Plots have been faxed to Dr. McDonald at the Univ. of Maryland in preparation for forth coming conferences.

Approximately 628 data sets have been removed from HSM and the system. TAG staff members were contacted to find out what happened to the data sets. TAG could not give an explanation for the data set disappearance, and asked for a list of the most critical data sets to be recovered. Operations personnel called requesting the most recent date of the data sets on a disk pack and a disk pack volume name for each and explained that he could not recover the data sets from security if he did not have this information. Most of the data sets were on migration, and the last known date the information resided on the disk pack is not known.

Because of a Tape Library compression, several reel tapes have arrived from the Tape Library. Tapes arriving from storage in Bldg. 2, Rm. W-20 and the tape arriving from the tape library are to be scanned. After scanning and identification, it will be determined if the tapes should be kept. If the tapes are to be kept, they will either be copied to tape cartridge and stored in the TSS facility or rehung in the Tape Library System. Libman reel tapes have been assigned new tape slot numbers and hung in the Tape Library.

Subtask 7: EPACT Software Support

HSTX staff wrote a program to reformat the LEMT and ELITE telemetry data received from the POCC with the telemetry data captured at the calibration tests. Staff wrote another program to compare the contents, byte-by-byte, to ensure the same byte allocation tables were used in the GSE software and by the Data Capture Facility. The tests were successful in comparing the randomly selected LEMT and ELITE major frames.

A staff member worked on the design document, data flow diagrams, and class libraries for the EPACT data processing system. The access of key parameter and orbit/attitude data in the Common Data Format (CDF) was investigated in the PC environment. A task member acquired and reviewed the PC version of the CDHF software and concluded that the routines can be used in the data processing system for extracting selected data values. Another investigation was conducted on the Microsoft routines to interact with the DOS operating system to retrieve system information for automation of the data processing system. As a result of the investigation, an HSTX task member designed, coded, and tested the SYSTEM, TIME, and Level-0 C++ classes that currently create the Level-0 ENCY data format. During PC comparison testing, an EPACT ENCY test file was produced, and discrepancies were discovered in the bytes as compared to GSE data. Extensive testing also was done on the CDHF Level-0 file on the ISTP VAX. Test results revealed several major problems with these data, bit dropping, partial zero filled major frames, and missing major frames. HSTX staff isolated and prepared test cases of the problems and delivered them in a meeting with the Code 562, Image Processing Department. The Data Capture Facility determined that there was a software bug in their software, and new test Level-0 data now are available at the CDHF for further testing.

A task member made coding upgrades to the MACRO analysis software to analyze the new EPACT ENCY format. Extensive testing was done using the EPACT ENCY data and the calibration test data. As a debugging tool, a task member coded a program to dump and display binary files at a specified byte offset, in a hex and ASCII format.

Staff conducted research on new hardware and software for future software development. The Pentium PC and Windows NT were evaluated and recommended to NASA for purchase.

Task member attended two, 1-week training courses on X Windows programming using Motif and Windows programming using Windows NT. Staff is actively involved in learning programming techniques in Windows using the Microsoft Foundation Class Libraries, Windows NT, and the Pentium computer. A staff member ported the user interface modules from the MACRO software system to X Windows using MOTIF as Graphical User Interface.

Staff updated and delivered the MACRO PDL and the MACRO Requirements documents.

HSTX staff provided ongoing support to engineers and users during the spacecraft-instrument integration.

Staff members successfully installed Visual C++ and MS-DOS 6.0 software on the PC's. The Doublespace program was executed to double hard disk space. Staff installed a CD-ROM drive on the PC for use in the EPACT data processing system testing.

A task member studied the object-oriented design principles, and prepared and completed 8 hours of instructional C++ classes to three NASA employees and a cotask member.

A staff member worked on the Voyager Helium PC response tables and executed the PC FLUX program for Dr. L. Barbier (Code 661) on specified time periods.

HSTX staff investigated an ISEE negative rate data problem by executing the LSELECT program on the IBM, and verifying the data error and reporting results to Dr. D. Reames (Code 661).

Subtask 8: SAMPEX Data Analysis Support

A task member has been successfully working on the Sun SPARC 10 workstation that is now fully operational and on the network. The task member performed routine system administration and learned SunOS, Openwindows, and the use of the 8-mm tape drive. The staff member installed the C Compiler and SPARCworks software.

A task member designed, coded, and tested the SAMPEX data processing program for the MAST instrument. HSTX staff produced test MAST data files and transferred them to the PC where extensive testing was conducted using the MACRO analysis software system. During the PC testing, it was discovered that duplicated MAST events occur throughout the files. Further testing on the raw data files supported these findings. A task member consulted J. Cummings at the California Institute of Technology, who verified the conclusions. The task member is working on an algorithm to examine and select the reasonable MAST events.

SIGNIFICANT ACCOMPLISHMENTS

Subtask 5: Voyager Programming and Maintenance

Staff produced high-quality PostScript plots for Dr. McDonald for presentation. The previously hand-drafted, photographic method, required a significant amount of time.

Subtask 7: EPACT Software Support

Task members discovered errors in the telemetry data produced by the Data Capture Facility software for the EPACT instruments, upgraded it quickly, and performed extensive testing and comparison of the data using the Level-0 telemetry data received from the CDHF and the calibration test data. Staff coded several new programs to isolate test cases of specific problems that were documented and delivered at a meeting with the Image Processing Department staff.

A task member has successfully prepared and delivered in a timely manner the MACRO graphic analysis software that can access the EPACT postlaunch ENCY data base.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements for this task.

DELIVERABLES SUBMITTED

Fits:
29 fits of proton data of Voyager-2 1991 data-flux as function of momentum
29 fits of helium data of Voyager-2 1991 data-flux as function of momentum
29 fits of helium data of Voyager-2 1991 data-flux as function of rigidity
29 fits of helium data of Voyager-2 1991 data-flux as function of total energy
29 fits of proton data of Voyager-2 1991 data-flux as function of total energy
6 fits of proton data of Voyager-2 1991 data-flux as function of total energy
6 fits of helium data of Voyager-2 1991 data-flux as function of rigidity
6 fits of proton data of Voyager-1 1991 data-flux as function of total energy
6 fits of helium data of Voyager-1 1991 data-flux as function of rigidity
12 fits of proton data of Pioneer-10 1991 data-flux as function of total energy, 2 bin sets
12 fits of helium data of Pioneer-10 1991 data-flux as function of rigidity , 2 bin sets

Originator: P. Schuster

Fits of new LP2 response track:
6 fits of proton data of Pioneer-10 1991 data-flux as function of total energy, 2 bin sets
6 fits of proton data of Pioneer-10 1991 data-flux as function of momentum , 2 bin sets

Originator: P. Schuster

Plots: 15 plots of the test LP2 track fits and original fluxes in the mentioned coordinates

Originator: P. Schuster

Plots:
145 plots of the above data + fits and fit parameters in the mentioned coordinates
48 plots of the above data + fits and fit parameters in the mentioned coordinates
29 plots of individual LET and HET fluxes by event-type proton and helium detailed spectra
2 plots: stacks of 4 and 3 plots, comparisons of Voyager-2 data and solar wind speed data, prepared with the ACE/gr plotting program
1 plot: stacks of 5, add more data, comparisons of Voyager-2 data and solar wind speed data, prepared with the ACE/gr plotting program
10 plots: stacks of 1 and 2 plots, comparisons of Voyager-2 magnetic field data and solar wind speed data, prepared with the ACE/gr plotting program
3 plots: 3 sets of 3 times, Pioneer-10, Voyager-1, -2 data in rigidity, H and HE on thc same plot
2 plots: the third of above, Pioneer-10, Voyager-1, -2 data in rigidity, H and HE on separate plots
2 plots: a fourth time set comparison, Pioneer-10, Voyager-1, -2 data in rigidity, H and HE on separate plots

6 ACE plots, previously prepared, modify to get different lettering and add specific notation to designated data areas
5 plots of 14 HET and LET low-energy bins, hourly averages, May 24-30, 1991
6 plots of rigidities with added AU distances, all data previously available, H and He data
2 plots: one 2 stack of IMP-8 6-hr averages 1990.9-1991.9 data; one penetrating rates data plus AU distances of Voyager-1 and Voyager-2 data for 1991.2-1992.2, ACE/gr plotting program
8 plots of magnetic field data and solar wind data of Voyager-2, and low energy LET data, comparing ~ 1991.3- 1991.5 times, LET data as hourly and 6-hr averages
1, 4-stack plot of total energy, rigidity fit parameters, and H and He ratios for previously available data, made with ACE/gr
1, 4-stack of ratios, fit parameters and other Voyager-2 data, delete points with large error bars, and change some lettering

Originator: P. Schuster

Matrixes: A-stopping HET matrixes for H and HE for two calibration time periods in 1977 and 1978

Originator: P. Schuster

Listings: Response table plots and listings of HET A-stopping tables for H and He
Former LET geometry factors (prior to 1990 changes)
Flux lists for Voyager-2 (4 times) Voyager-1 (3 times)
Pioneer-10 (3 times) 3.6-5.2 MeV H and He: match bins
Daily listings in 1991 of other bins and solar wind data already available
Flux H and He ratio lists for Pioneer-10, Voyager-1, Voyager-2 for 3 sets of 3 times each for each satellite, 3.3-5 MeV region
Flux lists for Voyager-2 for the 14 HET and LET hourly average data plotted above

Originator: P. Schuster

Source Backups to Workstation: Voyager, Helios, ISEE, IMP, Pioneer TAR backups

Originator: P. Schuster

Data: For Dr. Lockwood, 13 data sets of 15-minute and hourly average data for a May 1990 IMP-8 flare. Also 11 data sets of 5-minute data within this time
For Dr. Belcher, 2 data sets of Voyager-2 penetrating rate data, 6-hr and daily averages
For Dr. Fujii, standard galactic IMP-8 bins, 26-day averages from 1977-end of data, new FLUXPLOT program output version. Also, yearly quiet-time spectra of Pioneer-10, Voyager-1, Voyager-2 from 1977-1992

Originator: P. Schuster

Plots: 33 IMP-8 High Gain plots for interval 1822 to 1859 10 IMP-8 5-minute average rate plots for type 1A, 1, 2, 3, and 7 10 IMP-8 15-minute average rate plots for type 1A, 1, 2, 3, and 7

Originator: H. Lo

Cartridges: 6 IMP-8 ENCY
1 IMP-8 CNTS
1 IMP-8 PHA
1 IMP-8 FLUX
1 IMP-8 FLEX
Originator: H. Lo

Tapes: 2 test IMP-8 ENCY
2 test IMP-8 CNTS
2 test IMP-8 PHA
1 test IMP-8 SMCT
Originator: H. Lo

Data Sets: 10 IMP-8 5-minute average rate plot data sets for type 1A, 1, 2, 3, and 7
10 IMP-8 15-minute average rate plot data sets for type 1A, 1, 2, 3, and 7
10 IMP-8 5-minute average reformatted rate plot data sets for type 1A, 1, 2, 3, and 7;
10 IMP-8 15-minute average reformatted rate plot data sets for type 1A, 1, 2, 3, and 7
34 IMP-8 5-minute average rate plot data sets for ACE/gr program on Sun SPARCstation; 34 IMP-8 15-minute average rate plot data sets for ACE/gr program on Sun SPARCstation
Originator: H. Lo

Data Sets: IMP-8 main gain table (interval 1822-1859 updated)
Originator: H. Lo

Listings: Summary reports of the difference between 2 IMP-8 DECOM data (same timespans) generated from different programs at IPD
Originator: H. Lo

Tapes: Voyager-1—16 EDR
Voyager-2—18 EDR; 3 Edited EDR's; 2 EDR copies
Pioneer-10—11 EDR
Originator: J. Katen

Tape Cartridges: Voyager-1—1 library
Originator: J. Katen

Data Sets: **Voyager-1**—126 Proton/Alpha spectrum, 1-150 MeV; 2, 4.4-450 MeV Proton/Alpha spectrum; 1 IPENH; 7, 4.3-242 MeV H; 7, 4.3-480 MeV He; 1 IPENH/4.31; 4 Let, Het spectrum He; 1, 1.8-2.6 MeV H; 1, 4.2-6.2 MeV H

Voyager-2—45 Proton/Alpha spectrum, 1-150 MeV; 2, 4.2-450 MeV Proton/Alpha spectrum; 1 IPENH; 1, 3.29-5.61 MeV Proton; 7, 4.3-242 MeV H; 7, 4.3-480 MeV He; 7 IPENH/4.134; 1 Solar Wind; 4 Let, Het spectrum He; 1, 1.8-2.6 MeV H; 1, 4.2-6.2 MeV H

Pioneer-10—30 Proton/Alpha spectrum, 0.5–150 MeV; 7, 3.4–227.3 MeV H; 7, 3.4–453 MeV He

IMP-8—7, 24.25–229.5 MeV H; 7, 24.16–250 MeV He; 1, 4–6 MeV Proton LED; 2, 4.1–5.96 MeV H; 2, 28.74–81.00 MeV H

Originator: J. Katen

Listings: **Pioneer-10;**— 2, 26-day averages; 2 daily averages; 2, 5-day moving averages; 22 Proton/Alpha spectrum

Voyager-1—1, 3-day moving averages, standard gradient flux; 1, 5-day moving averages, standard gradient flux; 2 IPENH; 32 Proton/Alpha spectrum; 1 IPENH/4.31

Voyager-2—48 Proton/Alpha spectrum; 21 Proton/Alpha momentum; 1 IPENH; 1, 3.29–5.61 MeV Proton; 1 IPENH/4.134

IMP-8—1 Proton/Alpha spectrum; 1, 4.1–5.96 MeV Proton LED; 1, 28.74–81.00 MeV Proton MED; 3, 4.1–5.96 MeV H; 3, 28.74–81.00 MeV H

Originator: J. Katen

Plots: **Pioneer-10**—30 Proton/Alpha spectrum; 1, 4–450 MeV Alpha; 10 R2A+R3A 5DMA, Log; 8 Solar Wind, linear; 8, 3.45–5.15 MeV H, Log; 1 Matrix, 4:1 compression ratio; 1 Matrix, 1:1, 2:1, 4:1 compression ratio; 2 Matrix, standard compression ratio; 4, 3.4–227.3 MeV H, spectrum; 4, 3.4–453 MeV He, spectrum

Pioneer-11—8 Solar Wind, linear; 8, 3.45–5.15 MeV H, Log
Voyager-1—87 Proton/Alpha spectrum; 4 Solar Wind, Linear; 6 IPENH, Log; 4, 3.29–5.61 MeV H, Log; 2, 4.3-242 MeV H; 2, 4.3–480 MeV He; 1 IPENH/4.31

Voyager-2—47 Proton/Alpha spectrum; 21 Proton/Alpha momentum; 7 Solar Wind, linear; 4 IPENH, Log; 4, 3.29—5.61 MeV H, Log; 2, 4.3–242 MeV H; 2, 4.3–480 MeV He; 1 IPENH/4.134

IMP-8—4, 24.25–229.5 MeV H, spectrum; 4, 24.16–250 MeV He, spectrum; 2, 4.1–5.96 MeV H LED, spectrum; 8, 4.1–5.96 MeV H. 6-hr average; 4, 28.74–81.00 MeV H, 6-hr average

Originator: J. Katen

Spacecraft Comparisons: 1, 30–56 H, Voyager-2 and Pioneer-10; 1, 30–56 He, Voyager-2 and Pioneer-10; 1, 10–20 He, Voyager-2 and Pioneer-10; 1, 120–220 H, Pioneer-10, Voyager-2 and IMP-8; 1, 182–457 He, Pioneer-10, Voyager-2, and IMP-8; 1 Penn Rates H, Pioneer-10, Voyager-2, and IMP-8; 1 IPENH/4.31 and IPENH/4.134, Voyager-1, and Voyager-2

Originator: J. Katen

Documentation: MACRO Requirements Document; MACRO PDL Document

Originator: S. Tipparaju

Software: DUMP.C (C language, IBM PC/MS-DOS; MACRO (C language, IBM PC/MS-DOS)
Originator: S. Tipparaju

Software: COMPARE.C (C language, IBM PC/MS-DOS; TESTMJR.CPP (C++ language, IBM PC/MS-DOS); LISTFR.C (C language, VAX/VMS); EDP.CPP (C++ language, IBM PC/MS-DOS); PROCESS.C (C language, Sun/SunOS); TIMETST.c (C language, Sun/SunOS)
Originator: K. Wortman

C++ Classes: LEVEL-0; TIME; SYSTEM
Originator: K. Wortman

Data Files: EPACT ENCY; MAST ENCY
Originator: K. Wortman

COMPUTER USE

Minutes	Computer
600	IBM 3081
Dedicated	3 IBM PC/AT's
Dedicated	2 SPARCstation IPC's
Dedicated	SPARCstation 2
Dedicated	SPARCstation 1+

NASA Tasks 62–233–01–14: X-Ray and Gamma-Ray Programming Support

GSFC ATR: *T. Sheets*

Hughes STX Task Leader: *A. Etienne*
Hughes STX Task Numbers: *661–673*

This task provides software development, maintenance and support, data analysis and support, computer system management, and mission planning for various GSFC X-Ray and Gamma-Ray tasks. This includes production system support for the High Energy Astronomy Observatory (HEAO), x-ray data analysis, software development for the Energetic Gamma-Ray Experiment Telescope (EGRET), programming and data support for the Burst and Transient Source Experiment (BATSE), support for the Broad Band X-Ray Telescope (BBXRT) Ground Support Equipment (GSE), data reduction and analysis for the BBXRT, computer system management for the Laboratory for High Energy Astrophysics (LHEA), data analysis for EGRET, mission planning for BBXRT, and programming and data support for the Gamma-Ray Imaging Spectrometer (GRIS). Support is provided in part on the IBM 3081, MicroVAX, PDP 11/44, Sun, Tektronix, Macintosh, and Data General MV/4000.

FINAL CONTRACT SUMMARY

Subtask 1: HEAO-A2 Production System Support

One full-time data technician supported this subtask for about 6 months and one programmer on an as-needed basis from October 1988–September 1993. Staff converted approximately 400 x-ray data base 9-track tapes to cartridges, developed procedures to copy multiple files from tape to disk on the IBM mainframe, copied content of 1 cartridge tape to 11 disk files, and E-mailed relevant information about HEAO-A2 data base to cognizant personnel to assist HEASARC's effort to archive the entire MAX data base. HSTX personnel also generated APHA, BPHA, and CPHA data base tapes containing data from the OSO-8 experiment and supported maintenance work such as tapescans, tapecopies, and recovering old archived data sets.

Subtask 2: X-Ray Data Analysis

One programmer supported this subtask on an as-needed basis from October 1988–September 1993. Staff modified x-ray analysis programs written in FORTRAN on the IBM mainframe, so they would work with new Operating Systems—MVS-XA and MVS-ESA. Some JCL's also were modified to accommodate the changes.

Subtask 3: EGRET Software Development

The EGRET Data Analysis subtask began October 1, 1988, to provide technical support for NASA's EGRET experiment. The subtask began with two HSTX programmer/analysts responsible for most of the data management and data analysis software for the EGRET project. Over 20 programs were developed and/or maintained in that period with all critical software being completed before the launch of the instrument. A large portion of the software was developed to store, catalog, retrieve, and manage the gamma-ray data from EGRET. Other programs supplied the tools for scientists and data technicians to visualize and analyze the information.

In August 1990, two additional programmers/analysts were brought onboard to further meet the requirements of the project. Staff operated the EGRET instrument; participated in prelaunch testing at Cape Kennedy and subsequently became responsible for daily operations; and performed commanding and data validation throughout the mission.

Hughes STX staff also accomplished the major task of porting EGRET software from the IBM 3081 to the newly acquired Sun workstations because these machines are better suited for the needs of the EGRET staff. Completed rapidly and efficiently, this change made the software easier to use. The launch of the EGRET instrument onboard the Compton Gamma-Ray Observatory (GRO) on April 5, 1991, and the reception of the data shortly thereafter culminated the mission. HSTX personnel support continued to be instrumental in the success of the mission with focus now turning to increasingly enhancing and maintaining the software, as well as providing additional support in the data analysis aspect of the task. Staff also compiled EGRET results from the first phase of the mission for journal publication. This subtask has consistently enjoyed high ratings from the customer by delivering high-quality work in a timely manner.

Subtask 4: BATSE Programming and Data Support

The BATSE subtask began in 1988 to provide software support for postlaunch analysis of data obtained by the BATSE instrument onboard the Compton GRO. One HSTX programmer performed detailed design analysis, which was completed by January 1989. Two HSTX programmers began coding. A total of seven HSTX programmers worked on the task with a maximum of four programmers on the task at any one time. Staff delivered all mission-critical software prior to launch, and provided ongoing support for maintaining and upgrading existing software and implementing enhancements. The HSTX BATSE team provides software support to multiple remote sites. The BATSE team has consistently received high marks for doing a difficult job well.

Subtask 5: BBXRT GSE Support

Beginning in October '88 one system programmer supported the BBXRT GSE project by developing software to process the telemetry data from the instrument, and writing programs to display images from the instrument. Other software programs were written to determine the telescope positions. Staff provided user's guides and software documentation to supplement the software. Most of the work was performed on a Compaq 286. The subtask ended shortly after launch of the BBXRT in December 1990.

Subtask 6: BBXRT Data Reduction and Analysis

Two staff members developed software to handle the level-0 and -1 data. Level-0 data processing software is called PRIMA and was developed first. The interactive part of CHIP and part of the Aspect software was developed next. BBXRT was launched aboard Shuttle Columbia in December 1990. Another task member joined the BBXRT Data Reduction effort in February 1991. Two members on the team were transferring to a different project at that time. The task member worked on two main postlaunch software projects: 1) enhancing the CHIP data base software, and converting it into a batch-oriented executable program, and 2) developing the Aspect Solution software in C. This software was used to obtain the Aspect solutions for over 150 sources that BBXRT observed. Final enhancements for the software were completed by December 1992.

Subtask 7: LHEA Computer System Support

The LHEA Computer Support Task was started in mid-1989 to provide system and network management support for the growing number of Unix-based computers in the laboratory. In mid-1991, HSTX also added VAX/VMS system management to the support provided in this task.

In 1989, there was one full-time HSTX task member providing support for computer system management. Since then, the group has grown to 2 full-time staff members supporting the entire department (12 major projects), and 4 staff members working part-time to support the XTESOC, EGRET projects, and the department VAX/VMS systems. In 1989, HSTX provided support for two Sun servers. Currently, the department has 10 server class machines, over 150 workstations, over 150 microcomputers, and a large number of additional peripheral devices (printers, modems, data CD jukeboxes, and disk drives).

HSTX staff have been essential to the development of the LHEA network of computers. In addition to procuring and installing most new systems as they arrive, HSTX task members also have assisted in designing and implementing the current network.

The HSTX system managers also have been very active in user education and support. The HSTX system managers assisted in providing system accounts to new users and often taught new users how to use Unix and local versions of software. HSTX system managers often answered questions regarding use of the system, peripheral devices, and the network.

HSTX system managers have devoted much off-hour and weekend support in addition to regular weekly support for as well-rounded a system and network support as possible. With only one civil servant and no other contractors providing LHEA computer support, HSTX has become the backbone for computer system support within the LHEA division.

Subtask 8: EGRET Data Analysis and Management

The EGRET Data Management and Calibration/ Flight Data Studies task has been staffed for the full 5-year duration of the contract. During this time, it has grown from one scientist and one data analyst to the same data manager and eight data analysts.

Performance of the group has paralleled the major accomplishments of the EGRET instrument. Prior to launch, five analysts reviewed all calibration data from major tests at the Stanford Linear Accelerator Center (SLAC), as well as at accelerators at Bates (MIT) and Brookhaven. The enlarged team of eight has kept pace with the flow of flight data, following the April 1991 deployment by Atlantis. Their review represents 15 percent of the overall data flow, which meant that in the first 2 years of flight data, they analyzed more than 5 million individual spark chamber events. In this time, staff has remained within 5 weeks of data acquisition, and usually operated 2–3 weeks behind, significantly better than prelaunch estimates.

The data manager oversaw the growth of Unix workstations from 0–20, which was concurrent with the conversion of EGRET software from an IBM mainframe to these local workstations. Also, the data manager taught Unix to more than 35 users of the system over the 5-year period. Because of the inexperience of the group with the Unix operating system and with windowing environments, the ongoing need for user education has been met through classes, locally developed documentation, and many hours of one-to-one consultation. This has been done in conjunction with providing users with myriad public domain tools that smooth the interface for users or provide new functionality.

Subtask 9: BBXRT Mission Planning

The BBXRT mission planning task began in March 1989 and was completed in February 1991. A single HSTX task member worked on this subtask for the entire period and created data bases of possible BBXRT targets, wrote Excel macros to determine which targets were visible during a mission launched on a specific date, and for each shuttle orbiter attitude during that mission, created mission timelines for each launch data scheduled, generated the BBXRT Target Book, which included expected spectra and count rates and a skymap of the area around each target, participation in mission planning at MSFC during the simulations, mission, and regeneration of pointing log (as-flown timeline) after the mission obtained data from the Two-Axis Pointing System (TAPS) and the orbiter's attitude.

Subtask 10: GRIS Programming and Data Support

The GRIS Programming Support subtask began in April 1989 to provide the Low Energy Gamma-Ray group with software and system management support for the GRIS and their three Data General MV/4000 computers. One HSTX task member provided programming support and systems management. Routines were developed and modified to create reliable backups, system problems were determined and resolved, and procedures for bringing up the computers were developed and instituted.

GRISOP, the multiple-user, real-time, event-driven software responsible for collecting data from GRIS's telemetry link and providing some basic near-real-time data analysis was modified by HSTX staff to add new features, like a compressed histogram data file format, and correct old problems. Additionally, this Data General MV/4000 specific code was analyzed to determine the difficulty in porting it to another platform. A concurrent computer with a real-time Unix operating system was procured as the target platform for porting the GRISOP code. It provided the industry standard Unix operating system with special emphasis on real-time routines that are not usually found in Unix.

Because the Low Energy Gamma-Ray group uses Macintosh computers for word processing, data analysis, presentations, and other tasks, the HSTX staff was charged with maintaining this network. Systems were updated to use Ethernet, and allow disk and file sharing. Additional types of connections were developed and installed like AppleTalk, TCP/IP, LAT, ARA, PPP, and SLIP. After the April 1990 flight of the GRIS instrument, much of the work on GRISOP was suspended because of the crash landing of the instrument.

Subtask 11: TGRS Data Analysis and Programming Support

The Transient Gamma-Ray Spectrometer (TGRS) Programming Support subtask began in November 1990 to provide software for this ISTP WIND instrument. The TGRS instrument is similar in nature to the Burst Analysis Transient Source Experiment (BATSE) instrument. BATSE Spectral Analysis Software (BSAS) was used as the basis for TGRS Data Analysis Software (TDAS) so that much of the data analysis software can be reused with little modification and data between TDAS and BSAS can be compared and contrasted.

PRIM_DB_GEN, KPGS, THGEN, THQUICK_PLOT, THPLOT, and COUNT requirements and specifications were developed in conjunction with the scientists. Staff developed PRIM_DB_GEN as the program responsible for reading the level 0 data from the Central Data Handling Facility (CDHF) and creating a separate data file for each type of data present. Significant work went into creating realistic data from testing the PRIM_DB_GEN.

Key Parameter Generating Software (KPGS) was developed to provide scientists involved with the other ISTP instruments with access to some TGRS data. Time History GENeration (THGEN), Time History PLOTting (THPLOT) software, QUICK look Time History PLOTting (THQUICK_PLOT), and the INGRES data base routines needed to process the primary data bases created by PRIM_DB_GEN in a manner that is similar to and compatible with the BSAS system, are now being completed.

Subtask 12: XTE Science Operations Center

The duration of this task has been from November 1990 to present. The task has been staffed by system development personnel including a development manager, software analysts, system engineer, applications programmers, scientific programmers, system manager, and technical editors.

Major milestones for the XTE task include the following:

- May 1991—XTE SOC-002 Requirements Document
- August 1992-XTE SOC Preliminary Design Review (PDR)
- December 1992—XTE SOC Build 0 Release
- January 1993—XTE SOC-102 Requirements Document
- July 1993—XTE SOC Build 1 Release
- September 1993—XTE SOC Critical Design Review (CDR)

HSTX task personnel performed analysis of the SOC requirements and documented the resulting derived requirements in a detailed design document. A system architecture was then designed containing subsystems and allocated requirements. This design was presented at a PDR. Detailed design documents for each of the eight subsystems were then produced. Staff implemented the first two of seven builds: Build 0 containing the development environment, and Build 1 providing the system framework classes while continuing to refine the designs. The detailed designs were presented at the CDR.

Extensive planning, methodology, and interface documentation were produced in addition to the design documentation. Planning and methodology documents including a Software Development Plan, Integration and Test Plan, Software Standard Document, SOF Build Plan, Operations Concept Plan, and others were produced. Staff worked with interfacing groups to produce 4 Interface Agreement Documents and 10 Interface Control Documents.

Subtask 13: KONUS Software Development Support

The purpose of the KONUS Software Development Support Task has been to enable KONUS gamma-ray data to be used within the TGRS Data Analysis System. This task began in January 1992. The detailed task specification document was largely complete by September 1992, but modifications have continued to be made in response to requests from potential users of the data. One of the major changes has been that all the software requirements have now been levied on a single program, PRIM_DB_GEN, which not only locates and extracts the various kinds of data needed, but stores them in formats consistent with the TGRS programs THGEN and COUNT. Detailed program design was completed in December

1992, when coding began. Test data became available in May 1993. An early version of the program, which works well on error-free data records, was demonstrated in August 1993. In the course of handling unexpected instrument modes, and error-affected data records, excellent relationships have been established with both the Russian instrument builders and scientists and the ISTP CDHF staff who will deliver the postlaunch science data.

Subtask 14: XTE/PCA Programming Support

This task began in August 1992 with a part-time programmer. Currently, two programmers are supporting this effort. Activities include: Preliminary design of PCA requirements; XTE/CDR related prototyping, and housekeeping subclasses.

SUMMARY FOR CURRENT REPORTING PERIOD

Subtask 1: HEAO-A2 Production System Support

At the request of an HEAO-A2 scientist, HSTX staff updated old software and developed a new program for data verification.

Subtask 3: EGRET Software Development

Staff performed instrument commanding and telemetry verification, prepared for the upcoming orbit maneuver, modified and enhanced software as requested, and began work on new programs.

Subtask 4: BATSE Programming and Data Support

A new program, LSRCH, was designed, completed, and delivered. Two new DCL utilities LIST and IBDBFILES, were written to give user a quick look at the burst directories for available information. Staff provided support to GROSSC to upgrade their system to BUILD 10. Two other sites (MSFC and UCSD) want to stay at BUILD 9 for a little longer to complete current analyses. Work continued on adding new features and enhancing the existing software. Programming staff was reduced to only one during this period.

Subtask 7: LHEA Computer System Support

New workstations and peripheral devices were procured and installed. The LHEA network was expanded to support the growing user community. Also, service work was coordinated on some existing hardware. Users were trained in the use of LHEA software and resources. Several PR's for workstations and peripheral devices were generated. Meetings were held to discuss the LHEA network and the future direction of the LHEA computing environment. Security holes were corrected.

Subtask 8: EGRET Data Analysis and Management

Work on current data is less than 2 weeks behind data collection. Computer tools continue to be upgraded and presented to both new and experienced users.

Subtask 10: GRIS Programming and Data Support

No support provided at the request of the ATR.

Subtask 11: TGRS Data analysis and Programming Support

HSTX staff made changes to PRIM_DB_GEN for generating missing Major Frame start times. Data is then saved for use by THGEN and COUNT. THGEN, THQUICK_PLOT, work is being completed. A demo was given to show scientists the current capabilities of PRIM_DB_GEN, THGEN, THQUICK_PLOT, and COUNT and allow interaction with users for suggestions and changes.

Subtask 12: XTE Science Operations Center

Staff performed the following tasks:

- Produced and presented major portions of the XTE SOC critical design review on September 22 and 23 for the XTE Community including all SOF presentations and SOC presentations on external interfaces, operations, and integration and test.
- Rewrote and finalized methodology documents including the XTE SOC Software Development Plan, XTE SOC Software Standards, and XTE SOC Integration and Test Plan.
- Produced detailed SOF Build Plan containing over 300 milestones.
- Coordinated inputs to XTE Master Project Schedule.
- Developed detailed Build 2 schedules.
- Supported XTE project meetings and reviews, SOC-Instrument Team Meetings, and XTE Science Operations Working Group.
- Completed the Build 1 Release at end of July including software from six subsystems.
- Corrected all major outstanding DR's from this release by the end of August.
- Implemented, debugged, and used in Build 1 delivery and release an automated integration and configuration management process for all SOC software.
- Designed and implemented telemetry stream simulator framework.
- Performed the Trailblazer benchmark activity, which validated that current designs of real-time ingest and data management could meet performance requirements. This also demonstrated a working functional thread to ingest and store PCA housekeeping data and HEXTE Science Data.GOF staff produced a prototype XTE FITS Formatter.
- PCA staff provided Build 1 release of PCA/SOC software.
- Held Build 2 Planning Reviews and Design Reviews for all eight SOF subsystems, including update of all subsystem design documents.
- Resolved design issues in Science Monitoring analysis functions and real-time display, Spacecraft Data Accessors, Health and Safety trending, Mission Monitoring, and GUI Builder, and identified new Utilities Subsystem.
- Finalized SOF Detailed Requirements Specification.
- GOF staff performed an analysis of science requirements and design for the next generation timing analysis software.
- Worked with Code 500 and Instrument Teams to bring all ICD's (10 total) to preliminary state.
- Began work on two SOF/GOF ICD's.

Subtask 13: KONUS Software Development Support

Final integration and testing of program PRIM_DB_GEN has continued. Good test data were obtained. An early version of the program was demonstrated.

Subtask 14: XTE PCA Software Development

Staff delivered derived PCA housekeeping subclasses of various subsystems.

WORK PERFORMED

Subtask 1: HEAO-A2 Production System Support

In the process of archiving all x-ray experiment data to HEASARC, a cognizant person found out that a set of OSO-8 APHA, BPHA, and CPHA data tapes were unreadable with no explainable reason. At the request of the GSFC scientist, who decided to regenerate these data tapes, an HSTX member modified FORTRAN source code (originally written in FORTRAN H) and IBM JCL's to work with VS FORTRAN compiler and linker. A simple program RDPHA was written to verify data on the old tape and those on the new tape are identical. New load modules were made and JCL's were setup accordingly for upcoming production jobs.

Subtask 2: X-Ray Data Analysis

Work on this subtask was kept to a minimum.

Subtask 3: EGRET Data Analysis

100 SUN SOFTWARE

The GRSMRY software has been ported to the EGRET Sun workstations and adapted to get the PDB data from the optical file system. An XView interface has been created for it as well, and the program is now under configuration control. Documentation for the Sun version of the program has been completed and delivered. Staff also updated all the external documentation for the map programs (MAPGEN, INTMAP, ADDMAP, TRANSMAP) to reflect the latest changes in the software mainly the change from Xdialog to XView for the user interface.

Problems encountered with the ADDMAP programs with respect to low values at the poles and bins crossing the map have now all been corrected and the updated program has been put under configuration control. The ADDMAP and INTMAP programs were modified to read the input FITS files independently of the order in which the energy information is written. HSTX task personnel have installed the INTMAP program for EGRET collaborators at MPE in Germany by remotely logging on to their sun workstations.

Staff have completed the PTEXPO program, which computes the EGRET instrument exposure for a single point in the sky. The program is very similar to the INTMAP program and uses code from it. The program was then modified to output a binary file of the exposures as the Stanford PointExpose program. Documentation has been completed. A general purpose map adding program, called ADDFITS, has been completed as well. The program is similar to the ADDMAP program but is more general and allows adding likelihood maps and transforming maps.

Work has begun on writing an IDL version of the HKGRAF program. The new version is expected to provide major improvements in power, ease of use and user-friendliness over the old Template version. HSTX staff is currently developing the user-interface aspect of the program. A program to evaluate an integral for the intensity of the gamma-ray background has been completed. The program is named INTGRL. Code has been written to search for microsecond burst events in the Summary Data Base and the program, SRCMIC is now completed.

EGRET identified and unidentified gamma-ray source data are being compiled in preparation for publication of the EGRET catalog.

An all-sky Aitoff projection map of the summed Phase 1 EGRET data is being produced using IDL. Similar maps showing gamma-ray photons above 10 GeV and above 30 GeV are also being produced.

SKYMAP was enhanced to allow users to enter coordinates of individual sources to be plotted on the image and to select a color of the plotted symbol.

The IDL libraráries on the EGRET sun have been updated to contain the latest versions of routines from the GSFC IDL Astronomy Library and the JHU/APL IDL Library.

Likelihood analysis for viewing periods 18.0, 25.0, 30, 33, and 37.0 has been completed.

Viewing periods 16–30 have been delivered to the GRO Science Support Center.

The IDL SKYMAP source code and documentation were transferred to the GRO Science Support Center.

Work is underway to create a data base using Postgres data base management software on the EGRET Sun system to manage all potential gamma-ray source and viewing period analysis data. Programs are being written in C to convert and transfer to the data base the gamma-ray source list information and the analysis report data generated from the LIKE program. A user interface has been developed to query the gamma-ray source information.

A list of all EGRET scientists' publications and talks is being maintained in a file on the EGRET sun system.

Development of the Xcor GUI has been completed. The Xcor GUI was delivered to H. Mayer-Hasselwander (MPE).

Work is beginning on a task to convert code from running under MS-DOS to run on the SUN SPARCstations. The program is used to display gamma-rays from the drift chamber detector. The graphics section of the code will require extensive changes to incorporate calls to the IDL computer language. The code for DC4 was converted and built on the SUN and a prototype graphics version has been written.

Emacs 19.18 was built and installed on egretop, a SUN IPC workstation.

200 IBM 9021 SOFTWARE

The EXPHST program has been modified to make a new entry in the output file when 10 or more packets worth of data are found missing. The updated program is under configuration control on the IBM machine. The GRSMRY program was modified to permit nonsequential viewing period numbers in the timeline file. A modified version of the CHKOUT program named CHKMIC was developed to allow checkout of special events to search for microsecond bursts.

The CATLST program has been ported to the NCCS Convex computer in the pilot project of moving remaining IBM software to Unix platforms. The move was achieved smoothly and issues of displaying the output on the screen and on a printer have been resolved. No user-friendly interface has been developed at this time as it is not clear where the program will ultimately reside and what best user interface systems will be available.

A modification was made to HKSCRN, which is used to scan the EGRET housekeeping telemetry. The instrument deadtime was include to the message that is printed if a "lock up" is found,

A catalog of EGRET data tapes became corrupted. The data were recovered. This is believed to be a side effect of some outdated code. The code was rebuilt.

300 EGRET OPERATIONS

The copying of EGRET calibration data from 9-track tape to 8-mm tape has been completed. A delay was encountered when one of the 8-mm tapes was accidently overwritten and had to be copied from a redundant tape.

A instrument anomaly occurred on July 25, 1993. Because of a simultaneous execution of RTS commands, memory was over written, and no data was taken for about a half hour. The problem was self-correcting. These commands will be modified in the near future to reduce the chance of future problems.

New RTS loads were created for 5 RTS's. The timing between commands was tighten to reduce the chance of RTS conflicting with each other. Although the first load failed testing, a revised load with slightly different timing was loaded.

Additional preparations are being made for the upcoming orbit maneuver. Power consumption for EGRET was broken down by subsystem and reported to the flight operations team.

A number of tests of the GRO propulsion system have been conducted. During this time, EGRET is put in a safe configuration.

Weekly quick looks are being performed while another member of the EGRET team is on leave.

The PDP-11/44 was backed up and the disk was cleaned of nonpertinent files.

A couple of hours of data were lost on August 1 because of an operations problem. Some commands to activate the EGRET spark chamber were not executed.

Lockups continue to randomly occur. A task member searches the daily tapes and investigates and records each occurrence.

Some EGRET FITS files were re-created because of a revision to the scale factor that was used.

A comparison was made between recent data and data that are 2 years old to look for a significant increase in albedo gamma-rays. The change in GRO altitude causes more albedo gamma-rays to be accepted.

Subtask 4: BATSE Programming and Data Support

100 BATSE DATA ANALYSIS

A new release, BUILD 10, was prepared and sent to each site along with the instructions for how to upgrade their systems. In addition, the BSAS$SPEC_DATABASE directory where the IBDB files are stored needed to be restructured so that different versions of the same bursts may be maintained properly. A command file MAKE_DIRS.COM was written to perform this task and was also sent along with the instructions on how to use it. Staff worked with GROSSC to upgrade BSAS to Build 10 at that site.

110 Data Base Command Procedures

111 Command Procedures

Staff wrote two utilities LIST.COM and IBDBFILES.COM to allow users to view the BSAS$SPEC_DATABASE subdirectories to see what IBDB files exist for a given burst and also to list out the bursts for which SD/LAD data exists.

112 MATRIX

Testing continues for MATRIX as scientists suspect that Earth scattering produced by BSAS is not quite correct. In addition, it is noted both here and at MSFC that the DRM for LAD detector six has problems in certain regions. For both of these problems, it in not yet clear whether the algorithm or the coding or the coefficient matrixes or a combination of all these is incorrect.

115 MODFIT

MODFIT always performed fitting by folding spectra through the latest detector response matrix (DRM). Sometimes it is desirable to use one of the old DRM's. To accommodate this request, staff modified this program so that user may request a DRM id from the input parameter screen. The default is still the latest DRM.

118 COMMONS

Two new channel-to-energy algorithms were incorporated in BATSE software.

135 RDDRM

Staff modified RDDRM to report whether or not Earth scattering was included in the DRM and also the user comment entered at the time of DRM creation.

137 CALIB

CALIB was modified to allow two additional channel-to-energy algorithms, Band 2.1 and Band 3.

139 PDBGEN

PDBGEN was updated to create and store Band 2.1 and Band 3 parameters in the INSTITUTIONAL PDB.

143 RED2

Programs SETUP, PDBLST, and LSRCH were included in the INGRES REDuce menu.

146 LSRCH

Design and coding began for this new program. This will allow the user to perform a preliminary search for spectral lines in a spectrum. An initial version of this program was released to the development area for further testing. Modifications were made to the design to improve the speed of LSRCH.

Subtask 6: BBXRT Data Reduction and Analysis

400 ASPECT

This project has been completed.

Subtask 7: LHEA Computer System Support

An IPI disk controller and four drives were moved from the SAGE 0 server to the new EGRET server. One 8-mm Exabyte drive was moved from a workstation to the EGRET server, this device is used to backup up the EGRET SUN cluster.

Software tools for system administration were installed on both the VAX/VMS and SUN/OS clusters.

Work began to discover the source of network problems for the LHEA computing environment. This includes user interviews, network device reconfiguration, and workstation reallocation.

An HSTX staff member has been working with the Code 600 Director on X program training.

HSTX staff has been reworking the backup schedule for the LHEA and EGRET computer clusters. Backups for the month have been completed. HSTX employees assisted in training a civil servant on how to run the backup process. The civil servant will be assisting the system managers in the backup procedure.

HSTX staff installed a high-capacity, 8-mm Exabyte drive on the PCA cluster. Specialized backup and restore software was installed. Training for the backup software was provided by HSTX staff to members of the PCA group.

HSTX staff contacted hardware maintenance contractors to repair defective equipment in the LHEA department. HSTX staff worked with the maintenance contractors to minimize the downtime for users.

HSTX staff conducted inventory and produced complete lists of LHEA Sun equipment. This information was necessary to renew the department maintenance contract.

Several new SUN systems have come in. HSTX staff coordinated purchase, receipt, and installation of the new systems.

HSTX task members also coordinated the purchase, receipt, and installation of additional hardware (including tape backup devices, disk drives, modems, cables, and other assorted equipment) necessary to keep the LHEA computers running smoothly.

HSTX employees assisted in the purchase, receipt, and installation of several software packages for the LHEA computer systems. Installed software included (but not limited to) new versions of FrameMaker, Gnu C Compiler, Gnu C++ Compiler, and Object Center.

HSTX employees provided continuing service to the XTE project to ensure that the transition of HSTX XTESOC staff to offsite housing went as smoothly as possible and minimized the transition time to the project.

HSTX task members assisted in training a civil servant on how to process purchase requests for computer equipment. The civil servant will be assisting the system managers in the purchasing procedure for new equipment.

HSTX staff trained several new employees in the use of LHEA computer systems. This included (in some cases) introductions to the Unix environment and the LHEA environment in particular. The number of new users was higher this period as many summer students and summer GO's were just starting this period.

HSTX staff continued to provide user support services on a continuing daily basis.

Several security holes were corrected on the LHEA and EGRET networks.

HSTX staff assisted in laying new network cables to expand the LHEA network. The network was experiencing significant performance degradation until the new network cable was laid and machines switched over to the new cable. HSTX staff helped laid the cable and moved computers from the old Ethernet connections to new Ethernet connections, minimizing downtime for the users.

Many new workstations (more than 12) were procured for various projects during this recording period. HSTX task members were actively involved in procuring and installing the new workstations.

HSTX staff donated weekend and evening time to assist in shutting down and bringing back up systems for weekend and evening scheduled downtimes due to power outages, power switchovers, and air conditioning downtimes.

HSTX staff procured peripheral devices, cables, networking devices, and other assorted hardware necessary to provide effective daily system and network support for the LHEA department.

HSTX task members coordinated the hardware service maintenance for printers, disk drives, and other peripheral devices requiring maintenance.

HSTX staff provided programming support to generate new commands and procedures to provide new or improved services for the user community.

HSTX staff standardized system configuration within the XTE PCA network of computers so that each system was configured as similar as possible for ease of use.

HSTX employees have been installing local version of Openwindows 3.0 and X11R5 on various workstations within the department to help decrease network dependencies and network load. Approximately 25 percent of the machines on our network have local versions of this software. HSTX task members are working on getting this distributed to more machines as quickly as possible.

Subtask 8: EGRET Data Analysis and Management

100 DATA MANAGEMENT

At the request of the EGRET PI, a detailed document was prepared describing the events surrounding and following the crash of the SAGE 1 server in March. The document gave an overview of the situation and listed the complications that arose and how they were handled.

The data manager also compiled a document concerning issues of text editors within the Unix cluster, and offered tips and shortcuts for users wishing to use alternate editors (by modem vs. from a windowing console, for example).

A cron (a Unix construct that runs commands at given times) was established to handle both directions of data flow for data being transferred between the IBM MVS system (the Primary Data Basc) and the EGRET IBM RS/6000 workstation (where the SAGE pattern recognition program is run). The advantage of this is that data are handled expeditiously and automatically, although the process can be run by hand in addition, if even speedier turnaround time is desired.

A series of commands to allow nonroot users access to certain system commands was tested and implemented on a few workstations. Users will now be able to mount and unmount CD-ROM's without needing system privileges. Furthermore, limited system access can be granted to certain users for the purpose of line printer queue manipulation.

Service contracts for FY '94 were prepared during June. These included monthly maintenance contracts for the largest and most critical computers and 'time and materials' and per-call agreements for other equipment.

GSFC's Astrophysics Data System (ADS) was installed on the EGRET cluster. ADS provides a windowing interface for accessing many data bases of archival spacecraft data, journal abstracts, and other resources. Staff also worked with a visitor from the Stanford Linear Accelerator Center (SLAC) in porting the visitor's GISMO code to the SUN. (GISMO is a visualization tool for the EGS Monte Carlo code, and was originally written to run on PC's and NeXT's.)

Preparations were made for the move of the SPARCserver 690 ("EGRET") to the PDP-11/44 machine room (so as to have all the noisy machines in one place). New software drivers for the IPI disk controller were installed and a new kernel was built. Then, the disk controller was moved from the SAGE 0 server to EGRET. Concurrently, the PDP room was prepared for a large additional piece of equipment. Thirty feet of cabling was laid to place the console in an adjacent room. The contents of two cabinets was consolidated to make room for the 690 rack.

Staff upgraded a variety of public domain packages, including compilers (gcc and lib-g++), USENET news (nn and tin), network information retrieval (archie, xarchie, gopher, and xgopher), and a virtual window manager (tvtwm).

The data manager gave a presentation on Archie and Gopher to the HSTX System Administrators Group in late July. The 45-minute talk covered how to build the tools and tips on their effective use.

As long planned, the SUN SPARCserver 690 EGRET was moved to a computer room that already housed two PDP-11/44's. Video, audio, keyboard, and Ethernet cables were run 30 feet to the console and network transceiver box, which were located two rooms away.

A variety of sendmail and other network configuration issues were addressed on the EGRET SGI and IBM RS/6000 machines. Some of these were resolved (both machines can now send mail out) while other require additional investigation (trying to receive mail on these machines).

HSTX staff remotely rebuilt a system for an EGRET collaborator (and former CGRO project scientist at GSFC) now located at Hampden-Sydney College in southern Virginia. A student had inadvertently deleted a major portion of the operating system's binaries, and so the system had to be reinstalled, after several recovery efforts failed. HSTX staff talked the scientist through the initial steps of installation. Once the machine was back on the network, staff reconfigured the machine, formatted a new disk, and reinstalled compilers and public domain software.

The data manager also assisted a senior member of Code 665, the Theory Group, who was planning to spend 3 months in Japan. Connected by network to a NEC computer in Japan running its own variant of Unix, staff compiled pico and elm, a public domain editor and mail interface, respectively. Appropriate startup files also were installed.

A POP3 server, running Version 3 of the Post Office Protocol, was installed on a SUN and a Silicon Graphics in the EGRET cluster. This will allow non-Ethernet connected users to access E-mail locally on their personal computers. The Macintosh client program "Eudora" was installed on several machines, and an introduction was given to several users.

Staff continued to assist users inside and outside of the EGRET group. A new account was established for a soon-to-arrive postdoctoral, and E-mail was exchanged discussing and explaining aspects of the system setup. Staff helped two users properly set up their new X-terminals. Staff described X-Windows interface customization issues at length to two other HSTX colleagues. And the data manager continued his evangelization of 'elm', particularly for operating systems with no competing sophisticated mail interface, by building and installing it on a DECstation and a DEC Alpha workstation. Introductory tutorials were then given to users. And assistance was offered to a number of members of the HSTX System Administration Group on a variety of issues.

Staff substantially revised a tutorial document covering the topics of USENET and the 'nn' newsreader. Originally prepared for a Unix class taught to the EGRET Data Analysts in the spring of 1992, the document has been transferred to the SUNS (from a Macintosh) and reformatted for easier electronic distribution. Staff also updated the document to reflect network and resource changes.

200 FLIGHT DATA STUDIES

The data analysts continued to work very closely behind data acquisition. At the end of June, all data through the end of viewing period 224 (June 14) had been returned to the PDB. With the aborted reboost providing 3 days with no data, the analysts were working within 5 days of receipt of the data tapes.

The analysts completed the backup of a large set of EGRET data tapes, which were copied to 8-mm tape on the PDP.

HSTX staff performed final clear-out of EGRET materials (tapes and papers) from the tape storage area (Rm. W-20) in advance of its renovation.

The data analysts, although their ranks were thinned by summer vacations and other commitments, continued to work closely behind data acquisition. At the end of July, the Analysts were working onscreen with data from July 13, representing the end of Viewing Period 228.

The data analyst ranks were still reduced in August due to vacations and family emergencies. Still, the analysts did a good job of keeping up with EGRET flight data. At the end of the month, the analysts were working on August 18, less than 2 weeks behind data acquisition. All data was checked in through Viewing Period 229, which ended with the Perseid Meteor shower on August 11.

Staff began a microsecond burst review of a subset of all flight data. This is an investigation looking for events that happened sufficiently close together that they were recorded on a single same spark chamber readout.

A staff member made a second safety backup copy of all Helios data tapes. When other members of the LHEA cleared out the tape storage are a (Rm. W-20), the original Helios tapes were discarded accidentally.

With the data analyst team back at full strength in September (seven people), work progressed at only about a week behind data acquisition.

Subtask 10: GRIS Programming and Data Support

No support provided at the request of the ATR.

Subtask 11: TGRS Data analysis and Programming Support

Adding support for all of the allowed THGEN data types is now underway.

The successful demo of portions of THGEN and QUICK_PLOT along with PRIM_DB_GEN and COUNT demonstrated the current capabilities of the system to the scientists.

Work is being done to complete all of the modules and incorporate the suggestions of those who watched the demo.

Subtask 12: XTE Science Operations Center (SOC) Support

100 SOF

Overview

The Build 1 delivery into an integrated baseline area was accomplished for the SOF subsystems. A design for the Quicklook subsystem based on the use of XMGR and Athena plotter software was defined and prototyped. This design has been approved and will form the basis for future releases. The SOF Build Plan V2.0 was completed. This version describes subsystem build capabilities in a detailed fashion and reflects design changes since the previous version.

As part of the build planning process, met with representatives of all three instrument teams and coordinated and documented their build plans. A set of several hundred SOF/SOC project milestones were produced for input to the XTE project level PERT chart and schedule. Milestone dates and predecessors were assigned where appropriate. This list was given to the project office. Work was begun on producing software metrics estimates of number of classes, methods, lines of code, difficulty, and hours for producing the various software components.

Two software process descriptions were written specifying SOF design process and the SOF code documentation process. These descriptions define detailed specific requirements, procedures, and standards for each activity. Staff produced a draft outline for the SOF portion of the CDR. The outline contained major topics, topic contents, estimated times, and presenters. Staff compiled a set of proposed changes to the SOC software development standards and presented at an instrument team meeting. Changes were agreed upon and updated in the Software Standards Manual. A revised version of this document will be released following additional changes to the description of the "make" procedures. Task members attended XTE project coordination meetings including ground systems status, system operations working group meetings, and test coordination meetings.

In addition, task members performed the following tasks:

- Performed integration and test of the Build 1 baseline including both SOF and instrument team software.
- Held Build 2 planning and requirements reviews for each of the SOF subsystems.

- Produced a SOF staffing plan from now through expected launch.
- Began work on developing Build 2 schedules and metrics.
- Prepared a new version of the Integration and Test Plan with a more detailed plan.
- Began investigation of alternate User Interface Builder Tools to replace Interviews.
- Supported XTE project meetings including SOWG and Ground Systems Status.
- Reviewed and commented on XTE Project Test and Training Plan.
- Developed a plan for benchmarking the critical real-time elements of the system.
- Investigated the feasibility of utilizing a Code 500 package for trending in the SOF.
- Decided that this would not be cost effective due to portability concerns.
- Conducted Build 2 design reviews for all subsystems (eight in total). As part of this activity, staff updated all subsystem design documents.
- Prepared detailed Build 2 schedules for six of eight subsystems. Remaining subsystems will be completed shortly.
- Continued coordination with the project.
- Produced an outline of CDR agenda and viewgraphs.
- Completed first-draft viewgraphs for 12 presentations (over 250 slides).
- Began logistics planning for the CDR.
- Completed the Data Ingest portion of the Trailblazer benchmark. The purpose of Trailblazer is to determine what real-time data throughput rates the SOF can support. Results indicated that the SOF can support an ingest rate of greater than 2 Mbs, well above the requirement of 1 Mbs.
- Corrected all significant problems with Build 1 software release.
- Prepared and conducted a SOC-IT meeting on August 26.
- Selected TAE+ as SOF GUI builder.
- Developed and presented a new concept for Real-Time Data Display capabilities (part of Science Monitoring subsystem). Details of this approach are now being worked out.
- Completed the Final Version of the SOC Software Development Standards document with all comments incorporated or responded to.
- Completed the Final Version of SOC Integration and Test Plan document with all comments incorporated or responded to.
- Coordinated with GOF to include their inputs.
- Began development of Build 2 software.
- Develop detailed plans for Commerce I move.
- Tested networks and communications prior to the move.
- Completed initial version of a telemetry stream server. This program provides the framework to combine outputs of various instrument simulators into a telemetry stream. This will be very useful for testing.
- Prepared and presented major sections of the XTE SOC CDR.
- Provided logistical support for presentation material.
- Completed extensive revision to XTE SOC Software Development Plan.
- Produced a documentation set for the XTE CDR.
- Completed the Data Management section of Trailblazer benchmark. Current Data Management design will adequately meet performance requirements.
- Brought remaining IT and Code 500 ICD's to preliminary state.
- Finalized the SOF Detailed Requirements Specification.

Mission Planning

Staff performed the following tasks:

- Updated the observation description class code in design document to incorporate requirements changes in SPT document.
- Updated the ObGen, ObLook processes that operate on observation description objects.
- Updated the constraint classes code.
- Designed and developed the ObEdit process and associated utility libraries (The ObEdit process edits observation description objects).
- Delivered Build 1 processes, class header files, and source code.
- Continued development of the ObEdit program.
- Worked out design issues involving SPIKE.
- Continued development of Mission Planning/MIT ICD.
- Developed data formats to receive observation information from GOF.
- Continued development of the SOF/GOF ICD.
- Delivered quick fixes for ObGen, ObEdit, and ObLook to configuration management as well as 700 observation Description objects.
- Prepared documents for design review of the Mission Planning subsystem; continued developing Mission Planning ICD's with Instrument Teams (IT's) and Code 500.
- Started developing GUI for ObEdit using TAE.
- Created mission-planning CDR presentation.
- Fixed bugs in and performed quick-fix delivery on ObGen and ObLook processes.
- Successfully ran the SPIKE mission planing system on the xema workstation.
- Prepared materials for CDR; completed the TAE version of Obedit GUI.
- Continued work on detailed design document preparing for the task leader's departure and getting the documentation in a state that a new task member may continue development of the subsystem.

Command Generation

HSTX staff implemented and delivered the Build 1 version of the Command Generation subsystem. This includes: 1) the base classes (DesiredConfig and PredictedConfig) from which the IT's will derive their specific classes, 2) utility classes (CommandScript and CommandPacket) that the IT software uses to assemble instrument commands, 3) the derived configuration classes for the Attitude Control System (ACS), 4) a text version of the ACS configuration editor, and 5) a graphical version of the editor.

HSTX staff updated the ICD detailing the software interface between the SOC and the IT's. HSTX task members participated in a meeting with the XTE IT's on June 3. HSTX task members attended a meeting of the XTE Science Working Group in Berkeley, CA, both to present the status of the SOC software development effort and to tour the EUVE Science Operations Center (and to discuss development and operations issues with the EUVE SOC staff).

HSTX staff completed the detailed design for Command Generation Build 2, updated the design document, and conducted a subsystem design review for GSFC and STX reviewers. Several recommendations from the reviewers were incorporated into a revised design. Staff began implementing the relative timeline classes and the EOR editor program, incorporating the desired configuration classes delivered by the IT's at Build 1; prepared the first draft of the XTE SOC Critical Design Review materials for the Command Generation subsystem; and participated in a discussion of the Command Generation software and strategy at the IT meeting on August 26. A PCA representative described its approach for consideration by the other IT's. One conclusion is that the SOC should plan to screen command loads for certain hazardous commands (also called "stupid" commands).

HSTX staff prepared materials for the SOC Critical Design Review and clarified some details in the Command, Telemetry, and Monitoring ICD with the IT's.

Data Ingest

Task members performed the following tasks:

- Documented and reported to CenterLine a problem in ObjectCenter 2.0 regarding the correct parsing of backslashes in C preprocessor commands.
- Found a bug in the ObjectCenter interpreter—it doesn't recognize backslash-a as a valid escape sequence.
- Delivered Build 1 documentation.
- Incorporated SkipLists of Telemetry packets into INGEST.
- Updated the CCSDS packet hierarchy using a number of macros to make the life of IT implementors easier.
- Updated the INGEST subsystem document to reflect the current design.
- Reviewed latest ICD with Pacor which is now known as the ICD between the Sensor Data Processing Facility (SDPF) and XTESOC.
- Got the Real-time Server into usable condition.
- Performed general maintenance of the classes used by Ingest.
- Helped PCA group install InterViews.
- Found and reported a bug with the sig_atomic_t type in signal.h in ObjectCenter to CenterLine.
- Built latest version of g++ -- version 2.4. Installed a bug tracking tool known as problem.
- Delivered Build 1 products for INGEST Subsystem.
- Developed a Shared Memory Ring Buffer class for use with the real-time server and tested it.
- Developed a version of the real-time server using the shared memory ring buffer.
- Continued design and development work on Ingest subsystem.
- Templatized the SkipList class; found that Cfront can't deal with the complexity.
- Built and installed some cyclomatic complexity measuring tools.
- Built and examined PCAhksim, the updated PCA Housekeeping Simulator and reported a bug in its output.
- Attended the Critical Design Review for the Data Distribution Facility (DDF).
- Developed data management server to accept the names of packet files written to disk by Realtime Ingest and process them.
- Designed and implemented a templatized sorted list class.
- Reviewed latest ICD with DCF and DDF and passed on the comments.
- Updated the Command, Telemetry, and Monitoring ICD.
- Found and reported a bug with templates in ObjectCenter.
- Updated the Real-time Server to use TCP instead of UCP communication links with Real-time INGEST and the realtime clients.
- Provided a realtime client template that uses TCP to communicate with the Real-time Server.
- Moved xteprob and associated data bases from rosserv to xtesoc network.
- Fixed a couple of small bugs in the "problem" program.
- Continued design and development work on INGEST subsystem.
- Designed and built a templatized CacheLine class implementing a cache of objects.
- Updated INGEST Subsystem Design and presented at Data INGEST Design Review.
- Developed simple mathematical model of Data Ingest.
- Helped integrate the various subtrees of the PktCCSDS packet hierarchy into a coherent whole.

- Built a small packet library, libpkts-ingest.a, for use by modules which only need raw telemetry packets, i.e., those that don't need to distinguish amongst the many different types of packet objects.
- Had a meeting with DCF over current INGEST Subsystem design. They feel it meshes with the design of their subsystem.
- Modified real-time client template to use ShmRingBuffer and posted new code.
- Real-time Server now works with spacecraft data.
- Integrated spacecraft data caching scheme into real-time client template.
- Ported INGEST code to SGI machine.
- Recommended updates to SOC Requirements as a result of comments at the INGEST Subsystem Design Review.
- Developed CDR presentation for INGEST Subsystem.
- Presented sticky-bit issue and spacecraft data caching scheme at SOC-IT meeting.
- Wrote PCA HK instrument simulator using telemetry stream generator instrument template.
- Continued work on INGEST Subsystem.
- Wrote simple telemetry simulator for spacecraft ACSO mode.
- Set up machinery in PktCCSDS hierarchy for spacecraft packets.
- Updated $SOCFTP/pub/soc/icd/common/Real-TimeClient.doc to reflect current implementation of Real-time Client template.
- Helped MIT with the realtime client for ASM.

Data Management

Task members performed the following tasks:

- Updated all DM classes to use RogueWave persistence correctly.
- Built test procedures to verify proper storage and retrieval of each class.
- Modified PCA packet simulator to put a more realistic time stamp on packets.
- Made similar modifications to DataSet class to ensure proper data retrieval.
- Finished Build 1 modifications to PCA housekeeping packet handlers and data accessors.
- Completed an ingest/data management simulator system that produces packets, ingests, archives, and organizes data objects, then allows limited access to the packet data. This system became the Build 1 test procedure.
- Delivered Build 1 Data Management class software, test procedures, software documentation, and test plans.
- Developed a data server for use primarily with the XTE FITS Formatter (XFF) that interactively fetches data from the SOF Data Object Data Base.
- Began working with spacecraft data definitions to start writing spacecraft packet handlers and accessors.
- Updated DM and PCA HK classes for Build 2. This included the elimination of the class SimpleDescriptor.
- Improved the string handling features of class Descriptor.
- Added Build 2 scheduled capability to DataSet class.
- Developed the HEXTE Science Data packet handlers and access programs. This required design and implementation of packet classes (PktHexte, PktHxSc, PktHxHk), a science partition class (HxScPart), Accessor classes (AccHxSc, AccHxSc0, AccHxSc1, etc.), and various header classes (HxIDFHeader, HxScHeader, HexteHeader).
- Integrated the HEXTE packet handler software with existing DM/PCA housekeeping software.

- Modified HEXTE packet simulator to produce packet binary data for use by ingest software. The delivered version simply printed (ASCII) the data to the screen.
- Integrated MIT delivery of EDS/ASM packet handler software with existing DM/PCA housekeeping software.
- Generated problems/bugs for MIT redelivery.
- Supplied "quick fix" to Build 1 test program.
- Continued to implement spacecraft data handlers for Data Management.
- Updated SOC-MIT ICD for Measurement Data.
- Made minor revisions to data server for XFF.

- Developed spacecraft.h with structures for the XTE ACS TLM Packets.
- Updated methods of the class Descriptor to Build 2 capabilities.
- Developed the communication protocol between Data Ingest and Data Management. This link allows DI to notify DM when packet files are successfully archived.
- Integrated this software module into the existing DM Indexer process.
- Continued implementation of HEXTE Science packet handlers and accessors. Efforts were concentrated on descriptor accuracy and accessor completeness. The partition-building aspects of the HEXTE Science packet handlers are effectively complete.
- Modified HEXTE packet simulator to produce CONTINUOUS packet binary data for use in benchmarking software.
- Developed spacecraft.h with structures for the XTE ACS TLM Packets Continued to implement spacecraft data handlers for Data Management. Currently, packet classes (PktSC, PktACS) are coded and tested. Accessor classes (AccSC, AccACS0) are coded but not tested.
- Continued development of XFF data server for HEXTE science data.
- Reviewed and extended the set of descriptors for HEXTE Science data.
- Integrated all existing data handlers for Build 2 INGEST/Archive/Access benchmark tests (Trailblazer). The current DM Indexer process can accommodate packets from PCA Housekeeping, HEXTE Science (Modes 1-6), ASM/EDS (Partially) and spacecraft ACS-0 (Attitude Quaternion).
- Performed benchmark tests on PCA housekeeping and HEXTE Science.
- Began documentation of Benchmark results.
- Prepared materials for CDR presentation.
- Completed preliminary release of SOC-MIT MDATA ICD.
- Wrote and submitted report on the results of the Build 2 Benchmark tests.
- Prepared materials for upcoming Critical Design Review.
- Implemented accessor classes and packet handlers for a subset of the ACS Telemetry packets.

Health and Safety

Task members performed the following tasks:

- Delivered documents on User's guide and test plan to Build 1 directory.
- Delivered source code and Makefiles to Build 1 directory.
- Updated Health and Safety subsystem architectural design document.
- Modified some public methods (Open() and Save()) in the ParameterFile class to reset permission to read and write for the file being edited, and to avoid unwanted overwriting when save the file. To unselect a highlighted file in the dialog box, one of the InterViews' public methods was used after it's hierarchical classes were searched.

- Architectural design update for Build 2 is in progress.
- Examined MOC (Mission Operations Center) Health and Safety system document to find out possibility of running the package in the SOF's operational environment (instead of developing SOF's own Health and Safety subsystem).
- Decision was made that this would not be feasible due to package portability concerns and effort to interface with the rest of the SOF.
- A real-time client template program using TCP/IP protocol was modified to process PCA housekeeping packets. Options to select a single detector packets by a APPID and HK parameters by mnemonics were added. Data flow from a packet generator program (PCAhksim) to the realtime server and then to the realtime client for display was verified successfully.

- Prepared following documents for Build 2 Design Review and CDR: Architectural design document update, Design review document for Build 2, Draft viewgraph materials for CDR Discussed items to be delivered from the HEXTE team for the H\&S subsystem with the HEXTE scientist. An HSTX member made a list of document and files to refer to in the anonymous FTP directory and E-mailed it along with several sample software files written for PCA HK data.
- Work on modification of Mstrip, a stripchart program for real-time monitoring, to accept external data is in progress. Also, prepared CDR presentation viewgraphs, and examined and updated subsystem requirements.

Mission Monitoring

Task members performed the following tasks:

- Studied the overall architecture of SOC software and the original design of Mission Monitoring subsystem.
- Held Design Review meetings with SOF staff.
- Determined areas that require more work or major changes in the design.
- Prepared a list of items to be completed in the design and produced a schedule to complete these items.
- Continued working on Mission Monitoring (MM) design document.
- Finished the MM sections of ICD with IT's.
- Performed the design of the Build 2 software.
- Started working on the design of real-time telemetry receipt algorithm.
- Updated the MM operating scenarios in the design document.
- Prepared a schedule of Build 2 activities.
- Continued design and development work on MM subsystem.
- Presented the subsystem design in Build 2 Design Review meeting.
- Updated the design document based on comments at review.
- Prepared presentation for the CDR.
- Started developing base class Verification Report and ConfigError.
- Wrote base class MeasuredConfig to be used by IT's.
- Started work on real-time client program using TCP/IP protocol.
- Continued development work on base classes.
- Prepared materials for upcoming CDR.
- Updated the design documents to reflect changes suggested in design reviews.
- Continued work on real-time client program.
- Started work on ACS subsystem subclasses.

Science Monitoring

Task members performed the following tasks:

- Completed a Motif-1.1 version of stripchart, named mstrip. This new program has many advanced features such as zooming, interactive selection of data stream etc., The demo version runs off it's own data. External socket connections are being provided. The interface between Data Management and the Xmgr system has been worked out. This interface is undergoing prototyping. The issue of real-time client data access was discussed in the SOC/IT meeting on August 26. A reasonable design approach was elucidated. Some commitments for software templates have been obtained from the IT's. The hardware configuration was discussed with Dr. Nand Lal. As a result, details for the layout of the Duty Scientist have been obtained.
- Converted mstrip into a C++ class. Xmgr has been completely "protoize"d. It is now fully ANSI C compliant.
- Recompiled all programs under xmgr to compile under gcc compiler to emit no any warnings. This will make it easier to eventually convert the code to C++ while allowing us to link with the Data Management subsystem libraries during Build 2.
- Discussed a plan to interact with Data Management subsystem via simple descriptors.
- Constructed GUI extensions for the same .

Quick-look Analysis

Task members performed the following tasks:

- Modified Xmgr ver 2.10 GUI's.
- Hooked up Athena Real-Time displays to Xmgr.
- Successfully demonstrated Xmgr capabilities to project director and GOF personnel.
- Delivered Build 1 commitments for Quick-look subsystem.
- Planned the User Interface for the Quick-look system.
- Researched functions that Xmgr provided vs. SOC requirements level of effort has been drawn up.
- Completed preliminary design requirements planning for Build 2.

Utilities

Task members performed the following tasks:

- Started developing second version of SOC Error handler (syslog based).
- Presented a preliminary design of the Utilities.
- Designed GUI's for CM and duty scientist.
- Started implementation of SOCEnv class.
- Started collection of global methods.
- Installed the first version of SOCEnv utility Class.
- Installed the first version of utility global methods.
- Tested Utilities Makefile on SGI and SUN.
- Started writing callbacks for SOC Control Panel.

200 GOF

Activities related to GOF support are reported under Task 62-238-09.

300 EXTERNAL INTERFACES

Code 500 Interfaces

Task members performed the following tasks:

- Completed a draft ICD between XTE SOC and MOC.
- Reviewed the ICD, identified holes and deficiencies, and suggested improvements. Met with the GSFC and CSC personnel to resolve the issues on the alternate observations and target adjustments.
- Worked with the SDPF to produce a draft of PacorII/DDF ICD with SOC.
- Reviewed the draft ICD, identified holes and deficiencies, and suggested improvements.
- Coordinated these activities with the DDF CDR. FDF has difficulty obtaining personnel to provide the needed orbit support for the ICD with SOC. The draft ICD is delayed.
- Participated in the project XTE SOWG meetings and supported mission CDR.
- Reviewed and participated in the generation of Preliminary ICD with SDPF, Preliminary ICD with MOC, and Draft ICD with FDF.
- Wrote RIDS for the mission CDR.
- Participated in the SOWG meetings; suggested splinter meetings between SOC and spacecraft personnel for the S/C data formats.
- Reviewed the preliminary ICD with XMOC, and provided input in preparation for the final version.
- Reviewed the preliminary ICD with FDF, and provided input in preparation for the final version.
- Held a meeting to explain the review comments.
- Analyzed the outstanding issues in the Code 500 ICD's and their impact on the design and build.
- Incorporated the analysis in CDR material and in making the transition of responsibilities for these ICD's to other members of the SOC team.

Instrument Team Interfaces

Task members performed the following tasks:

- Completed the review and update of the ICD with MIT on the ASM analysis. The response on the first draft ICD on the measurement data objects is awaited from the MIT. They are running a little behind because of Build 1 schedule.
- Received comments on the mission planning and scheduling ICD from MIT.
- Reviewed these comments and additional classes. Work has started on the preliminary version due July 27.
- Considerable improvements have been made to the command generation and data ingest classes that constitute the interfaces with MIT. These have resulted in overall design improvement. Work on the mission monitoring is behind. A draft ICD with PCA team is ready. It has been reviewed and updated. Work is ongoing for a preliminary version of this ICD. A draft ICD with UCSD is ready. However improvements remain to be made that would correspond to those already made

in the PCA ICD. The final requirements document on the XTE observation scheduling is currently being critically reviewed by MIT. After this review, the document will be signed.

- Generated Preliminary ICD's for Command, Telemetry, and Monitoring with MIT, Mission Planning and Scheduling with MIT, ASM Analysis with MIT, the ICD with PCA team, and the ICD with UCSD.
- Formulated the outstanding issues in the ICD's and discussed them with the instrument teams at the monthly meeting.
- Generated a draft SOF-GOF ICD for mission planning and proposal management. Generated preliminary version of Measurement Data ICD with MIT, and sent it to MIT.
- Generated revised draft of ASM ICD with MIT.
- Analyzed the outstanding issues in the PI Teams ICD's and their impact on the design and Build.
- Incorporated the analysis in CDR material and in making the transition of responsibilities for these ICD's to other members of the SOC team.
- Reviewed MIT updates to the ASM ICD.
- Gave comments to R. Remillard.
- Expedited the review and signatures process at MIT for the SPT Requirements Document.

SOF-GOF Interfaces

An initial plan and schedule is worked to develop at least two ICD's between SOF and GOF. One ICD on the mission planning and proposal management has already been drafted. It has been reviewed and updated. A draft suitable for CDR will be ready by July 30. The second ICD will be on data analysis and calibration. It will be outlined and drafted next month. A draft suitable for CDR will be ready by August 30. Staff generated an advanced draft for the ICD for mission planning and proposal management, and work started on an initial draft for data management ICD.

Staff generated the first draft for the Data Management and Analysis ICD between SOF-GOF, and evaluated the SOF GOF ICD's for CDR and to transition responsibility for these ICD's to other SOC members.

400 INTEGRATION AND TEST

Task members performed the following tasks:

- Released the first version of I&T Plan (draft).
- Augmented CM facilities by installing "deliver" script to support deliveries from the I&T Master to the Build 1 I&T Tree.
- Started development of "qfx" scripts to support quickfixes to delivered subsystems.
- Developed suite of "build" scripts for initializing and "making" the SOF system components.
- Conducted dry runs of the system build in preparation for Build 1.
- Started preliminary work on test FITS files by installing the "astrolib" public domain IDL software for FITS IO into the IDL library.
- Re-evaluated use of Interviews for the I&T GUI, in light of Xmgr (Quick-Look) and Duty Scientist Control Panel developments.
- Installed instrument team software in the baseline.
- Performed several builds of the Build 1 baseline.
- Performed modifications to the installation procedures including makefiles. Implemented an automated quick-fix procedure.

- Produced first draft of I&T CDR viewgraphs.
- Installed all relevant public domain software onto the SGI.
- Started "system build" on the SGI.
- Enhanced Build scripts to support Build 2 dry runs.
- Performed Build 2 dry runs on SUN and SGI.
- Presented I&T CDR.

500 SYSTEMS MANAGEMENT

Task members performed the following tasks:

- Installed dial-in modems on xema and xiphias for dial-in capability which is especially useful when the network is down. Upgraded all client machines to SunOS 4.1.3.
- Repartitioned the disks on all client machines to efficiently utilize space, and increased swap space on all client machines.
- Set up all clients to mount shareable directories containing software, man pages, and mail boxes from servers.
- Installed and configured a new client machine for use by Paritosh Malaviya with the Mission Monitoring task.
- Installed FORTRAN 1.4, emacs 19.15, gzip, Athena widget libraries, gmake 3.67 in the Commerce I domain.
- Diagnosed systems and network problems and performed systems maintenance on an on-going basis.
- Transferred software from xema to xenopus and setup xenopus as file server for software.
- Upgraded all servers to SunOS 4.1.3.
- Reconfigured network with new IP addresses mandated by the HSTX move from Commerce II to Commerce I.
- Diagnosed and fixed E-mail problems resulting from this move.
- Installed and configured a new Silicon Graphics Indigo client machine for use by D. Hon.
- Installed and configured a new SPARCstation 10 as a secondary server.
- Upgraded memory on all servers and clients requiring upgrades—xema has been upgraded to 64 MB, xtesoc1 and xtesoc2 to 64MB, xenon to 48 MB and xyclose to 32 MB; the new SPARCstation 10 has been upgraded to 128 MB.
- Installed ANSI FORTRAN 2.0.1, ANSI C 2.0.1, Motif 1.2 and SPARCworks 2.0.1 in the Commerce I domain; attempted to install UIMX 2.5.
- Logged disk failure problem on server xema.
- Diagnosed systems and network problems and performed systems maintenance on an ongoing basis.
- Replaced defective DTK station color monitor.
- Sent damaged disk on server xema for replacement; awaiting replacement.
- Installed additional FrameMaker licenses.
- Installed UIMX 2.5 evaluation copies on xema and xpert.
- Installed the GUI Builder TAE in the Commerce I domain.
- Installed Sentinel 1.4, Linpack.h++ 1.2, Math.h++ 5.0, Matrix.h++ 1.2, and Objectcenter 2.0.2 in the Commerce I domain.
- Installed GNU make (gmake 3.68), Perl 4.036, and xgopher 1.3 in the Commerce I domain.
- Set up a new Macintosh for use by R. Dorsey.

- Prepared hardware inventory of all workstations and their peripherals in the Commerce I domain.
- Coordinated the XTE move from Commerce I third floor to the fourth floor.
- Performed systems and network maintenance on an ongoing basis.
- Successfully relocated all XTE workstations and peripherals from Commerce I third floor to the fourth floor.
- Replaced the damaged disk on server xema.
- Loaded redundant copies of xenopus's software on server xema and the new SPARCstation 10 server xpert to improve performance.
- Obtained new licenses for Objectcenter 2.0.2 license manager.
- Performed systems and network maintenance on an ongoing basis.

Subtask 13: KONUS Software Development Support

An analysis was completed of instrument test data obtained during the WIND spacecraft Comprehensive Performance Test. Several unexpected data modes were observed, and program PRIM_DB_GEN is being modified to handle them. The delivery cycle for PRIM_DB_GEN began. About 30 final actions were identified and are being closed in decreasing order of priority. A demonstration was made of the current version of the program, using ground test data. The results compared well with expectations, apart from a set of deficiencies in the data, which were reported to project personnel. Test runs are continuing and problems are being logged and eliminated as they are found.

Subtask 14: XTE PCA Software Development

Task members delivered derived PCA housekeeping subclasses, PktPca and AccPcaHK, to $SOCHOME directory. PktPca is a subclass of the PktTlm class of the INGEST subsystem, and AccPcaHK is a subclass of the Accessor class of the Data Management subsystem.

Staff modified PCA housekeeping packet decoding program (decodePcaHK.C) and it's related header files (pcahk.h and pcahkDesc.h) to include 20 bytes of diagnostic information. FITS format descriptor names were incorporated in all three files. A test main routine was written and output (SIMOUT.DAT) of PCAhksim, a upgraded PCA housekeeping packet generator program, was used to test proper decoding.

At the request of the PCA PI, a task member generated two OSO-8 C-detector CRAB PHA files containing data from days 255–264 and 1,358–1,369. Analysis of these data will be used by the PI team to investigate PCA (PCU) detectors' performances. An HK decoding program (getPcaKernel) was written to add a capability of returning one requested value at a time. Investigated HEAO Archive and Programs to be used in developing an initial prelaunch background model. The HEAO-1 PHA data files were read in from tapes and selected data items were plotted using IDL. Staff assisted in the evaluation of GUI builder TAE+ and in the design of User Interface for the Configuration Editor; began work on the design of PCA Instrument team Measured Configuration class; and assisted in preparing document for design review.

At the request of the document author, a task member reviewed 'PCA Software,' which was written for CDR, and returned comments.

PROBLEM AREAS

None.

SIGNIFICANT ACCOMPLISHMENTS

Subtask 3: Data Analysis

HSTX staff completed the IDL version of SKYMAP, which is a key tool in the EGRET data visualization and analysis and is widely used by the EGRET team at GSFC, as well as by their collaborators at Stanford University, Grumman Aerospace Corporation, and the Max Planck Institute in Germany. The IDL version also provides significant improvements in functionality, ease-of-use, and speed and reliability over the previous Template version and has been well received by the user community. The SKYMAP source code and documentation have been transferred to the GRO Science Support Center.

In addition, task HSTX personnel showed responsiveness and dependability by answering EGRET's scientists numerous requests for modifications rapidly and satisfactorily. The staff has made itself readily available to the customer and ensured that all the requests for modifications and enhancements were addressed promptly and dependably. Commanding and data validation also were performed in a reliable and responsible manner.

Subtask 7: LHEA Computer System Support

The LHEA uses a software package called X11R5 for communications (XTERMS), software libraries, and system utilities. X11R5 is a public domain software package that must be built onsite at each installation. The time required to build X11R5 is estimated at well over 20 hours, pending a clean installation. Typical builds for software as complex as this requires much debugging. In addition, the software must be rebuilt for each operating system that you wish to support.

The LHEA required that an HSTX System Manager install X11R5 for the following platforms, SUNOS, ULTRIX, RS6000 (IBM UNIX) and ALPHA OpenVMS. HSTX System Managers estimated that to run these installations for the above platforms would require at least 100 man hours.

An HSTX system managers was made aware of a book/CD-ROM from O'Reilly and Associates that has X11R5 prebuilt and debugged for the above operating systems. The cost of the book/CD-ROM is marginal (approx. $70.00), saving our company many thousands of dollars in software installation.

The HSTX System Manager took the initiative and personally ordered the book/CD-ROM to provide a cost-effective and timely installation of X11R5. The software has been installed on well over 20 systems thus far.

HSTX task personnel assisted in installing two new segments of network cable for the trailer network, thereby alleviating major network problems for the trailer user community. Staff standardized system configuration within the XTE PCA network of computers so that each system was configured as similar as possible for ease of use and to help meet production schedule deadlines.

Subtask 8: EGRET Data Analysis and Management

EGRET data analysts completed review of the Phase II Viewing Plan, that ran from November 1992 to August 1993. Staff reviewed regular 'questionable' data and 'high-latitude, SAGE-accepted' events, in a very prompt fashion (within just a few weeks of data acquisition), allowing for the scientists to analyze the data expediently.

Subtask 13: KONUS Software Development

HSTX staff benefitted the ISTP project by discovering errors in data and documents provided by the ISTP Central Data Handling Facility. Task personnel established a realistic schedule for the completion of program PRIM_DB_GEN by convincing all concerned of the size and difficulty of the project. Such a schedule had never been established so far. A working version of PRIM_DB_GEN was demonstrated, which successfully extracted all major KONUS data types from ground test data.

SCHEDULE CONFORMANCE

Work under the current contract has been completed for this task. Work will resume under contract NAS 5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be prepared for the task under the new contract.

DELIVERABLES SUBMITTED

Programs: PTEXPO, ADDFITS, CHKMIC, SRCMIC, INTGRL code
Originator: A. Etienne

Programs: GRSMRY, INTMAP, ADDMAP, EXPHST, CATLST updated code
Originator: A. Etienne

Documents: GRSMRY, INTMAP, ADDMAP, MAPGEN, TRANSMAP updated documentation, PTEXPO documentation
Originator: A. Etienne

COMPUTER USE

Minutes	Computer
1,280	Apple Macintosh PC
790	PDP-11
4,490	IBM 9021

1,030	IBM RISC/6000
250	LHEA VAX
300	BATSE 1
31,200	DEC Workstation
36,400	TGRS VAX
51,680	SUN Workstation
94,000	Tektronix 4200
400	ISTP VAX 6350 at CDHF

NASA Task 62-236-00: X-Ray Laboratory Support

GSFC ATR and Cognizant NASA Scientist: ***Dr. R. Kelley***

Hughes STX Task Leader: ***S. Murphy***
Hughes STX Task Number: ***676***

This task provides support for analysis of data from cryogenic X-Ray Spectrometers (XRS's) and related experiment preparation, measurements, and data collection.

FINAL CONTRACT SUMMARY

Two Hughes STX task members supported this task until 1989. Then, only one task member worked on this task. During the task, the following major activities were completed: 1) a thorough thermal analysis of the XRS Front-End Assembly (FEA) was made. The JFET's, which are near the x-ray detectors at 0.06 K, are the main source of heat because they run at 80 K. This initial work was instrumental in designing the FEA; 2) a breadboard FEA was designed and assembled by HSTX staff and has enabled the XRS detectors to observe x-rays with the required resolution; and 3) an engineering model, FEA 3, has been designed, as well as the bias box and bias board.

SUMMARY FOR CURRENT REPORTING PERIOD

Work continued on the third generation FEA, FEA 3. The JFET housing, bias box, and bias board were fabricated.

WORK PERFORMED

HSTX personnel completed fabrication of components for the FEA 3, including the JFET housings, FEA main body, bias box, and bias board. These components were fit-checked and polished. Personnel completed the design, fabrication, and testing of the JFET housing and detector assembly for integration with the dilution refrigerator. It performed well as problems were understood and rectified.

SIGNIFICANT ACCOMPLISHMENTS

HSTX personnel completed, on schedule, the development of the JFET housing for the dilution refrigerator in Building 2.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. No new work is expected under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The task is terminated. No renewal under new contract is expected.

COMPUTER USE

Minutes	Computer
35	Macintosh
20	VAX
150	PC

NASA Task 62-237-00: Compton Observatory Project Data Management Plan Support

GSFC ATR and Cognizant
NASA Scientist: *Dr. N. Gehrels*

Hughes STX Task Leader: *K. Pollock*
Hughes STX Task Number: 677

This task provides support to the Compton Observatory Project Scientist, the Science Working Team, and the Users Committee in developing the Project Data Management Plan for Phase II of the Compton Observatory Mission and associated science presentation materials. Support is provided to the Project Scientist in preparing scientific data and technical papers for conference proceedings. This task also provides administrative and general research support to the Project Scientist.

FINAL CONTRACT SUMMARY

This task was initiated in October 1990 and continued through September 1993. Task staff included a programmer/analyst who worked directly with the ATR on a daily basis handling administrative and research activities; six support scientists (subcontractor) from the fields of astronomy and physics who attended Compton Observatory User's Committee and Science Working Group meetings and scientific meetings that were Compton Observatory related at the request of the ATR, assisted with the research and preparation of scientific and technical papers for the above meetings, and assisted with the preparation of the *High Energy Astrophysics Division (HEAD) Newsletters*; and subcontractor secretarial, graphics, and administrative personnel who assisted support scientists with the preparation of visual materials, scientific papers, and newsletters.

Task personnel (both subcontractor and contractor) accomplished the major task of preparing the *HEAD Newsletters* on a bi-yearly basis, including setting up a new format, gathering source materials, and preparation and editing. The newsletters were delivered on or before schedule to the ATR. Task staff also handled the printing and mailing of the newsletter, including keeping mailing lists up to date, handling renewal of the mailing permit, and delivering the newsletters to the post office. Newsletters were mailed on or before schedule. In general, task staff helped the ATR to raise the quality of the *HEAD Newsletter*.

Task personnel (subcontractor) prepared and delivered to the ATR two sets of viewgraphs (scientific and popular) about the Compton Observatory for use by the ATR when giving talks about this observatory. These viewgraphs are now part of the Compton Observatory Science Support Center library and are borrowed by numerous scientists giving talks on the observatory and new data results.

Task personnel (subcontractor) assisted in the preparation of scientific and technical papers related to the Compton Observatory for presentation at various foreign and domestic scientific meetings, including doing extensive research for studies leading up to the papers. Staff also prepared the Compton Observatory (GRO) Project Data Management Plan, and prepared an analysis of potential ground observing sites for CCRES barium releases.

Task personnel acted as the GSFC contact person for two Gamma Ray Imaging Spectrometer (GRIS) balloon campaigns, one in Alice Springs, Australia (spring 1992), and the second in Ft. Sumner, NM (fall 1993). Significant tasks included getting equipment shipped to the field in a timely manner and hand-delivery of a germanium detector to the field in Alice Springs, for which task staff was recognized.

Task personnel assisted the ATR with preparations for the First and Second Compton Symposiums. Activities included preparing preliminary and final programs for both symposiums, assisting with the mailing of programs and announcements, and assisting with the preparation of the symposium proceedings. All deliverables were delivered on schedule, and staff put in extra hours to meet deadlines. Task staff were recognized by the symposium organizers for its contributions.

Task personnel assisted the ATR with the preparation and delivery of several proposals: the "Germanium GAlactic Plane Patrol (GGAPP)" proposal for the SMEX AO, and the "Gamma-Ray Imaging Spectrometer (GRIS)" and "Development of HgI2 Detectors for Low-Energy Gamma-Ray Astronomy" proposals for NASA's High Energy Astrophysics Gamma-Ray Astronomy Research and Analysis Program. Work included typing, arranging and editing text, preparing of figures, overseeing printing/duplication, and delivering the proposals to NASA HQ. Staff put in many extra hours to ensure the that proposals were delivered to NASA HQ on schedule. As a result, all three proposals were delivered on schedule, and both the GRIS and HgI_2 proposals were selected for funding.

SUMMARY FOR CURRENT REPORTING PERIOD

Subcontractor personnel performed research for a study of four Active Galactic Nuclei (AGN) with Dr. N. Gehrels (ATR) and Dr. S. Odenwald, and prepared a poster-paper based on this study entitled "Multi-wavelength Spectra of NGC 4151, Cen A, 3C 273 and 3C 279." Subcontractor personnel also attended the IAU Symposium #159, Active Galactic Nuclei Across the Electromagnetic Spectrum, held in Geneva, Switzerland, August 30 to September 3, 1993, to present the poster-paper. Task personnel continued to provide daily administrative support to the ATR, including assisting with HEAD secretarial/bookkeeping activities and preparing multiple mailings of updated Compton Observatory Phase 2 and Phase 3 Viewing Plans. Task personnel also assisted with preparations for the Second Compton Symposium, held at the University of Maryland, September 20–22, 1993, including preparing and mailing the preliminary and final program schedules, preparing poster numbers, and helping out with registration at the symposium. Task staff also provided support for the GRIS balloon campaign by acting as a GSFC contact person.

WORK PERFORMED

Subcontractor personnel performed extensive research, including locating more than 2,000 references using SIMBAD, for a multiwavelength study of four AGN: NGC 4151, Cen A, 3C 273, and 3C 279, which was a joint effort with the ATR and S. Odenwald (ARC). Subcontractor staff also prepared a poster-paper entitled "Multi-wavelength Spectra of NGC 4151, Cen A, 3C 273, and 3C 279" and presented it at the IAU Symposium #159, Active Galactic Nuclei Across the Electromagnetic Spectrum, held in Geneva, Switzerland, August 30 to September 3, 1993. Subcontractor staff prepared the poster-paper, coauthored by Gehrels and Odenwald, for journal publication. Subcontractor personnel also met with the ATR to discuss preparation of the fall issue of the *HEAD Newsletter*.

Task personnel continued to provide daily administrative support for the Compton Observatory Project Scientist (ATR). Task staff prepared numerous mailings including updated Compton Observatory Phase 2 and Phase 3 Viewing Plans, and letters to the Compton Observatory Science Working Team, the Scientific Organizing Committee for COSPAR's Symposium on Gamma Ray Astronomy, and the INTEGRAL Science Advisory Committee. Task personnel also assisted the ATR with editing and corrections to figures for the paper "Temperatures of Enhanced Stability in Hot Thin Plasmas," which was accepted for publication in the *Ap. J. Lett.*

Task personnel continued to support the ATR with HEAD secretarial/bookkeeping activities, including updating membership/mailing lists and mailing the announcement to calling for nominations for the Rossi Prize.

Task personnel acted as a GSFC contact person for the GRIS balloon campaign carried out in Ft. Sumner, NM during August and September 1993. Staff responsibilities included keeping in contact with the GRIS team, preparing shipments of computer and other equipment as needed, and keeping track of associated paperwork. Task staff also prepared plots of housekeeping data of the Spring '92 GRIS flights for use as reference on the '93 campaign.

Task personnel assisted with preparations for the Second Compton Symposium, held at the University of Maryland, September 20–22, 1993. Work included preparing (formatting, typing, and editing) and mailing the preliminary program schedule, preparing the final program schedule and abstract booklet distributed at the symposium, creating poster numbers for the poster displays, and assisting with activities at the symposium, including helping with registration.

Task personnel began preparation of tables summarizing the Compton Observatory Phase 3 Viewing Plan, the Guest Investigators, and their respective targets.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this task and contract has been completed. Work will continue under contract NAS 5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be prepared for the new contract to meet the requirements of this task.

Subcontractor personnel will continue preparation of the AGN paper for journal publication and will prepare materials for the fall issue of the *HEAD Newsletter* pending renewal of the subcontract.

Task personnel will continue to provide daily administrative support to the ATR, including a mass electronic mailing to persons associated with the ATR and his group informing them about fax machine number changes. Task staff will assist the Compton Observatory Science Support Center with the editing of the proceedings for the Second Compton Symposium. Task staff will also assist with the editing, printing, and mailing of the fall issue of the *HEAD Newsletter*.

NONLOCAL TRAVEL

Subcontractor personnel attended IAU Symposium #159, Active Galactic Nuclei Across the Electromagnetic Spectrum, held in Geneva, Switzerland, August 30 to September 3, 1993, and presented a poster-paper entitled "Multiwavelength Spectra of NGC 4151, Cen A, 3C 273 and 3C 279." Travel was from August 29 through September 4, 1993.

COMPUTER USE

Minutes	Computer
3,600	VAX
Dedicated	Macintosh IIfx

NASA Tasks 62-238-01-08: HEASARC Support

GSFC ATR: ***N. Laubenthal***

Hughes STX Task Leader: ***P. Jacobs***
Hughes STX Task Numbers: ***678–685***

This task provides support for programming and analysis of High Energy Astrophysics Science Archival Research Center (HEASARC) activities that includes installing, verifying, and maintaining existing software; software engineering support for developing graphics interface; science support for guest investigator program; handling data requests (archival and retrieval); and maintenance of the ROSAT proposal funding system.

FINAL CONTRACT SUMMARY

The HEASARC task started in January 1991 and has continued to operate since then. Three Hughes STX employees were originally assigned to the task. That number has now grown to approximately 20 people including 5 holding Ph.D. degrees in physics. A variety of backgrounds are represented including astronomy, physics, computer science, and engineering. One member of the group is assigned to the ISAS facility in Japan, to provide day-to-day support for the ASCA mission. The function of the HEASARC has evolved since its inception and now includes more than just data archiving and distribution. New methods of storing and presenting data have been developed. HEASARC personnel also contribute to the planning of future missions in an effort to ensure that any new data can be handled without problems. Additionally, software to analyze HEASARC's data has been created and distributed to the user community. In this way, the HEASARC provides a value added service beyond simple data archive. User interface systems also are developed to make the analysis packages useful to the widest possible audience. To accomplish all of these tasks the HEASARC has been divided up into several groups including data base population; scientific data base development; ROSAT, ASCA, and XTE support; Guest Observer Facility assistance; user interface construction; and overall software development and support. Accomplishments resulting from the work of these groups include improved methods for creating and storing data bases; increased storage facilities; improved methods for data base access; the development of an overall FITS standard for data storage; FTOOLS, which is an integrated package of tasks for analyzing FITS formatted data; software for ASCA, including XSELECT and the extractor codes; the development and maintenance of the XANADU x-ray analysis packages, including the XPI command line interface; enhancements to XSPEC; graphical user interface packages, to encourage greater use of the HEASARC analysis packages; and interaction with other software developers in the community including work with the Astrophysics Data System groups.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff provided onsite ASCA support for one month at the ISAS facility in Japan. This included software development and system management assistance. Many modifications and enhancements have been made to the Extractor package and the XPI Command Line Interface. Gopher and Mosaic servers were installed to allow wider use of publicly available HEASARC data. Additionally, the HEASARC FTP server was updated again to aid in HEASARC use. Improvements were made to the XANADU x-ray analysis package and a procedure established for XANADU distribution to the user community. The XSPEC package was modified with the result being a much easier installation process for all users. Additions were made to the XRONOS routines so that new types of data files can be read and written. The runtime characteristics of XRONOS also were enhanced. Work continued on the calibration data base and associated software utilities. A number of Pgplot-like routines were modified or replaced in an effort to standardize plotting capabilities. An automated mail handling system (LISTSERV) was updated to improve HEASARC message processing performance.

Many data bases have been transferred from IBM systems to VAX computers and rewritten to be in Flexible Image Transport System (FITS) standard format. These data have been placed in the HEASARC FTP area, where they are available to outside users. Modifications and updates were made to a number of existing data bases, and many new data bases were created.

Two memos were written for inclusion in *Legacy*, the HEASARC journal. In conjunction with this effort, several new FTOOLS tasks were written. ASCA support was provided at the peer review meeting. ROSAT funding proposal packages were generated also.

A client/server network data communications package was developed and used as an application program interface for the BULLETIN, XOBSERVER, and prototype Next Generation Browse systems. The ULTRIX SQL was successfully integrated with STDB, again for the Next Generation Browse system. The Remote Proposal Funding System (RPS) was modified so as to work for both ROSAT and ASCA projects.

An additional ROSAT memo was written for *Legacy*. Work continued on the development of the HEASARC System User's Guide. Technical and logistical support was provided for the several guest observers who visited the HEASARC. Staff participated on the local organizing committee for the ROSAT Science Symposium and Data Analysis Workshop. Staff compiled statistics concerning HEASARC usage.

A task member presented a paper on FTOOLS at the AAS meeting. Three public releases of FTOOLS have been made. Many enhancements have been made to the FTOOLS package. A number of new FTOOLS tasks have been written and modifications were made to a similar number of existing tasks.

Development work continued on the XSELECT package, which is used for the ASCA project. A new FTOOLS task was developed as a result of the XSELECT work.

A task member prepared a paper on the ASCA scheduling system developed at ISAS. The time to prepare weekly ASCA schedules has been reduced by two thirds. Enhancements were made to the scheduling software. Modifications were made to the Short Term scheduler package. AO-1 Japan-side proposals were prepared for merging and collated with U.S. proposals. Software was written to attempt to automate this task. Work continued on the Observation Data Base (ODB).

Work on a portable graphical user interface was begun. The Graphical User Interface (GUI) will provide uniform access to the multiple services of the HEASARC.

Staff made significant contributions and participated in the XTE/GOF CDR.

WORK PERFORMED

Subtask 1: HEASARC Data Analysis and Software Development

A staff member spent a month at the Institute for Space and Astronautical Science (ISAS) in Sagamihara, Japan, working on ASCA processing software. While there, several system management tasks were completed on the ISAS DECstations so that they would integrate better into the ISAS network and be more useful to the ASCA scientists. Many changes to XPI and the EXTRACTOR were implemented and released in quick succession as a result of work with the ASCA scientists. Most of the urgent enhancements were completed, and most of the problems were of a non-critical nature. The software was demonstrated at the ASCA science meeting on June 23-25 and performed successfully.

Work continued on the extractor and the XPI command line interface library. All reported bugs were fixed, and numerous enhancements were made.

A gopher server was installed on Athena, the Modcomp computer. This gopher server will allow access to the HEASARC data, which are available to the public. The gopher server was configured to have access to all the data, which also are available via FTP from legacy.

A mailer was configured and installed on the Modcomp, as well to allow the listserv software to be used on Athena. This mailer was installed to reduce the load on legacy.

A new version of the FTP server was installed on legacy. This version corrects a security flaw in the original.

Improvements were made and support was provided for the XANADU x-ray data analysis package for Unix, ULTRIX, VMS, and OSF/Alpha. Several patch releases were made during the period as well as the first ever release to support DEC Alpha computers.

As patches were being released work began on modifications to the XSPEC spectral modeling package (a package that is part of XANADU). These changes will be part of a release scheduled for early October that will include a new local model management system for XSPEC, which has been successfully tested locally. This October release also will include the first support for DEC/Alpha machines running OpenVMS and for Silicon Graphics Unix-based workstations.

Support was provided for users of the XANADU package at other sites who had system related or software related difficulties.

A new system has been created to effectively handle the introduction of local spectral models into the XSPEC spectral modeling package. Under the old system, it was not possible to install a new release or patch of XSPEC without the end user having to edit a configuration file, copy subroutines, and edit a makefile. This change also renders the local (HEASARC) version of XANADU identical to the version to be released with the exception of a local directory structure and the local executable.

An FITS reader and writer is being developed for the XRONOS package. The writer expands on the features of the existing ASCII output routine and produces a file that can be read back into XRONOS for further analysis. A prototype reader has also been written. A long term objective is to restructure all of XRONOS to run like FTOOLS, with parameter files and separate, well-defined tasks. Among the challenges is to read header information that may not conform to a particular standard. So far, the reader has been modified to handle two FITS data files not produced by the XRONOS FITS writer.

The writer has further been modified to buffer the data in sizable blocks of memory, saving a factor of between 10 and 100 in runtime compared with writing one element at a time. A similar modification to the reader is progress, with a view to expanding XRONOS's capability to select data from specified energy bands in the input arrays. Thirteen new subroutines have been produced, and modifications made to several existing ones.

The calibration data base has continued to ingest the latest versions of ASCA calibration files. Most notable are the calibration files required by the GISLIN and SISLIN software. The ASCA calibration data base at ISAS (Japan) has been simultaneously maintained.

The calibration data base software package (CALTOOLS) has continued to be updated and maintained. The CALTOOLS package now contains six software tasks.

A preliminary version of the software task XRTARF has been written. The task generates an ancillary response file usable by the analysis package XPSEC.

Many plotting routines related to the PGPLOT package are being rewritten and integrated into PGPLOT. Repairs have been made to existing PGPLOT tasks and new drivers have been written. New versions of PGPLOT have been installed at HEASARC and distributed to HEASARC users.

The LISTSERV automated mail handling system has been updated and moved onto a different computer in order to improve message distribution. New lists have been added as required.

A graphical user interface for the XSELECT package has been started and some existing GUI's are being moved to a Macintosh computer.

Continuing support was provided for the Astrophysics Data System.

Subtask 2: HEASARC Science Support

The transfer of the HEAO-1 A2 MAX tape data from IBM to VAX for optical platter ingest is 95 percent complete. Preliminary templates for converting this data to FITS format have been started.

Both COS-B and SAS-2 FITS format files are complete, as well as their respective calibration files. These files will be accessed and analyzed using the FADMAP software. FADMAP rewriting and testing is nearly complete. All data associated with these two missions have been loaded onto the Legacy for access using the BROWSE archive software package. These data are also available via FTP connect to Legacy.

Due to ROSAT and ASCA peer reviews, the HEASARC user's group meeting, and viewing interval deadlines, the SSS data conversion to FITS format was put on hold until early September. It is expected that the conversion production will begin by late September with completion set for early November.

The anonymous FTP areas for several data have been completed including GINGA, Einstein, COS-B, and SAS-2. All the FITS data files have been online since May. Areas for auxiliary files documentation, calibration files, and software have been completed and are currently being filled.

The program REGENFITS has been written and delivered and is used to read German ROSAT FITS data files and rewrite them with additional and adjusted FITS keywords so that they can be used with HEASARC software XIMAGE.

Staff completed the following data bases for HEASARC Online Service: Vela 5b products data base (VELA5B); General Catalog and Atlas of Cataclysmic Variables (CVCAT); ROSAT German REVO Public Data (ROSGPSPC).

Staff revised the following data bases for HEASARC Online Service: Einstein SSS IBM-listing (SSSHME); ROSAT Simbad Identifications (ROSID).

The maintenance of the HEASARC Online Service data bases includes periodic (approximately weekly) updating of ROSAT data bases—ROSATLOG, ROSUSPSPC, ROSUSHRI, ROSGPSPC, ROSPUBLIC, ROSSTL, and ROSLTL and updating of the BULLETIN data base on NDADS.

Data restoration and copying from 9-track tapes onto 8-mm and 4-mm DAT tapes continue. Approximately 750 tapes have been copied to date with at least another 75 to process. These are data tapes that had to be removed from storage in the basement of Bldg. 2 because that area will be converted into the XTE GOF. Other data tapes also are being scanned and copied onto 8-mm and 4-mm DAT tapes as requested by other HEASARC science team members.

Data bases that will be updated and other catalogs for which to create HEASARC Online Service data bases include the following: EXOSAT FOT List (EXOFOT); Einstein SSS Data Base (SSS); Einstein SSS IBM-listing (SSSHME); Bonner-Durchmursterung (BD); Parkes 1990 Radio Catalog (PKSCAT90); Veron-Cetty and Veron 1991 (VERON91); Ariel V Data Products (ARIEL5).

Staff continued maintenance of HEASARC Online Service data bases on the new Legacy machine; created and installed new data bases for the service; and continued testing of BROWSE software during the transition onto Legacy.

Subtask 3: Maintenance of the ROSAT Proposal Funding System

A task member prepared the spreadsheets containing preliminary scores for the ASCA project and attended the peer review in Tyson's Corner for a week. Staff also generated funding packages for ROSAT proposals.

The following tasks were developed for the subpackages of FTOOLS, HEASARC, and CALTOOLS. FTOOLS is a collection of standalone tools to create or modify data files in FITS. FTOOLS are available to the international community. CALTOOLS is a subpackage containing tasks related to calibration. HEASARC is a subpackage containing tools specific to high-energy astrophysics missions such as ASCA. The tasks are tested under VMS, Unix, and ULTRIX operating systems, in addition they can be used within an IRAF environment.

For HEASARC Software GRPPHA, version 1.0.6 has been delivered. The associated documentation also has been updated. The DMPRMF general calibration utility task has been updated to version 1.0.2. It displays the contents of a detector Redistribution Matrix File (RMF) to the terminal or to an ASCII file. RBNPHA is a new task that physically rebins a Pulse Height Analyzer (PHA) file in channel space. RBNRMF is a new task that compresses a FITS RMF in channel-space either to match that of a user-defined PHA file, or to give a user-defined number of resultant channels. The output is a new file containing the revised (compressed) RMF extension, and the corresponding extension containing the nominal energy bounds of each channel (EBOUNDS). The primary use of the task is likely to be to compress RMF data sets in channel-space such that the resultant number of channels matches that in a given PHA data set. Hence downstream spectral analysis packages can be used to unambiguously map the channels in the PHA spectrum and Response matrix.

For ROSAT specific software PSPCRPSF, version 1.0.2 has been delivered. ST2RPSF has been updated to version 1.0.3. It reads data from a FITS stwfits (stsdas/fitsio subpackage) assumed to contain a 1-dimensional radial profile of an image, and writes an Office for Guest Investigator Programs (OGIP) standard format for radial profiles. RPSFQDP has been updated to version 1.0.1, it reads data from a FITS OGIP standard format file, containing an extension with a radial profile, and an optional extension containing a theoretical/predicted model of the data. It subsequently writes an output file in ASCII qdp format, so that QDP/PLOT can be used directly on the file. Work has been started on a new FTOOL, a task to create an exposure map.

For CALLIB routines several general utility subroutines have been written. WTRPSF1992a.F, writes a FITS radial profile extension in OGIP 1992a format. RDRPSF1992a.F, reads an FITS radial profile extension in OGIP 1992a format. RDEBD1992a.F, reads an FITS OGIP standard 1992a EBOUNDS extension. RDRMF1992a.F, reads an FITS RMF extension in OGIP 1992a format. CMPFACT.F calculates the compression factor(s) given a resultant number of channels and in some cases a PHA file. CKFILE.F is a routine that checks the validity of an output filename, that is if a file of that name already exists, and if it is an illegal file as specified by the calling routine.

Two memos for *Legacy* have been written.

Staff developed the MPE/OGIP calibration memo CAL/ROS/93-015, ROSAT PSPC, and the Off-Axis Point Spread Function. This memo details the extension of the description of the point spread function of the ROSAT PSPC to include off-axis effects. We present the off-axis algorithm and compare the model to in-flight data. We discuss the limitations of this parameterization with respect to data analysis. The model is implemented in the form of a standalone CALTOOL task, PSPCRPSF by R. Yusaf. PSPCRPSF is compatible with VMS, Unix, and ULTRIX platforms, and is available to the international community. This memo will be in *Legacy 4, The Journal of the High Energy Astrophysics Science Archive Center.*

Staff developed another OGIP Calibration Memo CAL/SW/93-004, GRPPHA. This memo is essentially a description and user's guide to the GRPPHA software. GRPPHA is a task to define the channel grouping card, quality flag, and fractional systematic errors associated with a FITS PHA file conforming to an OGIP standard format. This tool is a standalone task within the HEASARC subpackage of FTOOLS. It is compatible with VMS, Unix and ULTRIX platforms. GRPPHA is available to the international community, and is used extensively at GSFC, and ISAS in Japan. GRPPHA is a task to define the channel grouping card, quality flags, and fractional systematic errors associated with a FITS PHA file conforming to an OGIP standard format. This memo will be in *Legacy 4, The Journal of the High Energy Astrophysics Science Archive Center.*

Subtask 4: EXOSAT Data Base Development

Modifications were made to the RPS and APS programs for ROSAT and ASCA to include an editing ability for abstracts. New LaTex forms for APS were created. RPS was ported to Unix (SUN). Staff provided technical support for the ASCA AO-1 peer review. ROSAT status reports were mailed to interested users from status report 62-66.

A staff member successfully designed and implemented a nontransparent task to task client/server TCP/IP network data communications software on the Unix platform (ULTRIX and Sun), which provides a reliable, highly efficient primitive data I/O application programming interface. Staff is using this software for network communications, BULLETIN. XOBSERVER user registration, and prototype Next Generation BROWSE data client/server software systems were implemented.

In the implementation of the prototype Next Generation BROWSE data server software, complex software integration of ULTRIX SQL (INGRES RDBMS) and STDB were completed. This task was composed of software installation, configuration, and verification.

Subtask 5: ROSAT Science Support

Task members thoroughly tested new ROSAT software and prepared results for a major ROSAT memo. Support was also provided for local (i.e., Laboratory for High-Energy Astrophysics [LHEA]) users by distributing a "recipe" guide to using the new software and handling all questions and bug reports.

A high level of assistance was provided for x-ray analysis tasks for visiting ROSAT Guest Observers, in accordance with primary task objective.

Development continued on the system user's guide for local users (scientists and programmers). Meetings took place with developers of local software packages to coordinate preparation of general systems files to be made available to all users; the system files will provide new users with a standard environment and reduce the proliferation of specific, often highly-convoluted, local files and environments. Staff presented preliminary results at the first monthly LHEA Programmer's Meeting and made plans to incorporate additional feedback from meeting participants into final products.

Task members provided computer support for the first Advanced Satellite for Cosmology and Astrophysics (ASCA) Proposal Peer Review, August 17–20, 1993. Typical work days during the review were 10–12 hours long; duties included recording decisions of the review panels, calculating relevant statistics, and performing remote electronic library searches, all on an interactive basis.

Staff assisted in archiving the LHEA tape library, generating 8-mm and 4-mm DAT tape copies of existing 9-track data. This is a massive archiving effort requiring the continuous participation of one or more individuals for a period of months.

Staff served the astronomical community by providing outstanding technical support to visiting ROSAT GO's during their stay at GSFC. To quote from one GO's comments, "The support was excellent. [The support team members] were very helpful. They knew the answers to most of our questions, and if they didn't, they knew where to find them. I was very impressed." (From Dr. A. Shafter's GO Exit Survey, August 12, 1993.)

Task personnel performed hundreds of tests of a new set of ROSAT software tools, resulting in the coauthorship of a major ROSAT memo and analysis technique to be released to the community in an upcoming issue of *Legacy*, memo CAL/ROS/03-015. The new software allows a researcher to study the effects of the Off-Axis Point Spread Function (PSF) on an x-ray source, and required approximately 1 man-month and 50 hours of CPU time to test. Demand for the new technique is so high that an early version of the memo has already been prepared and circulated in-house at GSFC.

Two Guest Observers visited the ROSAT GOF in June, two in July, four in August, and one in September. The task member handled all the logistics of their visits, booked them into the facility, loaded the data sets online and assisted in their software/scientific support during their visits.

The *ROSAT Newsletter 8* was mailed out, and work was begun on 9. A new technical writer for the OGIP was hired and the task member spent several days training her on the use of the VAX and SUN computers—how to transfer files and the emphasis of the *ROSAT Newsletter* and Browse documentation. The technical writer will eventually take over the *ROSAT Newsletter*. The task member will be starting the ASCA Newsletter.

The task member began analyzing ROSAT data to better understand the process of using PROS in data analysis. This knowledge will be put to good use when there are ROSAT Guest Observers visiting.

The task member is on the Local Organizing Committee for the ROSAT Science Symposium and Data Analysis Workshop to be held at the Univ. of Maryland, November 8–10, 1993. The task member will work with the Univ. of Maryland and GSFC system managers to coordinate computer/network connections for the symposium.

The task member called members of the science community to request their participation in the ASCA Peer Review.

A staff member modified and executed Excel macros to test the ASCA AO1 proposals against each other and the pointing verification phase targets for conflicts. The resulting information was included in the proposal packages sent out to reviewers.

The task member attended the ASCA AO1 proposal review as technical support. Statistics of the accepted proposals (time, cost, and priority) were kept in the worksheets and modified by macros that had been developed by the task member.

Task personnel compiled all the statistics for Japan's ASCA AO1 review. The results of the review were faxed to the task member who typed the results into the Excel data base and ran the appropriate macros to determine which targets will be merged with the U.S. targets during the merging process in Japan at the end of September. Several Excel macros were written to assist with a first cut at merging the two lists.

Two Guest Observers visited the HEASARC in July.

The third issue of *Legacy*, was mailed out. Work was begun on the fourth issue of *Legacy*.

Staff participated in archival tape scanning and copying.

Staff began regular compilations of use of the OGIP including visitors, phone calls, e-mail messages, and remote logins for the HEASARC, ROSAT, and ASCA. This information will be presented to the Office of Management and Budget (OMB).

Subtask 6: ASTRO-D Support

A staff member attended the June American Astronomical Society meeting in Berkeley, CA, to give a presentation on the FTOOLS software package to the astronomical community.

Three public releases of the FTOOLS were made during this period on monthly bases.

Weekly developer releases of the FTOOLS were made up until the first week of September, at which time it was determined that the software was sufficiently complete that reducing the number of releases would stabilize version control at other sites such as ISAS.

During this period, the number of FTOOLS tasks available for data selection and analysis has climbed to a total of 75. The original specifications called for approximately 25 tasks.

The XTE mission decided to adopt the FTOOLS philosophy for their mission-specific software. In addition, some discussions occurred with the AXAF team about using the FTOOLS in that mission.

The FTOOLS took the CALTOOLS, a collection of calibration tasks on board, as well as the XSELECT and EXTRACTOR analysis software packages. The current distribution of FTOOLS now contains approximately 10 MB of source code ported to SUNs, DECstations and VAXes.

Work began on porting the FTOOLS to the new Alphas at the HEASARC. Problems with 32-bit specific code provided by SAO have placed this port on hold until late September.

The FTOOLS and XSELECT software is now widely used and much user input has been received during the past couple of months. These have resulted in many bug fixes, enhancements, and modifications of the software. However, it does appear that real science is now being done with the software.

Problems with system administration at ISAS have resulted in the need to log into there computers as superuser from GSFC to sort out some network and installation problems that have impacted the use of FTOOLS at ISAS.

There were three revisions of the FTOOLS documents for installation, use, and development during this period to maintain documentation compatibility with the public releases.

Many new FTOOLS tasks were written, including:

- SISHIST—generates file for graphical analysis of hot and flickering pixels.
- FASTTIME—Corrects the time in SIS FAST mode data to the actual event time.
- BINCURVE—produces a light curve from a vector column.
- BINSPEC—produces a spectrum from a vector column.
- FTABCOPY—makes a new table with selected columns, can transform from ASCII <-> BINARY tables (reincarnation of FPROJECT).

- FLOOKUP—selects events based on a lookup table.

A number of tasks were improved, including:

- ALL—allow for specification of extension with a "+".
- ALL—updated C-wrapper programs to reflect changes to SAO host interface.
- F2DHISTO—fixed bug related to EXPOSURE keyword.
- FMERGE—allowed lastkey parameter = "-" to mean no action to be taken.
- FLTIME—fixed bug requiring first extension contain events.
- FDUMP—increased speed.
- FDUMP—fixed bug related to IRAF version not paging correctly.
- FDUMP—fixed but with scaled integer columns.
- FDUMP—introduced paging option.
- FMODHEAD—allow for change of keyword name without changing value.
- FARITH—sensible nulls and output datatype selection.
- FIMG2LST—default to primary array.
- FIM2LST—allow for infinitely sized array.
- FCURVE—output many light curves instead of just one.
- FAINT—update PHABINS keyword appropriately.
- FAINT—add echo removal, grade selection, enhance speed.
- FIMGDMP—allow for infinitely sized arrays.
- FCREATE—ignore blank lines in input files.
- FPLOT—plot up to eight values, plot vs. point number, improved labeling.
- FPLOT—additional parameter to offset *x* axis to 0.
- FPLOT—enable vector support.
- FBURST—check for file out of time order.

Staff continued maintaining VAX/VMS version of FTOOLS on LHEAVXcluster including testing weekly updates to the FTOOLS development version and answering user questions.

Some important new capabilities were added to the XSELECT package. Chiefly, the selection on the basis of the Filter files was incorporated, as well as ancillary functions to list and plot the available parameters, and to automatically locate the appropriate files. This greatly facilitates the analysis of the data.

Considerable time was spent in responding to user's problems. Now that most of the desired functionality of XSELECT was present, we could turn to getting the interconnection of all these tasks right. This was done in close concert with the users of the software at ISAS, GSFC, and elsewhere. They would suggest ways that they would like to use the program, and the logic was added to make this possible. Also, staff spent some effort insulating people against their own mistakes.

Much time was spent in incorporating XSELECT into the FTOOLS distribution, and setting up make scripts and user scripts that would make installation and user set-up more foolproof. The site at ISAS is particularly confusing, and staff worked hard to ensure that there were no version mismatches.

Some code was extracted from XSELECT and made into a separate FTOOL, SISCLEAN. XSELECT used to take 10 MB of memory to run, and now it only needs 4 MB. Given that many of the tasks that it controls use ~ 10 MB, this helped the sites that have smaller computers.

Finally, the first mission other than ASCA was incorporated into XSELECT, namely ROSAT. More work must be done, but the existing code worked surprisingly well when applied to ROSAT. It has been used by several of the scientists here who work on ROSAT, and seems better than the other packages that are available.

Work has begun on the GUI for XSELECT, and will continue with this project. This will not be part of the version that is distributed at the meeting, but it needs to be ready before these data go to the Guest Observers.

Subtask 7: ASTRO-D Operations Support

The task of making weekly schedules has been reduced from three days to approximately one full day of work. Additional information has been added to the scheduling software to simplify processing further down the pipeline. An increasing number of Targets of Opportunity (largely due to GRO observations) and schedule mishaps (due to typhoons) resulted in frequent rearranging of the long-term schedule.

Staff evaluated the observed target list and to-be-observed list and compared these with the initial PV time allotments. With PV goals in mind, the long-term schedule was updated and it was verified that all targets were given the time that had been allocated by the Science Working Group many months ago.

The SPIKE Long Term Scheduler continues to work very well. The Short Term Scheduler NEEDLE works well. Modifications to NEEDLE to decrease the workload of the attitude planner have been made, by adding more detailed information on roll angle, Sun constraint, and Moon constraint for each target scheduled. This information is given to the "touban" (duty scientist) and to the attitude planner in the weekly schedule summary sheet. Star tracker constraint information required lengthy verification but is now functioning.

AO-1 proposals have been received here. At present, there are very few methods for processing them except by hand. A PHS is being developed here in conjunction with M. Duesterhaus at GSFC. It is at present undetermined how much the GSFC software will help, since it is based on INGRES data bases, and the INGRES data base at ISAS is actually managed by Leicester University and has reduced capacities over a standard INGRES data base.

The ODB is fairly stable and had only one major crash, which was recovered without further mishap. It is being changed using feedback received during the PV phase. The ODB still has not been made publically available.

As suggested by ISAS, a task member has prepared a poster paper on the ASCA scheduling system, to be presented at the ADASS conference in Canada in October.

Analysis of ALGOL has begun and a brief presentation was made at the in-group seminar in mid September.

Subtask 8: Development of HEASARC Heterogeneous Environments

Staff began work on StarTrax, a portable graphical user interface that will provide uniform access to multiple services of the HEASARC, e.g., bulletins, catalogs, and proposal and analysis tools of BROWSE and ROSAT MIPS.

A task member presented StarTrax to HEASARC User's Group, and to the Second Astronomical User Interface Workshop, both here at GSFC.

XVT-Design was used to help in the generation of a portable GUI for a current bulletin board (BB) server. BB GUI began and finished, save for Help. This GUI provided the prototype and foundation for StarTrax. Staff also fixed some problems and made requested modifications and enhancements. Registration/XOBSERVER was implemented.

Staff wrote first draft of user guide (Software User Guide) with FrameMaker.

Staff began some data base interfacing, via XOBSERVER.

Subtask 9: XTE GOF Programming

Staff completed the coding effort for the prototype implementation of an XTE FITS Formatter (XFF), the purpose of which is to convert the SOF acquired level-0 telemetry data sets into FITS files for archiving and distribution; established the preliminary client-server interface with the SOF data management subsystem as a prelude to integration and testing; and completed the development of a document describing and proposing the scientific capabilities if the next generation of timing analysis tools as a multimission system. The proposed capabilities were presented to the SWG and largely accepted with the major request being to make the XTE timing and spectral analysis the highest priority. Staff continued development of the document describing architectural design and implementation strategy for the next generation, multimission timing and spectral analysis system. The original target date for the completion of the first order design was the end of June. The architectural design portion of the document is largely complete. Issues regarding the implementation strategy are still being debated. Staff participated in a meeting between the GOF and Code 631, the purpose of which was to better define the role Code 631 would provide in supporting the GOF requirements.

The integration and testing of XFF as a client of the SOF data management subsystem has been postponed until data management build 1 issues are completed.

Staff completed a document describing a proposed architectural design for the next generation, multimission timing and spectral analysis system. Personnel met with N. White and other GOF staff to discuss issues regarding the implementation strategy. The current strategy is to implement the existing capabilities of the XRONOS package, as well as any additionally required capabilities as part of the FTOOLS environment. In addition, a graphical user interface will be developed to simplify the creation of complex analysis procedures involving multiple FTOOLS potential data transport mechanisms (e.g., pipes, shared memory) will be explored as alternatives to the current disk file method for passing data between tools; and a distributed processing mechanism will be explored (i.e., for executing the different components in a complex analysis procedure on different platforms.

Task members installed multiple software packages in preparation for the development and implementation of the above, including: FTOOLS, FITSIO, XANADU, XRONOS, XSPEC, XIMAGE, KHOROS.

Some installation problems have yet to be resolved. The integration and testing of XFF as a client of the SOF data management subsystem has been delayed until a suitable subset of instrument team housekeeping and science data accessor software is in place. Task members continued development of an implementation strategy for the XTE/GOF data analysis system in collaboration with other XTE/GOF and OGIP staff; resolved several installation problems involving GOF oriented data analysis software; participated in a demo of Khoros for GOF staff; and began investigating Khoros's "cantata" visual programming language as a GUI for the XTE/GOF data analysis system to facilitate the combination of FTOOLS components into complex analysis procedures.

Task personnel continued developing an implementation strategy for the XTE/GOF data analysis system in collaboration with other XTE/GOF and OGIP staff, and resumed the integration and testing of the prototype XTE FITS Formatter (XFF) with the SOF data management subsystem. This included the benchmarking of XFF as a client to data management servers for a large volume of HEXTE science data and a modest amount of housekeeping data. Staff continued installing and resolving installation problems for GOF-oriented data analysis software (i.e., FTOOLS) and developing familiarity with the existing features and functionality. Staff continued exploring possible implementation solutions for the XTE/GOF data analysis system, including XVT and Khoros's "cantata" visual programming language as a GUI, Khoros' "metasystem" and Hence/PVM for heterogeneous distributed processing Pipes, and shared memory as data transport mechanisms between FTOOLS applications.

A presentation was given on the Proposal Management System for XTE/GOF in the critical design review.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED NEXT FOR PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
80,640	NeXT
237,600	SUN
153,600	DECstation
117,600	VAX
36,000	Macintosh
9,600	IBM2

NASA Task 62-241-00: ROSAT Analysis

GSFC ATR: ***Dr. J. Swank***

Hughes STX Task Leader: ***Dr. S. Reddy***
Hughes STX Task Number: ***691***

This task provides support for the analysis of ROSAT observation of Eta Corina region as specified in the proposal. This includes creation of a list of detected sources, special analysis of bright sources, timing analysis, and analysis of diffuse emission.

FINAL CONTRACT SUMMARY

A subcontracting arrangement was made and the task activities began as planned. Staff examined the count rates from a variety of stellar sources. The task member developed software to account for the local background and telescope point spread function and used it to determine the intrinsic source counting rate as well as a likelihood estimate for source detection.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff examined the count rates from a variety of stellar sources. The task member developed software to account for the local background and telescope point spread function and used it to determine the intrinsic source counting rate as well as a likelihood estimate for source detection.

WORK PERFORMED

As part of a comprehensive analysis of X-ray emission from the Eta Carina region, the task member examined the count rates from a variety of stellar sources. A comparison of the X-ray to bolometric luminosity of the various stellar types was of interest, as compared with a similar study done earlier with the Einstein data. The research to date has included writing software to account for the local background and telescope point spread function and using it to determine the intrinsic source counting rate as well as a likelihood estimate for source detection.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS 5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Staff will continue an analysis to make an Lx/Lbol plot of all of the detected sources and compare it with the one from Einstein. This analysis can also be used to look for trends among stars of the same spectral type and between spectral types.

COMPUTER USE

None.

NASA Task 72-270-00: Aperture Synthesis Radiometer and Lightning Radiation Modeling

GSFC ATR: *Dr. D. Le Vine*

Hughes STX Task Leader: *Dr. M. Kao*
Hughes STX Task Number: *751*

This task provides analysis, software programming, data acquisition, and data reduction support for the development of an aperture synthesis radiometer and provides data analysis and software programming support for lightning radio frequency radiation modeling research.

FINAL CONTRACT SUMMARY

During the lifetime of this task, one principal scientist has been working full time on this task.

The many accomplishments over the lifetime of this task include the following. In the lightning radiation research support, a study on the comparison between the measured lightning radiated electric field data and the simulated electric field data was completed. A FORTRAN program, which reconstructs a 3-D lightning channel from a pair of photographic image data was written in this study. In the aperture synthesis radiometer development support, the ESTAR testing, calibration, and image reconstruction methods were developed quickly at the beginning of this task. The data processing and data analysis of the ESTAR 1991 Walnut Gluch data and the ESTAR 1992 Washita data were completed in a timely fashion.

Remaining objectives to be accomplished are the ongoing of the data processing and data analysis of the ESTAR data and the support for lightning radiation research.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff completed the reprocessing of the ESTAR June 1992 Oklahoma data. The image data contaminated by the radio frequency interference were removed. Staff processed the ESTAR June 1992 meteorological Site 2 and Site 4 low-altitude data. The daily average brightness temperatures in those areas were calculated. The ESTAR June 13, 1992, Oklahoma data were reprocessed using a larger field of view. The postflight blackbody data and the lake Ellsworth water data for the ESTAR instrument calibration were processed.

WORK PERFORMED

100 APERTURE SYNTHESIS RADIOMETER

130 Data Acquisition and Processing

The reprocessing of ESTAR Washita '92 Oklahoma was completed. This reprocessing concentrated on the problem of the contamination of the radio frequency interference data. These contaminated data were detected and designated to a reserved number in the image data file. The flight data files of June

13 and 14, 1993, were extrapolated in order to process the ESTAR data. The image data format was changed from ASCII to binary. Eight ESTAR images were produced and delivered to the ATR.

A FORTRAN program REGRID.FOR was written. The program transforms the ESTAR image data file from 512 lines by 512 pixels to 93 lines by 228 pixels with the pixel size of 200 meters. Eight ESTAR images of this resolution were also produced and delivered to the ATR.

The meteorological Site 2 and Site 4 low-altitude data of ESTAR June 1992 Oklahoma experiment data were processed. This processing was concentrated on the registration of the meteorological site positions. The data analysis study on the Site 2 and Site 4 was also performed. Each site area was subdivided into several smaller regions. The daily average brightness temperature in each region was calculated.

The ESTAR June 13, 1992, Oklahoma experiment data were reprocessed. In the previous processing, no ESTAR data were in a region because of the missing of ESTAR data of that flight. In this reprocessing, a larger field of view is used in order to fill the ESTAR data from the adjacent flights to that region. An improved brightness temperature image of June 13, 1992, was produced.

A floppy disk containing the lake Ellsworth data was received. Processing of the Lake Ellsworth water data on June 11–18, 1992, was completed. Seventy-seven water scenes were plotted. The processing of the postflight blackbody data was also completed. Seven blackbody scenes were plotted.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work is proceeding as planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The calibration and analysis of ESTAR data will continue. A Work Control Plan will be updated for the new contract to meet the requirements for this task.

DELIVERABLES SUBMITTED

Images: 18 ESTAR brightness temperature images
Originator: Dr. M. Kao

COMPUTER USE

Minutes	Computer
4,000 (wall clock)	VAX 750
5 (CPU)	IBM 3081

NASA Task 72-271-00: Analysis of Spaceborne Precipitation Radars

GSFC ATR: ***R. Meneghini***

Hughes STX Task Leader: ***J. Jones***
Hughes STX Task Number: 752

This task provides software support for the analysis of algorithms for measurement of precipitation rates using a radar working at attenuating wavelengths, and for the processing of aircraft-based radar measurements.

FINAL CONTRACT SUMMARY

This task assignment was from October 1988 through September 1993. It was a follow-on to a task under the previous contract, and it is expected to continue under the upcoming follow-on contract. One senior analyst programmer (0.7 FTE) was assigned to the task.

Hughes STX staff analyzed methods for estimating rain intensity using models and simulations of radar observations from hypothetical space-based precipitation radar systems. Extensive simulations were done under the previous contract for a simple stratiform storm model; in this period, task personnel developed a significantly new version of the radar-modeling program using a 3-D storm model. The storm model specifies mass content and a particle-size distribution for each of several hydrometeor species at each 3-D cell. Task personnel presented papers at two conferences on this work: at the spring meeting of the American Geophysical Union, in May 1990, and at the Fourth International Conference on Precipitation, in April 1993.

A spaceborne precipitation radar will be reliable over a limited dynamic range. HSTX staff participated in an investigation into methods of using the information in a limited dynamic range to statistically estimate areal rain-rate distributions. This research resulted in a publication in the *J. of Appl. Meteor.* (February 1993), coauthored by the ATR and the HSTX task leader.

Under the previous contract, and early in this period, most of the software associated with this task was run on an IBM mainframe. During the last few years, task personnel ported most of the software to a Silicon Graphics IRIS Workstation. Much of this software produces graphical products, and staff rewrote these programs using a different graphics package. Using the workstation saves computer facility charges, but, if necessary, large jobs can also be run on the NCCS Cray.

Under the follow-on contract, further refinements are planned in the radar simulations and in the rain-rate distribution statistical studies. The Tropical Rainfall Measuring Mission (TRMM) is under active development, and task personnel will become engaged in development of algorithms and software for processing TRMM data.

SUMMARY FOR CURRENT REPORTING PERIOD

An HSTX analyst investigated the performance of reflectivity-profile estimation methods for an off-nadir look angle, and improved the method for choosing the near-surface range gate in these cases. Staff developed programs to generate color-filled contour plots, displaying various quantities from radar simulations as functions of vertical and horizontal position. Using a different graphics package, staff rewrote a program that plots individual simulated return-power profiles.

WORK PERFORMED

100 RAIN RADAR MODELING

130 Profile Reconstruction

An HSTX analyst investigated problems with methods for estimating radar reflectivity profiles when the observations are made off nadir. This situation is especially challenging when methods are employed that use the path integrated attenuation (PIA) at the surface as a constraint, because several range gates near the surface may be contaminated with ground clutter. Staff experimented with the choice of the near-surface gate in the profiling method simulation program, and improved the method for choosing the near-surface range gate in these cases.

Staff developed programs to generate color-filled contour plots, showing various quantities from radar simulations as functions of vertical and horizontal position; quantities displayed include raw return power, the concentrations of various species of hydrometeor, the true reflectivity, and the bias and standard deviation from simulations of various estimation techniques. Staff also rewrote a program that plots individual simulated return-power profiles. The code was ported from an IBM mainframe to a Unix workstation, and the graphics package was converted from Template to NCAR Graphics.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work on this contract has ended. Work is proceeding as planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue preparing a version of the TRMM radar algorithms paper for publication. A Work Control Plan will be completed for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	**Computer**
15,000 (wall clock)	SGI Personal IRIS

NASA Task 72–272–01: Polar Ice Studies: Mesoscale Sea-Ice Observations

GSFC ATR: *Dr. J. Comiso*
Cognizant NASA Scientist: *Dr. H. Zwally*

Hughes STX Task Leader: S. *Fiegles*
Hughes STX Task Number: *753*

This subtask provides general programming support to study large-scale characteristics of sea-ice cover using satellite passive microwave data sets. The focus of this study will be the preparation, analysis, and comparison of the ESMR, SMMR, SSM/I, and THIR passive microwave data sets for studies of ice dynamics and comparison with buoy data and numerical ice models.

FINAL CONTRACT SUMMARY

Over the lifetime of this task, which began on October 1, 1988, one senior programmer/analyst has been working full-time.

This task has attained many significant accomplishments and milestones during its lifetime, including the following. Effective and timely support was provided to the ATR to meet all publication, conference, and proposal deadlines. Numerous integrated, interactive software packages were written on the IBM 3081, IBM 9021, HP 9845, HP 9020, HP 730, HP 750, HP 735, and HP 755 in FORTRAN, HPBASIC, C, and IDL to perform a wide variety of analysis tasks. Extensive time series analysis using Arctic and Antarctic, ESMR, SMMR, SSM/I, and THIR passive microwave data was performed to resolve the temporal interannual variation of polar sea ice packs. Extensive interactive imaging software was used to better discern the large-scale spatial distribution of polar ice packs over time. Extensive inter-data set comparisons were performed to provide greater validation for analysis results. With the rapid advance of computer technology, task personnel were able to smoothly transition analysis support away from the IBM mainframe environment to the RISC Unix workstation environment. To greatly expedite this transition, 40 primary passive microwave data sets, comprising more than 30 GB, were transferred, reformatted, and stored on an HP 700 workstation archival DAT tape. This transfer was implemented with minimal ATR direction. Task personnel also provided system administrative support for all aforementioned HP computers and workstations.

Time series and imaging analysis of the aforementioned passive microwave data sets will continue under the new contract with increasing emphasis on newly arrived SSM/I passive microwave data. The scope of this analysis will be greatly facilitated by new HP 700 workstation technology.

SUMMARY FOR CURRENT REPORTING PERIOD

Task personal became involved in three primary projects during this period. Task personnel successfully completed time series analysis of Arctic SMMR on SSM/I grid ascending node and SSM/I total ice concentrations. Task personnel also transferred the bulk of remaining IBM 9021-resident SMMR, ESMR, and THIR passive microwave data sets (120 IBM 3480 cartridges/12 GB) to HP 700 archival DAT tape. This process involved the network transfer, Unix reformatting, and archival DAT backup. In addition, task personnel started a project involving the intercomparison of numerous Arctic and Antarctic ESMR Atlas brightness temperature data sets, THIR 1979 surface temperature data sets, and numerous temperature data sets from the Univ. of Calgary.

WORK PERFORMED

100 SMMR ANALYSIS

Task personnel successfully completed time series analysis of Arctic SMMR on SSM/I grid ascending node total ice concentrations. Newly generated SSM/I total ice concentrations from Julian day 232, 1987, to day 90, 1991, were appended to the original SMMR on SSM/I grid data set to extend the time series from Julian day 305, 1978, to day 90, 1991.

Special versions of the IDL image collage software were written to generate ice concentration images of five newly defined Arctic sectors using the SMMR Arctic atlas color scale. Numerous image collage hardcopies were generated on both the PHASER III and the dye sublimation printer. Additionally, numerous time series histograms and associated tabular dumps were generated for each of the five Arctic sectors for selected time periods. Task personnel worked 60 overtime hours to meet publication deadlines.

120 ESMR/THIR Analysis

The primary focus of this period was the beginning of a harmonic amplitude study using Arctic and Antarctic monthly and yearly averaged 1979 THIR surface temperatures, Arctic and Antarctic ESMR atlas yearly averaged brightness temperatures, and numerous Arctic and Antarctic brightness temperature and surface temperature data sets from the Univ. of Calgary.

After translating a harmonic analysis FORTRAN routine into IDL, staff developed an integrated package to do a variety of related tasks. This harmonic analysis should reveal the seasonal variation of the data. The 12 Antarctic 1979 THIR monthly averaged surface temperatures were used to calculate the harmonic coefficients at each pixel location and the resulting coefficient ratios were then stored, resulting in a harmonic coefficient ratio (A2/A1) image. An integrated IDL software package was written to perform approximately 30 related analysis tasks, listed below.

Approximately 30 different but related analysis tasks were performed for this project:

- Calculation and image display of harmonic amplitude ratio matrix using Antarctic and Arctic monthly averaged 1979 THIR surface temperatures.
- Calculation of harmonic amplitude ratios at 1350 latitude/longitude Univ. of Calgary positions from Antarctic 1979 THIR surface temperatures.
- Generation of scatterplots of Arctic ESMR 4-yr averaged 1973–1976 brightness temperature vs. Arctic N98 Calgary brightness temperatures.
- Generation of scatterplots of Arctic 1979 THIR yearly averaged surface temperature vs. N98 Calgary surface temperatures.
- Generation of scatterplots of Arctic 1979 mean THIR surface temperatures vs. N153 Calgary surface temperatures.
- Generation of scatterplots of Arctic ESMR 1976 mean brightness temperature vs. N98 Calgary brightness temperatures.
- Generation of a list of Arctic ESMR 4-yr averaged brightness temperatures interpolated at N251 Calgary latitude/longitude positions.
- Generation of scatterplots of Arctic 1979 THIR surface temperatures vs. N251 Calgary surface temperatures.

- Generation of a list of Arctic 1979 July surface temperatures at N98 and N176 Calgary latitude/longitude positions.
- Calculation of harmonic amplitude coefficients at N153 Calgary latitude/longitude positions.
- Calculation and display of Antarctic linear and hyperbolic accumulation map using ESMR mean 1974 brightness temperature and 1979 THIR mean surface temperatures.
- Calculation and display of Arctic linear and hyperbolic accumulation maps using ESMR 1974 mean brightness temperatures and 1979 THIR mean surface temperatures.
- Calculation and display of Arctic and Antarctic emissivity maps using ESMR 1974 mean brightness temperature and THIR 1979 mean surface temperatures.
- Display of images of the aforementioned ESMR and THIR monthly and yearly averaged temperatures.

Numerous enhancements were made to the primary IDL imaging software and image collage software, including enhancement of image PostScript hardcopies.

300 DATA ARCHIVING AND TRANSFER

Task personnel demonstrated initiative by using eight newly installed fast wide SCSI disk drives (16-GB capacity) to transfer approximately 18 SMMR, ESMR, THIR passive microwave data sets from the IBM 9021 to the HP 700 for subsequent reformatting and archival backup to DAT tape. These data sets comprise nearly 120 IBM 3480 data cartridges (12 GB).

Efforts to transfer these data sets were significantly impeded because of the repeated failure of the IBM 9021 MVS ftp server. Task personnel demonstrated resourcefulness by developing a new data transfer technique of using ULTRANET FTP software on the SGI fileserver to transfer data sets from the IBM 9021 to the SGI scratch disks and then to the HP 700. ULTRANET usage decreased overall transfer time by a factor of ten times and avoided the faulty regular IBM 9021 ftp server. Task personnel spent 50 overtime hours to further speed up data transfers.

400 SYSTEM ADMINISTRATION

Task personnel resolved numerous HP 700 system-related difficulties, which included HP 700/RX xterminal malfunction, HP 735 memory card induced system crashes, and GSFC/HSTX Lanham networking reconfiguration. Task personnel also performed the last HP 735/HP 755 physical system exchange between GSFC and HSTX with minimal system down time. Task personnel also reconfigured the HP 755, HP 9020, and peripheral systems after computer room remodeling.

Numerous HP-UX system software updates were installed along with new IDL versions.

Task personnel also assisted Climate and Radiation Branch personnel as well as MOLA personnel with the HP 700 system configuration and installation.

Numerous public domain software packages were installed or updated during this period. New versions of XV (image display software), tcsh 6.04 (Unix shell), and imake were installed. Greatly enhanced versions of Ghostscript/Ghostview (X Window PostScript file previewers) were also installed. Ghostview/Ghostscript permit the X Window viewing of any PostScript image or text file before the file is actually printed.

Also, several GNU (Free Software Foundation) software packages were updated or installed: GCC (GNU optimizing compiler), GZIP (GNU compression utility), GTAR (GNU tar utility), and GNU EMACS 18.59, as well as Vim 1.27 (enhanced VI clone).

SIGNIFICANT ACCOMPLISHMENTS

Innovative data transfer techniques were developed to increase transfer efficiency by a factor of ten times. Staff demonstrated initiative in porting numerous public domain/shareware utilities to the HP 700, thereby greatly increasing task capability and productivity.

To meet publication and conference deadlines and to expedite the IBM 9021 to HP700 data transfers, task personnel worked approximately 110 overtime hours.

PROBLEM AREAS

Repeated failure of the IBM 9021 MVS ftp server greatly impeded initial attempts to transfer huge passive microwave data sets from the IBM 9021 to the HP 700 for reformatting and archival backup. Innovative use of ULTRANET ftp software and Branch's SGI file server sidestepped difficulty and decreased transfer time by a factor of ten times. The problem was reported to NCCS Technical Assistance Group but was not resolved quickly enough for the IBM 9021 to be used.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTACT NAS5-32350

Task personnel plan to continue harmonic analysis project using Arctic and Antarctic ESMR atlas, THIR 1979, and Univ. of Calgary data sets. It is also hoped that staff can begin integrating simple IDL GUI interfaces into analysis software.

A Work Control Plan will be prepared.

TRAINING

Task personnel attended an HSTX-sponsored continuous measurable improvement (cmi) seminar to improve task productivity.

DELIVERABLES SUBMITTED

Images: 50 assorted images and image collages of Arctic SMMR on SSM/I grid ascending node total ice concentrations delineating 5 Arctic sectors printed in both paper and transparencies on PHASER III and Tektronix dye sublimation printers
Originator: S. Fiegles

Images: 50 assorted GIF images and image collages of Arctic SMMR on SSM/I grid ascending node total ice concentrations delineating 5 Arctic sectors
Originator: S. Fiegles

Data: 18 assorted passive microwave data set were transferred, reformatted, and backed up onto DAT tape
Originator: S. Fiegles

Images: 5 harmonic coefficient ratio (A2/A1) images derived from both Arctic and Antarctic 1979 THIR surface temperatures
Originator: S. Fiegles

Tabular Data: Numerous tabular data sets of aforementioned harmonic analysis and scatterplot comparisons generated and sent to the ATR's Calgary colleague
Originator: S. Fiegles

Images: 20 images and image collages of Arctic and Antarctic 1979 monthly averaged and yearly averaged surface temperatures
Originator: S. Fiegles

Tabular Data: Numerous tabular data sets of aforementioned harmonic analysis and intercomparisons generated in PostScript format and sent to Univ. of Calgary and given to the ATR in hardcopy format
Originator: S. Fiegles

COMPUTER USE

Hours	Computer
50	IBM 3091
15	HP 9020
675	HP 735/755

NASA Task 72–272–02: Polar Ice Studies: Sea-Ice and Climate Studies

GSFC ATR: ***Dr. J. Comiso***
Cognizant NASA Scientist: ***Dr. C. Parkinson***

Hughes STX Task Leader: ***J. Saleh***
Hughes STX Task Number: ***754***

This subtask provides general programming and technical support for the production of ice concentration images from satellite data, the generation of time series of ice concentrations, the calculation of statistics for sea ice and atmospheric variables, and the updating and use of a large-scale sea ice model.

FINAL CONTRACT SUMMARY

This task has existed for 5 years. One programmer/analyst has been working full-time to fulfill the task requirements. The lifetime of the task witnessed a variety of milestones and accomplishments. The following is a brief summary of the most important and noteworthy accomplishments of the task. Timely and effective support was provided to the ATR in the analysis of a variety of passive microwave satellite data (SMMR and SSM/I). This support includes utilizing statistical and mathematical techniques, developing complex structured algorithms, effective utilization of a variety of image processing and graphical utilities, and efficiently working in different computer environments. The ATR was provided a multitude of deliverables including laser plots, color/white satellite imagery, data reports, software documentation, and various mathematical/graphical representations of data while preparing papers, and presentations. As a direct result of efforts expended on this task, work was successfully transferred from the IBM to the IRIS workstation (UNIX-based) system. This accomplishment allows for easy and efficient access to data files with less time expended retrieving and accessing data. Colleagues of the ATR were provided data and software support in a timely fashion.

The remaining objectives include the continuation of SMMR and SSM/I data and analysis of sea ice concentration.

SUMMARY FOR CURRENT REPORTING PERIOD

Mathematical and statistical interpolation techniques and methods were successfully utilized on the Northern (NP) and Southern Hemisphere (SP) 22V SSM/I CD-ROM data sets for July 1987–March 1991. This effort involved spatial interpolation techniques to determine scattered missing data points, and temporal interpolation to fill-in the missing days of data. Backups of the data sets under study were created at each necessary interval. After interpolation of the above data, the staff member used the results to calculate the daily sea ice concentrations of the NP data set. The monthly ice concentrations for all major regions were then successfully calculated using these daily ice concentrations. A program, using the IDL graphics package was then designed to plot the calculated monthly ice extents.

SMMR 37H (November 1978–August 1987) were extracted from composed files on the IBM machine and placed in team format. The above reformatted SMMR 37H data then were used to calculate the Means, Variances, and Standard Deviations. The task member used the reformatted SMMR 37H data to interpolate for missing days and to eliminate the extra days of data. Finally temporal interpolation was used to fill-in the data gaps using a complete filled-in matrix.

For studying and comparing SMMR and SSM/I sensors, the task member used SMMR monthly ice concentrations to calculate the monthly ice extent for all major regions. Individual and combined plots of both SMMR and SSM/I data sets (November 1978–March 1991) were also developed. This study concentrated more on the Baffin Bay/David Strait regions.

For the overlap (July 1987) SMMR and SSM/I data, the staff member used the interpolated daily ice concentration and produced difference maps. These difference maps were then successfully used to develop a program to produce various histograms for an indepth analysis of the data.

WORK PERFORMED

Of the various efforts in which the task member was involved, the following are the most important and significant accomplishments for this task.

100 SMM/I DATA ANALYSES

The task member performed an analysis of the 22 common days of data for the SMMR and SSM/I T_B data. For the SMMR original and interpolated data, the task member calculated daily team ice concentrations. Daily ice concentrations using the new SSM/I filter were also calculated. Using this data, the task member then determined the differences of SSM/I and SMMR for both the original and interpolated data. The results of the differences were used to create histograms for comparison purposes.

The SMMR original data were retrieved from the IBM system and reformatted to the IRIS workstation format for later use.

The SMMR interpolated data were also retrieved from the IBM machine and reformatted from IBM form to the IRIS workstation form for later analysis.

The SSM/I original data were extracted from the CD-ROM's.

The SSM/I 19V, 19H, and 37V were restored from the DAT taps, and the 22V were spatially and temporarily interpolated. This effort was required to calculate the ice concentrations using the new SSM/I weather filter.

The task member wrote a program to calculate the differences of maps SMMR and SSM/I original and interpolated data for the month of July 1987.

The task member developed a program that creates histograms after specifying the number of bins and the range of values (minimum and maximum). The program produces ASCII files that can be read or plotted.

The staff member developed a program using the IDL graphics package to produce histogram plots of the above ASCII files.

The staff also generated numerous histogram plots for final data analysis.

200 SMMR DATA ANALYSES

For further analyses of new SSM/I weather filter, the task member successfully performed spatial and temporal interpolations on 19V, 19H, and 37V for Northern Hemisphere (NP) T_B data sets (July 1990–March 1991).

Data gaps and missing days of data were interpolated after the spatial interpolation.

The task member produced numerous color images of SSM/I original and interpolated daily data of (July 1987-June 1990).

300 SSM/I STUDY FOR 1978 THROUGH MID-1991 FOR NORTHERN HEMISPHERE

To determine the monthly ice extent (time-series), the following were accomplished on the full 1978 through mid-1991 data set:

- Daily brightness temperature (T_B) data were spatially interpolated.
- Daily T_B data were temporarily interpolated.
- Using the above interpolated data, daily ice concentrations (with the new SSM/I filter) were determined.
- The daily ice concentration data were then used to calculate monthly ice concentrations.
- Ice extent was finally established using the monthly ice concentrations for each major region.
- Numerous color images and time series plots were produced using the above results.

400 SMMR AND SSM/I OVERLAP-DATA STUDY FOR NORTHERN HEMISPHERE

For the months where an overlap of data existed for SMMR and SSM/I (July and August 1978), the two data sets were compared. To complete the comparison the following were accomplished:

- Daily ice concentrations were determined for the days that both data sets had data.
- Side-by-side images were produced for relative comparison purposes.
- Various histograms were produced using the common days of the overlap data sets.
- Difference maps were produced for the common days of the two data sets.
- Numerous color images for T_B, ice concentration, and difference maps for both data sets were produced.

500 SSM/I T_B DATA SET MANIPULATIONS FOR NORTHERN HEMISPHERE

The SSM/I T_B data set was used to determine six different combinations of difference plots. This effort was performed for all channels, and color images were produced for visual representation of the data.

600 BAFFIN BAY REGION (BBR) STUDY

BBR time series were established using SMMR and SSM/I data sets. The data consisted of monthly sea ice data for the years 1978–1991. For this task, the following steps were taken:

- Individual time series plots for both SSM/I and SMMR were produced.
- Combined time series plots for the two data sets were plotted.

- Monthly ice concentration for the BBR was represented as color images. This data will be used for publishing purposes in various scientific journals.
- The above was completed for both SSM/I and SMMR data sets.

700 IBM SMMR 37H DATA ANALYSES:

Extracted and reformatted SMMR 37H (November 1978–August 1987) from composed files into a single and more useful form files for further analysis.

The above SMMR 37H data were used to calculate Means, Variances, and Standard Deviations.

The above data set was used to interpolate for missing days and to eliminate the extra days of data. Temporal interpolation was used to fill-in the data gaps using a complete filled-in starting day of data.

800 IMAGE PROCESSING

A variety of sophisticated image processing techniques were effectively used for a better visual representation of data.

900 SYSTEM MANAGEMENT AND UPKEEP

A complete backup of system files and the user files were successfully performed at the end of each month. The backups are located on DAT tapes using the LOCF facilities.

Backup of all daily SSM/I 19V, 19H, 22V, and 37V for July 1987–March 1991 (after spatial interpolation) was also performed using LOCF DAT tape drives.

SIGNIFICANT ACCOMPLISHMENTS

The task member is continuing studies for the Master of Science degree in Computer Science on the task member's own time and initiative. These classes have been extremely beneficial for efficient use of time and resources, and have made technical issues flow much better.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue work on the following:

- Use SMMR SP monthly Atlas ice concentrations (November 1978–August 1987) to calculate ice extents, and produce time series plots using the above results.
- Continue to process the new received SSM/I NP data (April 1991–September 1991).
- Perform spatial interpolation of data for Southern Hemisphere (SP)SSM/I data for (July 1987–September 1991).
- Fill-in missing days by interpolating for these days using temporal interpolation. Most of the missing days are scattered, but there is a big gap from December 3, 1987–January 12, 1988.
- Fill-in the data gaps using temporal interpolation techniques.
- Calculate daily and monthly SP ice concentrations with the new SSM/I weather filter (July 1987–March 1991).
- Calculate the ice extents using the monthly averaged SP sea ice concentrations for Southern Hemisphere (July 1987–September 1991).
- Plot the time series that will indicate the area of ice covered with 15 percent and greater for the Southern Hemisphere daily sea ice concentrations with the new SSM/I weather filter (July 1987–September 1991).
- Learn and expand the knowledge of both GL and IDL graphics libraries for effective production of higher quality products. For example, enhance and generalize the image viewing software.
- A Work Control Plan will be updated and completed for the new contract to meet the requirements of the task.

DELIVERABLES SUBMITTED

Data: Numerous SMMR and SSM/I color images for testing purposes
Originator: J. Saleh

Data: Numerous SMMR and SSM/I histogram plots for testing purposes
Originator: J. Saleh

Data: Numerous SMMR and SSM/I time series plots for testing purposes
Originator: J. Saleh

COMPUTER USE

Hours	Computer
400 (clock)	IRIS workstations
226 (clock)	IBM/MVS and the IBM/VM
10 (clock)	VAX

NASA Task 72–272–03: Polar Ice Studies: Arctic Sea Ice Observation

GSFC ATR: ***Dr. J. Comiso***
Cognizant NASA Scientist: ***Dr. D. Cavalieri***

Hughes STX Task Leader: ***M. Martino***
Hughes STX Task Number: 755

This subtask provides programming support for the analysis of satellite, aircraft, and meteorological data sets for the following studies: 1) Special Sensor Microwave Imager (SSM/I) sea ice validation, 2) Scanning Multichannel Microwave Radiometer (SMMR) data analysis, 3) air–sea–ice interactions, and 4) climatic variability of ice sheets.

FINAL CONTRACT SUMMARY

This task has existed since October 1, 1988. Over the lifetime of this task, one programmer/analyst has been working 1 Full-Time Equivalent (FTE), and one data technician has worked from .25–1 FTE. One junior programmer analyst was added toward the end of the contract period.

Many major milestones have been passed and many accomplishments have been made over the lifetime of this task. This paragraph covers some of the highlights. Timely and effective support has been provided to the ATR during the preparation of papers, presentations, and the Sea Ice atlas. All data processing and image analysis for this task have been transferred from the IBM mainframe computer environment to PC's and Silicon Graphics workstations. This transfer has enabled the programmers to develop a variety of interactive image display and sea ice analysis programs that would have been impossible on the mainframe. Transfer of processing to the workstations has also made possible the use of commercial software packages not available on the mainframe and the production of presentation quality graphics. A major project to study air-sea-ice interactions in the western Arctic using meteorological data and SMMR-based sea ice data was completed. Analysis has been expanded from passive microwave sensors such as the SMMR and SSM/I to include visible band sensors such as AVHRR and active sensors such as SAR. Data and sample code have been provided to colleagues of the ATR at GSFC and other institutions. Old data from the mainframe and various 9-track tapes have been archived on DAT.

Remaining objectives to be accomplished include analysis of aircraft microwave sensor data, the continuation of the SMMR and SSM/I satellite passive microwave data, and expanded use of high-resolution sensors such as SAR and AVHRR for sea ice analysis.

SUMMARY FOR CURRENT REPORTING PERIOD

The task leader participated in an HSTX-sponsored continuous measurable improvement (cmi) workshop. Staff enhanced existing Wentz-format SSM/I gridding software to separate individual orbits. Task personnel produced numerous time series of various parameters for selected grid cells using the newly gridded single swath data. Staff worked with N. Sandoval (NSIDC) in verifying the implementation of the new 22-GHz-based SSM/I ice concentration weather effects filter. The task leader assisted the cognizant NASA scientist in developing several new polynya boxes for the Arctic Polynya Study, in response to reviewers' comments on the paper. Task personnel worked extra hours as needed to expand the data base to cover these new boxes and to produce tables summarizing the new data. Staff assisted one summer student in accessing and processing SMMR ice temperature and ice concentration data. Staff provided technical assistance in Unix and MatLab to the student. Staff continued archiving tape data sets, archiving IBM mainframe data sets, and packaging tapes for rehabilitation.

WORK PERFORMED

Staff packed up more than 400 9-track tapes in boxes and submitted paperwork for their removal by the tape rehab facility. Task personnel began copying data from 9-track tapes to DAT. Staff prepared SMMR ice temperature data for the summer student's use and assisted him in learning and using Unix and MatLab. Task personnel installed PCE EASI/Pace image analysis software on the workstation. The task leader attended an HSTX-sponsored cmi awareness course. Staff processed polynya study data using new algorithms and produced charts summarizing the data. Staff continued processing ERS-1 SAR data as they continued to be acquired.

100 SSM/I STUDIES

Task personnel began integrating MatLab graphics routines into existing SSM/I processing software. Task personnel provided ice concentration images to Sandoval to verify his implementation of the Team ice algorithm, using the new 22-19-Ghz GR weather filter. Only minor differences were detected. Task personnel obtained source code for McIDAS-X analysis software from MSFC and began work to compile it on the IRIS workstation. Staff continued work on micromap image analysis software for the IRIS.

115 SSM/I Thin Ice Algorithm

Task personnel produced time series of SSM/I brightness temperature channels for several pixels in the Bering Sea. These time series are based on single swath grids and include the time of day to show diurnal variations in the brightness temperature. Staff produced several hardcopies and overhead slides showing sea ice concentration and ice type in the Bering Sea and Greenland Sea.

400 ARTIC STUDIES

430 Artic Polynya Study

Staff assisted in developing new polynya boxes along the Siberian and Canadian coasts. Task personnel remapped the polynya boxes to the SSM/I grid for assessing the feasibility of converting the study from the ESMR grid to the SSM/I grid. This step was determined to be unnecessary. Task personnel obtained weather data for the new polynya boxes and began processing them. Staff implemented an improved dense water production algorithm and tested it on the original 26 polynya boxes. Staff provided charts summarizing the new data. Staff assisted in expanding the original 26 polynya boxes to 36. Task personnel identified three weather stations for use with the new boxes and developed grid-based weather data for the remaining seven new polynya boxes. Staff implemented a new dense water algorithm and made corrections to several equations. Staff computed the various polynya study parameters and provided the cognizant NASA scientist with tables summarizing these data.

SIGNIFICANT ACCOMPLISHMENTS

Task personnel worked extra hours as needed to provide expanded Arctic Polynya study data in time for the paper to be returned to the publisher. This work included obtaining new data to cover the expanded region and reformatting and processing these data.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work for this contract has ended. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will complete archiving of 9-track tapes and IBM mainframe data sets. Staff will continue work on various aircraft-based data. Task personnel will continue processing of SAR data. Task personnel will develop new data visualization techniques using the workstation. A new task member will join the staff.

A Work Control Plan will completed.

DELIVERABLES SUBMITTED

Images: Numerous SSM/I images showing sea ice concentration, ice type, and difference between 2 ice algorithms, concentrating on the Greenland Sea and Bering Sea
Originator: M. Martino

Charts: Numerous charts detailing and summarizing results of the Arctic Polynya Study heat flux/dense water production calculations
Originator: M. Martino

COMPUTER USE

Minutes	Computer
1,500	PC
4,800	IRIS Workstation

NASA Task 72-272-04: Polar Ice Studies: West Antarctic Glaciology and Ice Sheet Studies

GSFC ATR: *Dr. J. Comiso*
Cognizant NASA Scientist: *Dr. R. Bindschadler*

Hughes STX Task Leader: *P. Vornberger*
Hughes STX Task Number: *756*

This subtask involves the processing and interpretation of ice sheet imagery obtained by Landsat, SPOT, and NOAA-AVHRR. Staff will participate in field work and conduct data analysis of the West Antarctic glaciology program. Task personnel will also contribute to papers submitted for publication in professional journals.

FINAL CONTRACT SUMMARY

Several Hughes STX staff members were employed on this task for the past 5 years. Task personnel currently supporting the task include one full-time senior scientist.

A variety of work was effectively supported during this period. This work included the creation of a Landsat-TM image mosaic of Marie Byrd Land, Antarctica, in collaboration with the U.S. Geological Survey. A method of correlating these TM images of completely snow-covered surfaces was developed to allow automated computation of ice velocity. This software was distributed to colleagues and is receiving an increasing amount of use. A comparative study of Landsat-TM and Synthetic Aperture Radar images of the Greenland Ice Sheet was completed, and increased the understanding of what causes the variations in the SAR signature. A new approach to mass balance calculations, using GIS (Digital Geographic Information Systems)-based methods, was applied to a study area in Antarctica and was called ice plain B. An ice temperature profile modeling study of West Antarctic ice was completed. The detailed mapping of ice surface elevation of ice stream C, Antarctica, was accomplished using photoclinometry based on a Landsat-TM image, with airborne radar altimeter data as the control. A major activity was the support of field work in Antarctica (three field seasons), and included the reduction and analysis of field data both in the field and at GSFC. Numerous publications in peer-reviewed journals were supported, in both scientific content and graphical arts. Several conferences were attended, with oral and poster presentations given. During this task, work shifted from operating primarily on the DEC VAX and IBM PC computers, to Unix-based workstations and Macintosh computers. Data archiving and record-keeping were ongoing activities.

This task has now ended.

SUMMARY FOR CURRENT REPORTING PERIOD

The estimation of two parameters that are required for the photoclinometry algorithm was improved, by using a different statistical analysis of the input data. After implementing several changes to the algorithm to investigate some outstanding issues, the ice stream C photoclinometry project was completed. A major effort involved the backup of over 250 9-track tapes belonging to this task, onto both 8-mm and DAT tapes. Much of this work was done during overtime hours, and it was completed slightly ahead of schedule. All of the field gear were tested and packed to ship to Antarctica.

WORK PERFORMED

Ice Stream C Photoclinometry Study

This study proceeded with an attempt to include the cross-sun component of surface slope into the algorithm. The cognizant NASA scientist had already derived the algorithm to accomplish the effort. It was coded, however, when the program was run, it resulted in a propagation of error that became unstable and ridiculously large. Further attempts to correct this error failed. The cognizant NASA scientist, meanwhile, derived equations that determined the relative importance of the cross-sun slope component to the outcome was extremely small in comparison with the along-sun slope component, this effort was not pursued any further.

The analysis of the pattern of residuals between the photoclinometry-derived elevations and the radar altimeter data continued, with a different approach to computing these residuals. The derived elevations were forced to match the radar elevation wherever a flightline crossed an integration profile. This effort is basically the creation and pasting together of numerous small Digital Elevation Models (DEM's), discussed in the last progress report. Shading the resulting DEM produced an image that was practically an exact duplicate of the original TM image, which it should be.

Another approach to looking at the residuals was to integrate the photoclinometry algorithm over the full-length profiles, force the match to the radar data at the endpoints, distribute the mismatch linearly back along each profile, and use all intervening flightlines as control data from which the residuals are computed. By matching the two sets of elevation at the start and end points of the integration profiles, a more direct measure of the difference between them is made. The results gave a mean residual of −12.10 m with a standard deviation of 13.19 m.

In addition, the algorithm was applied over shorter distances to determine the effect of decreasing the integration profile length. The study area was separated into long strips, so that the integration length was 10 km, instead of up to 85 km as it was for the area treated as a whole. After integrating over 10 km, forcing a match with radar data at the end point, distributing the mismatch linearly back to the starting point, and comparing the result with a flightline crossing the area at the ~5-km point, the residuals were greatly improved, as expected. The results had a mean residual of −0.70 m with a standard deviation of 4.21 m, which was a large improvement over the previous results.

Finally, radar altimeter data of bed elevation corresponding to the surface elevation data were obtained, processed, gridded, shaded, and displayed with the same viewing geometry as the surface DEM. The comparison was interesting, it allowed a direct comparison between surface slopes and bed slopes. This figure was included in the NASA scientist's oral presentation of the research at the Fifth International Symposium on Antarctic Glaciology, in Cambridge, England, on September 6–10, 1993. A manuscript entitled "Detailed Elevation Map of Ice Stream C Using Satellite Imagery and Airborne Radar" was submitted to the *Annals Glaciol.*

Antarctic Fieldwork Preparations

All required testing of the field equipment was completed. This equipment included testing theodolites, electronic distance meters (EDM's), tiltmeters, and satellite geoceivers. This equipment was also packed up and shipped to Antarctica, ahead of schedule. Follow-up phone calls were made to ensure that the two crates arrived in California in plenty of time to load on the freighter ship bound for New Zealand.

Three Magellan GPS receivers were sent to the manufacturer for upgrades, and once they were returned, some testing began.

All required medical and dental exams were completed, with no difficulties.

HSTX personnel attended a 2-day, NSF-sponsored, Antarctic Orientation Conference in Arlington, VA. The purpose of attending this conference was to represent the NASA scientist's project at meetings, and to finalize decisions about logistics.

Data Tape Backup

Over 250 9-track tapes, generated by this task from almost 7 years of work, were copied onto 8-mm and DAT tapes. Much of this work was accomplished on weekends and after-hours, because of the availability of both the 9-track and the 8-mm tape drives. Some of the 9-track tapes required an extra effort to read because they were relatively old. This task was completed ahead of the deadline schedule imposed by the branch office.

Miscellaneous

HSTX personnel attended a Canon color copier training session. This session was helpful, because the machine operated as both printer and copier during the period.

Continued use and understanding of graphics art packages on the Macintosh computer were improved. Some Landsat imagery was retrieved from the tape archive, and statistics were performed on the data for a colleague. Two scientific proposals were reviewed for the National Science Foundation.

An upgrade to PCI Version 5.1 was installed on the workstation.

Backups of the workstation were made on a regular basis.

A power spectrum of selected lines and columns of a raw Landsat-TM image was computed, to determine the signal-to-noise ratio of the data. IDL was used to compute the FFT and to plot the results.

SIGNIFICANT ACCOMPLISHMENTS

Testing field equipment and arranging its shipment, was accomplished ahead of schedule.

The backup of the 9-track tape archive was completed on time because the staff worked overtime hours. A task member also created detailed records of the archive.

A task member has significantly increased familiarity with the Macintosh computer and some of the graphics utilities on it.

All figures for the cognizant NASA scientist's poster presentation at the National Academy of Sciences, and an oral presentation at the Fifth International Symposium on Antarctic Glaciology, were prepared on time.

The task member is coauthor of a paper entitled "Detailed Elevation Mapping of Ice Stream C Using Satellite Imagery and Airborne Radar," submitted to the *Annals Glaciol.*

PROBLEM AREAS

The availability of the 9-track and 8-mm tape drives was often limited, because only one of each exists in the computing facility, which at times impeded the progress of backing up the tape archive.

Access to the crates containing field equipment was frequently blocked.

Three files containing destriped, solar-zenith-corrected TM quads were lost because of a misunderstanding of the scratch disk purge schedule. These files were used for figures in a proposal that had already been submitted. Regenerating the files will proceed as time permits.

SCHEDULE CONFORMANCE

Work under this contact has been completed.

WORK PLANNED FOR NEXT PERIOD

None.

DELIVERABLES SUBMITTED

Plots: 4 variations of DN vs. cos(theta) histogram plots; 2-D black and white, 2-D color, and 3-D black and white viewed from two different angles
Originator: P. Vornberger

Plots: 2 contour plots of the DN vs. cos(theta) distribution
Originator: P. Vornberger

Plots: 164 plots of DN vs. cos(theta), including the RMA (reduced major axis) line, one for each box segment of the image
Originator: P. Vornberger

Plots: Numerous (at least 10) contour plots of residual between radar altimeter data and photoclinometry-derived surface elevation
Originator: P. Vornberger

Images: High-quality photographic prints of shaded relief of the generated DEM, illuminated from different angles
Originator: P. Vornberger

Prints: Prints of the input Landsat imagery overlain with contours of residual

Originator: P. Vornberger

Prints: Prints of the input Landsat imagery overlain with contours of surface elevation, both photoclinometry-derived and radar altimeter data
Originator: P. Vornberger

Profiles: 13 profiles of photoclinometry-derived surface elevation and radar altimeter data along the centers of strips of the image
Originator: P. Vornberger

Programs: 5 C programs, composed of different variations of the photo-clinometry algorithm
Originator: P. Vornberger

Data: Processed, gridded, contoured, and shaded-relief versions of the bed elevation data set
Originator: P. Vornberger

Equipment: 2 large crates filled with field equipment ready to be used
Originator: P. Vornberger

Tapes: 17 DAT and 17 8-mm tapes containing copies of the 9-track tape archive
Originator: P. Vornberger

Plots: 4 power spectrum plots of selected lines and columns of a Landsat-TM image
Originator: P. Vornberger

CONFERENCES

HSTX task members attended the U.S. Antarctic Program 1993 Orientation conference held in Arlington, VA, on September 8–9, 1993. The purpose of the conference was to become acquainted with Antarctic environmental and other regulations, and to make final comments about logistics schedules with other projects.

TRAINING

HSTX task members attended a 1-hour training session on the new Canon color copier/printer, purchased by the Division (Code 970) office.

COMPUTER USE

Minutes	Computer
500 CPU	SGI 4D/35 Workstation
20 CPU	SGI 340/VGX LOCF Server

NASA Task 72-272-05: Polar Ice Studies: Ice Processes and Microwave Emissivity Studies

GSFC ATR and Cognizant NASA Scientist: *Dr. J. Comiso*

Hughes STX Task Leader: *A. Allegrino*
Hughes STX Task Number: 757

This subtask provides programming support to investigate large-scale and mesoscale characteristics of the sea ice cover, including extensive analysis of Scanning Multichannel Microwave Radiometer (SMMR), Special Sensor Microwave/Imager (SSM/I), Temperature Humidity Infrared Radiometer (THIR), and Advanced Very High Resolution Radiometer (AVHRR) satellite data. In situ and aircraft data will be analyzed and correlated with satellite data.

FINAL CONTRACT SUMMARY

The current task assignment commenced on October 1, 1988. During this time, one senior programmer/analyst, and for approximately 21 months, one junior programmer/analyst and have been employed full time.

Many accomplishments were made in the last 5 years. Support given to the ATR for presentations, papers, and proposals has been timely and effective. Major changes have occurred in the processing of data sets and the development of software. During the current task assignment, data processing and program development were switched from a computer mainframe environment to a Unix workstation environment, and the C programming language and IDL were introduced allowing for quicker and more efficient computer output production. SMMR data set processing was completed and SSM/I data processing commenced during this task. The SSM/I processing will continue into the next task assignment. Data from other sensors have also been gathered to complement the SSM/I data. These include aircraft sensors (AMMR, ESMR, and SAR), other satellite sensors (SAR and AVHRR), and in situ data. Data sets have been archived on DAT tape, optical disk, and IBM cartridges in the proper format. A gradual transfer of data from the IBM to the workstation environment has occurred, which will also continue into the next task. Data requests from colleagues of the ATR at GSFC and at other institutions have been promptly addressed.

The objective of the task has been and will continue to be the study of the physical and radiative characteristics of sea ice using multisensor data. Emphasis on the next task will be on summer sea ice.

SUMMARY FOR CURRENT REPORT PERIOD

Hughes STX personnel attended a company-sponsored Continuous Measurable Improvement (cmi) course. Task personnel modified a Wentz orbital data gridding program so that it can grid all SSM/I channels for both poles and enhanced the IMAN image display program so that it could display 1024 by 1024 SAR imagery and calculate the total ice percentage for any SAR image. Task members also created an IDL program, which places two different *y*-axis variables on the same graph. Staff modified image display programs to produce black-and-white ice cluster images. Task personnel are preparing for the gradual removal or transfer of data sets from the IBM mainframe. A task member has also organized and boxed four cabinets of 9-track tapes for storage. HSTX staff has also been responsive to data requests from other investigators. Task personnel have been retrieving SSM/I orbital data from

California since mid-August. Staff has also enhanced IDL programs to generate multiple scatterplots with one submission and to plot several different areas on the same graph.

WORK PERFORMED

100 P3 PROJECT

HSTX personnel created scatterplots of low-altitude AMMR brightness temperatures for Days 139, 140, and 141 in 1987. Gradient ratio vs. polarization ratio plots were also created for the same data sets. The brightness temperature scatterplots used 18V, 37V, and 37H data.

300 CLUSTER ANALYSIS

HSTX personnel created black-and-white images of monthly ice cluster images. One image for the Arctic, used March 1988 data, while the other image for the Antarctic, used September 1987 data. Staff also created character cluster images that the ATR did not prefer. These images and the monthly averaged brightness temperature data sets for these months were used in a neural network study of ice classification. Task personnel also created a program that reduces the size of the 85 GHz channel maps.

600 WINTER WEDDELL SEA PROJECT

HSTX personnel created 16 SSM/I images of the Weddell Sea region using data obtained from Irene Rubinstein (Univ. of Toronto). Brightness temperature images were created using 37V and 19V channels for days 118, 129, 137, 143, 146, 156, 162, and 165 in 1993. Scatterplots of 19V vs. 37V and 19V vs. 85V, for day 199 were also created.

700 AVHRR PROJECT

HSTX staff continued working on scatterplots, images, and line plots involving a paper currently under review. Days 95 and 133 were analyzed. Day 95 was analyzed in two parts. (one for the Bering Strait and the other for the area surrounding St. Matthew's Island). In all cases, channel 2 was normalized to resemble channel 4 and similar analysis was performed.

800 ADDITIONAL STUDIES

HSTX task members modified the general-purpose IMAN program so that it could handle the 1024-by-1024 Alaska SAR imagery to conform to IMAN's 512-by-512 dimension limitations, every other pixel of the SAR images was used as input. The IMAN program was modified further to determine the ice concentration in a SAR image. Task personnel also processed six 9-track tapes of Alaskan SAR imagery for future analysis. Staff has started to back up the Alaskan SAR images onto tape according to the 9-track tape ID.

HSTX staff also experimented with different water filter slopes and intercepts to obtain an acceptable compromise between valid first-year ice near the ice edge and the amount of invalid ice in the mid-ocean region. When done for the North Polar winter season, the compromise slope equaled 0.8 and the intercept equaled 21.5, while the new water filter had no visible effects on the North Pole warm season ice concentration maps.

HSTX personnel boxed four cabinets worth of 9-track tapes to be either shipped to a storage facility or to be rehabilitated. A detailed account was made of all the tapes within each box shipped to storage. HSTX task members copied tapes belonging to the ATR and previous task members onto cartridges to enable the IBM tape librarian to remove tape slots, and assisted company manager in copying his tapes to cartridges.

HSTX personnel modified a program that places Wentz orbital data on the SSM/I grid so that it also grids all of the channels (including the 85 GHz channels for both poles). Comparisons with gridded data from NSIDC's CD-ROM were favorable at the lower channels, but with the 85 GHz channel, the Wentz map was "dirtier" than the map from the CD-ROM. Task members need to find the cause for this result.

HSTX staff have also modified a program, which computes an interpolated brightness temperature given a pair latitude/longitude values. The program can accept a file of latitude/longitude values instead of requiring the user to input individual latitude and longitude. The output values, julian date, latitude, longitude, and the interpolated brightness temperature, are placed into a file. South pole SSM/I, September and October 1989 data, South pole SMMR, August and September 1986 data, and South pole SSM/I, August and September 1992 data were processed. The results were then given to Dr. K. Arrigo (DOE, Code 971) for analysis. The quality of the Wentz 85 GHz channels was of little concern. HSTX staff also created interpolated 85 GHz brightness temperatures and ice concentrations for October 1, 1989–March 31, 1990, for Dr. Arrigo. Values were obtained over a half-degree grid that spanned from 55–78 degrees south latitude and 15–65 degrees west longitude, i.e., the Weddell Sea area.

HSTX personnel also created a series of hardcopy Alaskan SAR images for June 11, 15, and 21, 1992. For the ATR's trip to the SAR conference in Seattle, WA, staff produced the following: ice concentration transparencies for June 11 and 29, 1992; SSM/I brightness temperature transparencies for June 11, 20, and 29, 1992; scatterplots (19V vs. 37V, 37H vs. 37V, and gradient ratio vs. polarization ratio) for June 11, 15, 17, 20, 24, and 26, 1992, and July 1, 10, 16, 20, 25 and 30, 1992; lineplots of SAR ice concentrations and SSM/I ice concentrations for June 15, 20, 21, and 24, 1992; and lineplots of average SAR backscatter and SSM/I brightness temperatures, 19V and 37V, for June 15, 20, 21, and 24, 1992. A new IDL program was developed for plotting the average SAR backscatter and the SSM/I brightness temperature because two different y axes are used on the same plot.

HSTX personnel improved an image that contained two SMMR images by averaging out all missing data areas, thickening the track of the ship by two pixels on each of the two SMMR images, and removing isolated pockets of ice concentration values > 8 percent in the ocean areas.

HSTX staff also gave Dr. M. Rienecker (Code 971) the set of 1988 ice concentration maps for both North and South poles. A set of monthly averaged ice concentration maps for July 1987–June 1990, were also given to Dr. Rienecker.

HSTX personnel also prepared the ATR for his trip to Japan. Transparencies of select Alasakan SAR imagery for days August 8 and 20, 1992, were made. Transparencies of the ice concentration maps with the locations of all the SAR imagery for that day, were also created for the same days. Task personnel created plots of SAR-derived ice concentration values and SSM/I ice concentrations. Prior to the addition of the IMAN's ice concentration determination capabilities, the SAR ice concentration values were derived by visually determining the SAR threshold value for open water using the IMAN program, and supplying that threshold to a program that calculates the percentages of open water and ice. Plots were created for days 173, 221, 227, 229, 230, 231, 233, and 237 in 1992.

HSTX personnel began retrieving more SSM/I orbital data from Monterrey, CA, on a daily basis beginning August 16, 1993. These data coincide with a ship, which is making measurements of sea ice in the Amunsden–Bellinghausen Seas near Antarctica.

HSTX task members are also documenting files on the IBM to determine whether they can be deleted.

HSTX staff created gridded brightness temperature and ice concentration maps for February–May, 1992. Scatterplots and gradient/polarization ratio plots were created for specific days.

Task personnel created IDL scatterplot programs to plot specific areas on the SSM/I grid.

SIGNIFICANT ACCOMPLISHMENTS

HSTX staff modified a gridding program so that it grids all seven channels of Wentz orbital data for both poles and created an IDL program that places two different *y*-axis variables on the same graph. Task members also modified the IMAN program to calculate ice concentrations automatically from the SAR image once a threshold has been determined.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX personnel plan to develop 3-D plotting capabilities using IDL and the GL library routines.

Task personnel continued to retrieve data from Monterrey, CA for the month of September 1993.

A work control plan will be updated for the new contract to meet the requirements for this task.

DELIVERABLES SUBMITTED

Deliverable: 18 scatterplots of the Weddell Sea area
Originator: A. Allegrino

Deliverable: Hundreds of Alaskan SAR images
Originator: A. Allegrino

Deliverable: IMAN program (source code and object)
Originator: A. Allegrino

Deliverable: AMMR brightness temperature and GR vs. PR scatterplots
Originator: A. Allegrino

Deliverable: March 1988 (NP) and September 1987 (SP) black-and-white cluster images
Originator: A. Allegrino

Deliverable: 16 brightness temperature images of Weddell Sea area
Originator: A. Allegrino

Deliverable: 50 ASF SAR images for June 11, 15, and 21, 1992
Originator: A. Allegrino

Deliverable: 48 scatterplots for various days in June and July, 1992
Originator: A. Allegrino

Deliverable: 6 lineplots of SAR and SSM/I ice concentration values
Originator : A. Allegrino

Deliverable: 8 transparencies (SSM/I ice concentration and brightness temperatures)
Originator: A. Allegrino

Deliverable: 10 interpolated brightness temperature data sets for Dr. K. Arrigo
Originator: A. Allegrino

Deliverable: Eight lineplots of SAR and SSM/I ice concentration values
Originator: A. Allegrino

Deliverable: Eight transparencies of SAR imagery and two transparencies of SSM/I ice concentration images
Originator: A. Allegrino

Deliverable: Interpolated brightness temperatures data set to Dr. Arrigo
Originator: A. Allegrino

Deliverable: 1988 SSM/I North and South Pole daily ice concentration maps and SSM/I monthly averaged ice concentration maps for the period July 1987–June 1990 delivered to Dr. M. Rienecker

Originator: A. Allegrino

Deliverable: Scatterplots and gradient/polarization ratio plot of the Weddell Sea area for various days in the time period March–May 1992
Originator: A. Allegrino

Deliverable: Daily brightness temperature and ice concentration maps for the time period February–May 1992
Originator: A. Allegrino

TRAINING

HSTX staff attended the HSTX-sponsored cmi course.

COMPUTER USE

Minutes	Computer
30	IBM 9021
38,400	IRIS workstation

NASA Task 72–273–00: Processing and Analysis of Microwave Remote Sensing Data

GSFC ATR: ***Dr. J. Wang***

Hughes STX Task Leader: ***G.D. Vassiliou***
Hughes STX Task Number: ***763***

This task supports the analysis of microwave radiometer data obtained with the Airborne Multifrequency Microwave Radiometer (AMMR) and the Advanced Microwave Moisture Sounder (AMMS). The data are processed and combined as needed with ground and airborne data for water vapor and precipitation studies. A library of algorithms developed is used and modified or redeveloped as necessary for calibration and further research.

FINAL CONTRACT SUMMARY

The task covers the period October 1988 through September 1993. This task supports the analysis of microwave radiometer data obtained with the AMMR and the AMMS. A large library of algorithms was used to analyze the data from the TOGA-93 experiment in which the Microwave Sensors Branch (the ATR) participated. Initial milestones included setting up a PC to read and correct raw data and to be used as terminal connected to the IBM/MVS mainframe. Previously, this machine had not been connected to a dataline because of hardware problems. Furthermore, the analysis of all data to be delivered was done in a timely manner and consistently ahead of schedule. Any problems with the data, such as a change in the record structure, were addressed with development of the appropriate software. Also, the code was successfully edited and redeveloped as necessary.

Other milestones include the successful setup of X terminals and an IRIS SG workstation. The AMMR calibration program was successfully transferred to the workstation, and some work was performed to dot the same for the AMMS calibration work. Currently, the objective is for all the program listings and raw data from the IBM mainframe to be transferred to the workstation for storage. This task was terminated September 30, 1993.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff successfully concluded processing of the AMMS data for the TOGA-93 data set. After installation procedures for the sensor were concluded, staff successfully implemented the AMMR calibration software on the IRIS SG workstation. Staff also stored the TOGA 93 raw and processed data on the workstation, and, currently, storage of selected mainframe directories has started on the sensor workstation.

WORK PERFORMED

AMMS Data Analysis

The first-stage processing of the AMMS data from the TOGA-93 experiment was finished with the production of brightness temperature files vs. time in an ASCII format. The raw data were first corrected with a scheme proposed by W. Boncyk (Code 975) and approved by the ATR after subsequent meetings. The data were delivered both in floppy disks and stored on the new sensor workstation.

New Hardware Setup

A new Silicon Graphics personal IRIS Indigo XS24/4000 featuring storage on the order of 3 gigabytes and DAT and EXABYTE tape storage capability, as well as a CD-ROM drive, was purchased by the ATR. Staff oversaw the installation process and setup including that of the FORTRAN 77 compiler. Also, three X Windows NCD19c color terminals were installed on the GSFC network. These terminals boot from the IRIS computer and were used for development and other work on the sensor.

AMMR Calibration Software Development

The AMMR calibration software that resided on the GSFC IBM 9021/ESA mainframe was ported by FTP to the sensor workstation and redeveloped for use locally. After several successful tests, the software is now operational and calibration processes for AMMR data can be performed fully on the sensor.

Other Work

Staff performed a series of runs for several frequencies of a radiative transfer model that gives brightness temperatures for given atmospheric profiles to calculate temperature weighing functions. Further action on this is pending.

SIGNIFICANT ACCOMPLISHMENTS

Staff implemented the AMMR software on the sensor workstation after taking the initiative for reducing computer costs. The task's successful supervision of installation of the sensor workstation, peripherals, and networking resulted in zero downtime and accommodation of several users within the branch.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

This task was terminated at the end of September.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

This task was terminated at the end of September.

DELIVERABLES SUBMITTED

Data: The brightness temperatures product (complete TOGA-93 set) for the AMMS instrument; the fully operational version of the AMMR calibration program on the sensor workstation

Originator: G. Vassiliou

COMPUTER USE

Minutes	Computer
250	IBM Mainframe

NASA Task 72-275-00: Aircraft-Satellite Instrument Calibration Project

GSFC ATR: *Dr. P. Abel*

Hughes STX Task Leader: *R. Galimore*
Hughes STX Task Number: *765*

The objectives of this task are to establish a computer-aided data acquisition and analysis system for an aircraft-compatible double monochromator, to establish and document proper operational procedures for a system of calibration and Earth-scene data acquisition, and to accompany the data acquisition system when it is moved to designated testing and operational sites.

FINAL CONTRACT SUMMARY

The NASIC project was begun in February 1989. The start of the task under contract NAS5-30440 coincides with the transfer of the project from NOAA to NASA at GSFC. Since that time, there were a variety of personnel support configurations, but always at least 1 full-time equivalent working in the capacity of engineer and senior programmer/analyst with additional part-time equivalent and/or one temporary person available for support.

Numerous major goals and milestones were achieved during the span of the contract. The original instrumentation was obtained from NOAA in the spring of 1988 and was assembled, studied, tested, and made ready for its first and successful NASA ER-2 flight mission out of NASA Ames in October 1988. The system was prepared and flown on additional missions in April and July 1989, February and March 1990, and July and October 1990. All missions were successful in meeting their objectives, and data collected for those missions have been published. Subsequently, the system was taken out of action while new electronics were installed and the optics were refurbished and modified. The system was test flown on a NASA T-39 aircraft out of Wallops Island, VA, in December 1992 and again flown aboard NASA's ER-2 aircraft out of NASA Ames during a successful mission in May 1993. The data from that mission have been studied and found to be of good quality. During the course of the project, a considerable amount of software was developed and a large number of data products were delivered. Many hours of work done on the task were in support of mission planning and coordination and instrument maintenance, preparation, and programming.

Work on completing modifications to the electronic and optics remains, and a number of flight configuration issues remain. The system will need further characterization of its new configuration. Software modifications and additions will have to be made. Data collected from May 1993 will have to be further processed and the results published.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff members focused on assisting in the completion of deriving new calibrations for the NOAA-11 AVHRR and GOES-7 VISSR instruments and evaluating the performance of the NASIC system. GOES-7 VISSR data were secured and put in a format that was acceptable for gain processing.

May 1993 preflight calibration data and flight zero scan data were rigorously scrutinized for flaws in data integrity. These data studies were made in support of preparations for the determination of gains from the spring mission out of Ames. On return of the NASIC system to GSFC, work was done in support of troubleshooting and resolving a number of problems related to its electronics. Time was spent in developing programming skills in C++ and object-oriented programming in preparation for the upcoming software conversion.

Some time was spent reorganizing laboratory files and documents, assessing laboratory needs, and requisitioning laboratory equipment and supplies.

WORK PERFORMED

100 APPRAISAL AND ASSESSMENTS OF MONOCHROMATOR AND SUPPORT SYSTEMS

110 Software Evaluation

Attempts were made to read GOES-7 VISSR data, which had been sent in a format that the task's software was not set up for. A number of modifications were made to the READGARS program in an unsuccessful effort to decipher these data, but it was unclear as to whether an error had been made in the production of the tape sent from the supplier. After consultation with the supplier, the tape was returned to be reprocessed with a letter explaining the specific data requirements attached. The tape was reprocessed and returned by the Space Science and Engineering Center of the Univ. of Wisconsin; subsequently the image data were extracted and submitted to the ATR.

120 Hardware Evaluation

The NASIC system was set up in the laboratory and rewired for power. The connection called for a change from the aircraft configuration to a temporary laboratory configuration. Some time was spent searching for the cause of a large current draw that was observed when the system was first switched on. A Wallops technician was called to assist in locating and repairing what turned out to be a detached grounding wire in a cable bundle feeding the cam stepper motor.

After repairs were made, a set of data collection runs were made with the NASIC system in an effort to determine whether there was a significant difference in the zero or baseline values for scans taken when the order-sorting filter was in as opposed to when the filter was out. Plots made representing these data with respect to time revealed a serious instability in the signal coming from the detector. This instability, which was not seen during the critical spring flight mission out of Ames, was determined by staff and a Wallops technician to be related to poor performance of the thermoelectric heating/cooling unit, which is used in the regulation of the detector's temperature. A suitable replacement is being sought.

500 GENERAL TASK SUPPORT

A study of blocked beam (zero) scans from the May 8, 1993, NASIC flight was made to determine whether any artifacts or trends exist in the signal baseline. Plots were produced, and notes on findings were made and delivered to the ATR. A similar study was conducted for the blocked beam scans from related calibration data. A disk containing a set of files of each data type associated with the May 8 NASIC flight along with a READ.ME file describing each type was prepared and delivered to the ATR.

Following the evaluation of baseline data for flight and calibration runs, a thorough examination of Ames sphere calibration data sets was made. A plot of each scan's spectral profile along with its power spectrum was produced. Data collected from NASIC's viewing of light from a mercury lamp source were used to produced a wavelength registration for NASIC during the preflight calibration period. Additionally, plots were produced representing data from each of the flight scans. Some utility routines were developed to support production of the large number of plots in batch mode. All plots with statistical information, tables, and READ.ME files were submitted to the ATR.

Some time was spent in developing programming skills in C++. Software used for satellite image scene location will be converted from MS BASIC to C++.

Materials were collected and several people were interviewed via telephone in an effort to collect information related to characteristics of the Ames 30-in. integrating sphere.

Staff reorganized books, files, and documents in the laboratory. Some old and irrelevant materials were disposed of, and new catalogs were ordered from a number of current and potential parts and equipment suppliers.

PROBLEM AREAS

Characterization of the NASIC system is being held up while a suitable replacement for the current thermoelectric unit is identified and obtained.

SCHEDULE CONFORMANCE

Task work has ended on this task. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A reassessment of NASIC field of view will be made. The NASIC system will be recalibrated. Work should be completed for AVHRR and VISSR gains determination. Work will begin on reconfiguring NASIC for flight. Modification and conversion of data processing and flight software will begin.

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
31,000	Compaq Deskpro 386/25

395

NASA Task 72-276-00: Soil Moisture Studies

GSFC ATR: ***Dr. J. Wang***

Hughes STX Task Leader: ***Rajan Pardipuram***
Hughes STX Task Number: ***766***

This task provides technical support in the areas of active and passive microwave remote sensing. The support services include: 1) the analysis of data obtained from JPL AIRSAR (C, L, and P bands) and AVHRR over Chickasha, OK (MACHYDRO '92), for signatures of vegetation and soil moisture; and 2) modeling of microwave backscatter.

FINAL CONTRACT SUMMARY

This task began under contract NAS5-30440 on September 11, 1989. One scientist worked full time through November 8, 1992. From February 4, 1991 to August 1, 1991, another scientist also worked full time. From November 9, 1992, until the end of the task, one programmer/analyst worked full time and one scientist worked an average of 5 hours per week.

There have been many major milestones and accomplishments over the life of the task. Hughes STX staff members were coauthors of eight presented papers and posters and three journal papers (one in press and two in review). In addition, staff also coauthored a chapter in the WASHITA '92 field experiment data report. Efficient, thorough, and fully documented procedures were set up to process, calibrate, and display Aircraft SAT (AIRSAR) and SSM/I data. Spreadsheets were used effectively for data analysis of AIRSAR data over three different test sites to study the sensitivity of backscatter coefficients to roughness, topography (local incidence angle), and soil moisture. Frequency-dependent relationships were found. Task members took steps to acquire and incorporate digital elevation models to correct for the effects of topography. Four years of SSM/I data over the U.S. Midwest were processed demonstrating important geographical aspects of the correlation between SSM/I data and a soil moisture index. An improved approach, combining SSM/I and AVHRR data, was developed to derive information on moisture and vegetation status on the ground surface. HSTX staff participated in and made significant contributions to the data collection of two field experiments, MACHYDRO '90 in Pennsylvania and WASHITA '92 in Oklahoma. Staff had the primary responsibility for coordinating the land cover mapping. Existing data processing and display software were rewritten, where necessary, to run more efficiently and to improve program structure. New programs for data processing and display also were written and documented. Data and programs were transferred to a newly acquired workstation for more efficient processing. Effective and responsive support was provided to the ATR and other task personnel for presentation graphics and field data. Excellent communication was established and maintained with all experiment personnel. HSTX staff took the initiative to establish an excellent cooperative relationship with United States Department of Agriculture/Agricultural Research Service (USDA/ARS), which has been productive. This relationship should be beneficial to the ATR.

Remaining objectives to be accomplished include the continuing processing and analysis of AIRSAR data from MACHYDRO '90 and WASHITA '92 and the publication of results. A paper will be presented in October 1993 at the Fourth Annual JPL Airborne Geoscience Workshop.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff analyzed the AIRSAR images to study their sensitivity to variations in topography and soil moisture. Staff submitted a manuscript, based on the AIRSAR image analysis results, to the Fourth Annual JPL Airborne Geoscience Workshop committee. Staff performed a simulation study of the radar backscatter from vegetation-covered surfaces. Staff completed revisions of SSM/I-API and SSM/I-AVHRR papers, and submitted them for publication.

WORK PERFORMED

SAR Data

HSTX Staff received the new AIRSAR images consisting of three frequencies (C, L, and P-bands) and two dates (June 10 and 18, 1992) acquired over the southwest part of the little Washita watershed from JPL. These images were analyzed to study the effects of variations in topography and soil moisture. A finite strip of 200 pixels in the cross-track and 1,024 pixels in the along-track directions were chosen from each image. The strips were chosen such that they cover approximately the same area on the ground. Average backscattering coefficients of 200 pixels cross-track and 1,024 pixels in the along-track directions were computed for all images and the results were plotted. From the analysis of these results, it appears that backscattering coefficient, sigma-0 values are sensitive to surface parameters more than soil moisture. The ATR suspected variations in topography to be the cause of this low sensitivity. HSTX staff corrected these images for relief effects following the procedure used by K. Rao et al. From the results obtained, it appears that the correction procedure did not improve the sensitivity of sigma-0 to soil moisture variations. This could be because of defects in the Digital Elevation Model (DEM), which has not been tested for accuracy, or because of inefficiency of the correction algorithm. Currently, staff is looking into other correction algorithms. Based on the results obtained from the analysis, staff wrote a four-page manuscript and submitted it to the Fourth Annual JPL Airborne Geoscience Workshop committee. Staff will be presenting these results at the workshop to be held in Washington, DC, October 25–29, 1993.

Staff computed the sigma-0 values for the rangelands from the Little Washita watershed for L-band. These results were used by the ATR for his presentation at the International Geographic and Remote Sensing Symposium (IGARSS '93) held in Tokyo, Japan, August 18–21, 1993.

Staff obtained the field notes and maps containing soil moisture information for the oat fields (Mahantango, PA) from E. Engman (Code 974), J. Draves (HSTX), and T. Jackson (USDA/ARS). Staff computed the sigma-0 values (L-band, HH polarization) for the oat fields for the dates July 10, 13, 15, and 17, 1990. Staff submitted the soil moisture and the corresponding sigma-0 values for the oat fields to the ATR.

Staff communicated with Rao about the SAR-topographic effects paper. It was decided to revise and resubmit the paper to a journal other than *Trans. Geosci. Rem. Sens.* Staff began revising the paper based on comments received from the first review.

Simulation Study

Staff studied the model developed by M. Karam (NRC), which simulates the radar backscatter from vegetation-covered surfaces. Staff performed the simulation study by using the ground truth data collected during MACHYDRO '90. Staff compared the simulation results with the real-time AIRSAR measurements. From the comparison, it appears that simulation results and the real-time measurements have good agreement for like polarization (HH and VV) at C. L. and P-bands. However, in the case of cross polarization, there seems to be a difference of about 4–8 dB. This study was further extended by running the simulations with varying input parameters to the model such as soil moisture, leaf and stalk moisture content, leaf and stalk orientation angles, and surface roughness. This study was conducted to examine the sensitivity of the radar backscatter to the surface parameters mentioned above. From the results obtained, it appears that soil moisture and surface roughness have a significant influence on the radar backscatter. There was some concern regarding the scattering contribution from the surface. At C-band, contribution of the backscatter from the surface seems to be more than that of the leaves and stalk. Normally, at C-band, higher return is expected from leaves and stalk. Staff discussed this problem with Karam, and it appears that some changes should be made in the portion of the model that computes the scattering component from the surface. The results obtained thus far will be recomputed once this change has been incorporated into the model.

SSM/I Data

Staff completed revising the SSM/I-AVHRR paper and returned it to *Photo. Eng. & Rem. Sen.* for publication. The proofs of the SSM/I-API paper were received, reviewed, and returned to the *Int. J. Rem. Sens.* for publication.

System Administration

A new Silicon Graphics indigo workstation (sensor) was acquired by the ATR. Staff performed basic system administration duties such as adding users, software installation, and backup. Staff installed a 2-D plotting package (ACE/gr), an easy to use X Windows-based GNU-EMACS text editor, and TEX/LATEX, a document preparation software. These software packages were obtained from the public domain. Staff performed weekly backups of the workstation.

SIGNIFICANT ACCOMPLISHMENTS

HSTX staff submitted a manuscript based on the results obtained from the AIRSAR data analysis to the Fourth Annual JPL Airborne Geoscience Workshop committee.

Revisions of the SSM/I-AVHRR paper were completed.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue to process the AIRSAR images. Staff will continue to work with ARS on soil moisture and evapotranspiration. Staff will complete the revisions of the SAR-topographic effects paper.

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

DELIVERABLES SUBMITTED

Data: 20 plots indicating the sensitivity of radar backscattering coefficients to topography and soil moisture variations
Originator: R. Pardipuram

Data: 25 plots based on the results obtained from the simulation study, which indicate the influence of various surface parameters on the radar backscatter
Originator: R. Pardipuram

Backup Tape: Submitted the weekly backups of the Silicon Graphics workstation
Originator: R. Pardipuram

TRAINING

Task members attended the Continuous Measure of Improvement (cmi) awareness training (August 20 and 27, 1993) and an Introduction to Lotus class (June 5, 1993) at the HSTX Lanham office.

Task members attended a video course (June 23 and 24, 1993) on Principles of Remote Sensing, offered by the Learning Center at GSFC facility.

COMPUTER USE

Minutes	Computer
105 (cpu time)	Silicon Graphics (sensor)
40 (cpu time)	Silicon Graphics (meneg)
20 (cpu time)	Cray (charney)

NASA Task 72-277-01: NSCAT and TOPEX Support

GSFC ATR: ***Dr. A. Busalacchi***

Hughes STX Task Leader: ***L. Lo***
Hughes STX Task Number: ***767***

This task provides support to numerical modeling, NSCAT, and TOPEX activities. Support will include development and modification of physical parameterizations, inclusion of realistic coastline geometry, and optimization for a vector computer. Further duties include overseeing and coordinating reduced-gravity model experiments in the tropical Atlantic and Pacific Oceans.

FINAL CONTRACT SUMMARY

One senior scientist worked on this task from June 1990 to September 1993. During that time, the task member performed the following:

- Conducted benchmark ocean circulation experiments on IRIS1, DINGO, CYBER 205, and Cray Y-MP.
- Completely documented the model code.
- Compiled a user's guide to the model and typeset it using LaTeX.
- Acquired, processed, and analyzed oceanographic and meteorological data as they became available for modeling studies.
- Worked on sensitivity studies of different heat flux formulations with particular attention to the effects of improved incoming shortwave radiation on sea surface temperature (SST) simulation in the tropical Atlantic.
- Intermediate results from the surface heat flux sensitivity studies were presented in the 1992 AGU Ocean Sciences Meeting.
- Continued to work on a scheme to optimize the parameters in the heat flux formulation for more realistic SST simulation.

In the future, staff will embed the best-fit procedure into the 1-D mixed-layer model. The tuning procedure is then applied to points off the equator. Tuned variables will be used on various points for validation and comparison.

The best-fit procedure will be incorporated into the 3-D model and applied to tuning experiments for the tropical oceans. Again, the tuned variables will be used for SST sensitivity studies of the tropical oceans.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff continued the sensitivity study of the effects of surface heat flux parameterization to SST simulation in the tropical oceans.

WORK PERFORMED

100 RESEARCH

To better simulate SST in the tropical oceans, improvements on the surface heat flux formulation are needed. Because of the uncertainties in the heat flux parameters, the best-fit analysis was used to fine-tune the model parameters as detailed in Blumenthal and Cane, 1989 (BC hereafter). The tuning procedure, however, is highly model- and data-dependent. Results from BC are not appropriate for a reduced-gravity primitive equation model such as that of Gent and Cane, 1989 (GC hereafter), which was adopted by the present task for SST simulation.

Task personnel have been working on a scheme to apply the best-fit procedure first on the 1-D vertical mixing model developed by Dr. D. Chen (University of Rhode Island). It is planned, later on, that the procedure will be incorporated into the 3-D GC model.

Various exploratory experiments were conducted using the 1-D model as preliminary work for the best-fit procedure. The Seager, et al., 1988 surface heat flux parameterization was included in the 1-D model.

200 ADMINISTRATION AND COORDINATION

Staff assisted the ATR and colleagues of the ATR in preparing proposals.

SIGNIFICANT ACCOMPLISHMENTS

Significant progress has been made in the study to assess the influence of improved net surface heat flux on SST simulations in the tropical oceans. Task personnel were responsive to the ATR's needs in model development. SST sensitivity research is progressing smoothly.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Development of an ocean model and analysis of model results will continue.

COMPUTER USE

Minutes	Computer
38,160 (Wall clock)	CDC 4340 (Dingo)
38,160 (Wall clock)	MAYA
38,160 (Wall clock)	IRIS 1
38,160 (Wall clock)	Neptune
21.399 (CU's)	Cray Y-MP (Charney)
0.131 (CU's)	3081/MVS

NASA Task 72-277-02: Tropical Ocean Modeling Support

GSFC ATR: ***Dr. A. Busalacchi***

Hughes STX Task Leader: ***J. Beauchamp***
Hughes STX Task Number: ***768***

The objective of this task is to provide computer programming assistance for tropical ocean circulation modeling activities. This support will include running model experiments concerned with seasonal and interannual ocean variability, developing graphics programs for contour and time-series plots, cataloging and archiving model input and output data sets, and analyzing data and model results using time-series and statistical techniques.

FINAL CONTRACT SUMMARY

This task lasted for 5 years (1988–1993). One person, whose job title was scientist, participated in this task. Major accomplishments completed during this task include the following:

- Use of linear model to complete a simulation of the tropical Atlantic, forced by 1964–84 Servian winds.
- Analysis of Servian winds and Atlantic model results, including preparation of a videotape of animated model sea level and mode 1, 2, and 3 heights.
- Analysis of wind data (1979–83) used in linear Pacific model runs. These wind data include FSU, Sawins, and FNOC.
- Modifying the Gent and Cane model to be run as a one-layer model, and compared results of this model to those of the Cane and Patton model, forced by both real and synthetic winds. In these comparisons several model grid resolutions were used.
- Analysis of solar and latent heat flux data.
- Using the Liu et al., (1979) model to calculate latent and sensible heat flux and then incorporating this method into the Gent and Cane model.

To meet the remaining objectives, staff must test the effect on predicted sst of using the Liu et al., (1979) model in the Gent and Cane model.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff acquired Levitus temperature and salinity data, and prepared data sets of tropical salinity and of global temperature and salinity for Dr. D. Chen (University of Rhode Island). Staff continued developing a program to determine surface heat fluxes, based on the Liu et al., (1979) model. A climatology of COADS relative humidity was included to calculate the mixing ratio, and the methods for calculating the sensible and longwave fluxes were revised. Staff explored methods of estimating atmospheric temperature and mixing ratio, based on sea surface temperature (sst). Staff also investigated the sensitivity of surface fluxes to estimates of these two variables. Staff sent solar flux and cloud data, for July 1983–December 1987, to Dr. M. McPhaden (NOAA/PMEL). Using COADS sst, staff completed an analysis of the Indo-Pacific warmpool. The warmpool was defined as that area having sst greater than some critical value, e.g., 28°C. Staff revised the Gent and Cane Ocean model to include the Liu et al., (1979) method for calculating latent and sensible heat. The extensive changes included the addition of two more variables: Air temperature and relative humidity. Finally, staff completed an EOF analysis of TOPEX and TOGA altimetry data for the period September 1992–March 1993.

WORK PERFORMED

Staff acquired Levitus temperature and salinity data. These data were on a one-degree grid, global in extent, and defined at 24 levels (0–1,500 meters depth). Seasonal, salinity data, for all 24 levels, were extracted for the tropical Pacific and written to a file, which was made available for Dr. Chen. Sometime later, staff also prepared two files of Levitus temperature and salinity data for Dr. Chen. This time, data from the entire globe were included.

Staff continued to make improvements to the latent heat flux calculation, which uses the Liu et al., (1979) model. Staff acquired COADS monthly climatologies of air temperature and relative humidity. The program was modified to implement these two variables. Previously, the mixing ratio (at 19.5 m.) had been the product of the pseudorelative humidity and the surface saturated mixing ratio. It had been essentially a function of sst. With this change, the mixing ratio was based on the COADS air temperature and relative humidity.

Staff revised the method for calculating the sensible and longwave fluxes. In the previous method (Seager et al., 1988), these two terms were combined into one value, based solely on sst. Now, the two terms are determined separately. The revised sensible heat flux, like the latent heat flux, uses the Liu et al., (1979) model. Its values are directly proportional to the differences between sst and air temperature. The longwave flux formulation was taken from Clark et al., (1974). It is dependent upon sst, the difference between sst and air temperature, atmospheric vapor pressure, and cloud amounts. A more unstable atmosphere, with reduced vapor pressure and clouds, is conducive to relatively high values of outgoing longwave flux. Staff wrote a standalone program to determine this longwave flux and also included this calculation in the same program that determines latent and sensible heat flux. The combined sensible and longwave flux values, from these new formulations, were much different than the estimates from Seager et al., (1988).

Staff intended to implement these revised methods of calculating the surface heat fluxes within the Gent and Cane model so that sst forecasts could be improved. Staff used COADS air temperature and relative humidity data to calculate these surface fluxes. The ATR wanted to avoid having to read two additional data sets into the model, so staff tried to find the best method for parameterizing air temperature and moisture. The annual mean and standard deviation of the sea-air temperature differences were examined. Staff also compared two moisture fields: one calculated with COADS data and the other determined by sst and a constant pseudorelative humidity. Staff also completed numerous sensitivity tests, to see how much the latent, sensible, and longwave fluxes changed while varying air temperature and moisture. Small changes in air temperature alone, have a small impact on both latent and longwave fluxes. However, small changes in air moisture can have a large impact on latent heat flux. For example, varying the mixing ratio by 1 g/kg changes the latent heat flux by 20 percent (20–30 Wm^{-2}). This would significantly affect the net heat flux. The sensible heat flux is rather sensitive to changes in air temperature, but sensible heat flux values are typically small, so significant changes in sensible heat will have only a small impact on the net flux.

A colleague of the ATR's, Dr. McPhaden, requested monthly solar flux data for the period July 1983–December 1987, for an equatorial location at 140°W. Staff prepared two data sets of solar data. The first data set was comprised of ISCCP solar flux data, determined by the 'fast' radiative transfer method (Bishop and Rossow, 1991). The second data set was determined using a 'bulk' method, which uses ISCCP cloud fractions. This 'bulk' method is the same as that used in the model, and is described in Seager et al., (1988). Staff also sent Dr. McPhaden this same ISCCP cloud data. Solar flux data from the radiative transfer method were significantly greater than the 'bulk' solar data. One reason for this, was that in the 'bulk' method, surface reflectance was subtracted. However, this surface reflectance was too small to account for all of the difference.

Staff completed an analysis of the Indo-Pacific warmpool using COADS sst. Staff acquired COADS, monthly, sst data for the period 1950–1989. Data were extracted for the tropical regions of the entire Indian and Pacific oceans. Staff also extracted sst values from a COADS monthly climatology for this same region. An annual mean and seasonal cycle standard deviation were calculated from this climatology. Next, sst anomalies were determined by removing the seasonal cycle. Time-series plots of these anomalies, taken along the equator every 20 degrees longitude, were completed. In addition, the standard deviation of the interannual anomalies was calculated and plotted, along with the annual mean and seasonal cycle standard deviation. Next, the area of the Indo-Pacific warmpool was determined for each month. To do this, we defined a critical sst value of either 28, 28.5, or 29°C, and then count the number of grid boxes whose sst exceed the critical value. This was done for both interannual and seasonal cycle data. This number of grid boxes was then converted to units of area. To better see the interannual signal, the seasonal cycle area was subtracted from the interannual. Next, the warmpool was divided into the Indian and Pacific oceans and time-series plots of area were prepared for the entire warmpool and also for the Indian and Pacific sections. For the formal time-series plots, only the 28°C warmpool was used. Nondimensional, heating anomalies based on sst monthly climatology and monthly anomalies were determined for the entire 40-yr period. Special attention was given to the October 1982–March 1983 (El Niño) period. The spatial patterns of these values closely resemble that of sst anomalies. Finally, standard deviations for both the seasonal cycle and interannual heating anomaly were prepared.

Staff modified the Gent and Cane ocean model by adding the Liu et al., (1979) formulation, which required air temperature and relative humidity. Extensive changes were necessary to read in these two additional variables and to temporally and spatially interpolate these data to the model grid. The methods for calculating the latent and sensible heat flux were changed, so that these values now depend on output from Liu's formulation. Also, an updated longwave heat flux calculation (Clark et al., 1974) was added to the model. It is hoped that these changes can improve predicted sst.

Staff completed EOF analyses of TOPEX and TOGA dynamic height data for nineteen 10-day TOPEX cycles, for the period September 1992–March 1993. Daily TOGA data had been processed into 10-day means, which corresponded to the TOPEX cycles. Also, an optimum interpolation program had been used to grid these data. Staff extracted TOPEX data from 10°S to 10°N to match the TOGA grid. Staff calculated real EOF's for both TOPEX and TOGA data and plotted the spatial and temporal functions for the first three Eigenmodes.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-30440.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-30440

Staff will complete several 2-yr runs of the updated Gent and Cane model, using climatological values of wind stress, clouds, relative humidity, and air temperature. In one case, the mixing ratio will be determined using COADS data and in another case, the mixing ratio will be a function of sst. Another model run, using the Seager et al., (1988) formulation, would also be useful. The predicted sst values from these model runs may then be compared.

Staff will complete an EOF analysis of dynamic heights based on TOGA moorings, having data for all 19 cycles. This analysis will be based on observations instead of a gridded field. Also, an EOF analysis will be done on TOPEX gridded data, for that area where TOGA mooring data are complete.

Staff will prepare a Work Control Plan that meets the requirements of contract NAS5-30440.

COMPUTER USE

Minutes	Computer
0.416 CU's	Cray
0.002 CU's	MVS

NASA Task 72-277-03: Oceanographic Altimeter Research

GSFC ATR: ***Dr. A. Busalacchi***

Hughes STX Task Leader: ***E. Hackert***
Hughes STX Task Number: ***769***

The contractor will provide scientific support for oceanographic altimeter research in tropical oceans to assist in the implementation of work plans in support of the TOPEX/POSEIDON program. The support will include the processing and analysis of satellite altimeter measurements and numerical model simulations of sea level, and the implementation of statistical analyses, time series analyses, objective analyses, and interpolation techniques for in situ, model, and satellite ocean data.

FINAL CONTRACT SUMMARY

Initiated in May 1989, this task lasted until present. Comprised of one senior scientist, major accomplishments of the task include developing an optimal interpolation code for the Cray to objectively map GEOSAT data, conversion of GEOSAT slope to geostrophic velocities, comparison of GEOSAT gridded products against tide gauge sea level, intercomparison of all available wind products for tropical Pacific (both data and model results), conversion of the Gent and Cane (G+C) code for use on the Cray, and incorporation of major features in the G+C code (thermodynamics, irregular geometry, real wind stress as opposed to seasonal cycle winds, fixed linear/nonlinear switch, and restart capability). All model utilities were modified to run on the Cray, including upgrades to the interactive graphics package, view. A complete documentation of the G+C model and utilities was published. A data assimilation system using Kalman filtering and the linear model of Cane and Patton was developed, and experiments using real data for 1978–1983 were completed. The system was modified to incorporate XBT data and inhomogeneous error models. TOPEX data were processed and compared against TOGA TAO dynamic height data.

SUMMARY FOR CURRENT REPORTING PERIOD

Work continued comparing the sea level derived from TOPEX altimetry data against the dynamic height data taken from TOGA TAO buoys in the tropical Pacific. Model runs were completed, which tested the hybrid mixed layer for the G+C model using realistic and climatological winds and clouds. Final versions of model runs and statistics were completed for data assimilation of sea level and dynamic height in the tropical Pacific. New studies including an experiment to see how TOGA TAO winds improve ocean model forecasts were initiated.

WORK PERFORMED

100 MODEL DEVELOPMENT AND DOCUMENTATION

The G+C model was modified to run on Maya to track an error in the model code, which was discovered in the routine TKE0. This routine is a part of the Kraus-Turner mixing scheme of the hybrid mixed layer model in the G+C model.

A major error was discovered in the Cane and Patton (MEQ) data assimilation code. The code was first converted to run on the workstation, Maya, where it was discovered that expendable bathythermograph

(XBT) latitude and longitude indexes were being transposed. Two new error models were created that had similar spatial characteristics as previous inhomogeneous error models. These models are derived using the root mean square difference between FSU and Sadler wind products (1978–83) and have means of 1. and 0.75 (as opposed to the original inhomogeneous error model with mean 0.45). An error was discovered that indicated that the model code output the [P] matrix one time step after assimilation had ceased. This meant that the [P] matrix was radically different than the [P] matrix one time step earlier—when assimilation was taking place. The code for another model statistic, CPCT was completely checked. Nonsymmetry in the output of this statistic was eliminated using recursive code.

200 TROPICAL PACIFIC MODEL RUNS

The entire suite of G+C model runs were completed, which were run to test the new hybrid mixing scheme. All combinations of FSU 1987–88, SSM/I 1987–88 winds, and ISCCP 1987–88 and climatological ISCCP clouds were completed. Also, an experiment was initiated that compares model results driven by NMC winds to results driven by NMC winds improved using TOGA TAO buoy winds. The first four years of the NMC model run were completed (July 1982–July 1986).

All the runs assimilating XBT data were redone because of an error in the original code. These include all XBT points, all XBT points and the tide gauge stations (RJCSCTKP), all XBT points-shorteast (Note: these assimilate XBT as if they were tide gauge data), and the first four empirical orthogonal functions (EOFS) of XBT data. Four model runs were completed during the last period using the MEQ (Cane and Patton) model and the new inhomogeneous error models (mean= 1.0, 0.75) assimilating XBT data as points and as EOFS.

300 DATA PROCESSING

Plots were completed to assess the relationship among the G+C model runs using all combinations of FSU 1987–88, SSM/I 1987–88 winds, and ISCCP cloudiness. The variables plotted were wind stress, sea level, sea surface temperature, and cloudiness.

The standard suite of statistics was completed for all the XBT data assimilation runs. Also, as part of the MEQ model project, a comparison of the statistics between the homogeneous and inhomogeneous error models was undertaken. Code to calculate regression coefficients tested whether the inhomogeneous or homogeneous error model was performing better with respect to the bootstrap of the variance. Plots were created using IDL to show the values of bootstrap and MPMT statistics for the various model runs.

The major focus of the task has been to compare TOPEX gridded sea level product and the TOGA TAO dynamic height. This work included acquiring data, arranging data in comparable formats (using tools such as optimal interpolation of the dynamic height data to give a gridded product), and performing statistics on the two data sets. Statistics include grid correlation, grid rms, time correlation and rms, mean difference on the gridded data, and similar statistics on the point data. As part of this project, code has been developed to read data from the TOPEX GDR colinear data base, subsample and optimally interpolate it to a grid. Also, TOPEX data have been processed as if they are TOGA data and compared against the resulting TOGA gridded product. An objective analysis was performed to determine the Kelvin wavespeed using linear regression.

Several steps were completed in preparation for an experiment comparing the results of the G+C model using NMC reanalysis winds and these same winds improved by TOGA TAO winds. These steps included preparing the input files (Levitus temperature, thickness, NMC wind stress and Esbinsen and Kushnir cloudiness) and running the redating code.

400 TASK SUPPORT

Hellerman winds, Levitus temperature, salinity and Lamont's density code were supplied to researchers along with the UniTree utilities, getunitree and putunitree. Mean profiles were constructed for temperature and zonal current vs. depth. Weekly Reynolds SST and NMC winds were acquired in preparation for later studies. An equatorial cross-section was created for the Indian and Pacific oceans using Levitus temperature data. Since the summer student has left the project, task personnel have organized notes and code developed over the summer.

SIGNIFICANT ACCOMPLISHMENTS

Task personnel were responsive to the ATR's needs by writing major Cray projects for NCCS paper documenting scientific accomplishments for the year. Task personnel plotted up standard deviation of model sea level results for NASA HQ publications. Summaries were completed for Atlantic and Pacific work for ATR's report on TOPEX progress. The ATR's summer student was supervised during the project to combine 1-D hybrid mixed layer and biological models. Three-dimensional graphics were created for a graphics proposal, help was given to produce filter for GEOSAT data, and plots were delivered of model velocity data to help determine geostrophic velocity at 165E, 140W, and 110W. Task personnel were responsive to the ATR's needs by serving as system administrator by fixing problems with optical media, by taking care of all Cray computer accounts sponsored by ATR and by keeping ATR's colleagues informed about developments in the TOPEX-TOGA comparison project. Also an abstract was written for an ATR's collaborator that covered the data assimilation project for the AGU meeting.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work will continue comparing TOPEX sea surface topography and TOGA TAO dynamic height data. Publication of data assimilation results using XBT data will continue. The model study concerning NMC and TOGA improved NMC winds also will continue. Work Control Plans are being developed.

COMPUTER USE

Minutes	Computer
0.038	IBM 9021 MVS
74.197	Cray Y-MP
0.010	Convex
(318.04 of 600 CU's allocated) several thousand hours	IRIS

NASA Task 72-277-04: Graphical Analysis of Oceanographic Data

GSFC ATR: ***Dr. A. Busalacchi***

Hughes STX Task Leader: ***P. Ryan***
Hughes STX Task Number: ***770***

Task provides support for graphical and statistical analyses of 2-, 3-, and 4-D fields of oceanographic data on a Silicon Graphics IRIS workstation and a CDC MIPS workstation. Support will include implementation and application of existing animation and statistical plot packages, development of other analysis programs, and system management of the workstations.

FINAL CONTRACT SUMMARY

This task was initiated in July 1992 and will continue into the next contract period. The task consisted of one person working half time. This person was originally classified as an analyst/programmer but was later reclassified as a systems programmer.

Hughes STX staff spent a considerable amount of time deciphering the original ViewX code. The bulk of the code is undocumented and violates most standards of good coding style; nevertheless, the depth profiler was completed. It is now possible to draw a line across a contour plot of arbitrary data and then get a slice of the ocean at that line. In the new routine, the real depth of the ocean is used rather than the layer thickness.

As new code was put in the program, much of the old code was cleaned up and documented. In places where portability was a concern, the code was changed to meet the ANSI standard for the C language.

Much work still remains to be done in ViewX; for example, new functions need to be added to the program. Currently, ViewX understands only a locally written file format called datafile. It would be advantageous if ViewX were able to read and write a more widely used format such as HDF or netCDF. Aside from that, many of the jobs that ViewX does can be done better in the Interactive Data Language (IDL). It will be the job of this task to familiarize the group with IDL. The group will need IDL routines to read the existing data format into IDL.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff provided programming and system support for the ATR's group.

WORK PERFORMED

Staff performed standard system maintenance duties including software upgrade and regular system backups. Staff loaded NFS software onto the SGI Crimson machine. Staff members configured and enabled automount software that lowered system overhead from NFS-mounted file systems.

Task personnel created several new user accounts for summer students and assisted them in becoming acclimated to the cluster environment.

Staff configured X terminals to use new boot and server software. Difficulties were encountered because of the inordinate complexity of configuration parameters and bugs in the router code. NCD support personnel were called and the problems were fixed. NCD staff admitted to finding bugs in its code. All X terminals are now working properly. Staff also formatted optical disks for data archiving. New higher density optical disks were ordered. Staff discovered a potential security hold in Trivial File Transfer Program (TFTP) daemon. Staff investigated the problems and sent a memo to the Technical Assistance Group for evaluation. Local machines were then made secure.

Staff specified the purchase of a 2-GB external disk drive for its CDC machine.

A staff member presented a talk on X Windows Security at the Workstation User Group (WUG) meeting. The staff member described security dangers inherent in X. Staff completed work on the depth profiler in the ViewX program. Although some bugs remain, the depth profiler works properly.

Task personnel fixed the erase function in ViewX, so users can now erase multiple regions.

HSTX staff restored computer systems after a power outage, and data loss was kept to a minimum. All machines continue to operate.

Staff assisted summer students with use of IDL. Staff specified several purchases for the ATR's computers that included a 2-GB external disk drive and an optical drive for the ATR's group.

Staff set up a meeting with Research Systems Inc. (RSI) staff to discuss problems with IDL in detail. Staff concerns will be passed on to RSI development staff.

A staff member presented a talk on Perl language at the September meeting of the System Administrators' Group.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be prepared for the next contract period to meet the requirements of this task.

CONFERENCES

Staff attended meetings of the WUG and of the System Administrator's Group.

COMPUTER USE

Minutes	**Computer**
Dedicated	Sun, SGI, and CDC Machines

NASA Task 72-279-00: Polar Ocean Graphics

GSFC ATR: *Dr. S. Hakkinen*

Hughes STX Task Leader: *P. Ryan*
Hughes STX Task Number: 775

This task provides computer programming support for midlatitude and polar ocean modeling activities including visualization of model output and data using graphics routines on the Cray Y-MP supercomputer and Unix workstations. Activities will include the design, development, and implementation of graphics utilities.

FINAL CONTRACT SUMMARY

This task was initiated in January 1991 and will continue into the next contract period. The task consisted of one person working half time. This person was originally classified as an analyst/programmer but was later reclassified as a systems programmer. Under this task, the NASA scientists migrated their primary data analysis and visualization software from NCAR Graphics to the Interactive Data Language (IDL). IDL is now the primary software tool used in their data visualization. During the task, most data postprocessing was moved from the Cray to various Sun workstations. To handle the large volume of data generated by the model, these workstations were equipped with large hard disks and tape drives. Several objectives must still be achieved. The current format for model data does not lend itself easily to being read by integrated packages such as AVS. It would be advantageous to store model data in a self-representing format such as HDF or netCDF. Also, it would be helpful to have a menu-driven, widget interface to the model parameter display routines. Such an interface could be written using IDL widgets.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff developed software to display data from many different sources. Staff performed extensive system maintenance tasks on the Sun cluster. Staff prepared data animations for analysis.

WORK PERFORMED

HSTX staff plotted ECMWF data, Jaeger precipitation data, and SMMR ice data on an Arctic grid. Staff prepared many animations of ice thickness and concentration data. Task members also plotted model data for years 1946–84.

Staff configured X terminals to use new boot and server software. Difficulties were encountered because of the inordinate complexity of configuration parameters and bugs in the router code. NCD support personnel were called and the problems were fixed. NCD staff admitted to finding bugs in its code. All X terminals are now working properly.

Task personnel discovered a potential security hold in Trivial File Transfer Program (TFTP) daemon. Staff investigated problems and sent a memo to the Technical Assistance Group for evaluation. Local machines were secured against this threat.

Staff installed TeX and PostScript previewing software on the Sun cluster.

HSTX personnel worked on the vertical ocean slice plotting program in IDL. Problems were encountered because of IDL's poor handling of missing and irregular data. Staff updated the vertical slice program that uses NCAR Graphics. Staff encountered problems when porting code from the Cray to the Sun machine.

A staff member presented a talk on X Windows Security at the Workstation User Group (WUG) meeting. The staff member described security dangers inherent in X.

Staff added code to model postprocessing programs to read in configuration parameters. As a result, the code does not have to be recompiled each time parameters change. Several different parameters can be read in at runtime rather than being hardcoded.

HSTX staff determined the DAT drive on Sun to be unreliable for use. When staff took the DAT enclosure to a vendor for repair, it was found to be beyond repair and a new drive was specified. A new drive was received and installed without incident.

Task members restored computer systems after a power outage, and data loss was kept to a minimum. All machines continue to operate.

Staff assisted summer students with use of IDL.

Staff members installed new hardware on Sun machines including a 3.5-GB drive and an external DAT drive. Staff specified several purchases for the ATR's computers that included 7 GB of disk space, an external DAT drive, and an optical drive.

HSTX personnel plotted 30-yr salinity anomalies for the Arctic Ocean. Staff again encountered difficulties because of IDL's inability to handle missing data and data over an irregular grid.

Staff set up a meeting with Research Systems Inc. (RSI) staff to discuss problems with IDL in detail.

A staff member presented a talk on the Perl language at the September meeting of the System Administrators' Group.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff plans to accomplish these activities:

- Refine the vertical ocean slice plotting routines.
- Receive and install several new disk drives on the Sun cluster.
- Write a prototype for its model display interface program.
- Prepare a Work Control Plan for the next contract period to meet the requirements of this task.

CONFERENCES

Task personnel attended meetings of the WUG and of the System Administrator's Group.

COMPUTER USE

Minutes	**Computer**
Dedicated	Sun Workstations

NASA Task 72-280-00: EOS Liaison Support

GSFC ATR: ***Dr. A. Busalacchi***

Hughes STX Task Leader: ***J. Acker***
Hughes STX Task Number: ***776***

The task provides scientific and technical liaison support between the EOS Project Science Office, the EOS Ocean Panel, and the EOS Principal Investigators involved in oceanographic and cryospheric research activities.

FINAL CONTRACT SUMMARY

This task was initiated in September 1991 and continued to the end of the contract. One individual, assigned to the EOS Liaison Task, developed and maintained vital links between the EOS programs, NASA oceanographic programs, and the national and international oceanographic research community. Familiarity with NASA oceanographic research missions was fostered, and interaction was maintained. The EOS Oceanographic Liaison acted as rapporteur and coauthor for a University National Oceanographic Laboratory System (UNOLS) workshop on coastal oceanography, and as the primary NASA contact with that body. The EOS Oceanographic Liaison also acted as rapporteur for a conference on satellite and in situ observing systems for short-term climate prediction, and is preparing a paper on the meeting for publication.

Remaining objectives include the completion of the aforementioned paper, continuation of the activity as EOS progresses, new responsibilities within the SeaWiFS program (a vital EOS precursor), and directed research using SeaWiFS and CZCS data.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff participated in several activities of importance to the NASA oceanographic community, including preparation of useful publications with wide readership. Meeting activity was low, but connections to oceanographic research programs were maintained. Presentations of EOS oceanographic goals and activities were planned. Status of EOS instrumentation (MODIS) was updated.

WORK PERFORMED

100 EOS LIAISON ACTIVITIES

110 Climate Workshop

During June, staff edited and then sent notes from individual presentations at the climate workshop to authors. During July, these notes were prepared into final form, and a request for recommendations from each workshop session was transmitted. Recommendations were received in August and a summary writeup of each session's presentations was begun. Writing continued during September.

120 SeaWiFS Technical Memorandum Assistance

During June, staff commenced an information-gathering effort for a volume in the SeaWiFS NASA Technical Memorandum Series concerning the activities of the CZCS Nimbus Experiment Team and algorithm development group. Sources and references were tracked down and obtained during July, and initial editing and writing took place in August. September discussions with S. Hooker, SeaWiFS project, added initial responsibility for editing work on other editions, and focused on completion of this activity by the bio-optical algorithm workshop scheduled for GSFC in November, as several NET team members will attend. This task was hampered by slow efforts to obtain T_eX "typesetting" software, which is used by the project for the preparation of the Technical Memoranda.

130 EOS Project Meeting Attendance and Instrument Status

Staff attended the first two days of the MODIS meeting at GSFC on September 29 and 30.

140 Code 971 Report Distribution

In July, reports on the Oceanography Society meeting and the Spring AGU were approved and distributed to Code 971 personnel and branch heads.

150 Oceanographic Community Relations

In September, staff communicated with the UNOLS office to confirm attendance at the UNOLS council meeting in Washington, DC, on October 1, 1993.

In September, staff communicated with the Joint Global Ocean Flux Office to establish attendance at the next Scientific Steering Committee meeting and the Arabian Sea planning meeting.

In August, staff prepared an information sheet on obtaining TOPEX/Poseidon data from the PO.DAAC at the Jet Propulsion Laboratory and, following editing with PO.DAAC staff, sent this sheet to the World Ocean Circulation Experiment OCEANIC data base in September.

200 EOS PROJECT SCIENCE OFFICE SUPPORT

Staff discussed ongoing support needs in June with C. Griner of the EOS Project Science Office. Reports are electronically mailed to M. King, EOS Project Scientist, following approval by the ATR.

Reports on the Oceanography Society meeting and the Spring AGU were sent to M. King.

Staff received approval to present a poster concerning projected EOS interactions with the oceanographic community at the 1994 AGU Ocean Sciences meeting, February 1994, in San Diego, CA. It is expected that support will be provided to the EOS exhibit during the meeting.

300 OCEAN ALTIMETRY/OCEAN COLOR PAPER (FOR AGU NEWSPAPER EOS)

Work on this project did not proceed during the period.

400 CARBONATE GEOCHEMISTRY RESEARCH AND USGS COLLABORATION

During June, staff met with H. May and O. Bricker (U.S. Geological Survey) to discuss staff's paper on chlorite dissolution kinetics and final preparation of this manuscript for publication. H. May is preparing a substantial section of the paper.

Increasing familiarity with the SEAPAK software package and its new Unix-based format will allow processing of SeaWiFS scenes for this research. Collaborative research and coauthorship of peer-reviewable research papers are planned.

SIGNIFICANT ACCOMPLISHMENTS

Staff compiled corrected notes from participants in the climate workshop, and acquired "lost" CZCS documentation for the SeaWiFS Technical Memorandum.

PROBLEM AREAS

The typesetting software package was acquired slowly.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff plans to attend the UNOLS council meeting on October 1, 1993, (Washington, DC), the EOS Payload Panel meeting on October 4–6 (Herndon, VA—tentative), the JGOFS Scientific Steering Committee meeting on October 20–21 (Alexandria, VA), the SeaWiFS Bio-Optical Algorithm workshop November 8–10 (GSFC), and the JGOFS Arabian Sea planning meeting, November 16–18 (Washington, DC). A WOCE meeting may also take place during this period.

The paper on the climate workshop will be prepared for publication.

Work will continue on the SeaWiFS Technical Memorandum series.

An abstract will be prepared and submitted for the AGU Ocean Sciences meeting.

A Work Control Plan will be prepared.

CONFERENCES

Staff attended the SEAPAK Review Conference at GSFC on September 15 and the MODIS Science Team Meeting at GSFC on September 29 and 30.

TRAINING

Staff attended ethics awareness training.

COMPUTER USE

None.

NASA Task 72-281-00: EOS Heat-Water Balance Studies

GSFC ATR: ***Dr. B. Choudhury***

Hughes STX Task Leader: ***Dr. N. Ahmed***
Hughes STX Task Number: ***777***

This task provides technical support of Earth Observing System (EOS) interdisciplinary research requiring extensive satellite and ground data processing and analysis together with computer simulations using radiative transfer equations and heat and water balance models. Satellite data processing and analysis will be for different sensors (such as SMMR, AVHRR, and TOVS), whereas ground data will primarily be the synoptic meteorological observations.

FINAL CONTRACT SUMMARY

On April 1, 1991, the present task was awarded under contract NAS5-30440. Over the lifetime of this task, one scientist has worked full time. There have been major milestones and accomplishments over the lifetime of the task. Staff completed processing 10 years of SMMR and meteorological data (temperature and precipitation) and analyzed them to retrieve soil moisture from satellite observations only. A heat balance model and a radiative transfer model were modified to calculate the heat balance quantities (such as transpiration, evaporation, and surface temperature) and vegetation indices (such as NDVI and photosynthesis). Different field observations of these quantities were compared with the model simulations. A paper entitled "Relations Between Evaporation Coefficients and Vegetation Indices Studied by Model Simulations," by the ATR, the task leader, S.B. Idso, and R.J. Reginato, was submitted to the *Rem. Sens. Environ.* Staff also continued SMMR, SSM/I, AVHRR, ISCCP, and meteorological data retrieval for the heat-water balance studies.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff continued SMMR, SSM/I, AVHRR, ISCCP, and meteorological data retrieval for the heat-water balance studies. A radiative transfer model by the ATR has been studied thoroughly, and all previous simulations relating to NDVI, simple ratio (SR), photosynthesis, and photosynthetically active radiation (PAR) absorption have been simulated. The radiative transfer model was modified to improve the calculation of fractional intercept, albedo, and PAR absorption for fractional and total canopy cover. The heat balance model was run for two different soil conditions, dry and wet, to calculate the evapotranspiration for 30 days for wheat crop. With the same input of leaf area index as that for the heat balance model, the radiative transfer model was run for 44 different types of soil to calculate visible and NIR reflectances, NDVI, and SR. A paper entitled "Relations Between Evaporation Coefficients and Vegetation Indices Studied by Model Simulations," by the ATR, the task leader, S.B. Idso, and R.J. Reginato, was submitted to the *Rem. Sens. Environ.* for publication.

WORK PERFORMED

A paper entitled " Relationships Between Vegetation Indices, Radiation Absorption, and Net Photosynthesis Evaluated by a Sensitivity Analysis," by the ATR, was carefully studied to do analysis between vegetation indices and heat balance quantities and was submitted for publication. All previous simulations relating to NDVI, SR, photosynthesis, and PAR absorption have been simulated. The heat balance model was run for two different soil conditions, dry and wet, to calculate the evapotranspiration for 34 days for wheat crop. The potential evapotranspiration was also calculated by the Prestly-Taylor equation for these cases. With the same input of leaf area index as that for the heat balance model, the radiative transfer model was run for six different types of soil to calculate NDVI and SR. A vegetation index, Chi (the quotient of the difference between NDVI and minimum NDVI and the maximum difference of these quantities), was calculated by these NDVI.

As stated previously, the heat balance model was also run for three different soil conditions, dry and wet, to calculate the evapotranspiration for 30 days for wheat crop. The inputs for these soil conditions were run each day with meteorological variables, and the same set was also run with identical weather (clear sky) data. With the same input of leaf area index as that for the heat balance model, the radiative transfer model was run for 44 different types of soil to calculate visible, NIR, NDVI, and SR. Different measures of vegetation index, soil-adjusted vegetation index (SAVI), and transformed soil-adjusted vegetation index (TSAVI) were calculated and correlated with normalized transpiration for different dry and wet conditions. These measures were all found to be linearly related. A parametric equation for the vegetation index as a function of leaf area index was obtained by fitting the calculated data.

A program was written to calculate direct and diffused solar irradiance and the cosine of the zenith angle from solar irradiance and the hour of observation. This algorithm was tested by using FIFE site data and Mexico Ciano data. The radiative transfer model was modified to improve the calculation of fractional intercept, albedo, and PAR absorption for fractional and total canopy cover.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has ended.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Work under this contract has ended.

COMPUTER USE

Minutes	Computer
1,100	IBM 3081

NASA Task 72-282-00: EOS Hydrologic Modeling Studies

GSFC ATR: ***Dr. E. Engman***

Hughes STX Task Leader: ***J. Draves***
Hughes STX Task Number: ***778***

This task will support EOS interdisciplinary research requiring the assembling, modification, and running of hydrologic models. The primary hydrologic model to be used in this study will be the USGS's Precipitation-Runoff Modeling System (PRMS). This task will also require the development of meteorological, hydrologic, and site-characteristic data bases for input to the models (primary climate and streamflow data); and the incorporation of remote sensing and ground-based data into the models. Work in support of field experiments may be required.

FINAL CONTRACT SUMMARY

On February 26, 1992, NASA task 72-282-00 was started. This task has involved one scientist working 1 FTE, and one technical specialist working 0.5 FTE.

Several notable accomplishments during this task include the following: 1) Effective support of the ATR in the preparation of presentations and publications. Aid in determining and acquiring data necessary for the task; 2) conducting extensive model sensitivity and analysis work to determine model strengths and weaknesses; 3) creating several new modules to expand the capabilities of the modeling software used by the task; 4) calibrating the model to data collected during Washita '92, and anticipating to continue into the future given the nature of the study; 5) providing support in the collection, analysis, and publication of soil moisture data collected during Washita '92; and 6) providing data in a timely fashion to other investigators and processing of all MACHYDRO '90 TIMS and NS001, and Washita '92 NS001 flight lines to level-0 data.

Future objectives include processing Washita '92 TIMS data to level-0, and all Washita '92 and MACHYDRO '90 data to level-1. The MHMS model will be calibrated to the data collected during Washita '92. More modules will be developed as needed to expand MHMS's capabilities.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff successfully completed sensitivity analysis of the Topography-based Hydrological Model (TOPMODEL). Task personnel conducted evaluations that led to the development and implementation of a new and more simplified version of the model. Several additional modules were created to fully integrate TOPMODEL into the MHMS environment. Staff also reviewed the new MHMS software to determine its capabilities. Several features have been improved, but some critical areas still need enhancement. several calibration runs of MHMS were conducted using new watershed delineation techniques to improve model results.

Task personnel successfully completed processing to level-0 all NS001 flightlines from The Washita '92 field experiment. Processing efficiently was increased by a factor of three. Preliminary processing of level-1 data was performed.

Staff gave a presentation at the EOS (Interdisciplinary) Land-Surface Processes Investigation Working Group meeting. The talk focused on the modeling aims of MHMS, as well as some preliminary model sensitivity and calibration results.

WORK PERFORMED

100 HYDROLOGIC MODELING

Staff conducted several sensitivity studies on TOPMODEL. After examining the results, and findings from other TOPMODEL studies, it was determined that three parameters were essentially controlling the model output. After this determination, a new simplified version of TOPMODEL based on these three key parameters was constructed within the MHMS environment. The USGS version of TOPMODEL was also acquired with the upgrade of the MHMS software. Careful analysis of the USGS TOPMODEL revealed several differences in which data are required to operate the model. These models should complement each other in the task's modeling efforts.

Task personnel also conducted a review of the updated MHMS software to determine new features and capabilities of the model. Detailed variable information may be obtained at the hydrological response unit (hru) level, instead of the basin level. This should aid in the calibration of the model to the Little Washita data. The upgrade is incomplete, and new modules that will allow for model operation at time steps less than 24 hours should be completed soon.

The task leader has continued calibrating the MHMS model to the Little Washita River basin. Using a topographic analysis software package to delineate subwatersheds within the Little Washita basin, a new partitioning scheme was implemented. Results indicate that better calibration is possible. Statistical results are similar to earlier runs, but visual inspection of the output indicate improved results for periods of high flow. The new partitioning scheme combined with MHMS's new ability to provide output for hrus should aid in model calibration considerably.

200 DATA BASE DEVELOPMENT

All NS001 data from the Washita, Oklahoma field experiment were processed to level-0 data sets, consisting of 99 flight lines for dates June 10–June 18, 1992. NS001 flight lines were ingested via LTP VAX in the original line interleaved format and converted to band sequential level-0 data. This represents a factor of three increase of processing efficiency. The MACHYDRO 1990 NS001 data set consisted of 34 flight lines, which took 4 months to process (February–May 1993) to level-0, while the Washita NS001 data set took the same amount of time, but contained three times as much data (99 flight lines). Both processes were done at one-half task time effort. The efficiency increase was obtained by a software upgrade, and eliminating one processing step, which allowed writing output directly to 8-mm tape format. Using computer resources at early and late periods of the workday also improved processing times.

Level-1 parameters were defined and initial software tests for processing were started. Level-1 data applies radiometric corrections to flight lines as observed by the flight instrument.

300 DATA INCORPORATION INTO MHMS

Task personnel also developed several ancillary modules necessary to integrate both the task's version of TOPMODEL, as well as the USGS's, into the MHMS environment. The original MHMS modules were not designed to incorporate TOPMODEL parameters and variables into their algorithms, thus the MHMS analytical tools (graphical and statistical analysis routines) were unavailable to either version of TOPMODEL.

SIGNIFICANT ACCOMPLISHMENTS

Staff's presentation at the EOS (Interdisciplinary) Land-Surface Processes Investigation Working Group meeting was complimented by the ATR and several colleagues. A factor of three increase of level-0 processing efficiency was because of software improvements and computer scheduling.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue as planned under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The Work Control Plan will be updated for the new contract to meet the requirements for this task.

Staff will continue making improvements in MHMS' modeling capabilities through the creation and addition of more modules; testing and calibrating TOPMODEL to the Little Washita River basin; processing Washita '92 NS001 and TIMS flight lines; processing of MACHYDRO '90 level-1 data sets will proceed. Start processing of level-0 Washita TIMS data flight lines and begin processing of level-1 MACHYDRO TIMS and NS001 flight data.

NONLOCAL TRAVEL

On June 1 and June 2, task personnel attended the EOS (Interdisciplinary) Land-Surface Processes Investigation Working Group meeting at MIT in Cambridge, MA. Staff gave a 25-minute presentation on "Extension of the USGS Modular Hydrologic Modeling System for EOS Hydrology." The focus of the talk was on the modeling aims of the task using the USGS's MHMS. Preliminary results from calibration work on the Little Washita River basin and the sensitivity of hydrologic parameterization to geographical scale were also discussed. Staff interacted with several researchers involved with other aspects of the project, and was made aware of other research efforts related to the EOS land-surface processes investigation.

CONFERENCES

On June 1 and June 2, the task leader attended the EOS (Interdisciplinary) Land-Surface Processes Investigation Working Group meeting at the Massachusetts Institute of Technology (MIT) in Cambridge, MA. A 25-minute presentation on "Extension of the USGS Modular Hydrologic Modeling System for EOS Hydrology" was given. Staff interacted with several researchers involved with other aspects of the project.

Staff attended the talk "The Integration of Land-Surface Processes into the NCAR CCM-5 Model" on August 26 at the GSFC. Information was presented on land-surface processes representation, as well as mesoscale atmospheric modeling.

TRAINING

On May 17, staff attended a training session on the Silicon Graphics Explorer data analysis and display software package offered by Silicon Graphics at their Silver Spring, MD office.

COMPUTER USE

Minutes	Computer
105	LTP VAX
175	HP and SGI workstations

NASA Task 72-283-00: SAR Arctic Hydrology

GSFC ATR: ***Dr. E. Engman***

Hughes STX Task Leader: ***G. Linebaugh***
Hughes STX Task Number: 779

This task supports the study of ERS-1 synthetic aperture radar (SAR) Arctic hydrology data by procuring and analyzing SAR data scenes of areas in Alaska and Canada that contain lakes and glaciers. Data analysis involved study site selection and registration of SAR temporal scenes. Data processing options include the use of ancillary data (e.g., Landsat) of selected sites for comparisons.

FINAL CONTRACT SUMMARY

The task started in June 1992. One principal technical specialist has been working .5 full-time equivalent.

There have been several accomplishments over the lifetime of the task, including ERS-1 SAR data acquisition and computer analysis of radar passes over Glacier National Park (GNP), MT; joint planning of field work itineraries for lake ice measurements with GNP scientists; and completion of field work chronology documenting places and amount of data gathered. With these digital and field data, task personnel coauthored a paper entitled "Analysis of ERS-1 Data of Lakes in Northern Montana," presented at the Alaska SAR Facility User meeting in Seattle, WA, in July 1993. ERS-1 calibration problems were discussed extensively with ESA and ASF personnel to overcome processing deficiencies of Prince Albert, Canada, ground processing equipment. Extensive analysis of other potential lake ice areas in the northwestern United States and Alaska was performed.

Remaining objectives to be accomplished include data collection and analysis of SAR data from the 1993-94 winter season at GNP.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff assisted planning and layout structure for presentation papers titled "Radar Studies of Arctic Lakes and Glaciers," presented at GSFC in June, and "Analysis of ERS-1 Data of Lakes in Northern Montana," presented at the ASF User meeting in Seattle, WA, in July. The task leader discussed processing procedures with ASF personnel and inquired about raw data availability through the ERS-1 SAR order desk in Frascati, Italy, to enable calibration of SAR data over GNP. Field scouting was performed for candidate lakes in Northern Cascades National Park, WA. Summer student assistance was provided in radar processing methods associated with glaciers and lake ice.

WORK PERFORMED

100 SAR DATA ORDERING AND RECEIVING

Extensive communications were conducted with the ERS-1 order desk in Italy inquiring about availability of raw high-density data tapes (HDDT) of SAR data received at the Prince Albert ground station for data collected during November and December 1992 and January-March 1993 from GNP.

HDDT are needed for calibration studies to derive backscatter imagery. Actual calibration processing can be performed by the Alaska SAR Facility (ASF).

200 DATA BASE DEVELOPMENT

Eight candidate subscenes were produced to support layout of presentation papers titled "Radar Studies of Arctic Lakes and Glaciers" and "Analysis of ERS-1 Data of Lakes in Northern Montana." Field work in Northern Cascades National Park was performed on July 25 and 26 to assess the suitability of area lakes for radar lake ice studies. Candidate sites are currently under review.

300 DATA PROCESSING

Task personnel assisted summer students in methods of processing ASF SAR data and demonstrated display techniques on Unix workstations. Radar image site statistics were computed for the papers listed above.

SIGNIFICANT ACCOMPLISHMENTS

Staff developed a potential workaround plan to calibrate ERS-1 SAR data from the Prince Albert ground station.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has ended. Work will proceed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will finalize the process for ERS-1 SAR calibration and will begin planning data acquisitions for GNP for the 1993-94 winter season.

A Work Control Plan will be completed.

NONLOCAL TRAVEL

Task personnel attended the presentation of the paper entitled "Analysis of ERS-1 Data of Lakes in Northern Montana" at the ASF User meeting in Seattle, WA, in July.

CONFERENCES

Task personnel attended the ASF User meeting in Seattle, July 27–29, 1993.

DELIVERABLES SUBMITTED

Film: 8 11 x 11-in. Kodak camera prints of GNP, MT
Originator: G. Linebaugh

COMPUTER USE

Minutes	Computer
25	LTP VAX
95	Unix Workstations

NASA Task 72-284-00: Ocean Modeling

GSFC ATR: ***Dr. M. Rienecker***

Hughes STX Task Leader: ***L. Braunstein***
Hughes STX Task Number: ***780***

This task provides computer programming and scientific research assistance for global ocean modeling activities. The support will include the maintenance and running of the GFDL Modular Ocean Model (MOM), as well as programming analysis tools on various Unix platforms. In support of modeling activities, the duties include preparation of forcing and validation data sets and participation in the scientific analyses and publication of results in the referred literature under the supervision of the investigator. Some Unix workstation system administration duties may also be required.

FINAL CONTRACT SUMMARY

This task extended from November 1992 through May 1993. The staffing consisted of one full-time scientific analyst/programmer. Major activities under this task included processing oceanographic sea surface temperature data, incorporation of bathymetry data into the GFDL Modular Ocean Model, and some routine system management duties. Work was terminated in May 1993 as agreed on with the ATR.

SUMMARY FOR CURRENT REPORTING PERIOD

No work was performed under the current reporting period.

WORK PERFORMED

No work was performed under the current reporting period.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. No future work is planned.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

COMPUTER USE

None.

NASA Task 72-285-00: HAPEX-Sahel Experiment

GSFC ATR: ***Dr. B. Choudhury***

Hughes STX Task Leader: ***Dr. W. Teng***
Hughes STX Task Number: ***781***

This task provides technical support in the remote sensing of soil moisture and other terrain characteristics. The support services include the processing and analysis of data obtained from the airborne L-band Pushbroom Microwave Radiometer (PBMR), the 37-GHz radiometer, the NS001 Thematic Mapper Simulator, and the Thermal Infrared Multispectral Scanner (TIMS), all acquired during the HAPEX-Sahel experiment.

FINAL CONTRACT SUMMARY

This task began under contract NAS5-30440 on November 4, 1992. One scientist worked an average of 0.80 FTE for the entire duration of the task. There have been many major milestones and accomplishments over the lifetime of the task. Efficient, thorough, and fully documented procedures were set up to process, calibrate, and display PBMR, 37-GHz, and NS001 data sets. Data quality problems and undocumented data format changes were quickly identified; valuable analysis and display of data characteristics were provided to appropriate individuals. Existing data processing software was rewritten, where appropriate, to correctly and efficiently handle changes and improve program structure. Effective and responsive support was provided to the ATR and the experiment cooperators for presentation graphics and proposal preparation. Excellent communication was established and maintained with all experiment cooperators. Problems related to limited computer resources were effectively resolved. A research plan was independently prepared and submitted for the ATR's review. The central importance of terrain effects on data analysis was demonstrated.

Remaining objectives to be accomplished include the continuing processing and analysis of HAPEX-Sahel data sets and the publication of results.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff modified the 37-GHz postacquisition program, stats37.pas, to incorporate voltage offset factors derived by J. Wang (Code 975). Reprocessed flight line results seemed more reasonable; however, data fluctuations are still evident for some of the flight lines. Processing of NS001 data began. Staff processed seven flight lines for the intensive sites and one long transect flight line for September 17, 1992, from raw tapes to radiance and archived outputs on 8-mm tapes. A total of 216 output files were produced and archived. To assess the processed NS001 data, staff wrote AvgFltLine to average groups of pixels in the along-track direction. Output values from AvgFltLine were higher than previous results from MACHYDRO '90 and FIFE, which is expected because of the experiment's environment and geography. Staff plotted output values as flight line spatial series for various bands and combinations of bands, as well as scattergrams of different band pairs. Preliminary analysis seems to show that the gross variations of radiance are related to terrain effects caused by topography, soils, and vegetation. Staff estimated that 300 person-days is needed to process the remaining NS001 data. Staff drafted a letter to NASA HQ, which summarized the current status of data processing for HAPEX-Sahel and proposed a 1-yr extension (for FY '95) to the original funded investigation.

WORK PERFORMED

37-GHz Radiometer

Staff continued processing data from the 37-GHz radiometer. The postacquisition program, stats37.pas, was modified to: 1) process specific segments of a flight line, 2) incorporate voltage offset factors derived by Wang, and 3) compute the difference between the adjusted V and H channel values. Flight lines were reprocessed, results in spreadsheets were updated, and flight line spatial series were replotted. The voltage offset factors were empirically derived from calculated flight line statistics, flight line spatial series, water calibration flight data, and ground calibration values. The physical temperature of water was assumed to be essentially constant throughout the experiment period. The adjusted voltages seemed more reasonable; however, data fluctuations are still evident for some of the flight lines. Therefore, more work is needed to assess the 37-GHz data quality. For now, the data should be used only for qualitative analysis. Staff began to modify stats37.pas to decode the fifth, multiplexed, "housekeeping" channel to determine whether temperature variations during flight could be a cause of the voltage instability.

NS001

Processing of NS001 data began. Staff attended a meeting with T. Engman (Code 974) and A. Hsu (SSAI, Code 974) on NS001 processing procedures. Seven flight lines for the intensive sites and one long transect flight line for September 17, 1992, were processed from raw tapes (band interleaved by line format) to "Level 0" (band sequential format) and then to radiance and archived on 8-mm tapes. The Level 0-to-radiance processing was done using three programs obtained from Hsu—for flight line segmenting, panoramic correction, and radiance conversion. A short flight line segment was used to first test the programs, image display procedures, and tape archiving. A total of 216 output files were produced and archived on 8-mm tapes. Sketch maps of overlapping flight lines were drawn from their displayed images. For each flight line, a radiance image was created (comprising bands 2, 3, 4, and 8) and also archived to 8-mm tape. Extensive procedural checks were made throughout the processing, including the display of false-color composites of bands 2, 3, and 4 as well as band 8 (thermal infrared) to visually check processing results. Batch files were created to copy multiple files from 8-mm tapes to disk and vice versa; this improved efficiency because time during file transfers could be used on other work.

Some general observations were made from the displayed images. The tiger bush-covered, lateritic caprock highlands appeared distinctly on false-color composites and on the thermal infrared images. Areas immediately downslope from the caprocks (lateritic soils?) were also clearly seen. The tiger bushes showed some regularity in their distribution and orientation. Agricultural areas were mostly in the lowlands between the caprocks. On some flights, band 8 seemed to have a dropoff in values at both ends of the scans; i.e., the edges of the flight line coverage were darker than the center.

To assess the processed NS001 data, staff wrote a program, AvgFltLine, to average groups of pixels in the along-track direction. Pixels averaged can range from one to the entire flight line. The output is a spatial series of an along-track strip. Staff ran AvgFltLine on radiance files of one flight of the September 17, 1992, intensive field sites and flight line 1 of the September 17, 1992, long transects. Output values were compared with previous results from MACHYDRO '90 and FIFE. The HAPEX-Sahel values were higher in both cases, which is expected because of the experiment's environment and geography.

Staff transferred AvgFltLine outputs to a PC and, using Quattro Pro, plotted flight line spatial series for various bands and combinations of bands, as well as scattergrams of different band pairs. Preliminary analysis seems to show that the gross variations of radiance are related to terrain effects because of topography, soils, and vegetation. The overall variation of a spatial series for a flight line was not sensitive to the number of pixels averaged. The corresponding scattergrams showed, as expected, a decrease in the spread of data points with an increase in the number of pixels averaged. Scattergrams of NDVI (from bands 3 and 4) vs. thermal ir (band 8) showed the inverse relationship observed in the displayed images (i.e., higher vegetation density areas appeared cooler). Based in part on these preliminary results, staff wrote an outline of a research plan, which was provided to the ATR.

Based on data processed thus far and on inputs from G. Linebaugh (HSTX, Code 974), staff estimated the time needed to process the remaining NS001 data. Working assumptions for feasible scan lines/day were 15,000 for raw tape to Level 0 and 6,500 for Level 0 to radiance. The estimated total time of approximately 300 person-days incorporated the constraints because of a nondedicated computing environment (i.e., competing users of equipment and system, as well as system downtimes). Because of this constraint, some afterwork time was usually spent to use the computing facility more efficiently. A table of time estimates for each prioritized group of flights was compiled and provided to the ATR.

Staff attended a meeting, with the ATR and Engman, about HAPEX-Sahel data processing status and strategy. It was decided that "Golden days" flights should be processed first. As an outcome of the meeting and at the request of the ATR, staff drafted a letter to D. Wickland (NASA HQ), which summarized the current status of data processing for HAPEX-Sahel and proposed a 1-yr extension (for FY '95) to the original funded investigation.

Miscellaneous

Staff attended a meeting at USDA/ARS with T. Schmugge (ARS) and Wang on PBMR georegistration. Copies of the Nerdas (navigation data) tape and the GPS file were obtained from Schmugge. Staff sent to Schmugge by E-mail a list of bad PBMR flight lines and beams. Staff attended four seminars and four monthly Workstation Users' Group meetings. Staff completed transferring all files from Ocean1 (VAX) to Hydro1 (SGI), in anticipation of Ocean1's upcoming phaseout, and began transferring files from Gibbs (IBM) to Focus (SGI), in light of Gibbs' uncertain future. Staff replaced the 286 PC with a 386 PC, transferred files, performed housekeeping on the files, and optimized the 386's memory.

SIGNIFICANT ACCOMPLISHMENTS

Staff set up an operational processing procedure for NS001 data. For the ATR, staff prepared a letter to NASA HQ summarizing the status of HAPEX-Sahel data processing and proposing a 1-yr funding extension.

PROBLEM AREAS

Problems were primarily computer related. For NS001 processing, the 8-mm tape drive in the LTP facility is a bottleneck because of competing users; nights and weekends were used to minimize this problem. The Hydro workstations were often unavailable, because of their heavy use during the summer months, which slowed down the Level 0-to-radiance processing of NS001 data; again, off-hours were used to minimize this problem. Hydro1 had limited disk space, which made processing inefficient; a subdirectory was obtained on Focus, and subsequent processing on it resolved the limited space problem. Also, the 8-mm tape drive attached to Hydro2 malfunctioned, causing the reprocessing of some archived files; use of the 8-mm drive attached to Focus resolved this problem. The 286 PC-to-386 PC file transfers were slowed down because the 286 has only 5.25-inch floppy drives and the 386 has only a 3.5-inch drive; staff used its PC's at home to facilitate the 5.25-inch to 3.5-inch intermediate transfers. Staff's own PC's also were used for some of the NS001 processing.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will perform these tasks:

- Continue processing NS001 data.
- Continue analyzing NS001, PBMR, and 37-GHz data, including image processing.
- Submit processed 37-GHz data to the HAPEX-Sahel information system.
- Complete file transfers from IBM to SGI.
- Update the Work Control Plan for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Data: 37-GHz flight line spatial series plots and spreadsheet summary of flight line statistics
Originator: W. Teng

Data: 216 NS001 processed output data files on 8-mm tapes
Originator: W. Teng

Data: NS001 processing time estimates
Originator: W. Teng

Letter: To NASA HQ on proposed funding extension
Originator: W. Teng

COMPUTER USE

Minutes	**Computer**
30	IBM 9021
80	VAX 11/780
700	PC
850	Focus and Hydros

NASA Task 82-312-00: Late-Type Stellar Coronae

GSFC ATR: ***Dr. K. Carpenter***

Hughes STX Task Leader: ***Dr. J. Brosius***
Hughes STX Task Number: ***884***

This task provides support in the analysis of Hubble Space Telescope (HST), International Ultraviolet Explorer (IUE), and ground-based observations of late-type stars. The support would include performing theoretical calculations to deduce the physical processes and structure of the outer atmospheres of these stars.

FINAL CONTRACT SUMMARY

This task has been active during the period March 2 through September 30, 1993. The task leader has been the only Hughes STX employee working on this project during the entire period.

During this time, the task leader coauthored one refereed scientific publication and one abstract for a presentation. A computer code was developed to calculate the Doppler-shifted Lyman-alpha emission from a proton beam interacting with a stellar chromosphere, using Romberg integration, the VAL model solar chromosphere, and least-squares fits to numerous theoretical and observed atomic cross-sections.

Additional objectives that can be accomplished using the knowledge and expertise acquired during the course of this task include: 1) time evolution of the emitted Lyman-alpha radiation caused by ionization of the chromosphere by the proton beam, 2) diagnosis of chromospheric/injected proton beam properties by comparing observed spectra with theoretical spectra, and 3) improved understanding of solar/stellar flare mechanisms/properties.

SUMMARY FOR CURRENT REPORTING PERIOD

The task leader revised the Maran et al. paper in compliance with the referee's suggestions; the paper was recently accepted for publication in the *Ap. J.* The task leader also continued a theoretical treatment of the time development of the expected observable emission from a proton beam interacting with a stellar chromosphere. A computer code was developed that calculates intensity vs. wavelength shift using Romberg integration, VAL model chromosphere, and a variety of injected proton spectra. Code was written with the intention of simplifying incorporation of time evolution. The task leader also submitted an abstract for the Cool Stars 8 workshop in Athens, GA, in October. The HST Cycle 4 proposal was accepted, and followup documentation was submitted.

WORK PERFORMED

The task leader developed a computer code to calculate the Lyman-alpha intensity vs. wavelength shift for a proton beam interacting with a stellar chromosphere. Careful attention was paid to incorporating the appropriate atomic cross-sections, and errors made by previous investigators were noted and avoided. Least-squares fits to theoretical/observational cross-sections were calculated and incorporated into the code. The Romberg integration technique, adopted from Numerical Recipes (Press, Flannery, Teukolsky, and Vetterling, 1986), is used to obtain the electron and the hydrogen column densities, as well as the Doppler-shifted Lyman-alpha intensity. Additional routines from Numerical Recipes are also used. The Vernazza-Avrett-Loeser model solar chromosphere was adopted as the most accurate, self-consistent model chromosphere available; however, other model chromospheres can be easily inserted.

Although three different proton injection spectra have been treated (monoenergetic, thermal, and power law), the power law spectrum has received the greatest attention. The task's calculated Doppler-shifted Lyman-alpha spectra agree reasonably well with previously published results. Problems with Lyman-alpha emission from hydrogen atoms at energies below the low energy cutoff were resolved. Discrepancies between the task's results and previously published results remain for energies below about 3 keV, but this can be explained by inaccuracies in the approximations used (in the task's method as well as in the method of the previous authors). An abstract was submitted for a poster paper to be presented at the Cool Stars 8 workshop in Athens, GA, in October.

The Maran et al. paper describing observations of AU Mic in quiescence was revised in accordance with the referee's suggestions and accepted for publication. Preprints were obtained for distribution.

The HST Cycle 4 proposal, "Measurements of Proton Beams in Stellar Flares" (Woodgate, Carpenter, Robinson, Brosius, Holman, Linsky, Danks, and Kundu), was accepted. Phase II budget documentation was submitted.

Paper Accepted for Publication in the Ap. J. (1)

"Observing Stellar Coronae With the Goddard High Resolution Spectrograph. I. The dMe Star AU Microscopii," S.P. Maran, R.D. Robinson, S.N. Shore, J.W. Brosius, K.G. Carpenter, B.E. Woodgate, et al.

Abstract Submitted (1)

"Lyman-Alpha Emission as a Diagnostic of Superthermal Proton Properties in Stellar Flares," J.W. Brosius, R.D. Robinson, and S.P. Maran, Cool Stars 8, Athens, GA, October 1993.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Several activities are planned. The task leader will continue the theoretical treatment of time evolution of a proton beam interacting with stellar chromosphere and development of computer code for time-independent and time-dependent analysis. The task leader also will generate Doppler-shifted Lyman-alpha spectra for a variety of physical conditions, so that beam properties can be diagnosed from observations of stellar spectra with the GHRS. Staff will begin to incorporate heating of the chromosphere and changing of the ionization structure by the proton beam. A poster will be made for the Cool Stars 8 workshop. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	SPARCstation IPC
60	LASP VAXcluster

NASA Task 82-313-00: Observatory Assistance

GSFC ATR: ***Dr. A. Michalitsianos***

Hughes STX Task Leader: ***Dr. R. Cornett***
Hughes STX Task Number: ***883***

The objective of this task is to support the maintenance and operations of the Goddard 36-inch Telescope Test Facility. The support will include telescope operations, facility maintenance and upgrade, equipment testing, data reductions, observing support, and other related activities.

FINAL CONTRACT SUMMARY

This task was active from February 2 through September 30, 1993. The task team was composed of two part-time associate scientists.

The task's major milestones/accomplishments follow:

- Laser alignment of the 36-inch telescope's secondary mirror.
- Inventory and systematic storage of observatory equipment.
- Diagnosis and repair of Photometric Systems Incorporated (PSI) CCD system noise.
- Sustained observatory support.
- Design and construction of several telescope-instrument interfaces.

The remaining objective that can be accomplished is continued observatory instrumentation support.

SUMMARY FOR CURRENT REPORTING PERIOD

Troubleshooting and postrepair tests of the PSI CCD electronics package were performed. A new (Kodak/Photometrics) CCD electronics system (on loan from Dr. D. Klinglesmith [GSFC]) was installed, including designing and machining of an adaptor plate to mate the CCD to the spectrograph and telescope.

A universal plate was designed to mount the Kodak/Photometrics CCD camera onto a variety of spectrograph lenses. Sources of fluctuations in bias and rms error levels in the old (PSI) CCD electronics system were traced to the power supply and several chips, which were replaced. Materials were acquired for a flat-field apparatus.

Observations of Jupiter, Vega, and Arcturus were performed with the PSI CCD system and spectrograph. The observations were calibrated using fiducial lamps after spectral lines in observed spectra were identified. Similar line identification was performed using the Kodak/Photometrics system. Selected IUE spectra related to observatory programs were reduced.

WORK PERFORMED

After significant troubleshooting, staff repaired the CCD electronics package. It was possible to obtain good sensitivity and error values for several test images, but a time-dependent instability remained. Many attempts were made to find the cause of these fluctuations.

Staff members installed a new CCD electronics system on 5-wk loan from Dr. Klinglesmith. After becoming familiar with the system, staff also designed and machined an adapter to mount the CCD onto the spectrograph and telescope. Task members began testing the Boller and Chivens Coude spectrograph by measuring line resolution as a function of slit width for numerous diffraction gratings.

The time-dependent fluctuations in bias and rms error levels that had existed in the PSI CCD system were eliminated. A new on-card power supply was installed, several faulty TTL chips were replaced, and a new analog-to-digital chip was installed on the CCD head electronic videoboard. After repeated testing, bias and rms levels remained consistent.

Observations of Jupiter, Vega, and Arcturus were conducted with the PSI CCD system and spectrograph at the Goddard Geophysical and Astronomical Observatory (GGAO). The observations were matched with a variety of known-wavelength calibration lamps to identify spectral lines. H-alpha, H-beta, and H-gamma absorption lines were visible in spectrographic images of Vega. Similar line identification was performed using Dr. Klinglesmith's Kodak/Photometrics CCD system.

Staff members began to appropriate materials for construction of a flat-field apparatus. Staff installed cable guides in the Coude room of the GGAO and a wire-spool rack in the tool room. Staff also excessed items in storage at the observatory and designed a new universal plate to mount Dr. Klinglesmith's CCD camera onto a variety of spectrograph lenses.

IUE spectra were reduced and analyzed as required.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Continued support for observatory instrumentation development, repair, and maintenance will be performed. IUE spectra will also be reduced and analyzed as needed. Construction of the flat-field apparatus will begin. A Work Control Plan will be prepared for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
1,800 (connect)	IUE RDAF VAX

NASA Task 82-314-00: STIS Diffraction Grating Selection and Characterization

GSFC ATR: ***Dr. B. Woodgate***

Hughes STX Task Leader: ***Dr. C. Standley***
Hughes STX Task Number: ***882***

This task characterizes and selects the flight diffraction gratings for the Space Telescope Imaging Spectrograph (STIS) and optically simulates operating modes prior to launch.

FINAL CONTRACT SUMMARY

The duration of this task was from January 1 through September 1, 1993. The task leader, an optical engineer, was the only Hughes STX staff member working on this project during the period. The major milestones met were the construction and use of the STIS optical simulator for grating evaluation in the ultraviolet (UV).

The task's remaining objectives follow:

- To complete testing of all 32 nonflight STIS gratings.
- To make recommendations to Ball Aerospace for flight gratings.
- To test flight gratings prior to integration into the flight instrument.

SUMMARY FOR CURRENT REPORTING PERIOD

Of the 32 STIS evaluation gratings, 20 examples were received. All were tested for figure, nine were tested for efficiency, and two visible gratings (NG31H and NG41M) were tested for scatter.

The task leader's work concentrated on the development of the UV experimental setup. The equipment necessary to measure grating characteristics in the UV was assembled and integrated with a MAMA detector and software written by P. Kenny (GSFC) and F. Varosi into a STIS optical simulator.

WORK PERFORMED

STIS Mode Simulations and Vacuum Testing

Mode 1.3

The optics, mounts, and stages required to simulate Mode 1.3 of STIS were assembled and aligned on a vacuum-compatible Newport optical bench. The bench was lifted into the Diffraction Grating Evaluation Facility vacuum chamber a number of times, and the following experiments were conducted at a pressure of approximately $1e^{-5}$ torr:

- **NG13P Efficiency**—The efficiency of this cross-disperser from Perkin Elmer was measured from 117.6 nm to 177.7 nm. A peak absolute efficiency of 59 percent was seen at 140.4 nm.

- **NG13HI Efficiency**—The efficiency of this cross-disperser from Hitachi was measured from 117.6 nm to 177.7 nm. A peak absolute efficiency of 57 percent was seen at 134.6 nm.
- **EG13M Blaze Angle**—The blaze angle of this echelle from Milton Roy was measured at 32.46 degrees (different from the 32 degrees specification). The Mode 1.3 setup was adjusted to account for this deviation from specification.
- **EG13M Efficiency**—The efficiency of EG13M was measured in two orders, and a peak of 13.6 percent was found at 165.6 nm. Several full-format echellograms were taken and the data passed on to STIS calibration scientists.

Optics Mounting Hardware

Additional mounts for STIS optics in vacuum and air were ordered. These mounts will give the current vacuum setup more flexibility and allow Band 2 measurements to be performed in air.

Light Sources

Additional hollow cathode lamps were ordered from ISTC for use in the grating measurements and calibration.

Detectors

The MAMA detector from Ball Aerospace continued to work well. It has now been operational since April 1993 (6 months). May flat fields, efficiency measurements, and echellograms were recorded. At one point, the background count rate increased from 400 counts/sec to 10k counts/sec while the MAMA was in vacuum. However, after the MAMA was brought back to atmospheric pressure, the MAMA once again worked flawlessly.

The variation of total counts with applied channel plate voltage continued on a regular basis. No significant change in the data was seen.

Data Acquisition and Experiment Control

A Sun computer is now controlling the vacuum experiments. Kenny and Varosi have produced software to control the STIS optical simulator and acquire, reduce, display, and store the task's grating measurements. Incremental improvements to this software are being made.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The current schedule calls for the task to make recommendations for flight gratings to Ball by the beginning of 1994. As replicas of each grating are received, staff will be able to pass on its decisions to Ball; however, staff will not allow the schedule to slip. If staff members have only a single example of a grating and feel it meets flight specification, its purchase will be recommended.

The most important goal for the next 4 months is to get well into the testing of UV gratings. Three Band 1 gratings have been measured for efficiency, and scatter measurements on NG13P and NG13HI are the most immediate tasks. The UV STIS simulation is complete, and a substantial effort must be made to measure gratings quickly and keep up with the schedule.

The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	486 PC

NASA Task 82-315-00: Solar and UV Instruments

GSFC ATR: *Dr. T. Gull*

Hughes STX Task Leader: *B. Puc*
Hughes STX Task Number: *881*

This task provides data support for solar and ultraviolet instrument development. Support will include computational and algorithm support for flight and laboratory experiments, data analysis, computer-aided design, and test and maintenance of computer equipment.

FINAL CONTRACT SUMMARY

The duration of this task was for 1 year commencing in fall 1992. One individual was working under this task as a support scientist. Major accomplishments for this task were supporting the renovation of Rm. 117 in Bldg. 21 into a detector development lab and supporting the diffraction grating evaluation effort for STIS. Task accomplishments include sorting, evaluating, and cleaning out the old equipment in Rm. 117 and Rm. 117A; and specifying new requirements for the new lab equipment and personnel. Remaining objectives are to install, start up, and operate the new vacuum test chamber, configure the new equipment in the lab, finalize the layout and workflow in the lab, continue supporting the grating evaluation work for STIS, and provide support to the CID development work commencing in October.

SUMMARY FOR CURRENT REPORTING PERIOD

Rm. 117 and Rm. 117A were cleaned and most old equipment excessed. New equipment for the Detector Development lab was specified. New lab requirements were determined. Support was given to the STIS gratings evaluation effort in the Diffraction Grating Evaluation Facility (DGEF) lab in Bldg. 5.

WORK PERFORMED

The old vacuum tank system was removed and excessed from Rm. 117. Old equipment was sorted and evaluated for usefulness and excessed. The requirements for the new vacuum test chamber were determined, and a preliminary design agreed upon. A vibration-isolated optical bench was specified and purchased, and a floor plan was developed for the new lab equipment and personnel.

Task members supported the grating evaluation work for STIS. A vacuum-compatible optical bench was used to breadboard the optical configuration of the STIS instrument. Echelle gratings and cross-dispersers were evaluated in the DGEF.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Hours	Computer
408	Sun SPARCstation

NASA Task 82-316-01: HST Project Science for Operations and Ground Systems

GSFC ATR: ***Dr. R. Polidan***
Cognizant NASA Scientist: ***Dr. M. Niedner***

Hughes STX Task Leader: ***Dr. J. Childs***
Hughes STX Task Number: ***879***

This task provides support to the Hubble Space Telescope (HST) Project Scientist for Operations and Ground Systems (O&GS). Support will include analysis of HST operations problems; planning for improvements to ground and flight software systems; evaluation of science operations needs for future instruments; evaluation of ground and flight software readiness to support the science program; and support to the O&GS Project Scientist in relation to the HST user committee, the Guaranteed Time Observers Coordinating Group, and the Instrument Development Working Group; astronomical data collection; star catalog preparation and analysis; and proposal preparation for future funding of projects related to new or improved star catalogs for NASA satellite guidance and tracking.

FINAL CONTRACT SUMMARY

This task has been in place from May 1992 to the present. The work has been performed by the subcontractor Global Science & Technology (GST), Inc. The staffing has included one full-time senior engineer, one part-time principal engineer, a part-time senior analyst, a part-time system analyst, and a part-time program manager. Highlights of task activities under this contract include the following: GST, Inc., performed a study of the science efficiency of the HST spacecraft by analyzing scheduling and operations files, and made recommendations for improvement. Staff prepared a reference star catalog, complete to magnitude V=6.01. Staff performed orbit decay analysis of HST spacecraft and determined reboost requirements for future Shuttle servicing missions. Staff developed a software model for determining HST orbit decay. Staff also performed a study and developed software to analyze pointing history of the HST observatory and determine effects of new operational restrictions caused by recent FGS failures and Solar Array Drive Mechanism (SADE) failures.

SUMMARY FOR CURRENT REPORTING PERIOD

GST, Inc., staff continued to identify HST Shuttle reboost scenarios and discovered a conflict in HST Payload Integration Plan requirements. Staff continued to analyze GHRS efficiency from past GTO proposals. Staff made recommendations for FDF computation and presented the status of the Orbit Decay Study to SSWG.

WORK PERFORMED

GST, Inc., staff continued to conduct analysis with the SODA tool to identify HST Shuttle reboost scenarios. Staff discovered a conflict in HST Payload Integration Plan requirements in the negative margins of propellant requirements for HST rendezvous and return-to-Earth capabilities. Staff recommended a change request to the project eliminating the re-rendezvous and return-to-Earth requirements. Staff continued to analyze GHRS efficiency (using SEAL software) from past GTO proposals. Staff made recommendations for FDF computation and presented the status of the Orbit Decay Study to SSWG.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue the GHRS efficiency study and complete recommendations for FDF computation. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	GS&T PC's

NASA Task 82-316-02: HST Project Science for Flight Systems and Servicing

GSFC ATR: ***Dr. E. Cheng***
Cognizant NASA Scientist: ***Dr. M. Niedner***

Hughes STX Task Leader: ***Dr. J. Childs***
Hughes STX Task Number: ***880***

This task provides support to the Hubble Space Telescope (HST) Project Scientist for Flight Systems and Servicing (FS&S). Support will include: analysis of HST inflight performance problems having impact on the HST science program; evaluation of the HST Maintenance and Repair program and overall science program; evaluation of the readiness of the HST ground testing program to support the Orbital Replacement Instruments; interface to Orbital Replacement Instrument Teams and the Space Telescope Science Institute; and analysis of performance issues having impact on the HST Servicing Mission.

FINAL CONTRACT SUMMARY

This task has been in place from May 1992 to the present. The work has been performed by the subcontractor Global Science & Technology (GST), Inc. The staffing has included two full-time senior engineers, one part-time principal engineer, a part-time system analyst, and a part-time program manager. Highlights of task activities under this contract include the following: GST, Inc., performed a study to analyze the optical testing plans for the WF/PC-II and COSTAR instruments. Staff assisted the project with analysis of engineering issues that relate to the first servicing mission, scheduled for late 1993. Staff participated in HST First Servicing Mission project reviews, Contingency Operations Working Group meetings, and Servicing Mission & Systems Management Team (SMSMT) activities to study science issues affected by hardware, software, and servicing operations. Staff also performed systems engineering analysis to determine orbit decay scenarios that should be run by FDF.

SUMMARY FOR CURRENT REPORTING PERIOD

GST, Inc., staff developed test matrices and began development of the STIS CEI Specification - Part I. Staff participated in the HST Orbit Decay Study. Staff completed the science reinstallation matrix and a mission reinstallation matrix.

WORK PERFORMED

GST, Inc., staff developed NICMOS optical test matrices. Staff began development of the STIS CEI Specification - Part I, to be added to the existing Part II. Staff participated in the HST Orbit Decay Study, specifically in determining the Shuttle interfaces related to the study. Staff presented the science reinstallation matrix to SMSMT and a full mission reinstallation matrix to the HST Chief Project Scientist. Staff also presented Data Systems Study results to the HST SEB. Staff continued to track technical items that require closeout related to contamination, materials, and thermal issues.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Further work will be done on the test matrices, the STIS CEI Specification, and the Orbital Decay Study. The Work Control Plan will be updated for the new contract to meet the requirements for this task.

COMPUTER USE

Minutes	Computer
Dedicated	GS&T PC's

NASA Task 82-317-00: SKYMAP Catalog Enhancement

GSFC ATR: ***Dr. R. Polidan***

Hughes STX Task Leader: ***Dr. W. Warren***
Hughes STX Task Number: ***878***

This task prepares a proposal to NASA HQ to update and enhance the SKYMAP star catalog that is the primary source for guidance and tracking information for the star trackers aboard NASA space missions.

FINAL CONTRACT SUMMARY

This task was active during the period February 1 to September 30, 1993, inclusive. Hughes STX personnel consisted of a single principal scientist.

Major milestones and accomplishments over the lifetime of the task include the following:

- Definitions of the data structure, format, and content for the new version of the SKYMAP master catalog.
- Identification and acquisition of machine-readable versions of the most recent data sources to be used in the enhanced catalog.
- Formulation of a detailed procedure to be used for incorporation of the new data sources.
- Identification and analysis of selected areas of data ingest that require particular care and enhanced quality assurance to ensure that high-quality data are inserted into the new catalog.

Principal objectives for the remainder of the task under the new contract include:

- Complete the format and data content for the new SKYMAP catalog.
- Begin collaborative work with Computer Science Corporation (CSC) task personnel to examine the high-priority source catalogs and to prepare their data for incorporation into SKYMAP.
- Seek a funding source to allow continuation of the HSTX task so that Code 681 personnel can collaborate with those in Code 554 and CSC task personnel during the remaining CSC task assignment for preparation of the identified data sources.

SUMMARY FOR CURRENT REPORTING PERIOD

The series of meetings with GSFC Code 554 and CSC SKYMAP personnel continued for defining data sources and content for the new SKYMAP catalog. HSTX staff worked out a hierarchical list of photometric sources, extracted lists of wide double stars and stars having composite spectra from the Bright Star Catalogue (BSC) and provided them to SKYMAP enhancement personnel. HSTX staff also acquired a new large catalog of wideband photometry from the Sternberg Institute in Moscow. The SKYMAP group continued to define the new format for the catalog and prepared a list of hierarchical data sources based on the current limitations in time and funding for the enhancement project.

A preliminary analysis of a sample of double and multiple stars in the acquisition and tracking star catalog for the XTE mission was prepared for P. Newman (Swales Associates), who had requested that the sample be examined. A complete analysis of the XTE catalog has been requested, but the initiation of this work will depend on possible funding from the XTE project.

WORK PERFORMED

The series of SKYMAP enhancement meetings with Code 554 and CSC task personnel continued for refining the new catalog format and the existing list of data sources, and for developing a detailed enhancement procedure based on time and funding constraints within Code 550.

HSTX personnel compiled several independent lists of stars having specific characteristics in the BSC, based on group discussions and by request from the enhancement group. These lists included stars in both the BSC and the Supplement to the Bright Star Catalogue (BSS) apparently not in the current SKYMAP master catalog. Because the identification of stars was based on the absence of certain cross-identifiers in SKYMAP, these lists must be verified by direct comparison with entries in the latter. Lists of wide double stars (separations of 100 seconds of arc and greater) and stars having more than one spectral type (composite spectra) were also prepared.

A large Russian catalog of wideband photoelectric magnitudes and colors was discovered by HSTX staff. This recently published catalog contains V-R colors and other data for approximately 13,600 Northern Hemisphere stars and will be an important source for new SKYMAP photometric data. Following an inquiry and response from the catalog authors (at the Sternberg Institute in Moscow) indicating that the catalog was unavailable in machine-readable form, a sample of a thousand stars was manually keyed into a computer file for comparison with existing wideband data for the same stars. The comparison showed that the data are of high quality, although transformation of a few quantities may be required. Subsequent to this analysis and in response to a letter sent to Moscow, the complete catalog was received electronically and is now being studied further.

HSTX staff recommended that the several systems of photoelectric R and I data, the Cousins system, should have highest priority; however, all data should be flagged with a source code so that the system is defined to the user. The data can be transformed to a uniform system for any mission catalog if that is considered necessary for a particular mission's detector system.

Many new data sources, both catalogs and individual publications, were identified and collected into a data source list. Source publication data found in the literature will be acquired from individual authors as machine-readable files, where possible; several such files have already been obtained, although time and funding limitations may not allow the incorporation of their data. However, the enhancement group defined a core list of eight catalogs whose data will be given the highest priority for ingest into the new SKYMAP.

A nearly final draft version of the redesigned data content and format for the new SKYMAP was completed. After further discussion relating to close double and multiple stars, staff added several new data fields containing double-star data or flags to the catalog to allow for specific orientation to be defined.

A detailed enhancement procedure was developed and approved by the group, based on time and funding constraints imposed by Code 554 personnel.

HSTX personnel prepared an interim (6-month) detailed report for submission to Code 400 personnel by the Code 681 ATR for the HSTX task, Dr. Polidan. The report contains background information (motivation for task initiation), objectives, a summary of accomplishments as of July 31, 1993, and plans for future work.

Following completion of an acquisition and tracking star catalog for the XTE mission, extracted from data in Version 3.7 of the SKYMAP master catalog, and a preliminary check of data for double stars by Newman, the HSTX task leader was asked to check a sample of the stars using the latest data sources. Of 18 stars checked, discrepancies in either the SKYMAP magnitude difference/component separation were found for 8 stars (44 percent). Also, four of the stars containing multiple-star data in SKYMAP were found to be single or suspected single stars.

During a second meeting with Newman on August 25, 1993, when the results of the analysis were discussed, a machine-readable copy of the complete XTE catalog was made available and a request to check the entire catalog for discrepancies in the double- and multiple-star data was made. Although much of this work can be performed by doing a comparison with the highly reliable data in the BSC, some fainter stars will require independent checks using other sources. Because the XTE catalog contains only SKYMAP identification numbers, cross-identification software will first need to be written, then a separate program to examine double- and multiple-star data will be necessary. Possible discrepant stars may then need to be examined in the U.S. Naval Observatory observational data base of visual double stars. Because this project will likely require a considerable amount of HSTX task time, the request has been brought to the attention of the ATR and some additional funding from the XTE project will probably be requested.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

All activities are proceeding according to schedule, and all requests either have been completed or are awaiting approval and additional funding. Work under this contract has been discontinued and will resume contiguously under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX staff will continue to work with Code 554 and CSC SKYMAP personnel as consultants and will perform any special services needed for the SKYMAP project.

The following specific items are planned for the remainder of the supported SKYMAP effort:

- Complete the redesigned data content and format for the new catalog. An examination of all derived data remaining in the new format is currently in progress to determine which data items, if any, should be removed from the master catalog and optionally reserved for inclusion in specific mission and run catalogs.
- Continue to review the astronomical literature for new data sources and evaluate each potential source for use in the new catalog. Continuously update the master source list as each new source is accepted for inclusion, should it become possible to ingest additional sources into the new catalog.

- Evaluate the derivation of CCD magnitudes as determined from the standard broadband UBVRI magnitudes and derive an appropriate transformation. This study is currently in progress by CSC task personnel, with the assistance of Code 554 personnel and HSTX task staff.
- Further investigate the quality and transformability of the broadband photoelectric data for approximately 13,600 stars described in an earlier section of this report.
- Begin to examine and prepare the data in the highest priority source catalogs for incorporation of the subcatalogs into the new master SKYMAP. It may be possible for HSTX staff to assist with only a few, if any, source catalogs before the current HSTX task ends.

A Work Control Plan describing the nature and organization of the HSTX task, general background, technical approach toward accomplishment of the work, defined milestones, and resources available will be prepared and submitted within 2 months of the starting date of the new contract.

COMPUTER USE

Minutes	Computer
60	Code 680 VAXcluster
7 CU's	NCCS IBM 9021

NASA Task 82-318-00: CDAC Facility Support

GSFC ATR: ***D. West*** | **Hughes STX Task Leader:** ***G. Gavigan***
Hughes STX Task Number: ***877***

This task supports the implementation of the Cosmic Background Explorer (COBE) Cosmology Data Analysis Center (CDAC). Specifically, the task's activities include continuing development, operations, and maintenance of the CDAC and the production of the Project Data Sets.

The contractor shall operate and maintain the dedicated offsite facility in support of the COBE effort. This facility includes office space and a computer room which houses computer equipment.

FINAL CONTRACT SUMMARY

Hughes STX staff managed and operated the CDAC facility as an offsite NASA/GSFC center supporting the COBE program from February 1991 through September 1993. This effort included the execution of the move of 95 personnel and 2 million dollars' worth of computer equipment within a 2-week timeframe, provision of noise/vibration control to the HVAC room, procurement and installation of the motor generator in the computer room to minimize system downtime during commercial power outages, the build-out of the Operations area to accommodate the Operations staff, the network configuration being severed into seven segments using a network hub configuration, the build-out and expansion of the library, procurement and installation of auxiliary air conditioning for Operations areas, expansion of motor generator power to include workstation rooms and all five network zones, build-out of the Guest Investigator (GI) area to include auxiliary air conditioning and motor generator power, and maintenance of accurate tracking and recording of all CDAC Government-Furnished Equipment (GFE). The level of effort for the task was one senior technician.

SUMMARY FOR CURRENT REPORTING PERIOD

This triannual period encompassed many activities to maintain and operate the facility: 1) research was performed by staff to determine the feasibility of building a fireproof data vault, and a trade study was completed to determine the most cost-effective means of storing critical COBE data; 2) numerous items were procured through the facility budget to include optical storage cabinets, a fireproof safe, and a network analyzer; 3) two moves occurred concerning tape data storage—one was a near-site move of the CDAC system and incremental backups, and the other was the NASA Tape Staging and Storage Facility (TSSF) for COBE's long-term data; 4) the build-out of the COBE GI area was completed ahead of schedule with added air conditioning and protected power; 5) staff increased its efforts in tracking and recording all GFE, and an audit conducted by the Government Property Management Branch approved the HSTX procedures.

WORK PERFORMED

In June, staff did extensive research on the feasibility of building a fireproof data vault in the CDAC. After completing this study, staff determined that it would not be a cost-effective measure. A trade study was performed of external facilities to store critical COBE data. Staff presented the results of the study to the project and determined that use of the existing tape storage facility for critical data storage would result in a significant cost savings to GSFC.

Staff procured numerous items through the facility budget including optical storage cabinets and a fireproof safe to store critical COBE data. Staff installed a network analyzer subsystem in an engineering PC to monitor various segments and ribs of the CDAC LAN. The network analyzer will troubleshoot the throughput of network traffic for faster communications across Ethernet.

Two moves occurred concerning tape data storage. The first move involved the CDAC's near-site tape storage facility at GSFC Building 2. The area in Building 2 where the CDAC's data were stored was eliminated. The new area for near-site tape storage is now located in Building 21. The second move involved the CDAC's long-term TSSF. The TSSF was moved from Landover to Lanham by contractor and GSFC personnel. After the large-scale move had been completed, staff initiated an exercise in the retrieval and distribution system to verify that it remained the same during the move. This measure ensured continuity in the CDAC's long-term data archival system.

Staff completed on schedule the build-out of the GI area to include added air conditioning and motor generator power for the workstations.

Staff increased its efforts in tracking and recording all CDAC GFE. New procedures were instituted to perform and complete a physical inventory of all furnishings and equipment. The CDAC was audited during this period by the Government Property Management Branch, and HSTX tracking and recording procedures were approved.

SIGNIFICANT ACCOMPLISHMENTS

The CDAC facility operations have continued to run smoothly. HSTX staff has taken a great deal of initiative in resolving problems and following up on planned work, in particular, the build-out of the GI area ahead of the planned schedule.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

Staff will purchase the proper surge protection for the computer facility. The move of selected personnel back to GSFC for analysis work in Building 21 will be completed. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
1,200	COBECL VAXcluster
300	Macintosh

456

NASA Task 82-319-00: Computer System Management

GSFC ATR: ***D. Klinglesmith***

Hughes STX Task Leader: ***P. McCaslin***
Hughes STX Task Number: ***850***

This task supports the implementation of the Cosmology Data Analysis Center (CDAC). Specifically, the task's activities include the following computer system and hardware support: 1) computer system management, disk space analysis, and performance analysis; 2) maintenance and upgrade of the VAX/VMS operating system and layered products; 3) system tuning; 4) systems support for hardware maintenance and upgrades to the COBECL cluster; 5) regular archive backup including integration and operation of the offlining subsystem; 6) network/security management both internal and external to the CDAC; 7) computer operations support 24-hours, 7 days per week, as needed, to maintain operational status of the computer system; and 8) support for the efforts to augment and upgrade the CDAC facility.

FINAL CONTRACT SUMMARY

This task provided computer system management support for the COBE project. Over the course of the contract the scope of this task has increased as the COBE computer systems have grown in size and complexity. Task members have maintained computer systems through numerous operating system upgrades, as well as additions and upgrades to layered products and third party software. In February 1991, the COBE computers were relocated from GSFC to the Cosmology Data Analysis Center (CDAC). This was accomplished with minimal disruption to ongoing processing. The level of effort for the tasks ranged from six-four full-time personnel consisting of technicians and system programmers.

SUMMARY FOR CURRENT REPORTING PERIOD

This tasks supports the implementation of the CDAC. Specifically, the task members performed the following computer system and hardware support:

- Computer system management, disk space, and performance analysis.
- Maintenance and upgrade of operating systems and software products.
- System tuning.
- Systems support for hardware maintenance and upgrades to CDAC computer systems, including the COBE Guest Investigator System (CGIS).
- Disk backups.
- Security management.
- Support 24 hours per day, 7 days per week, as needed.
- Support for system augmentation and upgrade.

WORK PERFORMED

Hughes STX staff provided comprehensive computer system management support, with personnel on call 24 hours per day, 7 days per week.

CDAC magnetic disks were regularly backed up according to the published schedule. All backup logs were examined for errors.

CDAC VAXcluster I/O performance issues were addressed: An I/O bottleneck at the system disk, I/O queues at the HSC's, and contention at CI nodes.

A new HSC95 provides faster access to and caching of critical disks including the system disk. Approximately 33 percent of the I/O requests to cached disks are being satisfied from cache, resulting in faster interactive response and quicker batch job completion.

Obsolete RA80 and RA81 disk drives were replaced with RA73 disk drives. The RA73 drives have an average access time of 12.5 ms, compared to 36.3 ms for RA 81 drives, providing increased I/O performance.

Replacement CI interfaces on disk serving VAXes furnish twice the throughput of the boards they replace (2.6 MB/sec peak throughput vs. 1.2 MB/sec).

Phase II Volume Shadowing was implemented and shadowing was extended to additional disks, providing I/O performance increases and disk redundancy.

Staff performed project coordination and systems management services for the establishment of the CGIS. A VAXstation 4000 Model 60 was removed from the COBE cluster and setup in the CGIS workroom as a standalone node in anticipation of the arrival of guest investigators. In addition, a Macintosh computer and a DECstation 5000 Model 200 RISC platform (running ULTRIX V4.3) were installed in the CGIS workroom. All three platforms were configured by systems management staff with system software and additional scientific software packages needed to support the guest investigators.

Task members provided extensive support to the DIRBE and DMR subsystems to optimize their processing environment. Tailored environments with local SCSI disk stripe sets and intensive system tuning realized significant I/O improvements for both subsystems.

Systems management staff worked closely with systems engineering and hardware vendors to identify potential CDAC system architectural modifications to support increased COBE analysis activities. Staff supported in-house FDDI testing using an ALPHA workstation to demonstrate feasibility of FDDI for future growth.

Staff installed the following software:

- IRAF V2.10 for VMS.
- DTA (Dynamic Tape Accelerator) for VMS.
- GCC V2.4.5 for VMS.
- GCC 2.4.5 for ULTRIX.
- Version 1.1 updates of DECPS for VMS.
- FTOOLS for VMS.
- IMSL Version 2.0 for VMS.
- A2PS PostScript converter for VMS.
- C-KERMIT for VMS.
- Volume Shadowing Phase II for VMS.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

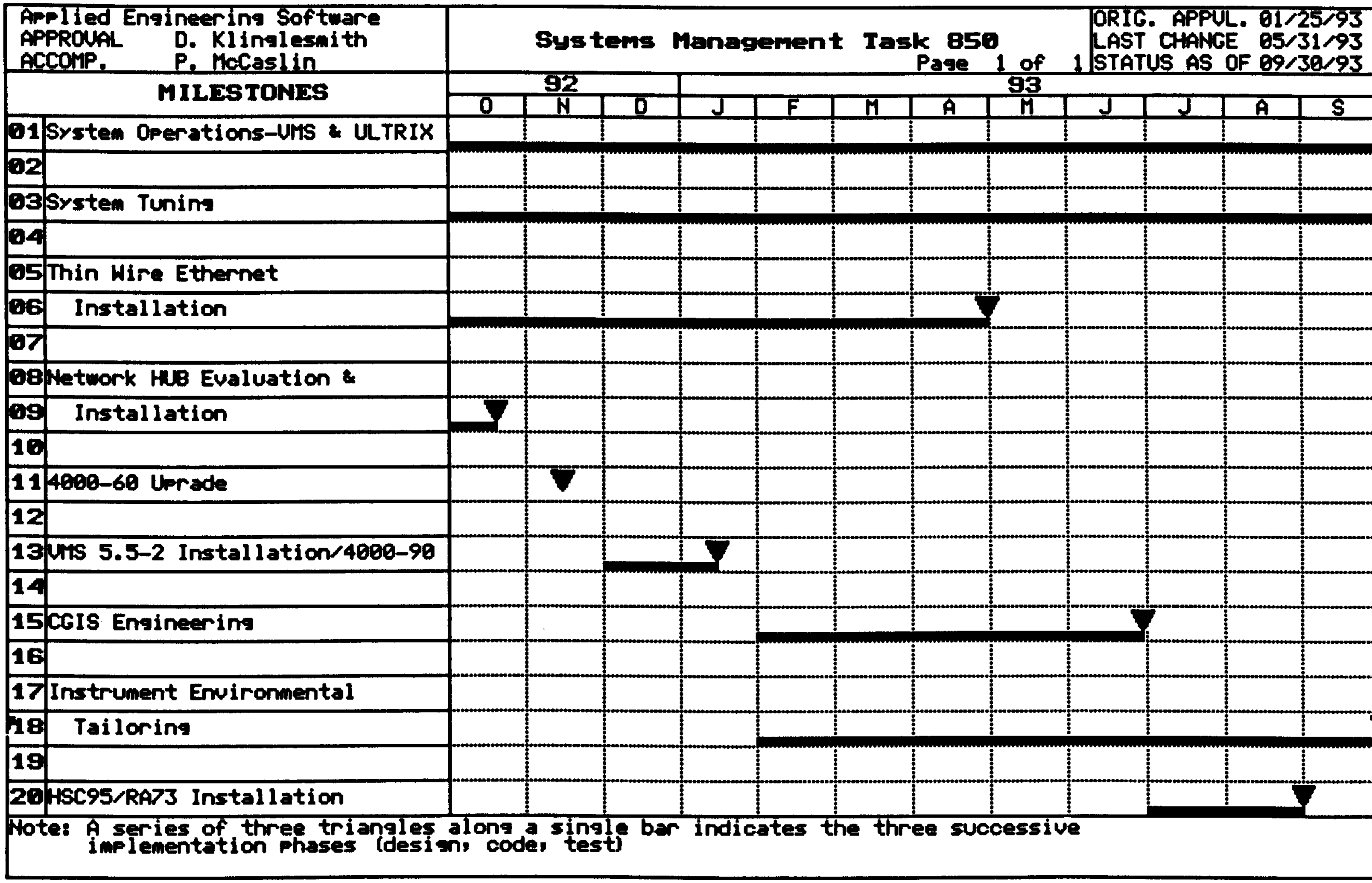
Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

HSTX staff will continue to support the operation of the CDAC computing systems, providing around-the-clock response. Task members will install and integrate new equipment that currently is in the purchasing pipeline. A Work Control Plan that meets the requirements of Contract NAS5-32557 will be prepared.

COMPUTER USE

Hours	Computer
2,600 (wall clock)	COBECL VAXcluster
600 (wall clock)	CUBA, HAITI (ULTRIX DECstations)


Applied Engineering Software
APPROVAL D. Klinglesmith
ACCOMP. P. McCaslin
Systems Management Task 850
Page 1 of 1
ORIG. APPVL. 01/25/93
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93
MILESTONES
92
93
O
N
D
J
F
M
A
M
J
J
A
S
01 System Operations-VMS & ULTRIX
02
03 System Tuning
04
05 Thin Wire Ethernet
06 Installation
07
08 Network HUB Evaluation &
09 Installation
10
11 4000-60 Upgrade
12
13 VMS 5.5-2 Installation/4000-90
14
15 CGIS Engineering
16
17 Instrument Environmental
18 Tailoring
19
20 HSC95/RA73 Installation
Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

NASA Task 82-320-00: Core Subsystems and Operations

GSFC ATR: ***D. West***

Hughes STX Task Leaders: ***S. Kaltenbaugh and P. McCaslin***
Hughes STX Task Number: ***851***

This task supports the implementation of the Cosmology Data Analysis Center (CDAC) software as well as the operational system.

Core Software

This support comprises the software integration and test as well as the maintenance, analysis, design, and implementation of approved enhancements to configured software in the following areas: 1) Utilities Subsystem—Interactive Offline Processing System (IOPS) and Graphics Display System (GDS) implementation on the CDAC VAX and detached workstations; 2) Utilities Programs—Field Retriever, Archive Data Server, Strip Chart, and Page Display; 3) Data Management Subsystem—COBEtrieve utilities and extensions, Skymap access and manipulation utilities, history recording software, and archive maintenance utilities; 4) Astronomical Data Base (ADB) Tools—analysis, design, and implementation activities required to ingest and access Astronomical data needed for the production and analysis of the COBE data; 5) Mission Planning and Instrument Command Verification Subsystem; 6) Archive Maintenance—catalog tools and online/offline data storage tools; 7) Attitude Subsystem—gyro calibration software and operational procedures for monitoring, and analysis of the attitude data; and 8) Ingest and Spacecraft Subsystem. In addition, this task provides maintenance of the Astronomical Image Processing System (AIPS) on the CDAC computers.

System Software

This support includes the design and implementation of software that improves the efficiency of the configuration management, development, or operational system including the following: 1) development of image processing techniques; 2) design and implementation of system tools that support the configuration management system, the production operations, or management information; 3) implementation of the COBEtrieve Data Server, including both the data server running on the COBECL VAXcluster under VMS and the client software to run under different operating systems and comprised of a FORTRAN-callable interface to operate the server; and 4) maintenance and enhancements as required to the Notebook software data base system.

Configuration Management, Testing, and Software Release

This support includes the configuration management of the CDAC software, that was previously delivered and of all software changes to it. Also included is the development and maintenance of the regression test environment, the regression testing, and the routine releases of software to the operational configuration.

Operations

The following CDAC-wide facilities are also supported: 1) design, implementation, and documentation of CDAC operational procedures; 2) operation of all CDAC software elements required for production of the Ingest and Attitude products and for quick-look and edit production processing of the instrument pipelines; 3) data base administration for the COBE archives.

Project-Wide Support

This support consists of the planning, monitoring, and documentation of the CDAC software and operational system.

FINAL CONTRACT SUMMARY

Subtask 1: Core Software

This task was added to the contract in 1990 to provide software support to the COBE project. Primarily, the staff members working on this task were programmer analysts and systems analysts with an average of 12 people. The major accomplishments were the support of the instruments tasks during their production passes, the ingestion of the raw telemetry and resolution of problems with the Sensor Data Processing Facility, the attitude solution production through 1992, and the ongoing spacecraft pipeline production.

Subtask 2: System Software

This task was added to the contract in 1990 to provide system software for the COBE project. Primarily, the staff members working on this task were programmer analysts and systems analysts with an average of two people on the task. Its major accomplishment has been the completion of the COBEtrieve data server. Other tasks include enhancements to the configuration management and testing software (e.g., the test log facility).

Subtask 3: Configuration Management, Testing, and Software Release

This task was added to the contract in 1990 to provide configuration management and testing support for the COBE project. Primarily, the staff members working on this task were technical specialists with an average of three people. The CM and testing systems were already in place when this subtask was added to this contract. These systems continued to evolve as the needs of the project changed. This task was instrumental in providing the project with smooth transitions for operating system and third party software upgrades.

Systems Engineering

Task members performed performance analysis, isolating performance problems and recommending solutions to optimize use of existing equipment. Extensive interviews with key members of the customer and user community were performed to characterize existing and anticipated processing activities. Long-term strategic architectural planning resulted in recommendations for future hardware acquisitions to meet long-term COBE processing needs. This activity has been supported by one senior system engineer.

Subtask 4: Operations

Hughes STX operations staff has provided a variety of services on this contract: real-time and near-real-time data processing during the early portion of the COBE flight mission, telemetry ingest and analysis, production pipeline processing, and comprehensive data management of the COBE public archives.

Over time, the task's emphasis shifted from a data processing role to a data management role. Maintaining the integrity of the COBE public archives, and providing timely access to COBE data in support of production and analysis activities were crucial services performed by task members. The support staff consist of operators and senior operators with an average of four people.

SUMMARY FOR CURRENT REPORTING PERIOD

The long-term spacecraft trend plotting was completed and distributed. The 1992 review of the attitude solutions was given. The solutions met or exceeded the requirements and are being successfully used for the instrument passes of the data. For the 1993 data, immediately after the failure of the C-gyro, software was put in place to provide solutions for quick-look operations. This innovative approach of determining the continuously changing spacecraft attitude without the gyro data in an operational scenario probably is the first ever such attempt for any spacecraft mission. In addition, a deviation from the nominal in the spacecraft attitude control was first recognized by HSTX staff and reported to the Flight Operations Team at GSFC for corrective action.

The HSTX operations group provided comprehensive data management of the COBE public archives and performed COBE production pipeline processing. Key areas of support include:

- Data management of COBE public archives.
- Quick-look processing of new COBE data.
- Attitude production processing.
- Spacecraft production processing.
- DIRBE production processing.

The HSTX Systems Engineering group defined the strategic architectural plans of the CDAC computing environment. Key areas of system engineering support are:

- System architecture optimization.
- Strategic planning.
- Data compression.
- Performance monitoring.
- Guest Investigator program support.
- PC support.

WORK PERFORMED

Subtask 1: Core Software

Attitude personnel provided quality assurance (QA) analysis for the daily attitude processing. In response to the C-gyro failure in July, software was immediately made operational to do attitude determination with a newly devised method that uses no gyro data. The transition to the new software was immediate, smooth, and successful. Since then, an improvement was incorporated to enhance the solution accuracy by 30 percent. Currently, the accuracy being achieved with the no-gyro case is within 20 percent of the 1-sigma specification for the gyro-based attitude solutions.

The QA of the 1992 Pass 2 attitude solutions was carried out and a review of the same was presented. These solutions are being used by the DMR team for their current processing.

A deviation from the nominal in the spacecraft attitude control was first recognized by HSTX task staff by monitoring the spacecraft attitude behavior and confirmed through the attitude sensor observations. This information, along with the substantiating plots, was passed on to the Flight Operations Team at GSFC for corrective action.

Task members collected and documented additional external astronomical data bases (ADB). An ingest was done for the Weaver Williams data set as requested by members of the Science Working Group (SWG). Hardcopy documentation of the ADB's was collected and placed in the CDAC library.

The spacecraft long-term trend plots were completed. Task members worked with the SWG to adjust the plots so that they would be most useful. The plots were placed in the instrument work rooms, as well as the library to aid in science analysis. Support for the production of the medium-term plots is ongoing. Task members encouraged the creation of a FIFO print queue to reduce the amount of manual sorting that would have been needed without it.

Several enhancements were made to the DBA software. Most notably was the new SCAT program to list the archive contents. Because it does not depend on DATAtrieve as the original archive listing tools did, it is much faster (CCR 728). Also, to facilitate the backing up of DMR data sets a modification was made to CNF to allow the times in the archive catalog to be changed. The jukebox code was removed from the system (CCR 654).

Staff delivered all core facilities documentation that will be printed in manual form exists. Conversions for several online help files that need to be converted.

Task personnel continued to fix problems in the code as they were reported. This included a correction to UDF so that the it will work with the latest release of the FITSIO package; an addition to the XFM shareable image for DIRBE processing; minor corrections to the USA facility to make it more robust; the IOPS Input routine now has a default size of eight for complex variables rather than four.

Task personnel continued to support the operations staff by responding to problems and questions associated with ingest, attitude, and spacecraft data processing.

Subtask 2: System Software

In support of the systems engineering task of procuring an ALPHA machine, task members verified that the data client could be ported to that platform. In addition, two studies were done to determine the effort involved in porting the DBA tools to the machine and the data server.

Staff analyzed a problem with the DMR DIDL facility. It was tracked to the upgrade to IMSL 2.0 and then turned over to DMR for correction.

Two new qualifiers were added to the read_skymap interface of the data client. These will allow faster access to the data for the BUILDMAP routine.

Support was given to the CGIS group in adding routines to UIDL.

The programmer's documentation was completed.

Subtask 3: Configuration Management, Testing, and Software Release

HSTX CM and Testing staff configured, tested, and released Builds 10.7C–11.1B. After review and approval of software changes by the Engineering Review Board, each build was configured and, after satisfactory completion of testing, released to the user community.

With the release of each build, CM loaded source code deliveries into Code Management System (CMS) libraries and performed maintenance procedures.

Quickfixes were implemented in the operational configurations as necessary. In particular, each quickfix also was incorporated into the Level-2 (L2) configuration, which was current at the time. Quickfixes for the L2 library are coordinated closely with testing personnel to maintain a stable test environment.

Additionally, CM staff maintained the Data Attributes File Specification (DAFS) data base in all libraries. Quickfix (QFIX), Facility, and System Problem Report (SPR) data bases also were maintained. Status reports were generated routinely. The hardware inventory data base was maintained.

CM staff continued to support the CGIS.

IMSL V2 was tested in a separate environment that was built by CM staff in the previous reporting period. Throughout the testing cycle, CM staff maintained this environment with the latest software changes. Comparisons were made between results from IMSL testing and the current build at that time to verify that the CSDR software system would not be disrupted by the inclusion of IMSL V2.

Regression testing of data compression continued in the Level-3 environment. A separate data compression environment was built by CM staff, and testing was implemented.

Testing staff supported changes in the attitude pipeline, as well as testing of the new attitude software for processing data without gyro, due to gyro failure.

CM task members completed an SCA build in support of analysis for the purchase of an ALPHA machine.

CM/Testing staff performed cross-training to provide continuing support in all areas of CM and Testing procedures.

Systems Engineering

Task members performed detailed cluster performance analysis and identified significant CDAC VAXcluster problem areas: An I/O bottleneck at the system disk, I/O queues at the HSC's, memory shortages on workstations, and contention at CI nodes. Staff identified system architectural changes that have reduced or eliminated these significant CDAC processing bottlenecks. A new HSC95 provides faster access to and caching of critical disks, obsolete disk drives were replaced with faster and more dependable RA73 disk drives, and replacement CI interfaces on disk serving VAXes furnish twice the throughput of the boards they replace.

Task members provided the COBE PI Group with extensive information and recommendations regarding future CDAC processing facility growth options. The following equipment is now in the procurement pipeline: An ALPHA 3000/400 OSF/1 workstation for DMR, an ALPHA 3000/400 OpenVMS AXP workstation for DIRBE, approximately 45 GB of additional online storage for DIRBE, an ALPHA 7000 OpenVMS AXP cluster server. These additions to the CDAC facility will supply an enormous increase in processing capability while also providing flexibility for future undefined analysis activities.

Cluster performance analysis techniques have been improved with: The acquisition of a network analyzer, the upgrade of DECps utilities, HSC95 cache analysis tools, enhanced user statistics code, and collection of network hub statistics.

Research on options for anticipated analysis needs continued. Including X-terminals or graphical display terminals, FDDI connectivity, and the eventual relocation of equipment GSFC.

Subtask 4: Operations

HSTX task personnel continued to provide support to the COBE flight operation, generating command integrated prints on a weekly basis. Staff provided a history of the commands executed through Command Storage Memory (CSM) for the duration of the mission.

Operations staff provided all necessary COBE mission support; routinely providing three-shift, 5 days/week coverage. Weekend support was provided as needed, to meet project production timelines.

Operations staff successfully performed daily quick-look processing of COBE Edit, prerelease, L2 CDAC application software testing and verification, transfer and ingest of Orbit/Ephemeris data, attitude and telemetry analysis, daily maintenance of the mission processing archives, and updates to reference archives.

Telemetry Operations continued the task of analyzing and performing quick-look processing of COBE raw Edit data as they become available from the Sensor Data processing Facility (SDPF). Newly received COBE raw edit data are routinely ingested, and processed through the Spacecraft, Attitude, and DMR pipelines.

Operations commenced duplication of all optical disk platters containing COBE data. These duplicate platters will be stored at an offsite facility.

Documentation of operations and systems procedures is ongoing.

Production of definitive attitude solutions for 1992 was completed.

Production of long-term spacecraft trending plots for the entire COBE flight mission were completed. Medium-term spacecraft trending plots currently are being produced.

Definitive ingest of the first 6 months of 1993 data was completed.

Spacecraft pipeline processing of the first 6 months of 1993 was completed.

Generation of definitive attitude solutions for the first 6 months of 1993 started.

Operations provided extensive data management support to DMR Pass 2 processing and DIRBE Pass 2 preparations.

DIRBE Pass 2 processing is in progress.

Operations provided support to various analysis activities, performing extensive data file movements to make COBE archive data available to the analysts.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

Subtask 1: Core Software

Task members will support the attitude and spacecraft production runs by performing QA analysis on the data, by correcting any software problems that are uncovered, and by refining the gyro calibration parameters as needed. In particular, the spacecraft medium-term plotting will be completed, and the attitude pass for 1993 will be started.

Task members will continue to support all subsystems with enhancements and fixes as needed.

Task members will continue to work on the software and procedures for ingesting external astronomical data bases. Additional requested data sets will be collected.

Subtask 2: System Software

Additional support will be given for conversion to the ALPHA platform. Also, support will be given to the CGIS group as needed.

Subtask 3: Configuration Management, Testing, and Software Release

HSTX Configuration Management and Testing staff will continue to follow the weekly build and test schedule.

Quickfixes will be installed in the released configurations as required. Every cluster quickfix also will be incorporated into the current L2 configuration.

CM personnel will continue to maintain Code Management System (CMS) libraries, as well as the SPR, QFIX, Facility, and DAFS data bases. Automated CM tools will continue to be developed and modified as needed.

CM personnel will continue to support the subsystem Project Evaluation and Review Technique (PERT) charts, the configuration of which is maintained by CM.

The integration of CGIS into the CSDR configuration management system will continue.

Testing in the data compression environment will continue.

Systems Engineering

Task members will assist in the procurement of new equipment: ~45 GB of disks for DIRBE analysis, an ALPHA 7000 MSCP disk server, and two ALPHA 3000/400 workstations.

New network analysis routines suitable for an FDDI environment will be developed.

Systems engineering support will be provided for the move of the COBE Guest Investigator Systems (CGIS) to GSFC.

The effort to port key COBE software routines to the ALPHA AXP environment will be supported.

Subtask 4: Operations

Task personnel will continue to provide weekly command integrated prints in support of the COBE flight operation.

Operations staff will continue to support daily quick-look processing with routine daily ingest and processing through the Spacecraft, Attitude, and DMR pipelines.

The operations staff will continue to provide all required operations support including extension of support through weekends to meet project schedules.

Medium-term spacecraft trending plots for the entire COBE flight mission will be produced.

DIRBE Pass 2 will be run.

Operations will continue to provide comprehensive data management of the COBE public archives. Production and analysis activities will be supported with all necessary file migrations.

DELIVERABLES SUBMITTED

Subtask 3: Configuration Management, Testing, and Software Release

Software: CSDR Software Builds 10.7C–11.1B
Originator: HSTX Configuration Management and Testing Team

COMPUTER USE

Subtask 1: Core Software

Hours	Computer
4,000 (wall clock)	COBECL VAXcluster

Subtask 2: System Software

Hours	Computer
880 (wall clock)	COBECL VAXcluster
8 (wall clock)	STARS VAXcluster
24 (wall clock)	CUBA ultrix workstation
8 (wall clock)	HAITI ultrix workstation

Subtask 3: Configuration Management, Testing, and Software Release

Hours	Computer
620 approx. (wall clock)	COBECL VAXcluster
16 (wall clock)	ULTRIX machines

Systems Engineering

Hours	Computer
2,400 approx. (wall clock)	COBECL VAXcluster

Subtask 4: Operations

Hours	Computer
2,400 (wall clock)	COBECL VAXcluster

Applied Engineering Software APPROVAL D. West ACCOMP. S. Kaltenbaugh	Core Task 851 Page 1 of 5	ORIG. APPVL. 10/01/90 LAST CHANGE 05/31/93 STATUS AS OF 09/30/93

	MILESTONES	92 O	N	D	93 J	F	M	A	M	J	J	A	S
01	Data Management & Utilities												
02													
03	Data Compressions Development												
04	(skymaps)												
05													
06	UDF Facility (CCR#655)												
07													
08	Regression Test Tool (CCR#331)												
09													
10	Automate DBA tools for optical												
11	plotter work (CCR#667)												
12													
13	SCAT (CCR 782)												
14													
15													
16													
17													
18													
19													
20													

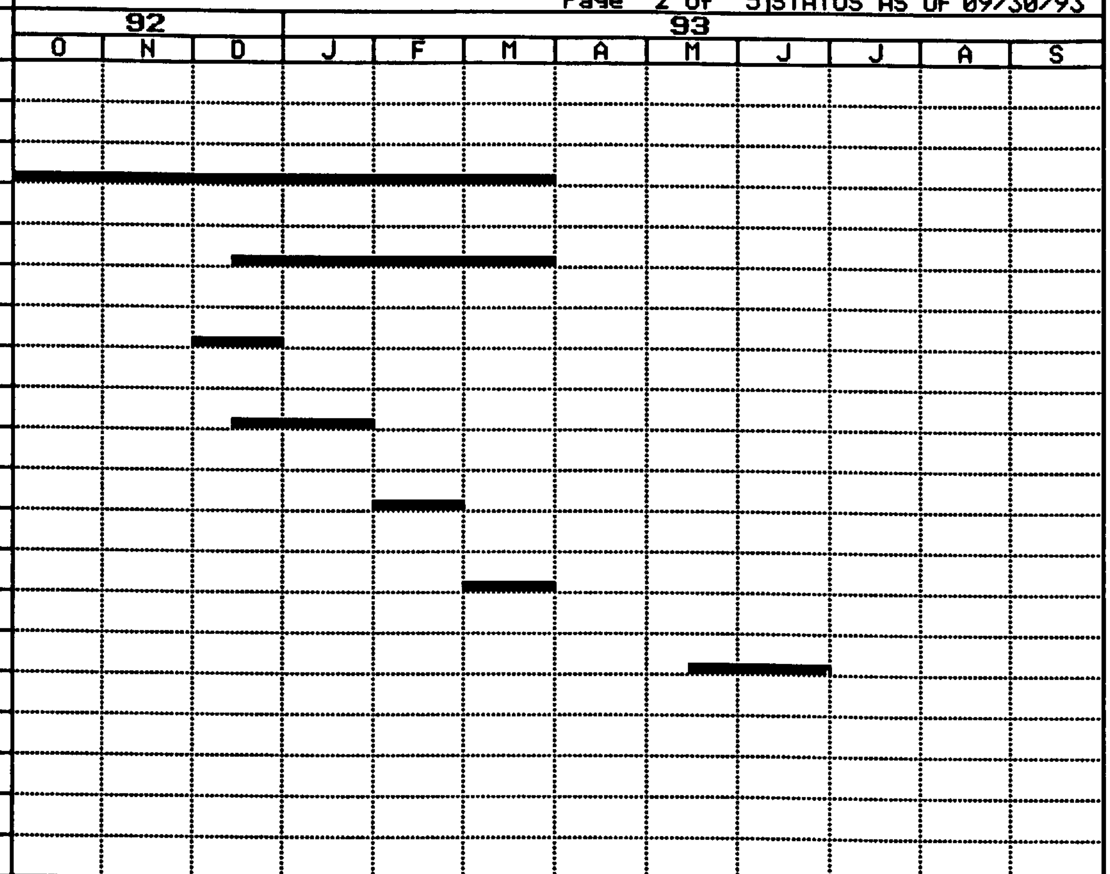
Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Kaltenbaugh

Core Task 851

ORIG. APPVL. 10/01/90
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES
01	Astronomical Data Bases
02	
03	ADB Prototyping
04	
05	Documentation
06	
07	Ingest of Greenbank
08	
09	Ingest of Reich
10	
11	Ingest of Haslam
12	
13	Ingest of Lockman
14	
15	Ingest of Weaver Williams
16	
17	
18	
19	
20	



Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Kaltenbaugh

Core Task 851

ORIG. APPVL. 10/01/90
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES	92 O	N	D	93 J	F	M	A	M	J	J	A	S
01	Ingest & Spacecraft												
02													
03	Telemetry Analysis												
04													
05	Modify trending to handle												
06	missing data												
07													
08	Support for SC trending pass												
09													
10	Support for SC medium term												
11	trending												
12													
13													
14													
15													
16													
17													
18													
19													
20													

Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Kaltenbaugh

Core Task 851

ORIG. APPVL. 10/01/90
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES	92 O	92 N	92 D	93 J	93 F	93 M	93 A	93 M	93 J	93 J	93 A	93 S
01	Mission Planning												
02													
03	Display DIRBE Non-viewed												
04	Areas (CCR#313)												
05													
06													
07													
08													
09													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Kaltenbaugh

Core Task 851

ORIG. APPVL. 10/01/90
LAST CHANGE 05/31/93
STATUS AS OF 09/31/93

	MILESTONES	92 O	92 N	92 D	93 J	93 F	93 M	93 A	93 M	93 J	93 J	93 A	93 S
01	Attitude												
02													
03	QA Support of 1992 Attitude												
04	Pass 2												
05													
06	Contingency Software												
07													
08	QA Support of 1993 Attitude												
09	Pass 2												
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

NASA Task 82-324-00: SRT Program Support

GSFC ATR: ***Dr. A. Silver***

Hughes STX Task Leader: ***F. Varosi***
Hughes STX Task Number: ***853***

This task provides support for the Scientific Research and Technology (SRT) Array Camera project by developing detector test facility software programs and hardware interface routines. Detector testing and operations will be performed on a PC in conjunction with an array processor. Postprocessing of laboratory and field data will be carried out on a Sun workstation.

FINAL CONTRACT SUMMARY

This task has been active since October 1988. The maximum working staff has been two programmers, and, currently, the staff consists of one programmer. The task has successfully supported 12 astronomical observing runs with the GSFC Infrared Array Camera, at sites such as the Infrared Telescope Facility (IRTF) on Mauna Kea, HI, and the McMath Solar Telescope on Kitt Peak, AZ. During this time, the MOSAIC image processing software package was developed, which is used by astronomers to process and analyze infrared images acquired by the camera system. MOSAIC is a powerful, extensive, interactive package written in the Interactive Data Language (IDL), and is now available to the public. Recently, a new real-time data acquisition system (hardware and software) for the Infrared Array Camera was developed and successfully used during two observing runs. This was a timely and essential development because the old system had failed and was beyond repair. Finally, task members developed IDL software to control optical testing evaluation of detectors and gratings for the Space Telescope Imaging Spectrometer (STIS). The user interface consists of X Windows widgets that give convenient means to control/read devices on a GPIB bus, control data acquisition, and analyze the resulting images.

SUMMARY FOR CURRENT REPORTING PERIOD

A digital logic problem was discovered, and the problem was corrected after a detailed analysis. Detection and correction of errors in the software proved to be too complex. Hardware solutions were analyzed. The problem of shifted pixels inside an image was solved. Staff also enhanced the MOSAIC image processing software. Task personnel supported the observing runs at IRTF, Mauna Kea, HI, and at the McMath Solar Telescope, Kitt Peak, AZ. Staff continued support for STIS detector and grating evaluation.

WORK PERFORMED

100 ARRAY CAMERA SYSTEM

A digital logic problem was discovered in the new real-time data acquisition system for the Infrared Array Camera. Defects in the signal minus reference image were noticed during lab testing of the camera system with the chopping mirror. Using an electronic image simulator in place of the infrared detector, the defects were examined more closely and found to be caused by missing samples. Each sample is a pixel pair (because the detector has two channels), and the effect of dropping a pixel pair is that the rest of the image is shifted abnormally. When a reference is subtracted from a signal image, if either image is missing a pixel, the result is a totally defective image with large variations and offsets. Normally, when the instrument observes a blank sky, the signal minus reference should give a flat noise image or, at most, a picture of the telescope beam offset pattern. Missing pixels destroy such images (that are important), and, of course, images of faint infrared sources become seriously damaged by dropped pixels.

By noting when the deviations in the signal minus reference image exceeded the expected noise level (during lab testing with the simulator), staff detected the dropped pixel pair events, and usually only one pixel pair was dropped per image. Statistics on the dropped pixel events were accumulated, and the expected interval between errors was found to be about 2 seconds. This error rate was found to be independent of pixel clocking rate; that is, the expected error interval was a fixed time so that slower clocking would result in more errors. The histogram of time intervals between errors was plotted and showed that the probability distribution of error intervals followed an exponential distribution. Therefore, this finding indicated that the errors are uncorrelated and can occur either immediately or after a long time.

Detection and correction of the errors in software proved to be impossible to implement for a wide range of observing conditions and sources. Therefore, it was necessary to find and fix the hardware problem. The hardware of the new system consists of an XBus-AD2 device that multiplexes two 16-bit parallel digital channels, from the analog-to-digital (A/D) converters on the Infrared Array Camera, into a serial fiber optic channel. The fiber optic lines then connect to an array processor (AP2) residing in the PC AT bus, which collects the data into buffers forming images and performs coaddition. The XBus-AD2 multiplexor was the suspected point of failure, so it was tested in detail using a digital logic analyzer. The detector timing generator creates 31-pixel-pair A/D convert pulses per one detector row pulse, so a simple program was coded into the logical analyzer so that it would trigger and store whenever it did not count 31 pulses per row pulse. Using this trigger program, staff examined the multiplexor circuit, tracing the external clock pulse through the circuit until the point of failure was found at a flip-flop. Examining the pulse I/O at the flip-flop, staff found that having an oscilloscope probe connected to the clock-in line made the errors more frequent, but connecting the oscilloscope probe to the reset line made the errors disappear. By soldering a 1,000-pf capacitor to ground in parallel with the reset line, staff members fixed the problem with the dropped pixel clock.

The problem of shifted pixels inside an image was solved, but another type of error was then discovered (that may have been occurring even in the old system). In the new type of error, the entire image was shifted because sometimes a pixel was added at the beginning of an image. This problem seemed to be related to the start of the frame trigger for the chop-coadd cycle, but fortunately happens rarely, about once every 2,500 chops. When staff coadded many images during each chop, the expected time between trigger errors was about 10 minutes or more, and these errors could be detected and rejected interactively during the observing runs.

200 DATA REDUCTION

Task members continued adding new features and enhancing the MOSAIC image processing software. The graphics option to push an image behind all others in the display window was generalized to handle images of arbitrary size. The MOSAIC software package is now available in the IDL astronomy library by anonymous FTP to idlastro.gsfc.nasa.gov.

Data from the two most recent observing runs were processed to form mosaics of sunspots observed coincidentally with the SERTS rocket flight, and the first-ever mosaic images of the Galactic center at 20 um.

300 SUPPORT OF OBSERVING RUNS

Task members supported two astronomical observing runs. First, from July 14–22, the infrared camera was operated at the IRTF on Mauna Kea, HI. One additional problem with the chopping mirror activation signal was solved on the first day at the IRTF. Two successful nights of observing at the IRTF yielded approximately 600 images of the Galactic center, Jupiter, Saturn, and other objects, all at a 20-um wavelength. The MOSAIC image processing software was installed on the Sun workstation at the summit and was used there to process the data and transfer the results to GSFC. From August 14–22, the Infrared Array Camera was operated at the McMath Solar Telescope, Kitt Peak, AZ. Approximately 2,000 images of sunspots at 4.8 um and 12.4 um were acquired, and, in particular, an active region of the Sun was imaged simultaneously with the SERTS rocket flight on August 15. The data acquisition control PC was successfully connected to Ethernet, and the data files were transferred to a Sun workstation, enabling immediate processing and analysis of the new images using the MOSAIC software. The data were then transferred to GSFC by Internet.

400 STIS DETECTOR AND GRATING EVALUATION

Task members continued development of IDL software to control optical testing and evaluation of detectors and gratings for STIS. The user interface consists of X Windows widgets giving convenient means to control/read devices on a GPIB bus and to control data acquisition using the MAMA detector. The resulting MAMA images can be displayed, analyzed, and stored to disk in FITS file format.

The X Window widgets consist of sliders or buttons, pulldown menus, and direct text entry. The control widget for the Klinger motion devices (each with x, y, z, and w axes) was enhanced with options to find and reset the origins, save and restore positions, or return an axis to its previous position. Software to read/write monochromator (light source with filters) was developed, along with a new widget to conveniently control the monochromator. IDL code was also developed to control/read other devices such as high-voltage power supplies, multimeters, and electrometers. A new widget was developed to control integrations with the MAMA detector, allowing the user to set the integration time, start/stop integrations, and obtain the current image. An image analysis widget was created allowing the user to conveniently display, examine values of, and compute statistics of pixels in an image. A subimage can be extracted and further analyzed, and images can be stored to disk in FITS file format. The particular MAMA detector in use has a "hot spot" that always give counts independent of illumination. The hot spot is also acquired separately by the real-time software on the Sun (written by others), and this hot spot can now be displayed in full 32-bit precision when extracted by the user from the usual 16-bit image.

SIGNIFICANT ACCOMPLISHMENTS

The discovery of, and solution to, a random digital logic problem in the new data acquisition system for the infrared camera was an essential and timely accomplishment, because the old data acquisition computer had just failed and was beyond repair (disk drive failure, with no support for an LSI-11 system). The problem was difficult to solve and required learning how to use a logic analyzer, and afterward tracing it to a flip-flop on the parallel-to-serial multiplexor circuit board (see Work Performed for more details). The circuit was stabilized with a capacitor to ground, a few days before all equipment was to be shipped to Hawaii for observing, and the system worked well during both observing runs.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Task members will continue developing and documenting the MOSAIC software for reducing and analyzing data from observing runs. Task members will continue developing IDL software to control optical testing evaluation of detectors and gratings. A Work Control Plan will be prepared for the task under the new contract.

COMPUTER USE

Minutes	Computer
Dedicated	Gateway-2000 (Lab System)
Dedicated	Sun386i (Lab System)
Dedicated	SPARC-2 (Lab System)

NASA Task 82-325-00: SMM/HXRBS Support

GSFC ATR: *Dr. B. Dennis*

Hughes STX Task Leader: *K. Tolbert*
Hughes STX Task Number: *854*

This task provides support for the Hard X-Ray Burst Spectrometer (HXRBS) instrument on the Solar Maximum Mission (SMM) spacecraft. HSTX personnel will provide software, data analysis, and data processing support for the operation, maintenance, and expansion of hardware and software systems used for the archiving and scientific analysis of HXRBS telemetry data.

FINAL CONTRACT SUMMARY

This task was initiated on October 1, 1988, and terminated on September 30, 1993. It is a continuation of a task under contract NAS5-28200 whose purpose was to provide support for the HXRBS instrument on the SMM satellite. SMM was launched in February 1980, enjoyed almost 10 years of successful operation assisted by a spectacular in-space repair in April 1984, and reentered Earth's atmosphere in November 1989. From the beginning of the task until November 1989, a team of two programmers, two research assistants, and two data technicians monitored the health of HXRBS, identified and cataloged solar flares, wrote software packages to display and analyze the data, and assisted in scientific interpretation of the data. After the demise of SMM, the team concentrated efforts on reading the more than 10,000 magnetic tapes of HXRBS data and archiving them on optical disk. The results of these efforts are published HXRBS and comprehensive SMM flare catalogs covering the more than 12,000 flares detected during the life of the mission, an optical disk archive containing 10 years of HXRBS data on 12 optical disk sides, and comprehensive temporal and spectral analysis software packages. During 1991, the team focused on developing and maintaining an online quick-look and analysis facility for solar flare data from the Burst and Transient Source Experiment (BATSE) on the Compton Gamma Ray Observatory (CGRO). In November 1991, the task was reduced to one part-time programmer who maintains and upgrades the BATSE facility software, a part-time data technician who identifies solar flares observed by BATSE and maintains a BATSE flare data base, and another part-time data technician who satisfies data requests for BATSE and HXRBS data. The facility is used regularly by the international solar physics community for a quick look at event times, event time profiles, and dumps of raw data.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff continued to support the CGRO/BATSE quick-look and archival system, cataloging more than 100 flares since May. Staff satisfied requests for HXRBS, GOES, and BATSE data.

WORK PERFORMED

100 SOLAR FLARE ANALYSIS

Task members created 10-day DC-format files for Dr. R. Shubert (Fullerton University) for the first 4 months of HXRBS data, and wrote detailed explanations of how to read and manipulate the data.

Staff created IDL save files for 1,500 HXRBS events for A. Conway (University of Glasgow).

Staff members assisted J. Blair (Fisk University) in accessing and interpreting the GOES data archive. Task members updated the REF11 reference library with more than 100 new references. REF11 will no longer function on the new SDAC Alpha computer, so a new account was set up on CHAMP and the REF11 software was installed there.

200 BATSE SOLAR FLARE ARCHIVING

HSTX staff continued processing the GRO BATSE Large Area Discriminator data, making BATSE and solar flare information available to the international solar physics community within 3 days of the observations. On a daily basis, staff examined the quick-look plots generated the previous night searching for indications of solar activity, plotted candidate solar flares in a variety of different formats to determine whether they are indeed solar flares and, if so, logged the flare in background times. Thus far, more than 4,031 solar flares have been cataloged.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX staff will continue to support solar flare analysis studies and data processing, and cataloging of BATSE solar flares. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	MicroVAX 3400 System

NASA Task 82-326-00: Infrared Spectrometer Laboratory Support

GSFC ATR: S. *Moseley*

Hughes STX Task Leader: *T. Powers*
Hughes STX Task Number: *855*

This task provides support services for infrared astronomical instrumentation in the areas of experiment control and spectrometer development for use in field observations.

FINAL CONTRACT SUMMARY

One senior analyst/programmer. Provided ongoing support for the Infrared Astrophysics Branch at GSFC. Support for existing instruments and development of new instruments for astronomical observations. These instruments are routinely flown aboard the Kuiper Airborne Observatory (KAO).

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff continued to assist with support of the 48-channel infrared spectrophotometer for observing flights on the Kuiper Airborne Observatory (KAO). Successful flights were made in April 1993 out of Christchurch, New Zealand. Development of new optics and some electronic assemblies are under way. A new liquid helium reservoir was installed on the dual stage He3 dewar. The dewar was tested and a final temperature of 255 mK was attained. In an effort to organize the lab and to more efficiently utilize the space available storage cabinets and shelves were obtained. This is part of an overall effort to maximize the working area available and to place the required instruments and components in a readily accessible area. Careful planning has gone into organizing the lab in an readily maintainable manner.

100 DUAL STAGE ^{3}HE DEWAR SUPPORT

Hughes STX staff oversaw the installation of a new liquid He reservoir for the DEWAR. The new reservoir uses an Aluminum to Stainless steel friction weld tubular transition joint for the fill tube. The use of this weld joint increases the reliability of vacuum. The initial tests produced a final temperature of 255 mK. The DEWAR is now at Yale University being used to test Josephson junctions as detectors.

200 LABORATORY SETUP FOR DETECTOR TESTS

Staff assisted with the setup for postflight tests of the 48-channel instrument. Problems with vacuum leaks in the DEWAR were found when the instrument returned to the lab. After temporary repairs were made the postflight calibration was carried out.

HSTX staff attended a LabVIEW course in preparation for use of the National Instruments software in laboratory data acquisition. LabVIEW is presently being phased in to use in the lab for data acquisition, instrument control, and data analysis.

300 48 CHANNEL INFRARED SPECTROPHOTOMETER SUPPORT

Efforts to improve the performance of the 48-channel instrument are underway. A redesigned optics can and rerouted wiring are being undertaken. The possibility of expanding to 96 channels is being considered and components for a prototype high-density junction field effect transistor (JFET) module have been ordered. A recordkeeping data base has been developed to assist with the procurement of components and equipment for instrument development and general laboratory support. The time required to get orders placed has been reduced.

PROBLEM AREAS

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

Efforts will continue to improve instrument performance in the present 48-channel configuration. Plans are underway to expand to 96 channels within the next year. System subassemblies are being considered to facilitate easier test and assembly and reduce the vulnerability of the instrument wiring to physical damage and electromagnetic pickup. A new Work Control Plan will be developed for this task that meets the requirements of contract NAS5-32350. Further integration of LabVIEW in the laboratory environment will be undertaken.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh LC III
10	CPU VAX

NASA Task 82-327-00: SHOOT, COBE, and AXAF Experiments

GSFC ATR: *Dr. S. Volz*
Cognizant NASA Scientist: Dr. A. Serlemitsos

Hughes STX Task Leader: *T. Hait*
Hughes STX Task Number: *856*

This task supports the development and qualifications of both the Superfluid Helium On-Orbit Transfer (SHOOT) experiment and the Advanced X-Ray Astrophysics Facility (AXAF) experiment. Additional support of the Cosmic Background Explorer (COBE) testing program may be required. The specific support activities include cryogenic laboratory assistance, mechanical and electrical design and development, software coding and maintenance, and project collaboration and analysis with NASA scientists and engineers.

FINAL CONTRACT SUMMARY

Since October 1988, task members provided excellent support to the Cryogenics, Propulsion, and Fluid Systems branch at GSFC. Work included COBE, SHOOT, and XRS flight projects, as well as daily cryogenic laboratory support. Two technicians and a programmer worked on the COBE project, providing preflight testing, payload closeout, and postflight data translation services. Our data analysis software helped predict when the COBE Dewar would run out of helium. The SHOOT technical staff included a scientist and two technicians, with occasional support from a technician and a programmer. Task members were involved early in the project, providing design work, mechanical and electrical assembly, and qualification testing support. Data acquisition software written for SHOOT helped calibrate and verify components. Hughes STX personnel continued to perform outstanding services on the SHOOT project throughout its successful launch on STS-57. Postlaunch data analysis and mechanical work is continuing. Two technicians supported the XRS project by assisting in the development of modular heat switches, growing paramagnetic salt crystals over solid gold buss wiring assemblies, and modifying the ADR to reduce the parasitic heat leakage. The original design goals were exceeded in both temperature and hold times. Two programmers helped design, install, and maintain the Code 713 LAN. Starting with just a few microcomputers, the LAN now supports more than 50 nodes. This support includes data acquisition systems in the laboratory.

SUMMARY FOR CURRENT REPORTING PERIOD

Task members provided outstanding support to the SHOOT flight project during critical prelaunch cryogenic servicing and closeout work. HSTX personnel served as part of the science team that controlled SHOOT activities. The mission completed all major objectives. Staff technicians assisted XRS by completing and installing the modular heat switches for a low-temperature test. Staff programmers made important enhancements to the Code 713 LAN, and instructed a 4-day LabVIEW software class.

WORK PERFORMED

200 SHOOT PROTOTYPE/FLIGHT SUPPORT

During this period, task members provided outstanding support to advance the SHOOT flight project to its successful June 21 launch. Technical staff assisted in critical testing and cryogenic servicing of the payload up to 65 hours before the flight.

During the mission, personnel served as part of the science team that controlled SHOOT activities from the Payload Operations Control Center (POCC).

Postflight support included packing the ground servicing equipment and the payload on trucks to ship back to GSFC, analyzing flight data, and deintegration of the starboard cryostat for evaluation.

300 AXAF DEVELOPMENT AND TESTING SUPPORT

HSTX technicians assisted the XRS program by completing the modular heat switches and installing them into the engineering model ADR. The modular design of the heat switch assembly allows easier charging and the addition of a redundant heat switch. A low-temperature run was set up to test the effectiveness of the heat switches. Other Dewars are being designed to further test the heat switches and ruthenium oxide thermometers.

Staff programmer support included developing of low temperature magnet controller software and integrating and testing a resistance bridge into the data acquisition system.

400 CRYOGENIC LABORATORY SUPPORT

HSTX technicians began building cables for the laboratory data acquisition network used by XRS, low temperature DDF and research work.

Staff programmers made important enhancements to the 713 LAN including hardware and software upgrades to the IBM compatibles, installing a Netware printer server in the Propulsion section, and set up a 386 Novell file server.

SIGNIFICANT ACCOMPLISHMENTS

Task members provided outstanding support to the successful SHOOT mission including final cryogenic servicing, POCC staffing, packing of the payload and GSE to ship back to GSFC, and flight data analysis.

Task members supporting XRS made significant progress by completing the modular heat switches and installing them on the engineering model ADR.

A task member took the initiative to develop and instruct a 4-day training course for the LabVIEW programming environment.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be prepared to support the Cryogenics, Propulsion, and Fluid Systems branch under the new contract.

NONLOCAL TRAVEL

Task members supporting the SHOOT payload traveled to Kennedy Space Center in Florida. The work performed since shipment include cryogenic servicing and functional testing.

TRAINING

A task member developed and instructed a training course for the LabVIEW programming environment. The 4-day class was attended by both contractors and civil servants.

COMPUTER USE

Minutes	Computer
Dedicated	HP 9000
Dedicated	Macintosh II (2)
Dedicated	Northgate 386
Dedicated	Beltron AT Clone

485

NASA Task 82-331-00: UIT Operations and Analysis Support

GSFC ATR: ***Dr. S. Neff***

Hughes STX Task Leader: ***Dr. J. Hill***
Hughes STX Task Number: ***860***

The objectives of this task are to provide preflight, flight operations, data reduction, and scientific support for the Ultraviolet Imaging Telescope (UIT); and systems and software support for the UIT Interactive Image Processing Facility.

FINAL CONTRACT SUMMARY

The UIT task continued throughout the lifetime of contract NAS5-30440. Currently, 11 individuals are working on the UIT task, including 5 astronomers and 6 programmers (2 of whom also are densitometer operators). Two students were employed during most summers as associate programmers. All necessary preparations, including writing and acquisition of data analysis software were made for the December 1990 Astro-1 mission. Task personnel staffed the Payload Operations Control Center (POCC) at Marshall Space Flight Center (MSFC); digitized the film exposures and reduced the data; delivered to the NSSDC all processed UIT data, software, and documentation; participated as first authors or coauthors of more than 15 publications based on UIT data. Currently, task personnel are preparing for the Astro-2 mission, scheduled for November 1994. In the future, the Astro-2 mission will be planned and supported in real time (including guest investigators), and data from them will be reduced and analyzed, and the scientific results will be published. Data will be delivered to the NSSDC.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff completed the rereduction of UIT Astro-1 flight images under the FLIGHT14 data stream, the final, currently planned UIT Astro-1 data product. Staff delivered FLIGHT14 data products to NSSDC through UniTree, including flux-calibrated, full-resolution and compressed images in the original and north-up orientation, with full astrometric solutions and geometric distortion corrections; completed batch and interactive BDR (pipeline) processing software; and updated MOUSSE (interactive) analysis software.

The M31 OB associations paper was accepted for publication by the *Ap. J.* (Letters). A final draft of a paper on M74 was circulated to coauthors. Analysis continued on other high-priority projects: LMC OB associations; SMC field IMF; NGC 1316; M1000; M74 HII regions; the N49 field in the LMC; and NGC1068. IUE observations of UV-bright stars in the globular cluster Omega Cen were successful, and a proposal for IUE observations of UV-bright stars in M79 was accepted. Detailed reanalysis of UIT calibration continued.

Preparations for Astro-2 continued. A basic timeline was submitted. GSE software development continued. Planning for mission operations, staffing, and guest investigator integration began.

WORK PERFORMED

Staff completed the reprocessing of all 750 UIT images for 71 targets of Astro-1 with the FLIGHT14 data stream.

M31 Associations

A poster session on M31 OB Associations was presented at the Berkeley AAS meeting in June. The article "UV Photometry of OB Associations in M31" by Hill, Isensee, Bohlin, O'Connell, Roberts, Smith, and Stecher was accepted for publication in the *Ap. J.* (Letters) and appeared in the September 1, 1993, issue, volume 414, p. L9.

OB Associations in the LMC

A poster session on the Lucke and Hodge OB Associations in the 30 Dor region of the LMC was presented at the Berkeley AAS meeting. Tables were created combining the photometric results from images NUV0127-9 and FUV0136-8. Masses and reddenings (E[B-V]) were estimated for all stars using the Schaller et al. evolutionary models interpolated to age 4.0 Myr for stars in associations, or half the stellar lifetime for stars not in associations, together with the Kurucz model atmospheres integrated over the UIT B5 and A5 bandpasses. The adopted mass and extinction are those values that predict UV magnitudes with minimum rms deviation from the observed UV magnitudes. A program previously used to investigate the initial mass function (IMF) in the SMC was adapted for the LMC. The program gives an IMF power-law exponent for stars in associations of −1.08. The field star IMF is fit to a power-law with index −1.74. The article "Initial Mass Functions from UV Stellar Photometry: a Comparison of Lucke and Hodge OB Associations near 30 Dor with the nearby Field," by Jesse K. Hill, Robert H. Cornett, and Joan E. Isensee et al. was written and submitted to the *Ap. J.* (Letters).

NGC1316

Surface photometry using the IRAF STSDAS routine ELLIPSE was replotted for ground-based CCD data. Surface density, integrated photometry, ellipticity, and position angle were plotted vs. radius.

M300

A poster session using UIT and optical images of M100 was presented at the American Astronomical Society Meeting at Berkeley, CA. The poster contained spectral synthesis results, which indicated that 60 percent of the light in the near and the far UV comes from B0-2 supergiants. Color maps were produced from the ground-based and UV data to aid in the study of the distribution of dust and gas in the circumnuclear region. Work continued on a paper for the *Ap. J. Lett.*, including in addition to the contents of the poster session, a comparison of colors of selected UV knots with model clusters to determine the evolutionary parameters of the nuclear ring (age, IMF, population, and SF rate).

N49 (Supernova Remnant in LMC and Surrounding Field)

A poster session by R. Hill, Smith, Cheng, Bohlin (STSCI), O'Connell, Roberts, and Stecher was presented at the AAS meeting. It included a comparison with identified visual features from the LMC Atlas, comparison with infrared, the detection of a high-excitation ring in C IV coinciding with the ring seen in the visual in [O III], and color-magnitude diagrams.

Color

Magnitude diagrams in B5 and visual B are being generated for the association LH52 and LH53 by a process of semi-interactive matching. Candidate B sources near each UV source are displayed one after another and the user picks the correct match, if any.

M74

Model results and other additions from coauthors were incorporated into the draft. Models for dust reddening and extinction under several assumed geometries were computed, and their predictions tested against measured UV colors. Data from M33 and M81 were compared with M74 surface photometry. Two-color plots were generated that show that M74's colors range from the bluest of M81's colors to the bluest of M33, and that, as concluded previously, reddening by dust is insufficient to produce this range. Final comments by coauthors on this analysis were received and are being incorporated.

M74 HII Regions

Work began on a paper involving the M74 UV-bright knots. A routine to create a geometrically corrected (north up and undistorted) version of the M74 substepped images has been completed and is now being tested. (A final version will be placed in the MOUSSE library).

Work began on an attempt to measure the aperture corrections of extended objects, such as HII regions. The aperture corrections cannot be directly measured because of crowding on the frame. An attempt to create artificial sources with the UIT's PSF is in progress.

M79

Investigation of the discrepancy between blue horizontal branch observations and theoretical models continues. An IUE proposal has been accepted for observation of the two UV bright stars.

Omega Cen

IUE spectra were obtained of the UV-bright stars ROA 5342 and Dk 3783, which were identified in the UIT image. The spectra were reduced and their quality found to be excellent. The fluxes from the spectra have been included in the UIT calibration file. A comparison has begun with optical spectra obtained earlier this year.

Small Magellanic Cloud

The procedure for fitting stellar masses and reddenings was modified to compute them for supergiants and for main sequence stars separately. This procedure, which is much more robust than the previous version, was then used to determine the proper isochrone age for the field. The model colormagnitude diagram was then generated by using stellar models for stars of half the appropriate main sequence lifetime for all stars older than twice the isochrone age. New mass functions and reddenings were generated using this technique; the current best value for the 'IMF' slope is −1.4. A manuscript describing this work was begun.

The method of delivery was setting appropriate permissions on the relevant NCCS UniTree files. Delivery was accepted by A. Warnock. The next delivery, scheduled in December 1993, is the last one currently planned for UIT Astro-1 data products.

Work continued on the UIT calibration. Comparison of all the existing calibration data shows a possible "reciprocity failure like" problem with the flux ratio of IUE to UIT data depending on the source intensity. An extensive investigation has begun into the possible cause of this problem by detailed checking of exposure times, aperture corrections, and IUE reductions. An IDL data base of UIT calibration data has been set up to assist in this analysis.

Analysis and development of Astro-2 mission planning operations continued. Plans for technical evaluation of proposals began.

A UITGE2 (geometric transformation) job on descratched images was done by special request for G. Hennessy (University of Virginia). Two PSF files were saved from BDR photometry runs for R. Bohlin, and an IDL procedure RDBDRPSF was created to read them into image arrays.

Planning for the Astro-2 science mission continued. The basic mission timeline was produced and delivered.

Work continued on the new version of the GSE software package. This is the package that collects Spacelab telemetry during the mission and writes it to disk. This software also allows the display of the data on the screen in a number of different formats. This package is a Borland Turbo Vision application.

Routine maintenance of the IDL MOUSSE library continued. A new program ANNSTATS does annular synthetic aperture photometry of extended sources with statistics on the component pixels. An updated version of IDL (V3.1) was installed on the VAX and Sun clusters, along with the new licensing manager required for this version.

Work began on planning the POCC personnel requirements and assignments for the Astro-2 mission.

Routine system administration for the UIT Sun SPARCstations continued this month. The SPARC 10 workstation "Kuylym" was installed.

Routine microdensitometer maintenance was performed.

Work continued on designs for a new film transport for the PDS.

Monitoring of outstanding hardware procurement continued.

Routine backups of all UIT system disks were performed. Additional backups were performed as needed for the FLIGHT14 processing.

Routine updating and additions to the UIT public-relations slide sets continued.

Production of publication-quality prints for UIT journal submissions continued. Five scientific prints were produced on the ColorFire 240.

Work continued on converting the 9-track tapes in the trailer into Exabyte format. This will allow the bulky 9-track tapes to be excessed, as well as rerecording the data on those tapes before they become unreadable because of age.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue planning the Astro–2 mission, continue scientific analysis using UIT data from Astro–1, and assist as necessary with Astro–2 guest investigator program. A Work Control Plan will be prepared.

DELIVERABLES SUBMITTED

Intensity Images:	2048 x 2048 and 512 x 512; (2) north-up, undistorted 2048 x 2048 and 512 x 512
Originator:	R. Hill
Software:	3 Batch Data Reduction (BDR) software, deposited for reference purposes; 4 latest version of BDR documentation ("tome"); 5 so-called IDL BDR software to allow users to experiment with their own data reductions, characteristic curves in particular; 6 an update of MOUSSE and documentation; 7 README and NOTES files describing the pieces of the delivery
Originator:	R. Hill

NONLOCAL TRAVEL

Task personnel traveled to MSFC to attend the quarterly Astro–2 IWG and IPS Working Group meetings.

Task personnel traveled to Johnson Space Flight Center to attend the Payload Operations Working Group meeting August 31–September 1.

COMPUTER USE

Minutes	Computer
Dedicated	VAX and Unix Workstations
Dedicated	VAXcluster

NASA Task 82-334-00: LASP System Support

GSFC ATR: *Dr. A. Silver*

Hughes STX Task Leader: *T. Creamean*
Hughes STX Task Number: *861*

This task supports the installation, operation, and checkout of Sun and VAX workstations for different projects in the Laboratory for Astronomy and Solar Physics (LASP). The required diagnostic tools or other means will be used for testing the systems. Support will also include instrument installations for the laboratory's 36-in. optical telescope.

FINAL CONTRACT SUMMARY

During this task, staff administered the software and hardware of a 45-node, peer-to-peer PC network, assisted with the hardware and network administration of a 29-node local area network VAXcluster and its supporting environment, and assisted with the support of other systems from Apple and Sun, and the expansion of FDDI capabilities. This is a one-person task that started when the task leader was hired on July 9, 1993, to facilitate the growth of the LASP.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff continued support for installing 486 machines, new motherboards, and memory systems. Staff evaluated and enhanced the network performance of the LASP and the VAXcluster.

WORK PERFORMED

Staff provided support for the following activities:

- Installed 486-compatible systems, new motherboards, memory Single Inline Memory Modules (SIMM's), CD readers, SCSI disks, and new HP 4M laser printers.
- Made recommendations to Code 660 personnel for network problems, lost sessions, bursty traffic, and physical length violations.
- Evaluated LASP VAXcluster networking performance using LAN management tools, the LANalyzer from Novell and the Sniffer from Network General.
- Shut down and restarted the LASP cluster and individual nodes, as required, for environmental, software, or hardware reasons.
- Entered updates for the rib 21.2 and 21.7 network data base.
- Excessed obsolete equipment.
- Replaced toner cartridges in laser printers and loaded paper in the 1g02.
- Installed TCP/IP updates and copies of MS-DOS 6.0.
- Assisted with the installation and termination of fiber-optic cable runs.
- Assisted with installation of a SPARCstation 10 and three NCD X terminals.
- Assisted the summer students by setting up LASP resources for them.

PROBLEM AREAS

None.

SCHEDULE PERFORMANCE

All work under the current contract will be completed as scheduled. Future work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will perform the following tasks:

- Install the new version of network software, software updates, and new hardware and repair failures as needed.
- Continuously monitor performance of network hardware and software.
- Generate a new Work Control Plan for this new period/contract.

COMPUTER USE

Minutes	Computer
1,325	VAXcluster
905	ALTEC 386
1,500	PC Network

NASA Task 82-338-00: Solar and Stellar Astronomy Research

GSFC ATR: ***Dr. G. Holman***

Hughes STX Task Leader: ***Dr. J. Brosius***
Hughes STX Task Number: ***864***

This task develops models for the microwave and related emissions from thermal structures in the solar corona and continues publishable work in solar and stellar astronomy of interest to the Laboratory for Astronomy and Solar Physics (LASP) Plasma Astrophysical Theory Group.

FINAL CONTRACT SUMMARY

This task has been active during the entire life of the present contract (October 1, 1988, through September 30, 1993). The task leader has been the only Hughes STX staff member working on this project during the entire period. During this time, the task leader was either first author or a coauthor on 9 refereed scientific publications, 5 non-refereed scientific publications (including conference proceedings), and 23 abstracts of presentations. A computer code was developed to integrate the equation of radiative transfer for any desired number of lines of sight through model solar loops and sunspots, using an adaptive stepsize control in the magnetoactive plasma. The code calculates the microwave emission from model coronal structures. The Sakurai potential magnetic field extrapolation code was adapted to calculate extrapolated coronal magnetograms at any desired height above the photosphere. The measurement of coronal magnetograms was pursued using campaign observations including simultaneous microwave and EUV or x-ray observations. Data from several solar observing campaigns (CoMStOC '87, Solar EUV Rocket Telescope and Spectrograph [SERTS] '89, SERTS '91, and CoMStOC '92) were acquired/analyzed. Understanding the properties of the solar coronal plasma and the magnetic field has been greatly improved through the analysis and interpretation of these observations. The task leader is the first person to derive a true coronal magnetogram using coordinated EUV and microwave observations.

Additional objectives that can be accomplished using the knowledge and expertise acquired during the course of this task include: 1) analysis of simultaneous multiwaveband observations to determine 3-D coronal active region plasma and magnetic field structure, 2) comparison of true coronal magnetograms with extrapolated ones, 3) applications to understanding coronal heating, 4) applications to understanding flare energy storage and release, 5) implications for solar coronal element abundances, and 6) verification of atomic physics calculations (oscillator strengths, collision strengths, and ionization fractions).

SUMMARY FOR CURRENT REPORTING PERIOD

The task leader wrote and submitted one paper to the *Ap J*. The task leader also gave a talk on the GSFC SERTS results at the Solar Physics Division (SPD) meeting at Stanford in July. The task leader wrote and submitted one proposal as PI, and contributed to another as Co-I, in response to NASA NRA-93-OSS-01.

WORK PERFORMED

Very little theoretical or computational work has been done on this task since the task leader started a new task. However, based on calculations that were completed before the start of the new (Late-Type Stellar Coronae) task, the task leader wrote and submitted one paper for publication. The task leader also presented results of the SERTS observing campaign of May 7, 1991, at the meeting of the Solar Physics Division of the American Astronomical Society (AAS) at Stanford University in July. Finally, the task leader wrote and submitted (as PI) one proposal in response to NASA NRA-93-OSS-01, and contributed to one other proposal (as Co-I) in response to the same.

Papers Submitted for Publication (1)

"Solar Coronal Temperature Diagnostics Using Emission Lines From Multiple Stages of Ionization of Iron," J.W. Brosius, J.M. Davila, R.J. Thomas, and W.T. Thompson, submitted to the *Ap. J.* (July 1993).

Meeting Presentations (1)

"Solar Coronal Plasma and Magnetic Field Diagnostics Using SERTS and Coordinated VLA Observations," J.W. Brosius, J.M. Davila, W.T. Thompson, R.J. Thomas, G.D. Holman, N. Gopalswamy, S.M. White, M.R. Kundu, and H.P. Jones; presented at a meeting of the SPD of the AAS, at Stanford Univ., Palo Alto, CA, in July.

Proposal Submissions (2)

"Plasma Properties and Magnetic Field Structure of the Solar Corona, Based on Coordinated Max '91 Observations from SERTS, the VLA, and Magnetographs," J.W. Brosius, PI, in response to NASA NRA-93-OSS-01. This proposal requests funding for 2/3 working year for each of 2 years.

"Formation of the He II 304 A Line in the Solar Atmosphere," S.D. Jordan, PI, J.W. Brosius, Co-I, in response to NASA NRA-93-OSS-01. This proposal requests funding for 1/5 working year for 1 year.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350, depending on availability of funding.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Until funding for this research becomes available from NASA, the task leader will be able to do very little on this task. It is hoped that the thorough analysis and interpretation of the SERTS '91 observations will proceed.

A Work Control Plan will be prepared. Such a plan is inherently tentative, because the work whose control is planned depends entirely on the availability of funding.

NONLOCAL TRAVEL

The task leader attended the SPD meeting at Stanford Univ. in Palo Alto, CA, July 12–18.

CONFERENCES

The task leader attended the SPD meeting of the AAS at Stanford Univ. (Palo Alto, CA) July 12–18.

COMPUTER USE

Minutes	Computer
Dedicated	SPARCstation IPC
60	LASP VAXcluster

NASA Task 82-339-00: AXAF BCS Development

GSFC ATR: ***Dr. B. Woodgate***

Hughes STX Task Leader: ***B. Puc***
Hughes STX Task Number: ***865***

This task provides support in the development of x-ray diffractors to be used in the MIT Bragg Crystal Spectrometer (BCS) on the AXAF spacecraft. Support will include the use and maintenance of a computer-controlled test system for analysis of crystal performance characteristics, application of previous results to improve diffractor fabrication procedures, and environmental testing to qualify substrates for prototype and flight levels.

FINAL CONTRACT SUMMARY

This task was transferred to this contract on July 1, 1990, from the previous contract NAS5-28750. The task terminated in December 1992 because of the cancellation of MIT's Bragg Crystal Spectrometer from the AXAF instrument suite. Task staffing consisted of one full-time laboratory physicist. Major activities under this task included in-house design and fabrication of an interferometer bending and bonding platform for crystals, which was used to test the bonding of lithium fluoride crystals to aluminum substrates. The task leader performed extensive alignment and calibration of the crystal test setup using mechanical improvements, and a ray tracing program was used to model the x-ray beam path. Reports were prepared and delivered on ray trace analysis and on comparison of bending and bonding procedures. A new, vibration-isolated optical bench and a more precise motion control system were installed in the test setup. Upon learning that the BSC instrument would be dropped from the AXAF instrument roster, several final reports were prepared including a study comparing x-ray reflection on both polished and unpolished crystal surfaces.

SUMMARY FOR CURRENT REPORTING PERIOD

No work was performed during the current reporting period.

WORK PERFORMED

No work was performed during the current reporting period.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. No future work is planned.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

COMPUTER USE

None.

NASA Task 82-340-00: Astronomical Sounding Rocket Project

GSFC ATR: ***Dr. A. Smith***

Hughes STX Task Leader: ***R. Hill***
Hughes STX Task Number: ***866***

This task supports the Code 680 Astronomical Sounding Rocket Program. Support will include software engineering; assistance in the assembly, alignment, and calibration of instruments; and reduction and analysis of sounding rocket and associated data.

FINAL CONTRACT SUMMARY

From July 1, 1990 through September 30, 1993, the Hughes STX task leader accomplished the following major milestones for the task: calibration, integration, alignment, and launch of sounding rocket flight 36.068GG, which successfully observed the galaxy NGC 4449; performance of image motion compensation on a time-tagged photon file to produce a calibrated ultraviolet (UV) image; and analysis of data together with ground-based, emission-line data obtained by Code 680 personnel, in cooperation with F. Bruhweiler and A. Home (CUA).

The task leader also produced an initial version of C++ software to support future UV imaging payload calibrations by controlling laboratory peripherals and acquiring data.

"MAMA Detector UV Imagery and Emission-Line CCD Imagery of NGC 6240" was published in *Ap. J.* with the ATR as first author and the task leader as second author of four. This paper represents the results of sounding rocket flight 36.043GG (under previous task) and cooperative observing with F. Vrba (U.S. Naval Observatory/Flagstaff Station).

SUMMARY FOR CURRENT REPORTING PERIOD

At the ATR's request, no work was performed (because of funding).

WORK PERFORMED

At the request of the ATR, no work was performed.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Staff must accomplish the following objectives: Acceptance of the NGC 4449 paper and completion of testing and debugging of laboratory software.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will support the new sounding rocket launch during calibration and/or field operations as required. A Work Control Plan that meets the requirements of contract NAS5-32350 will be prepared.

COMPUTER USE

Minutes **Computer**

None.

NASA Task 82-345-00: Solar Data Analysis Center Support

GSFC ATR: *Dr. J. Gurman*

Hughes STX Task Leader: *R. Nakatsuka*
Hughes STX Task Number: *868*

The objective of this task is to support the Solar Data Analysis Center (SDAC) in archiving and distributing solar data, developing and maintaining software for the interpretation of those data, managing minicomputer and workstation systems, and assisting scientific staff and visitors in the use of data and software.

FINAL CONTRACT SUMMARY

Hughes STX task 868 provided services to NASA during the period July 1990 through September 1993. The task team was composed of three full-time senior programmer/analysts with additional responsibilities in the area of system management. During the service period, the task provided continuing support to the GSFC SDAC (known prior to January 1992 as the Solar Maximum Mission [SMM] Data Analysis Center). Task personnel provided programming services in the form of new software written to customer specifications, enhancement of existing software, and modification of software to adapt to changing external operating environments. HSTX staff also supported data analysis efforts through examination and reduction of data at the request of staff or visiting scientists, and interpretation of those data within the framework of current physical theory and observational data from other sources. Additionally, computer system management services were provided for technical workstations and minicomputers. These services consisted of hardware configuration and maintenance, system software upgrades and maintenance, scheduled backups and management of disk space, troubleshooting and handling of anomalous events, and maintenance of the local area network. Task personnel assisted in the relocation of the entire Data Analysis Center to GSFC from its former location at the Maryland Trade Center. HSTX staff continued to support the SDAC in a number of other service areas such as accounting, document storage, publications, stores stock, and procurement.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff provided assistance and advice in configuring a number of new Digital Equipment Corporation (DEC) Alpha computer systems. The Usenet newsreader package and a device-dependent typesetting software module were rebuilt to function under changed external operating environments. Task personnel wrote demonstration software to exhibit data from SMM instruments and the Space Environment Laboratory (SEL) Solar Imaging System (SELSIS). Staff completed software to automatically retrieve Geostationary Operational Environmental Satellite (GOES) x-ray data from SEL computers daily and to archive them locally in Flexible Image Transport System (FITS) format. A new feature was incorporated into the display software for the SMM instruments, to preserve the currently examined data in Interactive Data Language (IDL) save files. Task personnel analyzed solar and stellar observations in an ongoing study to determine an absolute photometric calibration for the SMM Ultraviolet Spectrometer/Polarimeter (UVSP) instrument. A data base search program was created for the SMM UVSP and incorporated into the UVSP image display program. Data products from various spacecraft were provided to researchers at GSFC and at remote sites. System hardware and software management services were continued on OpenVMS, ULTRIX, and OSF/1 computers.

WORK PERFORMED

HSTX staff assisted in converting the computing resources of the SDAC to reside on a new DEC Alpha 4000 AXP computer. As part of this conversion, a MicroVAX 3400 computer in the SDAC was eliminated, requiring the reconfiguration of hardware elements previously connected to the MicroVAX. Thus, two 1.0-Gbyte optical disk drives were moved from the MicroVAX to a VAX 4000 computer in the SDAC, and the remaining 9-track magnetic tape drives were removed and reclassified as excess property. In addition, task personnel modified SMM Hard X-Ray Burst Spectrometer (HXRBS) and GOES software to automatically search for data files in the new location. User identification codes on the MicroVAX 3400 and VAX 4000/200 computers were compared to find any conflicting entries. Unnecessary user accounts and files were removed, and the user authorization files were merged. In addition, data directories were consolidated for migration to the Alpha computer, and routine backups of many magnetic disks were performed. HSTX staff also provided system management assistance to Dr. C. Bennett (Code 685) and M. Amato (Code 683) in configuring Unix workstations.

Task personnel rebuilt the Usenet newsreader program on the SDAC DECstation 5000/200 computer when problems arose in posting to news groups from the DECstation. Changes in the news server collection software caused changes to be required in the article headers generated for posting on Usenet. Staff also rebuilt the "xtex" program to run properly on a DEC 3000 AXP computer under the OSF/1 operating system. This task required a modification to the xtex C code to account for the different sizes of data structures under OSF/1. The xtex software is the device-specific portion of the TeX typesetting software that is used to generate appropriate output files for the Talaris 2090 laser printer in the SDAC.

HSTX staff wrote demonstration software to display data from the SELSIS and from a number of instruments on the SMM spacecraft. The software was successfully exhibited at a workshop on the Space Physics Data System (SPDS) in Houston. Task personnel also ported various software packages from the OpenVMS operating system to Unix, allowing data from various SMM instruments to be displayed on computers running under either operating system. In addition, HSTX staff added a new feature to the display software for several of the SMM instruments, enabling a user to retain the currently displayed data in an IDL save file for restoration at a later time.

Task personnel modified analysis software for the GOES data to use either the data base in Data Comparison (DC) format or the new FITS format data base, depending on the time interval selected by the user. The DC-format files cover the years 1980 through 1992, whereas the FITS files cover the period from January 1, 1993, to the present. Staff completed software to automatically retrieve GOES 3-sec x-ray data from a remote site and archive them locally in FITS format, thus maintaining the currency of the FITS data base. Task personnel also continued to support the Burst and Transient Source Experiment (BATSE) archive and analysis facility in a number of ways. For example, HSTX staff corrected a problem in the software that writes BATSE Flare Data Base (FDB) files. The problem had caused data outside the intended range to be erroneously included when the range ended in a data gap. In addition, task personnel modified a routine that extrapolates pointing data during periods when the omnidirectional antenna is being used and no pointing data are provided.

Staff members performed a number of software conversions. Software written in Interactive Data Language (IDL) Version 1 was converted to IDL Version 3, because Version 1 is unavailable on the new Alpha computers in the SDAC. Programs for the analysis of data from the SMM HXRBS and the Gamma Ray Spectrometer (GRS) are being converted from VAX FORTRAN to DEC FORTRAN so that they will be compatible with the compilers available on the Alpha computers. Software for reading and displaying information from the SMM Primary Event Catalog is also being converted from VAX FORTRAN to DEC FORTRAN. A program for searching the SMM UVSP catalog was converted from FORTRAN to IDL, and a widget interface was constructed to improve its ease of use. The various modules in the program are designed for ease of inclusion in other future software packages, such as those that would access a proposed SDAC multi-instrument catalog.

Task personnel continued an ongoing study of SMM UVSP observations that may be useful in determining an absolute photometric calibration for the UVSP instrument. In particular, stellar observations and long solar spectral scans were analyzed to investigate the consistency of the UVSP data set. Comparisons were also made with data published by other researchers or obtained from other sources. Work continued on the sections of the SDAC User's Guide related to the SMM HXRBS and UVSP instruments.

HSTX staff began work on software for planning daily observations by the Coronal Diagnostic Spectrometer (CDS) on the upcoming Solar and Heliospheric Observatory (SOHO) mission. The software will provide a graphical representation of the science plan and will produce input to a program for generating the instrument command load. A preliminary menu interface was written, and work proceeded on incorporating an editing feature into the program.

Task personnel provided a significant amount of support to special requests from scientists. For visiting scientist Dr. G. Doyle, HSTX staff modified the UVSP display software to generate a text file containing a list of all plotted data points with their associated times of observation. The UVSP display software and selected data and text files were also copied to magnetic tape for Dr. Doyle. In addition, task personnel wrote an installation guide explaining how to restore the tape onto disk and how to set up IDL to run the UVSP software. Task personnel also assisted Dr. B. Dennis (Code 682) in acquiring time profiles of Yohkoh Hard X-ray Telescope (HXT) observations and corresponding GOES data. Task personnel also wrote software in IDL to automatically produce multiple plots of a large number of selected events from these data sets. HSTX staff assisted J. Lee (California Institute of Technology) in performing spectral analyses and interpreting data from the SMM HXRBS instrument. Task members assisted J. Blair (Fisk University) in using IDL and the SDAC GOES software to determine event onset times for more than 500 solar flares. Task personnel wrote an IDL procedure to create 10-day DC format files for all the data on an optical disk from the HXRBS archive for Dr. R. Shubert (Fullerton University). Staff also wrote an IDL procedure to create save files in External Data Representation format for 1,500 solar flares observed by the SMM HXRBS instrument. The data generated by this procedure will be used by A. Conway (University of Glasgow) for neural network predictors.

Staff continued to support the SDAC in a number of other service areas such as accounting, document storage, publications, stores stock, and procurement. In addition, HSTX personnel are generating photocopies at reduced scale of the SMM operational planning timelines produced by the SMM solar forecast center.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX staff will add more items to the search menu for the UVSP catalog search program. The user help facility for the UVSP catalog search program will also be improved. Task personnel will continue to convert software for the new Alpha 4000 AXP computer, and work will continue on the SDAC User's Guide. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Software: A demonstration program to display the capabilities of the SDAC IDL widget-based data analysis software
Originators: A. Tolbert and E. Einfalt

Software: An initial version of software to search the SMM UVSP observational catalog from the UVSP data display program
Originator: E. Einfalt

COMPUTER USE

Minutes	Computer
9,000	VAX 4000
19,000	MicroVAX 3400
28,000	VAXstation 3100
12,000	DECstation 5000
1,000	Alpha 3000 AXP

NASA Task 82-346-00: SMM Travel Support

GSFC ATR: ***Dr. J. Gurman***

Hughes STX Task Leader: ***Dr. J. Childs***
Hughes STX Task Number: ***869***

The objective of this task is to provide support for furthering scientific analysis of Solar Maximum Mission (SMM) data by providing for travel and per diem for scientists not supported by SMM Guest Investigator grants.

FINAL CONTRACT SUMMARY

The period of performance on this task was from July 1, 1990, to the present. The work activities for this task were to provide travel expenses to visiting scientists (at GSFC or some other institution) and to provide support for furthering the analysis of Solar Maximum Mission (SMM) data. Direct labor was charged at a low level of effort by the onsite SMM Hughes STX task manager, the task leader, and a secretary; the bulk of the task charges were nonlocal travel expenses. Over 50 trips were supported by the task under this contract.

SUMMARY FOR CURRENT REPORTING PERIOD

Travel expenses were provided to five solar physicists for a High Energy Solar Physics (HESP) Mission meeting held in July 1993.

WORK PERFORMED

Travel expenses were provided to Drs. Forrest, Hurford, Lin, Ling, and Schmahl to attend the meeting of the HESP Mission, held at Univ. of CA, Berkeley, on July 8–9, 1993.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Travel arrangements and expenses will be provided as required by the ATR.

COMPUTER USE

None.

NASA Task 82-347-00: Lyot Filter and STIS Development

GSFC ATR: ***Dr. B. Woodgate*** **Hughes STX Task Leader:** ***Dr. A. Danks***
Hughes STX Task Number: ***870***

This task will support the instrument development of the Space Telescope Imaging Spectrograph (STIS) and provide data analysis and system engineering support for the Lyot Filter/CCD camera instrument. STIS support will include data collection and evaluation from proposed flight gratings and systems engineering for the development of the Multianode Microchannel Array (MAMA) detector system. Lyot Filter support will include development of a test plan and software for the checkout of the system, as well as interface with the contractors responsible for the associated hardware and software.

FINAL CONTRACT SUMMARY

During this contract, the task leader monitored the performance of STIS grating's in the DGEF gratings lab at GSFC; reviewed the design of the Lyot filter and purchased the quartz optics, computer, data storage, and stepping motors to build the system; reviewed the contract to build the filter at Sunspot and also purchased the order sorting filters; participated in the assembly of the filter twice; and reviewed the interface to the telescope. The CCD 2048 camera contract at Photometrics is complete, and the task leader arranged for the camera to be used at the MDM observatory until the Lyot is ready. This task is entering the final design and construction phase of the Lyot. The task leader overviewed the design and use of the Boller chivens spectrograph with a ground-based MAMA and this was used twice at the McDonald observatory for monitoring star burst activity. This project is continuing with a collaboration with Irish scientists at the La Palma observatory. During this period, the task leader participated in the design team for STIS MAMA's and the review and testing of the STIS demonstration MAMA's and the redesign after the successful demonstration. The task leader acted as the interface between Ball for the delivery of the STIS-like STD-6 detector to the DGEF gratings lab. This detector is working daily for use in STIS gratings in the UV.

SUMMARY FOR CURRENT REPORTING PERIOD

The task leader continued to monitor the progress of the STIS EMU MAMA builds at BECD; monitored the progress of cathode development of the Cs2Te cathodes for the Band 2 detector; and assisted in measuring the phosphorescence of the MgF2 windows, resulting in the discovery that Optovac is a better supplier than Hawshaw. However, Hawshaw has poor machining capabilities, and the task leader directed Ball to visit the vendor and try to improve the quality of the product. Progress has been made with the GBO and an extended S-20 cathode has been deposited. The GBO tube is in scrub. During this period, Ball discovered that the tube bodies delivered for the EMU's had small "grain" leaks, and they were directed to solve the leak inspection problem. As a result of the leaks, the build of STE1 had to be abandoned and STE2 was accelerated. It finally entered the chamber and had a Cs2Te cathode deposited and is now under scrub. SOHO has had two EMU failures under "shake and bake." This had profound repercussions on STIS as these detectors are made in the same Ball Lab. The task leader spent time on a SOHO red team to look at the problems both as an STIS observer to learn if any of the failures have relevance to the STIS project, and as an adviser to the SOHO team as to how to proceed. The task leader participated in meetings at Ball, GSFC, and NASA HQ. The task leader spent almost 3 weeks using the ESO Echelle spectrograph in Chile and obtained some good scientific results; attended the Berkeley AAS meeting and presented a paper; reviewed the ETC for the MAMA lab; and participated in negotiations of the Ball/GSFC contract.

WORK PERFORMED

The task leader continued to monitor the progress of the STIS EMU MAMA builds at BECD; monitored the progress of cathode development of the Cs2Te cathodes for the Band 2 detector; and assisted in measuring the phosphorescence of the MgF2 windows, resulting in the discovery that Optovac is a better supplier than Hawshaw. However, Hawshaw has poor machining capabilities, and the task leader directed Ball to visit the vendor and try to improve the quality of the product. During this time, progress was made with the GBO and an extended S-20 cathode was deposited. The GBO tube is in scrub. Ball discovered that the tube bodies delivered for the EMU's had small "grain" leaks, and they were directed to solve the leak inspection problem. As a result of the leaks, the build of STE1 had to be abandoned and STE2 was accelerated. It finally entered the chamber and had a Cs2Te cathode deposited and is now under scrub. SOHO had two EMU failures under "shake and bake." This had profound repercussions on STIS as these detectors are made in the same Ball Lab. The task leader spent time on a SOHO red team to look at the problems both as an STIS observer to learn if any of the failures have relevance to the STIS project, and as an adviser to the SOHO team as to how to proceed. The task leader participated in meetings at Ball, GSFC, and NASA HQ. The task leader spent almost 3 weeks using the ESO Echelle spectrograph in Chile and obtained some good scientific results; attended the Berkeley AAS meeting and presented a paper; reviewed the ETC for the MAMA lab; and participated in negotiations of the Ball/GSFC contract.

SIGNIFICANT ACCOMPLISHMENTS

The task leader maintained the production of STIS MAMA's through the difficult period during SOHO's MAMA production problems, and published one paper on interstellar medium work using a STIS like Echelle spectrograph.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

In as much as is possible, the task is on schedule. The task leader expresses it this way, because of the "normal" unexpected interference from outside. For instance, a stop-work order by SOHO at Ball affects directly shared resources, and schedule conflicts arise that must be resolved by mutual agreement where possible. Similarly, the resignation of a critical person at D-TECH influenced the delivery of the MCP's. These conflicts are solved on a daily basis and the schedule has been held with about a 6-week slip on the MAMA production.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The task leader will be responsible for the oversight of the MAMA contract at Ball for the STIS MAMA detectors. Both SOHO and STIS detectors have been built by Ball in one MAMA lab, answering to the individual projects SOHO and STIS. It appears that the SOHO part of Ball's work may go away, at which time HSTX staff will reorganize the MAMA work into the STIS project at Ball rather than a separate management. Further task members are just entering the EMU builds of the detectors and the next 6 months are critical. The task leader is preparing for the CDR, which is in November, and a coinvestigator team review to follow on directly. In addition looking to the future, task members are already undergoing procurement for the flight hardware and issuing flight hardware contracts. A Work Control Plan that meets the requirements of contract NAS5-32350 will be prepared.

NONLOCAL TRAVEL

The task leader spent 2.5 weeks in Chile to use the Coude Echelle spectrograph to observe interstellar lines.

TRAINING

The task leader received ethics and cmi training at HSTX.

CONFERENCES

The task leader attended the AAS conference in Berkeley, CA.

COMPUTER USE

Minutes	Computer
Dedicated	IBM PC
100	VAXcluster

NASA Task 82-348-01: FIRAS Software Development Support

GSFC ATR: *D. West*

Hughes STX Task Leaders: *S. Read and S. Alexander*
Hughes STX Task Number: *871*

This task supports the implementation of the Cosmology Data Analysis Center (CDAC). Specifically, this task's activities include the following, which support the FIRAS instrument: 1) detailed design, implementation, and testing of the remaining CDAC FIRAS software builds; 2) maintenance of earlier software builds and enhancements to existing software; 3) support for the integration of the FIRAS Subsystem into the CDAC Software System and for the CDAC Systems Test; and 4) documentation of final software designs, testing, and data products in support of delivery of the Project Data Sets (PDS) to the COBE Science Working Group (SWG).

FINAL CONTRACT SUMMARY

The FIRAS software development task lasted for 5 years. Over this period of time, between three and five full-time Hughes STX software developers have worked on the task. The major accomplishments of the task were the successful development of the FIRAS pipeline processing software and the configured production runs of this software. The pipeline software consists of programs to flag bad records and convert raw (digital) engineering readings into physical units, programs to identify groups of records to average (coadd), a program to remove the cosmic ray hits and coadd the interferograms (IFG's), programs to convert the IFG's to spectra and apply a calibration model to the spectra, a program to remove time-dependent signal residuals, and programs to combine the spectra measured at the same sky position throughout the mission. The configured production runs led to the delivery of the FIRAS Initial Product to the NSSDC in the summer of 1993. This delivery consisted of measurements of the galactic plane spectra from the FIRAS high-frequency channels and corresponding calibration models of the FIRAS instrument. Remaining objectives include refinement and enhancement of existing software; writing of new software in pursuit of scientific goals for the FIRAS data; and production of the PDS consisting of the spectra from all FIRAS channels, including the Cosmic Microwave Background Radiation (CMBR), with complete sky coverage.

SUMMARY FOR CURRENT REPORTING PERIOD

The most significant accomplishment in this period was the completion of the Pass 2A production run of the FIRAS_Calibrate_FIRAS (FCF), FIRAS_DeStriper (FDS), FIRAS_Apply_Destriper (FAD), FIRAS_Combine_Spectra (FCS), and FIRAS_Initial_Product (FIP) facilities for the entire mission of sky data on the high-frequency channels and the corresponding calibration models. Following conversion to the FITS format, these data were delivered on schedule to the NSSDC as the FIRAS Initial Product. Team members conducted QA/QC of outputs throughout the production run. In addition, the task completed the Pass 2A production FCF run for the low frequency channels and the processing of all preflight Integration and Test data through the FIRAS_Interferogram_Coaddition (FIC) facility. Team analysts participated in the validation of the FDS and FIP facilities. Task developers designed, coded, tested, and delivered the FIRAS_Calibrate_Covariances (FCC) Facility and the FIP_Covar program for validation.

WORK PERFORMED

Pipeline Software

FIRAS_Calibrate_FIRAS (FCF)—FIRAS task members reviewed the code for this facility and removed some hardcoded constants; they delivered the code to CSDR configuration.

FIRAS_Destriper (FDS)—HSTX task personnel participated in the validation of the configured FDS. This code is designed to remove time-dependent signals observed in the FIRAS data that are not removed by the calibration process. Team members inspected the theory and method of FDS, modified the IDL driver procedures, created command files for running FDS, and validated the input reference data sets. Team members also validated the algorithms used to calculate the spectrum for the exponential decay term and the mission-period dependent corrections. Following validation, the FDS facility was delivered to CSDR configuration.

FIRAS_Apply_Destriper (FAD)—FIRAS team members developed the code for this facility, participated in its validation, and delivered it to CSDR configuration.

FIRAS_Combine_Spectra (FCS)—HSTX task personnel implemented several requested enhancements to this code based on new requirements. Task members also revised the walkthrough document.

FIRAS_Initial_Product (FIP)—Team members conducted the validation of the FIP_SKY module for converting FCS output to FITS files as Initial Products for the NSSDC. Staff wrote an IDL procedure to compare the FCS and FIP_SKY outputs, validating the conversions performed. Task personnel also validated the FIP_MODEL module that converts the calibration models to FITS format. Staff received the requirements document for the FIP_COVAR module, wrote and presented the design document, and wrote and tested the code that was delivered for validation.

FIRAS_Calibrate_Covariances (FCC)—FIRAS task personnel received requirements for this new facility, prepared and presented the design walkthrough, and completed coding and testing. The code was delivered for validation.

Analysis Software

FIRAS_View_Archive (FVA)—HSTX FIRAS personnel worked on altering FVA to format and output time-tagged files, including reference data sets. This will enable FVA to write outputs of any FIRAS data set.

Mission Reprocessing

Pass 2A, Phase 4—HSTX FIRAS personnel completed the production run of FCF on all sky data for the mission for which calibration models could be produced. In support of this effort, task staff wrote configured command files and performed QA/QC on the data as they were produced.

Pass 2A, Phase 5—Task members completed the production run of FDS on the FCF output data and installed the resulting FEX_EJ reference files in the FIRAS reference area. Staff also completed the FAD production run on all calibrated sky data and conducted ongoing QA/QC as the data were produced.

Pass 2A, Phase 6—FIRAS personnel completed the production run of FCS on the mission sky data; QA/QC was conducted.

Pass 2A, Phase 7—Team members completed the production runs of FIP on all sky data and calibration models, and completed the UDF production run to produce the FIRAS Initial Product files in the FITS format. QA/QC was conducted and the FITS files were delivered, with the required documentation, to the NSSDC.

Integration and Test Reprocessing

HSTX FIRAS personnel processed all of the INT data using the FEC and FIC facilities, resulting in calibration coadds made from an initial, unanalyzed set of calibration plateaus. Further analysis will refine the plateau selection process.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

Task members will continue work on the requirements specification, design, code, and test of the FIRAS Pipeline and update of existing programs.

Staff will continue to build, configure, and test the FIRAS software in the Level 3 and development areas. Staff will continue to maintain the test archives containing the benchmark data for testing, test tools, test reports, and analysis software written in IDL and FORTRAN.

Task members will fix any new System Problem Reports (SPR's) against the current software for problems critical to data analysis or future reprocessing.

Task personnel will run the PDS production and provide analysis support for the processed mission data. Task members will provide information and formal reports to the CDAC on disk requirements, configuration requirements and other CDAC-related issues.

Task members will update the PERT chart as necessary.

A Work Control Plan that meets the requirements of Contract NAS5-32557 will be prepared.

COMPUTER USE

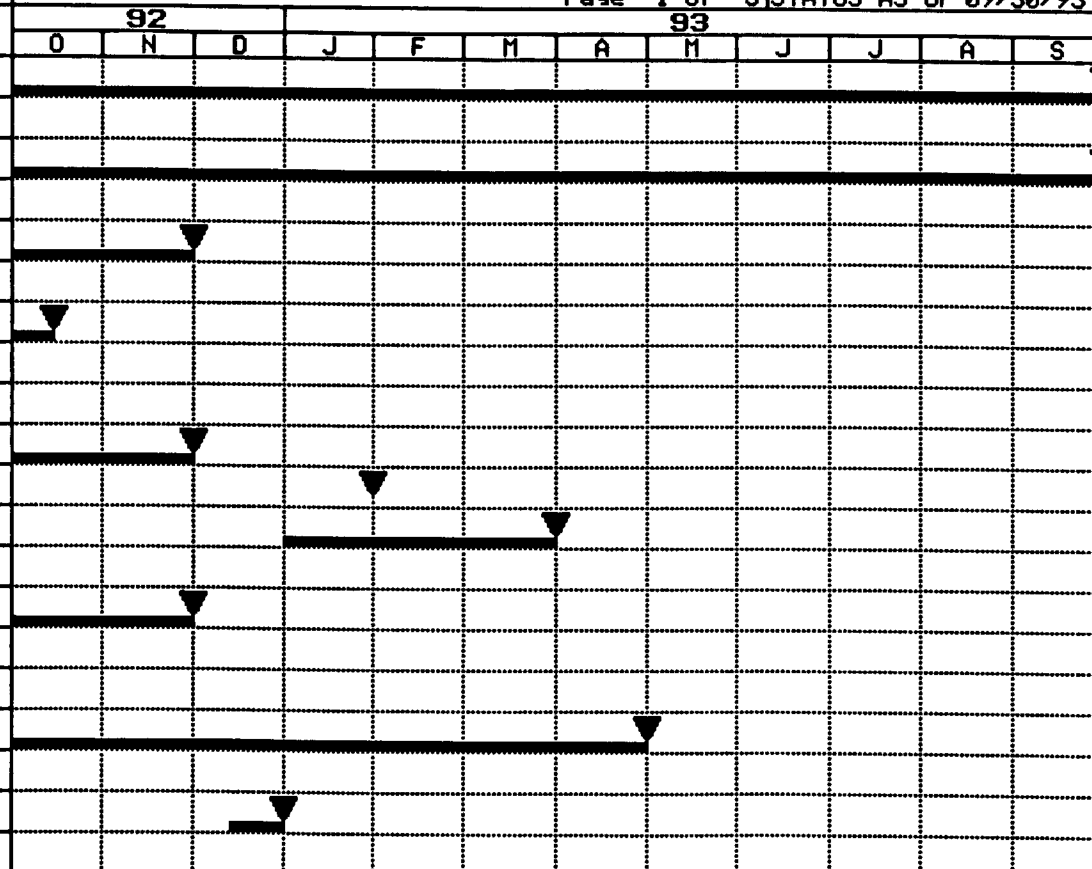
Hours	Computer
1,600 (wall clock)	COBECL VAXcluster

Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Read

FIRAS Task 871

ORIG. APPVL. 10/01/91
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES
01	System Integrate/Coordinate
02	SW Maintenance of Existing
03	FIRAS System
04	FIRAS Reference, Help &
05	Message Manual
06	Pass 1-3A Process Mission Data
07	Through FIC
08	Complete Verification of FIC
09	Pipeline SW & Commands
10	Analyze Data
11	Final FIC Verification Report
12	Validate FIC Reference Data
13	Pass 1-4 Process Mission Data
14	Through FCF
15	Complete Verification of FCF
16	Pipeline SW & Commands
17	Analyze Data
18	Pass 1-5 Process Mission Data
19	Through FIC
20	



Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

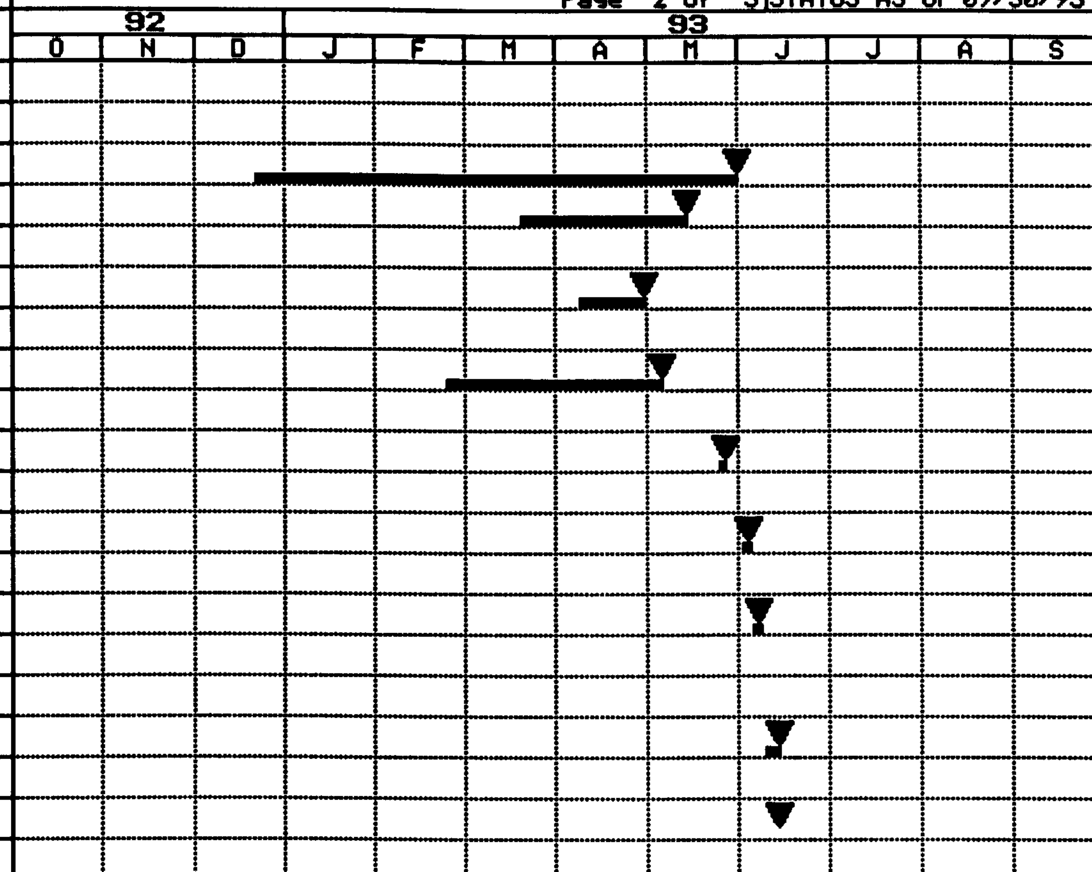
Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Read

FIRAS Task 871

Page 2 of 3

ORIG. APPVL. 10/01/91
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES
01	Complete Verification of FCS
02	Pipeline SW & Commands
03	Analyze Data
04	Integration & Test Data Prod
05	FAD Design, Code, and
06	Complete Verification
07	
08	Pass 2A FIC Production
09	
10	Pass 2A FCF Production
11	
12	Pass 2A FDS and FAD Production
13	
14	Pass 2A FCS Production
15	
16	FIRAS Initial Production
17	PDS Production
18	FIRAS Initial Product
19	Delivery to NSSDC
20	



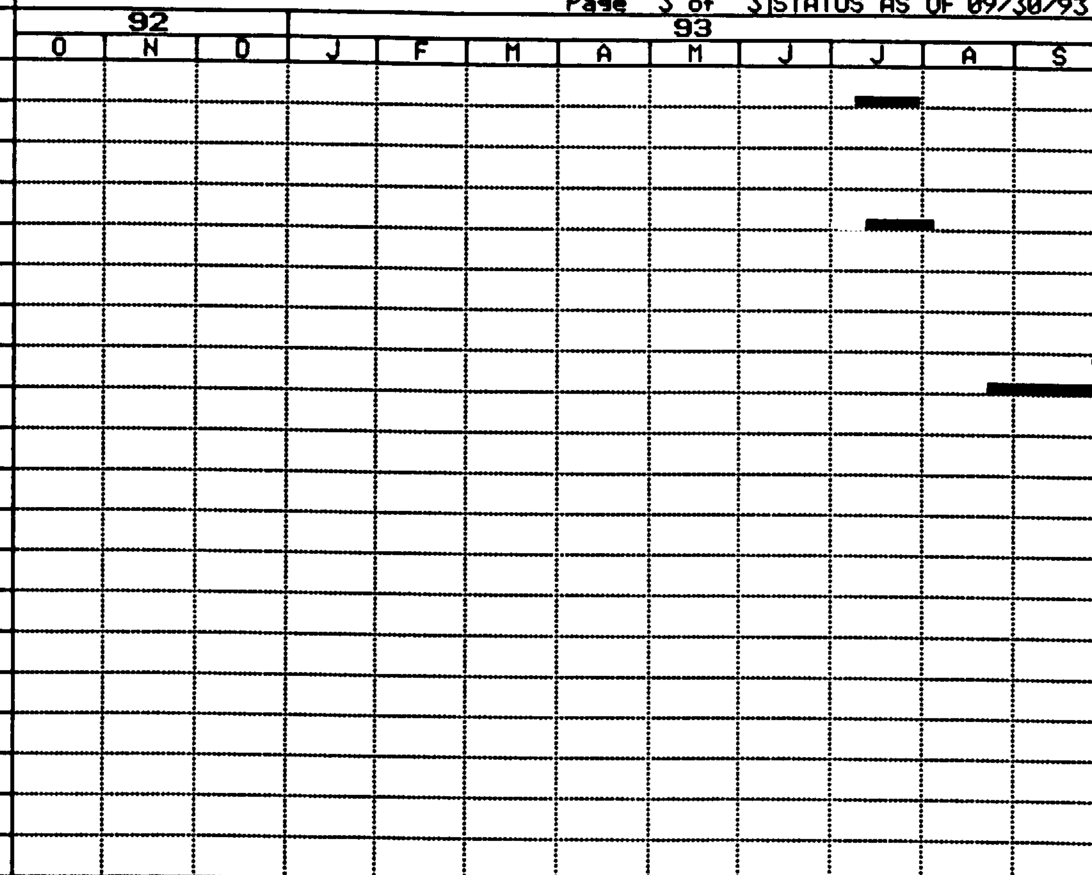
Note: A series of three triangles along a single bar indicates three successive implementation phases (design, code, test)

Applied Engineering Software
APPROVAL D. West
ACCOMP. S. Read

FIRAS Task 871

ORIG. APPVL. 10/01/91
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES
01	FCC Calibrate Covariance
02	Matrix Design, Code and
03	Verification
04	FIP Covariance Matrix
05	Design, Code and
06	Verification
07	
08	FIRAS Software to reconstruct
09	Covariance matrix from FITS
10	files for Guest Investigator
11	
12	
13	
14	
15	
16	
17	
18	
19	
20	



Note: A series of three triangles along a single bar indicates three successive implementation phases (design, code, test)

NASA Task 82-348-02: FIRAS Data Analysis Support

GSFC ATR: *D. West*

Hughes STX Task Leader: *S. Read*
Hughes STX Task Number: *872*

This task provides support for the implementation of the Cosmology Data Analysis Center (CDAC). Specifically, the task activities include scientific data analysis and software support for the FIRAS instrument including: 1) validation of the calibration algorithms and software; 2) validation of the deglitcher software; 3) analysis of the instrument performance and characterization of its properties; 4) trend analysis and skymaps of engineering and scientific parameters; 5) analysis of the response of the FIRAS to the Moon; 6) development of Interactive Display Language (IDL) tools to support analysis activities; 7) configuration and maintenance of analysis software tools; and 8) management of disk space for analysis and archives.

FINAL CONTRACT SUMMARY

The Hughes STX FIRAS analysis task began one-half year before the COBE launch and has lasted for more than 4 years. During this period, a total of nine science analysts, with two to four full-time equivalents at various times, have worked on the task. The major contributions of this task have been the thorough characterization of the FIRAS instrument and its trends over the mission; analysis and validation of the algorithms used in the pipeline processing and calibration of the FIRAS data; development of IDL tools for analysis; and configuration of disk space, analysis software, and reports. Some of the most significant studies performed are the formulation of the secondary template to preserve spatial gradient features during the deglitching process; the setting of limits on the residual contributions of Sun, Earth, and Moon signals to the spectra; the setting of limits on allowable glitch rates for the channel and scan mode combinations; correlations of detector and other noise sources with instrument parameters; demonstration of negligible thermal cross-talk between the external calibrator and the other temperature controllable parts; precise determination of the mirror transport mechanism timing from the in-flight data; the setting of temperature limits for the dihedral mirrors from analysis of radiation contributed by dihedral emissivities; measurements of an anomalous time dependent residual signal in the sky data; and characterization of the C+ and N+ emission lines in the FIRAS interferograms and corresponding spectra. Validation of many of the science algorithms used in the FIRAS data processing system facilitated a timely delivery of the FIRAS galactic plane data in the first release of the COBE data to NSSDC and the scientific community.

SUMMARY FOR CURRENT REPORTING PERIOD

Significant contributions of the HSTX FIRAS analysis task to the validation of scientific algorithms in the FIRAS data processing system facilitated a timely delivery of the FIRAS galactic plane data in the first release of the COBE data to NSSDC and the scientific community. These algorithms include the removal of anomalous, time-dependent signal residuals observed in the sky data, determination of the variance for the averaged interferograms and the calibrated spectra, quantification of the detector noise, and coordinate transformations required for producing the FITS files. The team's quality assurance and statistical analysis on the calibration of the galactic plane data from the mission ensured the release of a high-quality product for the astrophysical community. Their demonstration that the Moon residual signal is not detectable beyond 25° from the FIRAS line-of-sight removed astrophysical concern about Moon contamination. The task analyst's participation in research on atomic and molecular lines observed in the FIRAS spectra produced significant results on their relevance to the study of galactic structure and the interstellar environment. The morphological relationship between the FIRAS N+ and C+ lines show that these transitions act as an important cooling source in the inner galaxy. Task members successfully fit the line profiles and baseline continuum by several methods. Staff also investigated the spatial distribution of the dust components that produce the FIRAS dust continuum by correlating to other surveys that probe the gaseous phase of the interstellar medium.

WORK PERFORMED

The HSTX FIRAS analysis team has made significant contributions to the validation of scientific algorithms in the FIRAS data processing system and thus facilitated a timely delivery of the FIRAS galactic plane data and the corresponding instrument models in the first release of the COBE data to NSSDC and the scientific community. In addition, staff performed extensive quality assurance (QA) at all stages of the Project Data Set (PDS) production and statistical analysis on the calibration and combination of the galactic plane data from the mission. QA ensured the release of a high-quality product for the astrophysical community.

The team's demonstration that the Moon residual signal is not detectable beyond 25° from the FIRAS line-of-sight removed concern about Moon contamination.

HSTX's task-specific efforts included the validation of the following algorithms:

- Computation of detector noise, variances for the averaged interferograms, and variances for the calibrated spectra in the processing software. Task members established that other sources of variance exist in addition to the detector noise. There is time variability of the variance and a dependence on glitch rate. As part of the task report to the science team, our analysts concluded that improved understanding of variance will result in a reduction in skymap noise and minimization of bias in the skymap signal.
- The removal of anomalous, time-dependent residual signals observed in the sky data, which is not accounted for by the calibration process. The algorithms estimate the spectrum for an exponential decay term and mission period dependent corrections. The spurious signal gave a striped appearance to some of the skymap images. The removal of the signal is thus called destriping. A new IDL software facility, FDS_Destriper, was developed for this purpose. The validation required verification of algebra for inversion of a partitioned matrix and detailed steps to generate the destriping parameters. It also required verifying the computation of variances for the spectra. The team checked the computed destriping parameters and correction spectra in the reference data set produced by the FDS_Destriper and verified that the reference data were correctly applied to the FIRAS spectra in our new FAD_Apply_Destriping Facility. Task members generated new skymap images after the destriping to demonstrate the effectiveness of the removal of the anomalous signal. The validation results proved that the corrections must be applied to the data before delivery to the science community.
- Coordinate transformations and unit conversions required for the production of Flexible Image Transport System (FITS) files to be released to NSSDC. These algorithms are implemented in a series of FIRAS initial product (FIP) programs that select the galactic plane data at the appropriate frequency cuts and prepare these data for inclusion in FITS files. The team also validated the FIRAS specific details in the informational (header) section of the spectral and instrument model FITS files.

HSTX analysts participated in research on atomic and molecular lines observed in the FIRAS spectra and produced significant results on their relevance to the study of galactic structure and the interstellar environment. Of particular significance are the fine structure lines from C+ and N+ at 63 and 48 wavenumbers, respectively. The morphological relationship between the FIRAS N+ and C+ lines show that these transitions act as an important cooling source in the inner galaxy. Team members had an active role in finding that the N+ and the far-infrared continuum at the line frequency are correlated by a three halves power law in the inner galaxy.

Task analysts are investigating the spatial distribution of the galactic dust components that produce the FIRAS dust continuum by correlating to other surveys, which probe the gaseous phase of the interstellar medium. One data set used for comparison is the velocity integrated 21 cm H I survey compiled by Lockman. Task members have completed correlation studies of H I with FIRAS bands at various galactic longitude and latitude bands and have made skymap images for ratios of the H I with the FIRAS band intensities (11 frequency bands from 20–70 wavenumbers). The FIRAS, high-frequency data used for the studies have both the monopole and dipole removed, leaving only the dust continuum and noise as the residual.

Task members participated in validating analysis algorithms that find the integrated line intensities of the emission lines observed in the FIRAS galactic spectra. Two general methods were investigated. In the first method, the baseline in the vicinity of the line is approximated using a complex polynomial of degree three, and an unapodized instrument line profile is used to model the line. In the second method, all lines are fit simultaneously. The covariance matrix was used for weights at the frequency points. Results using the two methods are consistent and agree within a few percent for the strong lines. To improve the estimate of the baseline, the second method has been adopted as the standard for recovering the integrated line intensities.

The team has developed processing tools for science analysis of the FIRAS data products. Included are tools that identify and characterize spectral lines in the FIRAS galactic plane observations, tools that display frequency-integrated intensities on a galactic latitude/longitude grid, routines that compute correlations, and tools for computing parameters for single or multiple component dust models to characterize the galactic spectra.

Task members completed a work schedule for reprocessing the integration and test data (I&T) and are producing a catalog of the calibration coadded interferograms. Task analysts also have completed a statistical analysis of the coadded data.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Documents: FIRAS science and instrument analysis reports; validation reports; related skymap images and plots; information for CES; other documentation, plans, and schedules
Originators: S. Read and HSTX team

COMPUTER USE

Hours	Computer
600 (wall clock)	UDBG VAX-8800, DEC workstations

NASA Task 82-349-01: DIRBE Software Development Support

GSFC ATR: ***D. West***

Hughes STX Task Leader: ***J.A.J. Skard***
Hughes STX Task Number: ***873***

This task supports the implementation of the Cosmology Data Analysis Center (CDAC). Specifically, the task's activities include the following, which support the DIRBE instrument: 1) detailed design, implementation, and testing of the remaining CDAC DIRBE software builds; 2) maintenance of earlier software builds and enhancements to existing software as approved by the ATR; 3) maintenance and implementation of approved enhancements for the DIRBE Offline Software; 4) software support for the integration of the DIRBE subsystem in the CDAC software system and for the CDAC regression tests; 5) documentation of final software designs, testing, and data products in support of delivery of the Project Data Sets (PDS) to the COBE Science Working Group (SWG); and 6) support for quick-look operations, command load planning, and instrument state verification.

FINAL CONTRACT SUMMARY

During the time span covered by this task, Hughes STX staff has completed the entire DIRBE processing pipeline, including the coding and implementation of six new software facilities and significant upgrades to the already-existing software. Staff completed one full processing pass through the 1st year of DIRBE data, and produced and delivered the DIRBE Initial Product to the NSSDC on schedule. After implementing a large number of algorithm enhancements, staff has now started Processing Pass 2, which will include the production of the DIRBE Project Data Sets. The staffing level on the task has varied from 6–13 and down again to the present 7 staff members, consisting of scientists and programmer/analysts, as well as one instrument specialist (IS), responsible for the daily commanding of the DIRBE instrument.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff completed significant enhancements to the pipeline software, particularly in the data linearization area, in preparation for Processing Pass 2. Staff implemented facility BSP_Special_Pointing. Staff also completed the implementation of planet-based beam profile facility BBP_EBP. Task members continued to improve the facilities BPW and BSL and started the full-up Processing Pass 1, Stage 1, after a successful "kickoff" review.

WORK PERFORMED

Software Development

DIRBE staff continued to respond to changing software requirements, as various instrument effects were becoming better understood. Good interactions between HSTX staff and the validators was essential during this process. The software changes for processing Stage 1 have now been completed. DIRBE's Edit Processing Pass 2, Stage 1, has started and is currently underway.

The primary accomplishments in the preparation for Pass 2, Stage 1, were in the following software facilities:

BIT_IRS_Trends—Algorithm for correction of gain effects induced by previous Internal Reference Source (IRS) runs and by South Atlantic Anomaly (SAA) passages; subtraction of three different detector offsets; storage of only the radiative detector offset in the BIT_DO file, corrected to standard temperature; and additional information provided in the output files.

BIC_Internal_Calibration—Algorithm for normalization of all IRS-trend queue entries to standard IRS response values, thus providing an absolute calibration relative to the IRS; greater flexibility in script specifications, and enhancements and corrections in the report file; and capability for specifying a systematic error term for the IRS responses.

BLI_Linearize_Intensities—Algorithm for correction of gain effects induced by previous IRS runs and by SAA passages; subtraction of three different detector offsets; correction for photon-induced responsivity enhancement in one band; trending of photon exposure for each detector; "blanking" of data for script-specified period after hard moon passages; and full tracking of magnitude of corrections applied to the data.

BBP_Beam_Profile—Extended beam profile using planet data is now fully operational. Output data sets are sorted in time order, which became necessary after the introduction of different time intervals for the formation of beam profiles for different detectors.

In preparation for Stage 2 of the processing pass, DIRBE staff continued to improve the facility BPW_Produce_Weekly_Files. The implementation of several new algorithms for robust data averaging caused several difficulties that have been addressed, one by one. Staff also improved the BCI/SAD facility for greater flexibility. This facility can now select pixel patches from any input skymap.

Work to improve the facility BSL_Stray_Light_Study continued. This facility now produces stray light results both for the Moon and for Jupiter, and is starting to return interesting and valuable information.

The implementation of the facility BSP_Special_Pointing was completed during this period. This is a menu-driven interface to the facility BCS, to be used for special studies of effects in skymaps.

DIRBE staff continued to fix SER's and SPR's, and closely monitored the regression test results after each new software build to ensure that the results were as expected.

Instrument Operations

Daily operational support of the instrument by the DIRBE IS remains suspended by request from the DIRBE PI.

The IS continued to provide analysis support to the science team by analyzing detector cross-talk effects in collaboration with the DIRBE DPI.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work conforms with the attached milestone schedule, except as noted below.

Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

Software Development

- Complete the entire DIRBE Edit Pipeline Processing Pass 2, including careful monitoring of the results.
- Continue software documentation, starting with DIRBE software used by other subsystems or by analysts.
- Continue to file and fix SPR's against the configured software.
- Update the Work Control Plan for the new contract to meet the requirements of this task.

IS Support

IS support will be offered on an as-needed basis.

DELIVERABLES SUBMITTED

Software: SPR's and SER's
Originators: J.A.J. Skard and the HSTX team

COMPUTER USE

Hours	Computer
2,800 (wall clock)	COBECL VAXcluster

MILESTONE NOTES

1. Stage II of BCS concerns the handling of general sentinel values and prescriptions (such as "all values .GE. 9999.0"). Handling of standard DIRBE sentinel values has already been implemented. (1/31/93)

2. The BSL schedule has slipped because of a personnel emergency. (5/31/93)

3. The BSP implementation has been delayed, because of resource reallocations, to higher priority tasks. (5/31/93)

4. The completion date for this item has been advanced by 1 month. (5/31/93)

5. The processing start date has been advanced by 2-1/2 months, and the duration has been shortened. (5/31/93)

6. The start of the documentation work has been delayed, because of resource allocations, to higher priority tasks. (5/31/93)

7. This work has been delayed, because of resource allocations, to higher priority tasks. (9/30/93)

8. The processing start for pass 2 took place later than scheduled, because of the large number of required software changes. (9/30/93)

9. The BSL schedule has slipped because of unexpected software difficulties. (9/30/93)

Applied Engineering Software
APPROVAL D. West
ACCOMP. J. A. Skard

DIRBE Task 873

ORIG. APPVL. 10/01/92
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES	92			93								
		O	N	D	J	F	M	A	M	J	J	A	S
01	BCS Generalized Sentinels									1,7			
02	BCC Design, Code, Test												
03	BPW Design, Code, Test												
04	BSL Design, Code, Test									2			9
05	BSP Implementation										3		
06	Edit Pass 1, Stage 2, Phase 1												
07	Edit Pass 1, State 2, Phase 2												
08	Produce Initial Data Product												
09	Document IDP												
10	Deliver IDP to NSSDC												
11	S/W Upgrades for Pass 2											4	8
12	Edit Pass 2											5	8
13	Draft System, PDS												
14	Documentation												6
15													
16													
17													
18													
19													
20													

Note: A series of three triangles along a single bar indicates three successive implementation phases (design, code, test)

525

NASA Task 82-349-02: DIRBE Data Analysis Support

GSFC ATR: ***D. West***

Hughes STX Task Leader: ***H. Freudenreich***
Hughes STX Task Number: 874

The objective of this task is to provide support in the analysis of data from the Cosmic Background Explorer (COBE) Diffuse Infrared Background Experiment (DIRBE). The contractor shall also support Cosmology Data Analysis Center (CDAS) activities as applicable to the DIRBE subsystem, including project management, CDAC Reviews, and future CDAC software builds and data set deliveries.

FINAL CONTRACT SUMMARY

The duration of the task was from July 1, 1990, through September 30, 1993. Two people, a principal scientist and a senior scientist at the time of closeout, worked full time on the task. The many accomplishments of the task included: corrections for detector temperature and photon-induced gain variations; detection of glitches and anomalously noisy data; software for outlier-resistant fitting, point-source removal, averaging, and statistical analysis; most of the work on absolute calibration and color correction of the data; much of the scheme for relative calibration; software for polarization calculations; the first beam profiles, maps of particle-radiation rates, and signal variance; the first maps in Mollweide, polar, and cylindrical projections; the first thesis based on DIRBE data; verification of the detector offsets being the same with shutter open or closed; establishment of a lab for testing detectors similar to those flown on COBE; software for modeling the Galactic bulge and the zodiacal light; scientific papers on comets and Galactic structure; and limits on extra-Galactic background brightness obtained by extrapolating from the behavior of the zodiacal brightness.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff continued to study the behavior of the gallium-doped germanium detectors in the lab and, during the mission, characterized the detector offsets as functions of time and temperature, determined the effect of internal calibration on the noise in skymap data, and wrote modules for the pipeline implementing the photon-induced responsivity correction. Staff members made simulations of the zodiacal cloud and templates of Galactic emission to be used in empirical fitting. Staff discovered a probable asymmetric component to the zodiacal cloud and proposed a theory explaining it. Staff collaborated on papers on comets, interstellar polarization, and Galactic structure.

WORK PERFORMED

Much time in this period was spent preparing a test setup of detectors similar to those flown on DIRBE; the experiment must be comparable to the actual DIRBE. In the lab, linearity tests were begun. The linearity was also studied in mission data by comparing the detectors in question to detectors known to be linear in response. The effects of glitches and a radiative offset on the correction for photon-induced gain enhancement were also investigated.

Staff spent several man-weeks investigating the behavior of the detector offsets in different data modes; the concern was that the offsets had been mishandled before. After this, staff proved that the offsets had not been mishandled after all. The task's proposal to use constant detector offset values was accepted, and staff members provided the values. Task personnel demonstrated that the DIRBE internal calibration does not benefit most detectors, so it was dropped for two detectors.

The task was also active in scientific research. Staff wrote a program to model the zodiacal cloud and compared the DIRBE results to different models obtained from the literature. Staff also proposed an iterative scheme for empirically characterizing both the zodiacal cloud and the Galaxy simultaneously, and performed one iteration, resulting in maps in which most of the Galactic contribution has been removed. HSTX staff collaborated on papers on comets, the Galactic bulge, the Galactic warp, and polarization by Galactic and solar system dust. By factoring out the dependence of zodiacal brightness on Earth's distance from the Sun, staff members uncovered strong evidence for eccentricity in the zodiacal cloud near Earth's orbit and proposed a specific cause of this eccentricity.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32320

Work planned includes the preparation of a Work Control Plan. Other work includes the continued laboratory testing of detectors and the continuing study of the data quality and of corrections to be applied to the data in the upcoming reprocessing.

COMPUTER USE

Minutes	Computer
Dedicated	VAXes
Dedicated	PC's

NASA Task 82-350-01: DMR Software Development Support

GSFC ATR: ***D. West***

Hughes STX Task Leader: ***V. Kumar***
Hughes STX Task Number: ***875***

This task supports the implementation of the Cosmology Data Analysis Center (CDAC). Specifically, the task's activities include the following which support the DMR instrument: 1) DMR instrument operations, including planning, analysis of quicklook data, and trending; 2) development of the Project Pipeline software, including algorithm development, coding, testing (including support of data reprocessing), modeling and removal of systematic effects from the data, and development of software tools necessary to support the aforementioned efforts; 3) development of the science analysis software, including algorithm development, coding, testing (including support of data reprocessing), validation, development of astronomical emission models, development of software tools necessary to support the aforementioned efforts; 4) DMR system maintenance and enhancements of existing software, regression testing, maintenance of disk space usage plans, maintenance of CPU usage plans, data reprocessing, build releases, and data and code backups, as needed; 5) documentation of final software designs, testing and data products in support of the delivery of the Project Data Sets (PDS) to the Science Working Group (SWG) and subsequently to the National Space Science Data Center (NSSDC); and 6) participation in scientific activities such as publication of results.

FINAL CONTRACT SUMMARY

The DMR software development support task is a 5-year task under the present contract. Under this task Hughes STX designed and developed the software system necessary to support prelaunch integration and testing and postlaunch instrument operation; monitor the health and safety of the DMR instrument; removal of systematic errors in DMR data and reduction of the data to skymaps; display and analyze DMR data using IDL image display tools; produce DMR analyzed science data sets (ASDS). The Hughes team supported prelaunch testing of the DMR instrument, COBE launch readiness, COBE launch (November 18, 1989) and early-orbit operations. Within 3 days after launch, the staff produced DMR skymaps showing detection of dipole in the cosmic background radiation (CMB). DMR skymaps from the first month of data, which were already more sensitive than any previously published data, were presented at the January 1990 American Astronomical Society meeting. The staff assisted in the modeling and removal of various systematic errors in DMR data, chief of which are the magnetic susceptibility, lunar emission in the DMR horn sidelobes, emission from the planet Jupiter, and the Doppler emission caused by Earth and spacecraft velocities. The DMR skymaps corrected for these errors were presented at the 1992 American Physical Society meeting, which demonstrated the existence of structure in the CMB on the order of a part in 100,000. This was a historical discovery that made news headlines worldwide. The DMR initial products, consisting of skymaps and pix-perm data, from the first year mission data were produced and delivered to NSSDC in June 1993. Currently, the HSTX team consisting of three senior scientists and four senior application programmers, is assisting the COBE project in production and verification of DMR project data sets from the 4 years of DMR observations. Staff will continue assisting the COBE science working group in the scientific analysis of DMR data. HSTX personnel will continue to provide instrument analyst support until the end of DMR mission in 1993.

SUMMARY FOR CURRENT REPORTING PERIOD

During this evaluation period, HSTX worked on 1) Pass 2 processing of the DMR data, 2) systematic error analysis of the Pass 2 data, and 3) the analysis support. The team successfully completed the production and preliminary verification of the 2-year DMR galactic skymaps of the first 2 years of the mission data. Systematic error analysis of Pass 2 data was continued. The DMR initial products and the initial product documentation were delivered to NSSDC. Analysis support was provided to the SWG on sky rms analysis and the three-point correlation analysis. The instrument specialist support for the continuous monitoring of the instrument performance was continued.

WORK PERFORMED

Quick-Look Operations

HSTX personnel continued to provide Instrument Specialist (IS) support for the DMR instrument in its fourth year of operation. Task personnel continue to monitor the quality of the 1993 mission data and the health of the DMR instrument. The 31B radiometer is monitored closely as the signal RMS remains high and the signal remains noisy. Eclipse operations support was provided to the COBE mission operations.

Two online event log files were maintained: The DMR flight events log and the solar events log. The DMR flight events log is used to evaluate instrument and spacecraft effects on the Pass 1 data. Trending of various spacecraft and instrument housekeeping data continues.

Software Development

HSTX personnel successfully completed an important project milestone with the delivery of initial products (DMR skymaps and pix-perm data) from the first year DMR data to NSSDC.

Task personnel completed revising and validating DMR facilities DES4, DMC4, DTB4FFT, and DAIRMS. Other software development activities included: 1) adding options to V7NORM and V4NORM to facilitate solving skymaps with user-specified measurement vectors, 2) DAIRMS revised to include fast smoothing algorithm and the skewness and kurtosis calculations, and 3) DGB enhancements to work at resolutions higher than index level 6 and create noise maps.

Task personnel developed a FITS rasterizer for rapid conversion of both DMR skymaps and BINTABLE FITS files into rasterized images suitable for viewing, for example, from SAOImage. Staff also developed RDL-to-FITS and FITS-to-RDL converters for both skymaps and pix-perms.

The team successfully completed Pass 2 processing of 2-year pix-perm data, lunar calibration (DMC) data, Earth-velocity correction (DEV) data, and DES maps. The team also successfully completed production of the galactic skymaps of the third year (1992) mission data. Staff completed reprocessing of 3 years of DCA_TOD data sets due to a software bug that was recently found while processing third-year data. The software error was determined to affect only 90A and 90B data. Other production runs completed by HSTX task personnel include: 1) skymap processing with alternate Earth limb model based on DES maps, 2) short-term and long-term FFT runs on 2 years of mission data, and 3) data binning by spin and orbit angle.

Task members continued to assist in the verification and the systematic error analysis of Pass 2 data. The analysis activities included comparison of Pass 2 and Pass 1 results, specifically magsus, DMP, DHI, and absolute calibration results; fitting Zodi on 2-year data analysis of LIA memory effects; investigation of alternate Earth limb model that uses DES results; comparison of dipole and quadrupole values from DMP, DEV, and DHI investigation of eclipse effect on 31-GHz channel data; and FFT analysis to study spin-modulated magsus effects.

Task personnel investigated the effect of loose objects reported (from radar tracking) to be floating around COBE in orbit. The investigations so far have shown no evidence of any effects of these debris on DMR observations.

Task personnel also investigated the effect of the Perseid meteor shower on DMR observations and found no evidence of DMR observing the meteor shower.

Task personnel continued to maintain and enhance the DMR image processing software, DIMAGE.

Task personnel assisted in the conversion of DMR software to switch to use IMSL version 2.0.

Staff made significant contributions toward the understanding the use of DMR data in determining the polarization of the cosmic microwave background radiation. It is possible to derive maps of the linearly polarized component of the celestial microwave signal from the 53-GHz and 90-GHz DMR data. Such maps are extremely interesting both in relation to the galactic modeling and to the questions of polarization of the cosmic microwave background. However, the size of the problem, the problem of defining the polarization model functions, and the ability to recognize and deal with the degrees of freedom in the map that are not determined by the data, render this problem extremely difficult. HSTX staff was recently successful in finding ways to deal with or work around each of these problems and has started the production of the maps of the linearly polarized component of the celestial microwave signal.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32557.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32557

A Work Control Plan that meets the requirements of Contract NAS5-32557 will be prepared.

Quick-Look Operations

Task personnel will continue to provide monitoring and analysis support for the DMR instrument, including analysis of short-term and long-term trends in science, housekeeping, and engineering data.

The 31B radiometer activities will continue to be monitored and analyzed. Necessary support in the preshutdown DMR special tests will be provided.

Software Development

The DMR team will continue systematic error analysis of Pass 2 data and DMR software updates as needed.

Staff will continue the revision and validation of DMR Pass 2 software; complete Pass 2 processing of the 3 years of DMR mission data; determine formats of PDS deliverables; continue to provided quality development support and validation of the project software; continue to maintain high documentation standards; continue to support presentations to the COBE Science Working Group; and contribute to papers involving both the science and software aspects of the DMR instrument.

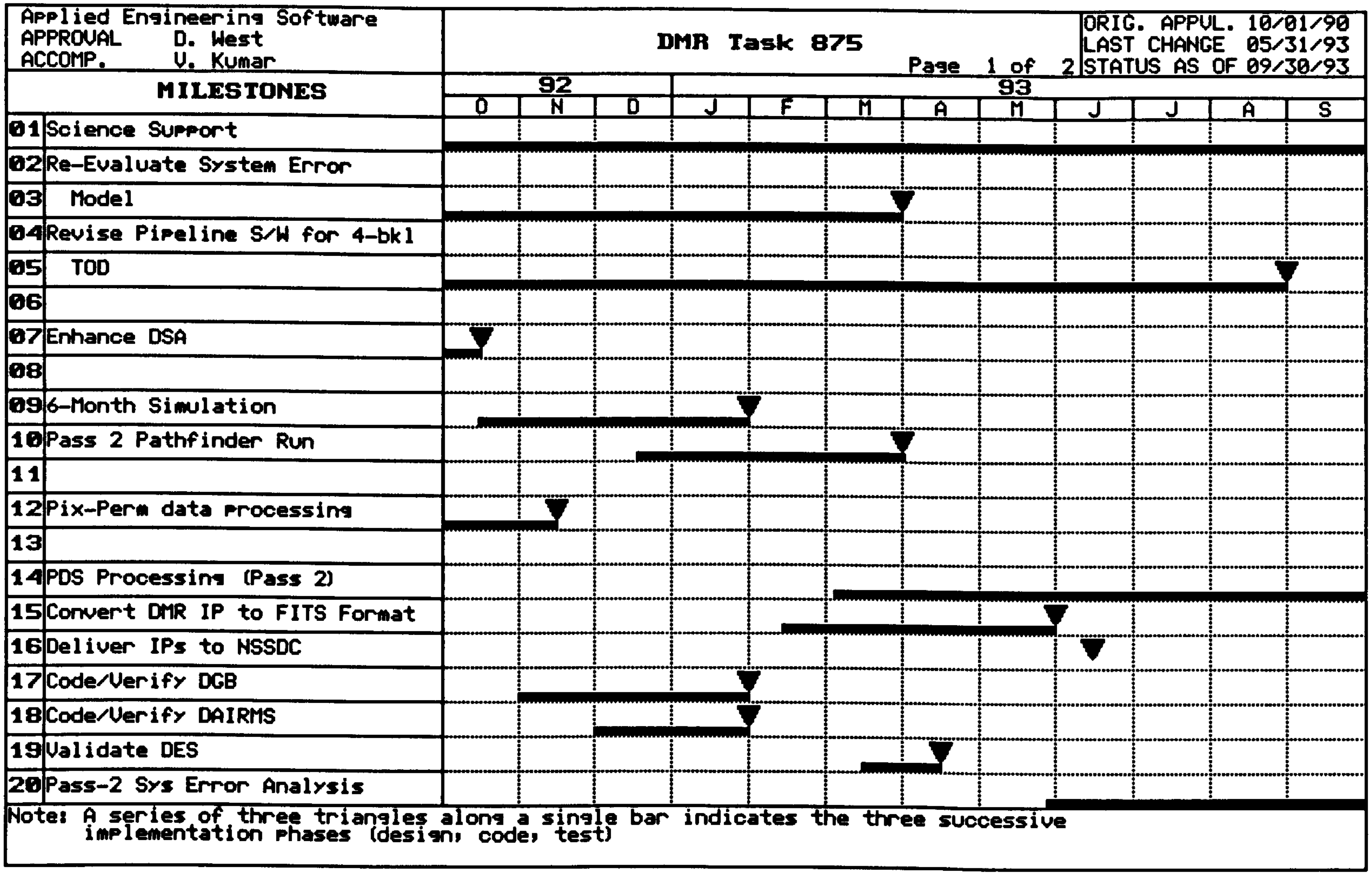
DELIVERABLES SUBMITTED

Data: DMR Initial Products including 6 DMR skymaps in FITS format; 6 DMR pix-perm data sets in FITS format; and documentation on the DMR initial products

Originator: DMR Team

COMPUTER USE

Minutes	Computer
9,900 (CPU)	COBECL VAXcluster


Applied Engineering Software
APPROVAL D. West
ACCOMP. V. Kumar
DMR Task 875
Page 1 of 2
ORIG. APPVL. 10/01/90
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93
MILESTONES
92
93
O N D J F M A M J J A S
01 Science Support
02 Re-Evaluate System Error
03 Model
04 Revise Pipeline S/W for 4-bkl
05 TOD
06
07 Enhance DSA
08
09 6-Month Simulation
10 Pass 2 Pathfinder Run
11
12 Pix-Perm data processing
13
14 PDS Processing (Pass 2)
15 Convert DMR IP to FITS Format
16 Deliver IPs to NSSDC
17 Code/Verify DGB
18 Code/Verify DAIRMS
19 Validate DES
20 Pass-2 Sys Error Analysis
Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

Applied Engineering Software
APPROVAL D. West
ACCOMP. V. Kumar

DMR Task 875

ORIG. APPVL. 10/01/90
LAST CHANGE 05/31/93
STATUS AS OF 09/30/93

	MILESTONES	92 O	92 N	92 D	93 J	93 F	93 M	93 A	93 M	93 J	93 J	93 A	93 S
01	Prepare DMR Users Guide (V6)												
02													
03	Validate DCA												
04	Validate DDFT												
05													
06													
07													
08													
09													
10													
11													
12													
13													
14													
15													
16													
17													
18													
19													
20													

Note: A series of three triangles along a single bar indicates the three successive implementation phases (design, code, test)

NASA Task 92-351-00: High Temperature Superconducting Detector and Planetary Atmospheres Instrument Development

GSFC ATR: *Dr. J. Brasunas*

Hughes STX Task Leader: *Dr. B. Lakew*
Hughes STX Task Number: *950*

This task provides scientific and technical support for the development of a High Tc Superconducting (HTS) infrared bolometer and short wavelength detectors for the Composite Infrared Spectrometer (CIRS) on Cassini.

FINAL CONTRACT SUMMARY

This task lasted 5 years. Two Hughes STX scientists actively supported the efforts to develop an HTS bolometer and the CIRS focal plane 1 (FP1) fabrication, assembly, and characterization tests. Major accomplishments during the life of the task were the building of the first transition-edge, composite, high Tc bolometer in late 1988; the building, since then, of many generations of high Tc bolometers with improved sensitivities and time constants; and, finally, only a few weeks ago, a high Tc bolometer with prethinned $Al2O3$ having a record performance (NEP and D*). During the last 5 years, seven papers were coauthored by HSTX personnel. Several conferences were attended. Two trips were made by HSTX personnel to coordinate efforts to build CIRS detectors in Germany and the FP1 assembly and testing here at GSFC. A custom pumping system with an online residual gas analyzer and an automatic pneumatic valve to protect the detectors in case of power failure was put together by HSTX staff. An RGB color video system, with a frame-grabber system and customized software, was recommended, purchased, and installed by HSTX personnel. This video system will play a major role in the documentation of flight FP1 hardware and also in the alignment and centering of optical parts of the FP1 subassembly. Many CIRS pre-prototype and prototype detectors were tested and characterized by HSTX personnel. Many cryogenic devices were designed, fabricated, and assembled. An HSTX LabVIEW expert custom programmed LabVIEW to computer control as many as seven instruments in the lab shared by the High Tc and CIRS projects. The CIRS FP1 breadboard was assembled, tested, and characterized by HSTX personnel. The breadboard was delivered to Code 717 personnel for integration into the CIRS interferometer. Staff played a major role in the preparation of an ICD signed by both GSFC personnel and those of the University of Karlsruhe, Germany.

SUMMARY FOR CURRENT REPORTING PERIOD

Task members worked on the following activities:

- A high Tc bolometer with record performance was built and characterized by HSTX personnel.
- A paper coauthored by HSTX personnel presented the performance of the high Tc bolometer and discussion on the noise, NEP, D*, and future work to improve the time constant. It was submitted to the *Appl. Phys. J.*
- An RGB color video system was installed by HSTX personnel improving the imaging, measuring, and processing of the CIRS detector subassembly.
- HSTX personnel traveled to Germany to help the German team at the University of Karlsruhe solve problems they have encountered during the fabrication of the CIRS FP1 detectors.

WORK PERFORMED

100 HIGH TC SUPERCONDUCTOR (HTS) BOLOMETER

HSTX personnel built and characterized an HTS bolometer with an NEP and a D* orders of magnitude better than the previous high Tc bolometers built at GSFC. The results will soon be submitted to *Appl. Phys. Lett.* for publication. Possible improvements to obtain even higher sensitivity are currently being studied by an HSTX staff member. HSTX personnel coauthored a paper entitled "Transition-Edge 1/f Noise in YBCO Thin Films Before and After Exposure to Ionizing Radiation." The paper will soon be submitted to a refereed journal. Task personnel supervised the work of a summer student who designed, assembled, and tested a quick testing system for high Tc film and for data acquisition using LabVIEW.

200 COMPOSITE INFRARED SPECTROMETER (CIRS)

201 Thermopile Subsystem Development

HSTX personnel prepared a tolerance buildup analysis that was the basis for a request to redesign the FP1 subsystem. The design changes have since been obtained from project management. Task personnel participated in several review meetings and provided suggestions and critical assessments of the new design. Task personnel traveled to the University of Karlsruhe, Germany, as part of a NASA team to investigate technical problems encountered by the German team fabricating the FP1 detectors. Staff members made a presentation on the FP1 subassembly work at GSFC and the detector absorber centering capabilities at GSFC using the video/frame-grabber system. Task personnel worked on the final details of the FP1 detector ICD before obtaining the signed approval of GSFC and Karlsruhe personnel. Task members attended the CIRS team meeting in August and several FP1 subassembly meetings during this reporting period.

202 Thermopile Subsystem Testing

In the Dewar area, a microvalve was installed and tested. A circuit for a pump power failure was designed, made, and installed for the small turbo pump. The detector test unit (dtu) had a radiation shield fabricated, painted with chemglaze, and installed. A stray light box was made to protect the detector, and a new low-frequency chopper was mated to the dtu and tested. Detector 245 was tested for responsivity and detectivity. Detector 240 went to acoustic testing in Bldg. 7.

Other subsystem work included a test setup for analyzing the effects of concentrator-detector misalignment, filter tests at long wavelengths, concentrator measurements using Bldg. 5 equipment, analysis of a new low-noise preamplifier, and installation of FP1R and FP1T in the Code 700 breadboard, assisted by D. Cornwell (Code 713). A new major activity was integrating video equipment and software into the task's science. The software packages IPLab, Automatix, and Image 1.49 were reviewed and tested. Image 1.49 macros were learned and adapted for specific CIRS tasks. The new RGB color video hardware arrived and was configured for the task's use in the cleanroom. Miscellaneous video activity included having a new video microscope stand fabricated, testing various lighting configurations, and retrieving from excess equipment to be used for camera placement. Other lab work included learning EasyCAD, assisting with the installation of an Ethernet card, and processing contamination data for Karlsruhe's Dewar chambers and the task's dtu. Finally, some time was spent studying the topic of remote sensing.

A setup for analyzing detector-concentrator alignment was designed, fabricated, and used. Detectors 244 and 280 were tested twice for responsivity and detectivity. The response program was updated accounting for nonlinearities induced by the transformer and preamplifiers. Another MathCAD program was written to scrutinize the harmonics of the detector signal with a theoretical plot, and then to automatically derive a "best fit." A design for a custom thermopile was generated and submitted to a vendor for bid. The video work included meeting with an IPLab representative, designing a new mount for the second vertical camera, procuring some of the parts for the second camera, writing/modifying macros for Image 1.49, and fine tuning the RGB system. Other work included testing a preamplifier's low-noise characteristics, characterizing the long wavelength filters, assisting Cornwell in removing the breadboard from the lab, investigating the requirements to float the optics table, bringing the new nitrogen gas cylinder online, initiating a design for a POMD modification, and coordinating the new Ethernet connection. Detectors 262, 268, 280, 281, and 282 were each tested twice for detectivity. The MathCAD response program was improved to include harmonic comparisons, automatic calculations of the time constant, and real transformer data, thus giving the most accurate data yet. Video activity included calibration images for microscope and lens combinations, archival of the MIRIS focal plane, purchase of more lenses, and construction of an adjustable arm to save space on the clean bench. Other work included attending a 4-day LabVIEW course, installing a tape drive on the lab 486, investigating and purchasing a new Macintosh computer for archiving and displaying images, getting the Macintosh IIci running on Ethernet, and "fetching" files from NIH and Karlsruhe Univ., and providing miscellaneous laboratory support.

SIGNIFICANT ACCOMPLISHMENTS

An HTS bolometer with orders of magnitude better than NEP and D* performance was built on prethinned Al2O3 and tested. Results will soon be submitted for publication. Task personnel traveled to Karlsruhe as part of a NASA team to help the German team fabricating CIRS FP1 detectors to solve some recent failures in the thermopile sensors. Staff integrated a new RGB color video/frame-grabber system and software customized it to meet CIRS laboratory documentation and micron-level measurement requirements. Staff designed hardware that successfully demonstrated that if the parabolic concentrator and FP1 detector are aligned, the concentration efficiency of the concentrator is equal or greater than the nominal value of 5.2.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will build a composite high Tc bolometer with even greater D* and a smaller time constant by using silicon as the absorber substrate. Staff also will provide to Code 713 personnel an improved version of the FP1 breadboard. Task members will continue CIRS detector tests and design new holders for the detector cylinders that do not apply mechanical stress. The RGB imaging system will be improved. A Work Control Plan will be prepared for the new contract to meet the requirements for this task.

COMPUTER USE

Minutes	Computer
3,000	VAX 11/780
450	Macintosh SE
37,000	IBM PC
12,000	Macintosh II

NASA Task 92-354-00: Geophysical Data Acquisition and Software Support

GSFC ATR: ***Dr. P. Wasilewski***

Hughes STX Task Leader: ***M. O'Bryan***
Hughes STX Task Number: 952

This task provides data acquisition and software support for the rock magnetism facility in the Astrochemistry Branch of the Laboratory for Extraterrestrial Physics (LEP).

FINAL CONTRACT SUMMARY

The duration of this task was 5 years. One associate technical specialist served on this task. Hughes STX staff produced and revised 51 documents, 15 proposals, 20 abstracts, and 12 publications for oral presentations. Staff gathered data and completed measurements on the natural and saturated magnetic remanence; thermal demagnetization; and alternating field demagnetization of 1,555 meteorite, Xenolith, basaltic rock, lodestone, and chondrule samples. This work included more than 12,000 individual measurements of these samples using the Superconducting Rock Magnetometer and the Vibrating Rock Magnetometer equipment. The task member also logged records for further analysis. In addition, staff created and integrated 863 charts and graphs with data in support of research on magnetic remanence. Staff assisted the ATR with organization and implementation of a storage filing system for Xenolith and meteorite information and devised a comprehensive guide for all Xenolith samples complete with a graph that details each study on individual samples. HSTX staff created a hardcopy Master System File detailing all documents contained on the computer system. Staff installed software and hardware upgrades including a new large-capacity hard drive data storage system on the ATR's computer. Through diligent work and judicious use of time, the HSTX task member met all deadlines, even though many publications required tight schedules.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff produced and revised documents for publication using the Macintosh SE. Staff gathered data and completed measurements on the natural and saturated magnetic remanence; thermal demagnetization; and alternating field demagnetization of meteorites, Xenoliths, basaltic rocks, lodestones, and chondrules using the Superconducting Rock Magnetometer and the Vibrating Rock Magnetometer equipment. The task member also logged records for further analysis. In addition, staff created and integrated charts and graphs with data in support of research on magnetic remanence. Staff organized and stored ~300 maps in a newly acquired map storage cabinet.

WORK PERFORMED

100 GEOPHYSICAL DATA ACQUISITION

HSTX personnel continued to perform measurements for natural and saturated magnetic remanence; alternating field demagnetization; and thermal demagnetization data acquisition on lodestones, Xenoliths, basaltic rocks, and meteorite chondrules from Antarctica and Japan using the

Superconducting Rock Magnetometer and the Vibrating Rock Magnetometer equipment. Staff also logged records for further analysis.

200 GEOPHYSICAL SOFTWARE SUPPORT

HSTX personnel were responsible for the preparation, and revision for publication, of several publications including the following:

- Magnetic Anisotropy of Gneissic Rocks from Skarvsnes Area, East Antarctica Abstract.
- A detailed study of dust bands and the ice in which the bands reside: Allan Hills, Elephant Moraine, and Pecora Escarpment Proposal.
- Rock Magnetic Framework for Improved Interpretation of Satellite Geomagnetic Anomalies Proposal.
- Rock Magnetism Facility Insert for Research Analysis and Test Capabilities and Facilities.
- Inserts for Xenolith Magnetic Record in Antarctica and Xenolith Magnetic Record in the Japan Arc.

HSTX staff created and updated charts and graphs in support of magnetic research on Xenoliths, lodestones, basaltic rocks, primitive meteorites, and chondrules. Charts developed and integrated with data included the following:

- NRM and SIRM alternating field demagnetization charts for Halling, OCH, and Saratov.
- Stereoplots for Bjurbole, Chainpur, and Soko Banja.
- Antarctic Xenoliths.
- Magnetization charts for ICH (1), IKI (4), KIRK (2), and Antarctic Xenoliths (5).
- Data, magnetization charts, and remanence acquisition for Lodestone 99484.
- Graphics for the Xenolith Magnetic Record in the Antarctic and the Japan Arc.
- Pecora Escarpment graphic.
- Convoy Ridge map.
- NRM's and Xo Values for Samples Examined in the Thin Section/Summary of Xenolith Results.
- Properties of Representative Volcanic Rocks on Hut Point Peninsula, Ross Island, Antarctica/Summary of Published Xo Susceptibility Data.

SIGNIFICANT ACCOMPLISHMENTS

HSTX personnel organized a master reference list by compiling all reference lists into one master list. This Master Reference list will greatly reduce the time spent searching for missing references during the production of proposals. Staff created a data base of all samples measured in the lab complete with sample number, types of experiments performed, and other information. This data base will greatly improve the production of new experiments.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-23250.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

100 GEOPHYSICAL DATA ACQUISITION

HSTX staff will continue to provide data acquisition support and research, assembly, and production of magnetic data related to the study of Xenoliths, lodestones, rocks, chondrules, and meteorites. Staff will continue natural and saturated magnetic remanence, alternating field demagnetization, and thermal demagnetization of Xenolith, lodestone, rock, chondrite, and meteorite samples using the Superconducting Rock Magnetometer and the Vibrating Rock Magnetometer equipment.

200 GEOPHYSICAL SOFTWARE SUPPORT

HSTX personnel will continue to provide technical publication support for development of publication-quality graphics. Research will continue on the natural and saturated magnetic remanence of Xenolith, lodestone, rock, chondrite, and meteorite samples. Work on upgrading software programs will continue as requested. Staff will also continue organization of the meteorite, lodestone, rock, chondrule, and Xenolith data base, as well as updates to include ongoing studies of samples. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh SE

NASA Task 92-355-00: Ulysses URAP Experiment Software Support

GSFC ATR and Cognizant NASA Scientist: ***Dr. R. Stone***

Hughes STX Task Leaders: ***Drs. R. Hess and M. Reiner***
Hughes STX Task Number: ***953***

This task provides support for designing, developing, testing, integrating, and documenting software to decommutate, display, and analyze data from the Unified Radio and Plasma (URAP) experiment onboard the Ulysses spacecraft. The URAP experiment is composed of five instruments for measuring electric and magnetic fields: Radio Astronomy Receiver (RAR), Plasma Frequency Receiver (PFR), Waveform Analyzer (WFA), Fast Envelope Sampler (FES), and Sounder.

FINAL CONTRACT SUMMARY

HSTX scientific and programming staff successfully supported the Ulysses URAP experiment from prelaunch preparations through launch, Jupiter encounter, and high-latitude phases of the mission. This support included test monitoring, decommutation software development, display and routine product development, routine and special data handling services—especially during high-activity periods such as the Jupiter encounter—and commanding and instrument status support.

During high-activity periods, HSTX staff also provided extensive logistical support for activities carried out at remote sites, including near-real-time data processing and computer systems support. HSTX personnel's involvement in these activities materially assisted scientific staff from several participating institutions in rapidly and successfully investigating phenomena encountered in real time, allowing effective interaction and appropriate instrument response. This was especially important in the fast-paced Jupiter encounter where long commanding lags made rapid response to changing conditions critical.

HSTX analysts provided ongoing commanding support for URAP and were responsible for reacting to instrument anomalies by consulting with team members and developing a consensus strategy to deal with problems. HSTX staff has successfully coordinated the URAP team response to several spacecraft and instrument anomalies in a timely and correct manner. Task analysts have been responsible for developing several procedures that are used by Mission Operations as the default response to particular situations.

HSTX scientific staff have made significant contributions to the description and understanding of various interplanetary and Jovian phenomena measured by the suite of instruments comprising URAP. These contributions have involved both published papers and presentations at a number of scientific conferences. HSTX scientists have furthered the understanding of type III and type II radio bursts and of several of the radio emissions associated with Jupiter—especially in reference to the location of the emission source regions.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff continued support of the Ulysses/URAP team. Staff processed routine Ulysses data in a timely manner and distributed the results to team members. Task personnel created new software to produce line plots of URAP RAR data and enhanced the data visualization software. Staff interacted closely with the Data Management Team at JPL to complete implementation of the Ulysses Common Data File. Task personnel responded quickly and effectively to a series of problems involving the Ulysses spacecraft including loss of one of the DSN antennas, a DNEL, and an upset in the URAP instrument. Staff reprocessed selected periods of old data to test the newest version of decommutation software and made final preparations for complete reprocessing of all URAP data received since the start of the mission. Staff upgraded the operating system on the URAP computers and installed MOTIF as the new graphical user interface. Staff enhanced access to data on the URAP computers by implementing NFS to allow remote mounting of URAP disks. Staff scientists presented new results on Jovian radio emission phenomena at the URSI conference and contributed to a number of scientific papers concerned with Ulysses scientific results.

WORK PERFORMED

100 SOFTWARE DEVELOPMENT

110 Data Processing Software

HSTX staff updated the DECOM software to include the source file name in the output file headers. This was done so that a user could determine whether the data source was an EDR or a QEDR file.

Staff created and tested a batch command procedure to reprocess old data. This procedure allows the reprocessing to be done when the URAP computers are not being used interactively.

120 Data Storage/Access/Transfer Software

HSTX staff created command files to assist in the compression and decompression of data and tested the software suite that will perform the automated reprocessing of the Ulysses data.

HSTX personnel developed a method to perform the decompression of data files in a way that is transparent to the user. This method uses a detached process to perform the decompression. Communication with the detached procedure is achieved via a VMS MAILBOX.

130 Data Visualization Software

HSTX staff initiated several enhancements to the URAP data visualization software and data products. HSTX staff enhanced the VISUAL interactive graphics software program to improve plotting of PFR and FES data. Staff performed an exhaustive test of the plotting capabilities of VISUAL, examining all of the many quantities that can be plotted. Also, a procedure was created to produce plots of daily summaries of the intensity of selected frequencies of the radio astronomy receiver, because the dynamic spectra produced on the summary plots were not adequate for scientific analysis. These new daily plots will be routinely supplied to the ATR. Because of the very large files generated, the plots are run in batch mode at night to avoid tying up the printer queues during normal working hours.

140 Data Analysis Software

The DFIND program for performing direction finding of radio sources was updated. Many changes were made to the IDL part of the program to enhance the graphs that can be produced.

An HSTX staff scientist wrote a new program to perform simple ray tracing in and near the Jovian magnetosphere. This program launches a ray from an assumed source near Jupiter and calculates the refraction of the ray at the magnetopause and bow shock boundaries. An optimization procedure is used to determine the ray launch direction that causes it to intercept the Ulysses spacecraft.

150 Utility Software

New versions of the public domain compression/decompression routines were acquired from archives on the Internet. The new routines, unlike the routines previously available, have a standard VMS interface, allow wildcard file specifications, and provide an online help facility.

160 Software Configuration Management

Configuration managed software was kept up-to-date as new versions of the programs were produced.

170 Software Documentation

Software documentation was kept current with revised software. This included changes to VISUAL and to the DECOM output files.

180 Library

The URAP library was made more useful by placing online a catalog of its contents. Users can perform a computerized search of the catalog to find the location of particular items in the library.

200 COMPUTER HARDWARE AND SYSTEM SUPPORT

HSTX staff made a number of improvements to the system software on the URAP computers. The latest version of the VMS operating system was installed. This version adds new functionality and corrects some problems with older versions. Also, it was necessary to install the new version in order to use the new and upgraded workstations that are scheduled to be installed shortly.

At the same time as the new version of the operating system was installed, the MOTIF graphical user interface was installed. MOTIF has become the standard for many computer systems and provides additional functionality over the previously installed interface.

HSTX staff continued to make preparations for the installation of new hardware. A new version of IDL was made available to users. This new version provides additional functionality and is consistent with new documentation recently acquired.

300 DATA PROCESSING

Routine processing was performed in a timely manner, and data products were distributed to team members. Several times, HSTX staff processed data on an accelerated schedule because of spacecraft problems.

400 DATA ARCHIVING

Backup copies of data products and EDR's were produced on a regular schedule.

500 SPACECRAFT SUPPORT

HSTX staff responded rapidly and effectively to several spacecraft problems that occurred. These problems included a Disconnect Non-Essential Loads (DNEL), a loss of one of the DSN antennas, and an upset in the DPU on the URAP instrument. In all these cases, HSTX personnel participated in decisions regarding the appropriate response to the problem and helped to prepare the appropriate command sequences to reset and/or reconfigure the spacecraft.

600 SCHEDULING AND ADMINISTRATIVE SUPPORT

HSTX personnel helped with scheduling URAP meetings at GSFC and made travel arrangements for the URSI meeting.

700 LIAISON WITH OTHER EXPERIMENTERS

HSTX staff kept in close touch with URAP team members at other institutions. This collaboration included sharing of URAP data and software, responses to spacecraft anomalies, and joint investigation of scientific subjects.

800 SCIENTIFIC AND TECHNICAL SUPPORT

An HSTX staff scientist continued the study of magnetic clouds and resonances in magnetized plasma. The work on magnetic clouds included the effects of finite beta, rotation, and dissipation. Also studied was a comparison between the magnetic flux rope model and the spheromak model of magnetic clouds.

Work on resonances focused on determination of the magnetic field in the Io torus during the Ulysses February 1992 flyby of Jupiter. This included a comparison between natural radio emissions and sounder-stimulated resonances.

An HSTX scientist continued analysis of the Jovian hectometric (HOM) radio emissions observed by the Ulysses URAP experiment with the purpose of better understanding the beam characteristics. By examining the emission as a function of Ulysses' position relative to Jupiter, it was concluded, contrary to what was assumed by previous investigators, that the HOM beaming exhibits a dependence on the Jovian longitude of the observer. It was also concluded that if the radiation is assumed to be emitted into a hollow cone of large opening angle, then the emission comes only from a finite sector of this cone. Finally, it was observed that HOM is not symmetric with respect to the Jovian centrifugal equator, which is the symmetry axis of the Io plasma torus.

HSTX scientists also continued analyzing various aspects of the Jovian broadband and narrow band radio emission. Work has commenced on the analysis of type III radio bursts and on radio emission from Earth's bow shock.

An HSTX scientist began a study of the dependence of the source direction of Jovian quasi-periodic bursts on frequency. This dependence may be caused by refraction of the radio waves at the magnetopause and at the bow shock, so a detailed knowledge of this dependence may help to determine the overall shape of the Jovian magnetosphere.

900 ULYSSES JUPITER ENCOUNTER

HSTX staff continued work on many scientific projects examining and explaining the data collected by URAP during the Jupiter encounter.

SIGNIFICANT ACCOMPLISHMENTS

HSTX staff responded quickly and effectively to problems that arose on the Ulysses spacecraft. Spacecraft commands were generated that restored URAP to a healthy and useful configuration.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract is completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

All old URAP data will be reprocessed using the latest decommutation software to bring the data up to the most recent correctness level.

The URAP computer cluster will be upgraded, including installation of new disks that will increase the online disk capacity to approximately 10 GB. A new workstation will be installed, and all Ethernet connections will be switched to 10baseT cables.

A Work Control Plan will be prepared.

NONLOCAL TRAVEL

Two staff members attended the 25th General Assembly of the Union Radio-Scientifique International (URSI), August 25–September 3, 1993, in Kyoto, Japan.

TRAINING

One staff member received training as a meeting facilitator and two staff members received training in the continuous measurable improvement (cmi) approach to quality management.

DELIVERABLES SUBMITTED

Paper Presented at Scientific Conference: Jovian Radio Source Locations and Beam Characteristics Deduced from Ulysses URAP Observations," presented at 25th General Assembly of the URSI, August 25–September 3, 1993, Kyoto, Japan
Originator: M. Reiner (principal author)

Paper Presented at Scientific Conference: "Subsidiary D Resonances as a Natural Magnetometer," presented at 25th General Assembly of the URSI, August 25–September 3, 1993, Kyoto, Japan
Originator: V. A. Osherovich (principal author)

Scientific Publication: "Source Characteristics of Jovian Narrow-Band Kilometric Radio Emissions," published in *J. Geophys. Res.*, *98*, 13163, 1993
Originator: M. Reiner (coauthor)

Scientific Publication: "Non-Linear Evolution of Magnetic Flux Ropes. 1. Low-Beta Limit," published in *J. Geophys. Res.*, *98*, 13225, 1993
Originator: V. A. Osherovich (principal author)

Scientific Publication: "A New Component of Jovian Kilometric Radio Emission," submitted to *J. Geophys. Res.*
Originator: M. Reiner (coauthor)

Scientific Publication: "The Non-Linear Evolution of Magnetic Flux Ropes. 2. Finite Beta Plasma," submitted to *J. Geophys. Res.*
Originator: V. A. Osherovich (principal author)

Scientific Publication: "The Self-Similar, Non-Linear Evolution of Rotating Magnetic Flux Ropes," submitted to *J. Geophys. Res.*
Originator: V. A. Osherovich (coauthor)

Scientific Publication: "The Non-Linear Evolution of Magnetic Flux Ropes," submitted to *J. Geophys. Res.*
Originator: V. A. Osherovich (coauthor)

Scientific Publication: "The Magnetic Flux Rope Versus the Spheromak as Models for Interplanetary Magnetic Clouds," submitted to *J. Geophys. Res.*
Originator: V. A. Osherovich (coauthor)

Scientific Publication: "Quasiperiodic Jovian Radio Bursts: Observations from the Ulysses Radio and Plasma Wave Experiment," submitted to *Planetary and Space Sciences*

Originator: R. Hess (coauthor)

COMPUTER USE

Minutes	Computer
Dedicated	VAXstation 4000/200
Dedicated	VAXstation 4000/60
Dedicated	VAXstation 4000/VLC
Dedicated	Apple Macintosh
300 (CPU)	IBM
60 (CPU)	LEP VAX

NASA Task 92-356-00: Voyager Infrared Support

GSFC ATR: *Dr. B. Conrath*

Hughes STX Task Leader: *J. Guerber*
Hughes STX Task Number: 954

This task provides software support for studies of atmospheric thermal and compositional characteristics of the outer planets and their associated satellites using data from the Voyager Infrared Interferometer Spectrometer (IRIS).

FINAL CONTRACT SUMMARY

Over the lifetime of the task, October 1, 1988, through September 30, 1993, one programmer/analyst has been supporting it.

During this task, staff has accomplished the following:

- Maintenance and extensive enhancement of the Voyager IRIS temperature-inversion and atmospheric parameter software.
- Use of temperature-inversion and atmospheric parameter software to produce temperature profiles and derived data such as para-Hydrogen fractions, and plots and maps of these data.
- Onsite support provided at JPL to the IRIS team during the Voyager–2/Neptune encounter.
- Fitting of Malkmus band-model parameters to synthetic homogeneous-path transmittances, using Levenburg-Marquardt fitting and requiring analysis and solution of extensive numerical instabilities.
- Calculation of transmittances in inhomogeneous, nongrey atmospheres via the Correlated K-distribution method using the Malkmus parameters, for both limb and nadir geometries, and comparisons made with Curtis-Godson and line-by-line integration methods.
- Integration of Correlated-K transmittance calculation with Mars Observer (MO) Thermal Emission Spectrograph (TES) inversion software.
- Contribution of synthetic Saturn temperature inversions to the successful instrument proposal for Cassini.
- Assistance with the setting up the Planetary Data System (PDS) Atmospheres/IR subnode, including research into data base systems and equipment.
- Assistance with system administration and utility software for MicroVAX, Sun workstations, and microcomputers.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX task personnel modified the limb-mode Correlated K-distribution software to divide the initialization and calculation steps and to process multiple frequencies, integrated it into the MO limb temperature-inversion program, and used the inversion program to produce temperature profiles based on synthetic Martian spectra. Task staff also wrote an IDL program to plot MO TES contribution functions. Staff members modified the nadir-mode Correlated-K software to allow varying emission angles. HSTX personnel used the Voyager temperature-inversion and atmospheric-parameter software to calculate new atmospheric parameters for five Voyager–1 Jupiter and Saturn data sets with new pointing, and generated Q-point files for them. Task personnel studied the Sun floating-point exception (FPE) handling mechanism and the Unix 'make' program. Staff members also solved a file-transfer problem for the PDS, installed new compression software on the Sun, and worked on tuning the PC's X Windows and memory-management software.

WORK PERFORMED

100 ANALYSIS SOFTWARE DEVELOPMENT

130 Atmospheric Transmittances via Correlated-K

HSTX task personnel extensively restructured the limb-mode Correlated-K (corrkl) program (Unix version) to divide the initialization and computation steps. This approach provides a much better fit with the rest of the MO temperature-inversion software. Task staff members then integrated it into the MO limb-mode inversion software (limb_inv). This integration required some modifications to limb_inv, which was not computing all the values required by corrkl. Retrieved temperature profiles using synthetic radiances were the same shape as earlier runs using analytic transmittance estimates, but were too warm. The ATR and HSTX staff members realized that this condition could be because the synthetic radiance program was also using the analytic expressions. Task members modified the limb_inv program to print the radiances, used limb_inv and the original summer stock temperature profile to derive the appropriate radiances, and used these in the limb_inv input file. The resulting retrieved temperatures compared favorably with the original profile.

Task staff modified the limb-mode Correlated-K software (Unix version) to process multiple frequencies, so that initialization needed to be done only once per run. Subroutines corrkl_init, corrkl, and rdmalk02 were affected, as well as the test driver, corrkltst. Limb_inv was changed to use the modified software, and testing was successful.

HSTX staff members modified the VAX version of the nadir-mode correlated-K program (corrkn) to allow varying emission angles.

150 Miscellaneous

Task members studied the Sun FPE handling mechanism, attempting to provide better FPE tracing for the task's software. The tracing method outlined in the Sun manuals is cumbersome, but task members have not yet found a better method. If not corrected, FPE's produce erroneous results. This knowledge later enabled task personnel to quickly locate FPE-producing bugs in new limb_inv modifications.

Task personnel researched the Unix 'make' program, to improve the building of the Correlated-K software and its integration with the limb inversion program.

200 DATA ANALYSIS

HSTX personnel produced atmospheric parameter files for five Voyager-1 Jupiter and Saturn data sets with newly recalculated pointing, using the Voyager inversion program (INV) and atmospheric-parameter programs NDEL6 and CLOUD3. All were successful except for one of the Saturn data sets, which was found to have faulty input data. Task members also generated files of the Q points, which define the Voyager IRIS field of view (FOV), for these data sets.

300 DATA MANIPULATION AND DISPLAY

Task personnel wrote cf_plot.pro, an IDL program to plot TES contribution functions.

Staff members produced plots of temperature profiles produced by the limb_inv and corrkl programs from synthetic Martian spectra.

400 MISCELLANEOUS

The PDS Atmospheres node at the University of Colorado was having trouble transferring binary files between Viris and its VAXes over Internet. HSTX personnel determined that the problem involved a loss of file-header information and recommended software to correct the file headers. University of Colorado personnel obtained and used the software successfully.

HSTX task members worked on tuning the Desqview/X and QEMM software on the Gateway 2000 PC, and succeeded in getting MS Windows, which had been broken, to run both standalone and under Desqview/X. The BIOS Setup program now also runs. The Desqview/X Network Manager software still has not arrived, so task members pursued this problem with the vendor.

Task members installed the GNU Zip file-compression software on Chryse.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work on this task will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Task members expect to modify the nadir-mode Correlated-K software for initialization/computation and multiple-frequency operation, generate new Malkmus fits, and begin work on convection in the outer planets. A Work Control Plan will be prepared for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Software: Improved limb-mode Correlated K-distribution subroutines and test drivers
Originator: J. Guerber

Software: Contribution function plotting program in IDL
Originator: J. Guerber

Data: Voyager-1 Jupiter and Saturn atmospheric parameter and FOV (Q-point) files
Originator: J. Guerber

Graphics: Comparison plots of limb_inv/corrkl retrieved temperature profiles
Originator: J. Guerber

TRAINING

HSTX staff attended a Continuous Measurable Improvement (cmi) course.

COMPUTER USE

Minutes	Computer
1,105	LEPVAX/LEPVX2 (VAX 11/785 - VAX 8810 cluster)
4,276	VIRIS (MicroVAX II)
*	Chryse (Sun SPARCstation 2)
*	Gateway 2000 4DX-33V (PC)
*	Gibbs (IBM 9021)
*	Compaq Deskpro 286 (PC)

* No statistics available.

NASA Task 92-357-00: Voyager and Mars Observer IRIS Support

GSFC ATR: ***Dr. J. Pearl***

Hughes STX Task Leader: S. ***Dason***
Hughes STX Task Number: ***955***

This task provides software support in three major areas: 1) determination of optical constants of ices from thin film spectral data, 2) development and maintenance of a prototype data system based on Mariner-9 infrared spectral data, and 3) studies of thermal and compositional characteristics of the Jovian moon Io using data from the Voyager Infrared Interferometer Spectrometer (IRIS). Also included in this task is the development of algorithms to extract atmospheric temperature profiles, dust composition, and density from data to be obtained by the Mars Observer Mission.

FINAL CONTRACT SUMMARY

Over the 5-year lifetime of this task, Hughes STX staff has provided support for a range of infrared (IR) spectroscopic studies, supporting the Voyager, Mariner-9, and Mars Observer missions. Staffing on this task has varied between one programmer/analyst to one programmer/analyst and one senior programmer/analyst. A task member has performed the primary design, development and implementation of Mars Observer atmospheric correction software. This effort has included participation in algorithm design, responsibility for the integration of the efforts of several programmers, and coding of approximately one-half of the subroutines. The total volume of software is currently approximately 10,000 lines of code contained in about 100 subroutines. Staff also maintained maximum flexibility of the software design at all times, persuading the ATR and the Thermal Emission Spectrometer (TES) team to adopt configuration management. Staff was responsive to scientific needs and requests for modifications, participating in algorithm sensitivity studies. As part of the Mars Observer effort, staff also acted as cosystem manager for the Sun cluster, which is the primary platform for this software at GSFC, and supervised the activities of a co-op student. Other IR support activities included a task member's determination of the spatial response functions of Voyager IRIS instrument detectors. Staff also contributed to the development of code for determining thermal emission from semitransparent solid surfaces. Staff determined the thermal continuum for Voyager IRIS spectra of Io. Staff ported Mariner-9 IRIS data from the IBM onto VIRIS, reformatted the data (VIRIS is a VAX machine), and entered them into DATATRIEVE.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff undertook software integration responsibilities for the Mars Observer TES team. Staff produced a first draft of the TES atmospheric correction algorithm description and presented it at a TES team meeting at Arizona State Univ. (ASU). Staff ported program DERIV (a component of the atmospheric correction algorithm developed by a graduate student at Cornell) onto the Sun workstation CHRYSE. Staff guided the activities of a NASA co-op student and other TES programmers. Staff incorporated the Smith-Conrath temperature inversion algorithm, an analytic noise approximation, and an error computation into the TES limb mode software.

WORK PERFORMED

Staff members began performing TES software coordination tasks, trying to map out a timetable for the completion of various components and stages of the atmospheric correction software. Staff members began integrating a co-op student into the team. Task members merged input from GSFC scientists and other sources to write a first draft of the TES atmospheric correction software description and construct a preliminary flowchart. Staff members presented these at a TES team meeting at ASU. HSTX staff assisted the TES data base and hardware coordinator with defining the task's data needs and negotiating for these at the team meeting. Staff members also assisted with defining hardware needs. Task personnel assisted another programmer with incorporating the correlated-K transmittance algorithm into the limb mode software, and also assisted an NSF graduate student who was incorporating correlated-K transmittance calculations into a pilot model of the nadir software. Staff ported programs SCRIPTSPECT, BALLPARKTAU, FIRSTGUESS, GETCORRK, and FIT onto LEPVAX (code was developed on a Macintosh by a graduate student at Cornell). Staff incorporated the Smith-Conrath temperature inversion algorithm, an analytic noise approximation, and an error computation into the TES limb mode software.

SIGNIFICANT ACCOMPLISHMENTS

Staff produced a first draft of the TES atmospheric correction algorithm description and presented it at a TES team meeting at ASU.

PROBLEM AREAS

A major problem was the loss of the Mars Observer spacecraft.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

In the event of Mars Observer recovery or a rebuild, staff will continue integrating the TES atmospheric correction, tuning the limb mode software, and incorporating changes in the models as necessary. Staff will also continue with system support on CHRYSE. If the Mars Observer task is ramped down, staff will assist in collating all efforts to date, with a possible reanalysis of the Mariner-9 IRIS data. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Text and
Flowcharts: Release II TES atmospheric correction software description

Originator: S. Dason

COMPUTER USE

Hours	Computer
400 (connect)	LEPVAX (VAX 11/785)
30 (connect)	VIRIS (MicroVAX II)
400 (connect)	SUN SPARCstation II
Dedicated	Macintosh SE

NASA Task 92-359-00: Interplanetary Plasma Data Conversion and Fitting

GSFC ATR: *Dr. K. Ogilvie*

Hughes STX Task Leader: *Dr. D. Berdichevsky*
Hughes STX Task Number: *956*

This task provides software support for data processing and fitting of interplanetary plasma from the Ulysses and Voyager missions. It also contributes to the data reduction for the ICE studies and the development of codes for the planned SWICS experiment on the WIND spacecraft.

FINAL CONTRACT SUMMARY

Hughes STX staff began working on this task in May 1989. Staff undertook the task effort that at the time involved two STX positions (one half-time senior programmer and one full-time junior programmer). The original purpose of the task was to perform the fitting of ion data from the Voyager MIT Faraday's Cup experiment, later expanded to include fittings to the ICE-3 composition ion experiment (1989) and Ulysses-SWICS composition ion experiment (1990). Staff developed innovative noniterative fitting codes that exceeded the established quality requirements as well as the accuracy of other more traditional iterative methods. These codes were completed for all three instruments: ICE in 1989, Voyager in 1990, and Ulysses in 1991. After 1991, work concentrated on calibrating the H^+ and $^4He^{++}$ Ulysses-SWICS auxiliary and main channels, and supervising the production phase of the archiving file of the solar wind (SW) parameter data processing. Development of the common data file (CDF) was performed with delivery in May 1992 to the Jet Propulsion Laboratory (JPL). Work hours began to be increasingly devoted to the data reduction and research on the structure of the ions' phase space density in the interplanetary solar medium. This included several presentations at conferences and publication of unique results on the evolution of the proton phase space density near interplanetary shocks, close to the ecliptic plane, and between 1.5 and 5.12 AU from the Sun.

SUMMARY FOR CURRENT REPORTING PERIOD

Using an innovative idea, staff developed and upgraded the determination of the H^+ and $^4He^{++}$ density for the cases where the aspect (Earth-spacecraft (SC)-Sun) angle is small. Preliminary analysis of a case when the aspect angle was near 1° showed promising results. Hughes STX staff continued supervision of the production phase of the routine processing and storage on optical disks of the SW parameters (Ulysses-SWICS auxiliary channel experiment). HSTX personnel demonstrated an improvement in the plotting of the SW bulk velocity by introducing a linear scale with folding instead of the previously used semilogarithmic one. Staff produced and distributed within the Ulysses-SWICS collaboration a final version of the document "The Archive File of the SW H^+ and $^4He^{++}$ Parameters," describing the unformatted storage of parameters and processed data on optical disks. Staff also participated in a survey of the quality of the CDF SWICS parameters produced at JPL with a code based on the code previously produced by staff. It was determined that there was a spread of approximately 4 percent in the calculated value of the SW $^4He^{++}$ bulk velocity as determined by different members of the SWICS collaboration. The values produced by HSTX staff were inside this range.

Staff instructed and supervised the work of a Martin Marietta summer fellow. With his help, HSTX staff reprocessed main channel data from the SWICS-Ulysses instrument for 37 periods of time and created

H^+ phase space density plots as a function of the ion velocity. Also, histograms for SW parameters and other graphical presentations of the data for the selected intervals of time were produced. Staff also delivered the calculated H^+ phase space density data for several cases to Johns Hopkins University/APL, Laurel, MD (Dr. E. Roelof) as part of a collaboration. A partial presentation of this work will be made at the coming 1993 fall AGU meeting in San Francisco. Staff also contributed several cases of H^+ flux data in the downstream region after a shock occurrence, as well as the upstream and downstream ion SW parameters for comparison with numerical modeling of interplanetary shocks, as part of a collaboration with Dr. M. Baring (GSFC). Part of the work was presented at the astrophysics section of the international AIAGA meeting in Buenos Aires, Argentina, August 8–15, 1993. Staff contributed in the test of the value of 0.000458 cm^2 str for the effective area of the Ulysses-SWICS main channel in good agreement with the cross-analysis of data from the Ulysses-SWICS and HI-SCALE observations.

WORK PERFORMED

100 DEVELOPMENT OF ULYSSES ION SOFTWARE FOR AUTOMATIC PROCESSING OF THE H^+ AND $^4HE^{++}$ DATA

Promising results for the determination of the density at small aspect angles were obtained when comparing the new upgraded version of the task's fast noniterative code executable image MAPY13.EXE, with the results from the URAP experiment. The comparison corresponded to day-of-year (DOY) 238, 1991, when the Earth-SC-Sun angle was close to 1^o. Staff used the ratio in counts between the auxiliary and main channels of the instrument to determine the actual angle between the SW, the SC, and Earth. Currently, and to be resolved under contract NAS5-32350, is the remaining problem of observed distortions in the ratio of $^4He^{++}$ to H^+ densities. A comparison of the densities with those from the SWPE experiment is planned.

With assistance from HSTX staff, GSFC technical personnel continued the routine processing and storage on optical disks of the SW parameters and processed data as well as the production of plots of eighth selected parameters for the following combination of counts in the auxiliary channel: those in the ACPS1 rates, and those added per velocity channel in the ACPS1, ACAS1, and ACPS2 rates. The generated unformatted "archive file" includes the SW parameters from the launching, October 1990 until June 1993. A final version of a tutorial document "The Archive File of the Solar Wind H^+ and $^4He^{++}$ Parameters," describing in detail the parameters and data stored in the unformatted archive file, as well as storage information and the way to read it, has been distributed to the SWICS-Ulysses collaboration at GSFC; the University of Maryland, College Park, MD; and the University of Bern, Bern, Switzerland.

To expedite the analysis of bulk velocities, a new folding scale plot routine was introduced. Now, the scale of the coordinate as a function of the time is lineal and extends from 200–500 Km/sec when the symbol in the plotting is a rhombus, but corresponds to values from 500–800 Km/sec when the symbol is an "A." The scale corresponds to values from 800–1100 Km/sec when the symbol is a "B," and it continues to follow the alphabetical order for higher values of the SW bulk velocity.

HSTX personnel participated in a survey of the CDF data produced at JPL. Preliminary analysis found values in overall agreement with the SWICS-CDF code developed and tested at GSFC, and delivered to JPL. However, differences in the values of the parameters remain, of up to 1 percent in the bulk velocity value for the $^4He^{++}$ ions, in particular.

Staff compared SW bulk velocity determinations for DOY 130, 1993, between the different group reduction packages in the Ulysses-SWICS collaboration. Staff observed a spreading in velocity values of approximately 4 percent. The University of Bern group in Switzerland was consistently in the lower range. The University of Maryland, College Park, values were in the upper range. The GSFC numbers were in between, in most cases less than 2 percent off of the University of Bern values. In all cases, the bulk velocity is referred to a moving coordinate system attached to the spacecraft. Systematic errors are of the same magnitude as the observed spread in the bulk velocity value. However, the 4 percent spread in the velocity values suggests a difference in the velocity used for the instrument channel in the data reduction. It should be noted that, in previous comparisons of GSFC velocity values with those from the Ulysses-SWPE Bame experiment, the disagreement was within 1 percent.

200 DATA REDUCTION FOR THE ULYSSES, VOYAGER, AND ICE MISSIONS, AND DEVELOPMENTS FOR THE SWICS INSTRUMENT ON WIND

HSTX staff guided a Martin Marietta summer fellow in the use of HSTX staff-developed software for data processing and reduction, as well as the use of VersaTerm-PRO and Kaleidagraph Macintosh applications. This augmented collaborations on the study of the behavior of the H^+ phase space density near interplanetary shocks in the upstream and downstream regions. An implication of this study is the possibility to learn about the acceleration mechanisms at work for different types of propagating magnetic discontinuities in the interplanetary medium that characterize observed collisionless shocks.

Using constant flux periods in the low energy end of the HI-SCALE LEMS130 detector, HSTX personnel found that for three decades of low high energy proton intensities (34-71 KeV), the value of 0.0009 holds for the ratio of the proton counts/sec of the SWICS-Ulysses main channel (H^+) to the HI-SCALE-Ulysses LEMS130 ion detector. This result soundly agrees with the calibrated effective area of 0.000458 cm^2 str for the H^+ counts in the Ulysses-SWICS main channel assuming an isotropic flux of ions in the SW frame of reference.

The Martin Marietta summer fellow attached to the Ulysses group completed the task of supporting HSTX staff in the data analysis and processing of H^+ main channel SWICS-Ulysses data for the following 35 periods of time in the Gregorian calendar: 94 21:36 to 96 16:00, 96 16:00 to 97 04:48, 97 04:48 to 07:00, 97 10:00 to 98 01:00, 98 03:00 to 07:00, 98 07:00 to 16:30, 113 19:12 to 116 07:12, 116 07:12 to 117 07:12, 118 06:00 to 10:00, 118 10:00 to 19:00, 118 19:00 to 22:00, 119 07:12 to 120 14:24, 120 16:00 to 121 05:45, 121 05:45 to 07:50, 145 00:00 to 146 10:22, 146 10:22 to 147 03:30, 147 03:30 to 18:30, 147 03:30 to 11:00, 147 11:00 to 18:30, 147 18:30 to 148 02:24, 148 02:30 149 00:00, 155 14:24 to 158 00:00, 161 13:12 to 162 09:00, 182 14:24 to 184 00:00, 184 14:24 to 185 02:30, 185 02:30 to 186 05:00, 186 21:36 to 188 14:24, 297 12:00 to 299 01:15, 299 02:10 to 21:00, 299 21:30 to 300 12:00, 320 04:00 to 21:00, 320 21:00 to 321 07:00, 321 07:00 to 20:00, 1991, and 5 16:00 to 6 01:30, and 6 1:30 to 11:00, 1992.

For the periods listed above, phase space proton density plots as a function of the ion velocity were produced. Also, histograms of the variation of the bulk velocity parameter within the selected periods were made, as well as plots of the proton double and triple coincidence counts as a function of the ion velocity.

Staff delivered to Dr. Roelof, as part of the collaboration mentioned previously, files per E-mail with the H^+ phase space density as a function of the velocity for the following periods of time: DOY 97 10:00 to

98 01:00, 147 03:30 to 18:30, 161 13:12 to 162 09:00, 185 02:30 to 186 05:00, 320 21:00 to 321 07:00, 1991, and 6 01:30 to 11:00, 1992.

As an extension to the contribution "Heating of Minor Ions and Exponential Enhancement of the High Energy End of the SW Ion Distributions at the Passage of a Shock" to the 1993 spring AGU meeting in Baltimore, HSTX staff wrote a preliminary report on the "Exponential Enhancement of the High Energy End of the SW Ion Distribution." This report discusses the finding, that after the passage of a shock, the H^+ distribution, between the SW velocity and twice its value, follows a simple exponential law. The exponential decrease was steeper when the magnetic field was in the eye of the field of view of the instrument.

A selected set of main channel proton flux data was contributed to a collaborative study titled, "Comparison Between Ulysses Observations Near Interplanetary Shock and Computer Simulations." An aspect of this study was presented at the AIAGA meeting in Buenos Aires, Argentina, August 8–15, 1993. The spectra of data compared with the simulation were taken from cycles starting at DOY's 97.2999, 147.4297, and 162.3151, 1991.

To extend the study in the collaboration described previously, HSTX personnel sent by E-mail the average flux spectrum for the following periods of time: DOY's 118.54 to 118.57, 147.5 to 148.035, 185.71 to 186.21, 321.00 to 321.04, 1991, and DOY 006.31, 1992. HSTX personnel also delivered SW parameter plots before and after shocks corresponding to the aforementioned periods of time.

The study of the SW flux prior to and after Ulysses's Jupiter encounter, in the neighborhood of Jupiter's magnetosphere, was completed. No clear manifestation of ion evaporation from Jupiter into the interplanetary medium was found.

SIGNIFICANT ACCOMPLISHMENTS

HSTX staff developed and upgraded an innovative method for determination of the H^+ and $^4He^{++}$ density in cases where the aspect (Earth-SC-Sun) angle is small. The preliminary analysis for a case when the aspect angle was near 1^o showed promising results. This work will enhance the task's ability to process accurately a larger fraction of the data generated by the SWICS experiment in the Ulysses mission.

HSTX personnel contributed to collaborations on the study of acceleration mechanisms for ions in the downstream region of interplanetary shocks. An aspect of this study was presented at the AIAGA meeting in Buenos Aires, Argentina, August 8–15, 1993. An extended study for higher energies including results from the HI-SCALE Ulysses experiment is to be presented at the 1993 fall AGU meeting in San Francisco.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

100 DEVELOPMENT OF THE ULYSSES ION SOFTWARE FOR AUTOMATIC PROCESSING OF THE H^+ AND $^4HE^{++}$ DATA

Refining of the newly developed software for data from periods of time when the Sun-SC-Earth angle is less than 7^o is planned.

Production and storage of the archive file will continue.

Work on a document containing all Ulysses-SWICS experiment characteristics is planned.

200 DATA REDUCTION FOR THE ULYSSES, VOYAGER, AND ICE MISSIONS, AND DEVELOPMENTS FOR THE SWICS INSTRUMENT ON WIND

Staff will continue support for the ongoing research activities of the ATR. This includes collaborations with Dr. Roelof on the study of the proton distribution for energies that extend from the pickup of interstellar H (at approximately 5–8 KeV) up to 5 MeV in the spacecraft frame of reference.

Staff also plans to continue support for the ATR's collaboration with Dr. Baring on a "Comparison Between Ulysses Observations Near Interplanetary Shock and Computer Simulations."

The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Memo: Document with 3 figures illustrating progress on density determinations at small angles, limitations on the accuracy of the thermal velocity parameter when obtained from the auxiliary channel for data near the background level, and the linear relation between the SWICS-Ulysses main channel and the HI-SCALE-Ulysses P1, LEMS130 detector (June 1993)
Originator: Dr. D. Berdichevsky

Memo: Notes on the ion flux and the comparison of the effective SWICS-Ulysses instrument area (34–60 KeV H^+) with that from the LAN-Ulysses P1, LEMS130 detector (56–78 KeV ions) (June 1993)
Originator: Dr. D. Berdichevsky

Document: "Exponential Enhancement of the High Energy End of the Solar Wind Ion Distribution," with 4 pages, 1 table, and 4 figures (June 1993)
Originator: Dr. D. Berdichevsky

Data: Files containing the H^+ flux spectrum as a function of the ion velocity (SWICS main channel MR2 after the forward shock for the times 97.2999, 147.4297, and before the reverse shock for the time 162.3151, all in DOY units, 1991 (July 1993)
Originator: Dr. D. Berdichevsky

Document: Notes on "Bad Count Numbers, an Estimate" (July 1993)
Originator: Dr. D. Berdichevsky

Figures: Spectra of the processed Ulysses-SWICS main channel H^+ space phase density: 35 periods of time: DOY's 94 21:36 to 96 16:00, 96 16:00 to 97 04:48, 97 04:48 to 07:00, 97 10:00 to 98 01:00, 98 03:00 to 07:00, 98 07:00 to 16:30, 113 19:12 to 116, 07:12, 116 07:12 to 117 07:12, 118 06:00 to 10:00, 118 10:00 to 19:00, 118 19:00 to 22:00, 119 07:12 to 120 14:24, 120 16:00 to 121 05:45, 121 05:45 to 07:50, 145 00:00 to 146 10:22, 146 10:22 to 147 03:30, 147 03:30 to 18:30, 147 03:30 to 11:00, 147 11:00 to 18:30, 147 18:30 to 148 02:24, 148 02:30 149 00:00, 155 14:24 to 158 00:00, 161 13:12 to 162 09:00, 182 14:24 to 184 00:00, 184 14:24 to 185 02:30, 185 02:30 to 186 05:00, 186 21:36 to 188 14:24, 297 12:00 to 299 01:15, 99 02:10 to 21:00, 299 21:30 to 300 12:00, 320 04:00 to 21:00, 320 21:00 to 321 07:00, 321 07:00 to 20:00, 1991, and 5 16:00 to 6 01:30, 6 1:30 to 11:00, 1992 (August 1993)
Originator: Dr. D. Berdichevsky

Data: Spectra of the interplanetary H^+ flux for the following periods of time: DOY's 118.54 to 118.57, 147.5 to 148.035, 185.71 to 186.21, 321.00 to 321.04, 1991, and DOY 006.31, 1992 (SWICS-Ulysses main channel) (August 1993)
Originator: Dr. D. Berdichevsky

Figures: Plots of the SW bulk velocity, thermal velocity, and H^+ density corresponding to the upstream and downstream shock regions for the interplanetary shocks that passed the Ulysses spacecraft on DOY's 97, 118, 147, 185, 299, and 321, 1991, and DOY 006, 1992 (August 1993)
Originator: Dr. D. Berdichevsky

Data: The Ulysses H^+ phase space density spectra for the 35 periods of time indicated previously from the processing of the H^+ SWICS-Ulysses main channel data (September 1993)
Originator: Dr. D. Berdichevsky

Paper Presented at Scientific Conference: "Comparison Between Ulysses Observations Near Interplanetary Shock and Computer Simulations"
Coauthor: Dr. D. Berdichevsky

TRAINING

Staff attended HSTX workstation user's group meetings and an HSTX visualization and display meeting.

COMPUTER USE

Minutes	Computer
7,200 (connect)	LEPVAXcluster
7,700 (connect)	Macintosh IIsi

NASA Task 92-360-00: Programming and Analysis Support for the San Marco D/L Electric Field Instrument

GSFC ATR: *Dr. T. Aggson*

Hughes STX Task Leader: *S. Cobb*
Hughes STX Task Number: *957*

This task provides programming, maintenance, and analysis support for studies of the equatorial ionosphere, based on data from the San Marco D/L Electric Field Instrument (SMEFI).

FINAL CONTRACT SUMMARY

The period of performance for this task was October 1, 1988 through September 30, 1993. Work under this task was performed by one scientist and three programmer/analysts assigned to work part time in line with scheduled requirements. Work included the following:

- Code was developed to access reduced data sets in the Interactive Data Language (IDL), thus simplifying much of the analysis, as well as the production of nonstandard plots.
- Telemetry data were reduced.
- Orbit data were merged into the telemetry files.
- A problem with the horizon sensors was analyzed and a formal report was submitted on this problem to the ATR.
- Work was modified on a program to predict the spacecraft ephemerides.
- An analysis of the global averages.
- An archive data set was submitted to NSSDC and SRI.
- Staff coauthored a paper presented at VIII the International Symposium on Equatorial Aeronomy and developed standalone read routines to access the data base.
- Staff coauthored a paper for the COSPAR meeting in The Hague, and a paper that was submitted to JGR.
- Staff coauthored a poster on equatorial bubbles presented at the AGU.
- Completed an analysis of sun and horizon sensor data and obtained an acceptable solution to the vexing problem of bad horizon sensor data at the start of each pass.
- Papers were presented at the San Marco Experimenter's meeting.

SUMMARY FOR CURRENT REPORTING PERIOD

Work was confined to several hours of consultation on previous analysis activities.

WORK PERFORMED

Work was confined to several hours of consultation on previous analysis activities.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

DELIVERABLES SUBMITTED

None.

COMPUTER USE

None.

NASA Task 92-362-00: Dynamics Explorer Magnetometer Programming and Analysis Support

GSFC ATR: *Dr. J. Slavin*

Hughes STX Task Leader: *Dr. E. Greene*
Hughes STX Task Number: *959*

This task assists those involved with the Dynamics Explorer Project. Support is also provided for collaborative studies initiated by the GSFC scientific team. Magnetospheric modeling and data analysis will be performed, and support will be given as requested to EOS/GOS phase B studies.

FINAL CONTRACT SUMMARY

Hughes STX task personnel provided DE–1 and DE–2 magnetometer data analysis, production processing, data base, and data library support in a timely and organized manner. MAG-A and MAG-B data were completely processed and sent to the NSSDC for archiving. Numerous data requests by scientists both within GSFC and in the general community were promptly filled. The ISEE–3 plasma, magnetometer, energetic particle, and superthermal particle data were collected, and graphical display programs were developed to aid in scientific analysis. Numerical studies of collisionless reconnection and global modeling were performed. Numerous scientific papers were presented at scientific meetings, including work on plasmoids, traveling compression regions, and collisionless reconnection in Earth's magnetotail. Several scientific publications resulted from this work with HSTX staff members as principal authors. Staff members also coauthored and/or supported many papers authored by GSFC investigators.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX personnel provided DE–1 and DE–2 magnetometer data analysis, production processing, data base, and data library support in a timely and organized manner. Task personnel discovered scaling laws for reconnection rates based on a parameter study of numerical simulation of collisionless reconnection. Staff initiated a collaboration with Dr. J. Drake (University of Maryland). An HSTX task member organized the theory/modeling working group session of the Geospace Environment Modeling (GEM) workshop in Snowmass, CO.

WORK PERFORMED

100 HYBRID SIMULATION SUPPORT

HSTX task personnel continued the investigation of collisionless reconnection in current sheets. Numerical parameter studies were performed that led to scaling laws for the reconnection rates under various circumstances. The results are currently being written for the *J. Geophys. Res.* HSTX personnel initiated a discussion about collisionless reconnection with Dr. J. Drake. Dr. Drake is currently pursuing a slightly different approach to the problem than task personnel. A comparison of the different results and approaches will prove fruitful in the future.

110 Charge Exchange Study

HSTX task personnel organized the theory/modeling working group meeting as part of the GEM workshop in Snowmass, CO, together with Dr. T. Speiser (University of Colorado, Boulder). HSTX personnel attended the workshop and cochaired the theory/modeling working group meeting. The working group came up with a game plan for activities in theory and modeling for the GEM magnetotail/substorm campaign. A report currently is being developed. HSTX task personnel were asked to coordinate research efforts in the area of interscale coupling for the inception of a global circulation model.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work was completed as planned.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None. This task was terminated in July 1993.

NONLOCAL TRAVEL

HSTX personnel attended the GEM workshop in Snowmass, CO.

DELIVERABLES SUBMITTED

Document: "Game plan for the theory/modeling working group of the GEM workshop"
Originator: Dr. M. Hesse, cochairman

CONFERENCES

HSTX personnel attended the GEM workshop in Snowmass, CO.

COMPUTER USE

Minutes	Computer
Dedicated	486 DOS PC
Dedicated	2 Sun Workstations
Dedicated	Macintosh IIfx
Dedicated	MicroVAX II (DE696)
Dedicated	MicroVAX II (MAGSPA)

NASA Task 92-363-00: Dynamics Explorer High- and Low-Altitude Plasma Programming and Analysis Support

GSFC ATR: ***Dr. R. Hoffman***

Hughes STX Task Leader: ***J. Humphreys***
Hughes STX Task Number: ***960***

This task provides programming, maintenance, and analysis support for the Dynamics Explorer (DE-1 and DE-2) High-Altitude Plasma Instrument (HAPI) and Low-Altitude Plasma Instrument (LAPI). Specific activities include ongoing data processing, maintenance and enhancement of existing software and development of new software, HAPI and LAPI data base support, and support for other data bases such as those from S^3-A, interplanetary field data, and other DE instruments.

FINAL CONTRACT SUMMARY

Since 1989, four people have worked on this task. Initially, this task consisted of one data technician who was responsible for production processing of LAPI Stand-Alone Telemetry (SATM) files from the Sigma-9 computer. When it was discovered that some of the SATM files were missing, a programmer/analyst was added to the task to investigate the problem. This task member discovered that more than 1,900 SATM files were missing and decided to regenerate the entire LAPI and HAPI data base. This task member converted the generation software so that it could be used on the MicroVAX instead of the Sigma-9, which eliminated dependence on Sigma-9 availability. A new SATM format was developed that included additional OA parameters while at the same time increasing efficiency and saving disk space. A scientist task member was added in 1992 to assist the ATR in data analysis and to finish the HAPI and LAPI archiving. The HAPI and LAPI archiving was completed during this period. Other notable work done on this task included the temperature measurement study done by a task member and the ATR that was presented as a poster at the 1993 spring AGU meeting by the task member, and which will result in a published article. Throughout the duration of the task, task members provided programming support to several scientists. Task members were responsible for making plots of data from various sources and making computer-generated graphics for use by the ATR in presentations, proposals, and publications.

SUMMARY FOR CURRENT REPORTING PERIOD

HAPI/LAPI archiving was completed. Programs were written and modified for a temperature measurement study and for Dr. Fujii's substorm study. A task member wrote and revised a paper on temperature measurements. Publication figures were made for the temperature paper, Dr. Fujii's study, and a proposal.

WORK PERFORMED

100 PRODUCTION SUPPORT

Staff copied metadata to HAPI and LAPI optical disks and closed HAPI and LAPI optical disks. Staff also made two backup copies of HAPI and LAPI data copies on 8-mm tapes.

200 SOFTWARE SUPPORT

210 Analysis Software

Staff wrote programs that do the following for the temperature measurement study: 1) plot error vs. et/ephi, 2) plot error vs. width, and 3) plot error vs. et/E01. Staff also modified the MAG plotting program to do the following: 1) allow choice of coordinates, 2) allow for time range, and 3) mark regions. In addition, staff wrote a program to plot MAG data with time backward and a program to calculate temperature using the usual method.

300 SOFTWARE AND DATA BASE MAINTENANCE

320 Maintenance of Data Base

Staff submitted HAPI and LAPI data to the NSSDC.

400 DATA ANALYSIS SUPPORT

Task members made 1 LAPI spectrogram for B. Burke (Hanscom AFB); 27 MAG plots for Dr. S. Fung (NSSDC/HSTX); 4 sets of LAPI spectra for Dr. V. Troitskaya; and 28 MAG plots, 1 LAPI spectrogram, and 3 tables of number flux for the ATR.

600 GENERAL PROJECT SUPPORT

Staff made and presented a poster at the AGU meeting. Staff also presented a poster at the GSFC Tea. A task member wrote and revised a paper on temperature measurements and made and revised figures for the paper. Task members read articles as suggested by the ATR. Task members also picked up and sent photographs for Dr. Fujii. Figures were also made and modified for the Fujii substorm study and a proposal.

SIGNIFICANT ACCOMPLISHMENTS

HAPI and LAPI data were submitted to the NSSDC for archiving.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Activities have proceeded as planned. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NA5-32350

Staff will make additions to the paper on temperature measurements and submit it to the *J. Geophys. Res. (JGR)*. Staff also will continue analysis support for the ATR and will begin a new project. SAI images will be made for Dr. Troitskaya. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Data: 2 LAPI spectrograms
Originator: J. Humphreys

Software: Program to make plots of error vs. width
Originator: J. Humphreys

Software: Program to make plots of error vs. et/ephi
Originator: J. Humphreys

Software: Program to make plots of error vs. et/E01
Originator: J. Humphreys

Software: Program to calculate temperature
Originator: J. Humphreys

Data: 55 MAG plots
Originator: J. Humphreys

Data: 4 sets of LAPI spectra
Originator: J. Humphreys

Data: 3 tables of number flux from LAPI
Originator: J. Humphreys

Data: Figures for the temperature paper
Originator: J. Humphreys

Data: Figure for Dr. Fujii's study
Originator: J. Humphreys

Data: Figure for proposal
Originator: J. Humphreys

Software: Program to make MAG plots with time backward
Originator: J. Humphreys

COMPUTER USE

Minutes	Computer
Dedicated	MicroVAX II (DE696)
Dedicated	MicroVAX II (MAGPSA)
Dedicated	MicroVAX II (DEXIO)
Dedicated	VAX (LEPVAX)
Dedicated	VAX (LEPVX2)

NASA Task 92-368-00: Plasma Electrodynamics Studies: Acquisition, Planning, and Analysis of Data From Chemical Release Experiments

GSFC ATR: ***Dr. R. Hoffman***

Hughes STX Task Leader: ***Dr. P. Marionni***
Hughes STX Task Number: ***962***

This task includes the development of physical/mathematical formulations for the mission planning and analysis of chemical release experiments, software for the analysis of geophysical conditions during chemical release field operations, and analysis and image processing software for the reduction and enhancement of primary chemical release image data. Major areas of activity include mission planning support for chemical releases that are planned from the Combined Release and Radiation Effects Satellite (CRRES); planning, analysis, and field support for Pegsat chemical releases; and analysis of data from the "Churchill 89" sounding rocket campaign.

FINAL CONTRACT SUMMARY

The period of performance on this task was October 1-September 30, 1993. Work under this task was performed primarily by three Ph.D. scientist/programmer analysts assigned part-time in line with scheduled requirements. Work included the following:

- Calculated ion motions for the premission planning and operations of the Pegsat and Combined Release and Radiation Effects Satellite (CRRES) chemical releases.
- Calculated orbital/geomagnetic parameters for the planning and operations of the Pegsat and CRRES chemical releases.
- Developed improved numerical chemical release models for the analysis of chemical release data.
- Improved ion/magnetic field line tracing for the analysis of ion position data following chemical releases.
- Provided critical planning and logistics support for the "Churchill 89," chemical release campaign.
- Participated in field activities during optical data acquisition from the "Churchill 89", Pegsat, and two CRRES chemical release campaigns.
- Participated in meetings with officials from the Canadian Space Agency and the National Research Council of Canada in preparation for the Pegsat chemical release campaign.
- Worked with staff from the National Research Council of Canada to develop near-real-time, multistation, acquisition and display capabilities of CANOPUS ground-based magnetometer data in support of Pegsat operations.
- Participated in CRRES Science Working Team meetings and the planning of CRRES releases under GSFC cognizance.
- Coauthored a major paper detailing a 1984 shaped-charge chemical release experiment.
- Developed code for the multi-ion simulation of chemical releases.
- Contributed to four chemical release research proposals by providing detailed simulations of barium and lithium ions following chemical releases.
- Undertook a detailed study of the March/April 1986 chemical releases.

SUMMARY FOR CURRENT REPORTING PERIOD

Task termination activities centered on updating the triangulation data base, a comparative analysis of photometric scan data and ray images, and updating the modeling of ray motions using the updated data base. An informal report, outlining the status of analyses for releases from rockets 35.015 and 35.016, is being prepared as a reference for any follow-on investigations.

WORK PERFORMED

300 ANALYSIS AND SPECIAL STUDIES

310 1986 Barium Releases

Limited resources were directed toward filling several gaps in the analysis of barium releases from rocket 35.015 prior to the September 30, 1993 task termination. This primarily involved: 1) Incorporating a new set of Release No. 1 triangulations into the previously existing data base; 2) conducting a cross comparison between image triangulations and photometric scans from the Seeley Lake and Calgary sites; and, 3) updating the motion analyses of Ba+ rays using the expanded data base.

Excellent agreement between the photometer scanning data and image triangulations was demonstrated.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

COMPUTER USE

Minutes	Computer
500 (wall clock)	MicroVAXII (ELDYN)
Dedicated	Macintosh Quadra 700

NASA Task 92-370-00: Plasma Electrodynamics Studies: Rocketborne Electric Field Experiments

GSFC ATR: ***Dr. R. Pfaff, Jr.***

Hughes STX Task Leader: ***Dr. P. Marionni***
Hughes STX Task Number: ***963***

This task provides general software support for the processing, display, and analysis of electric field data acquired by rocketborne instrumentation.

FINAL CONTRACT SUMMARY

The period of performance on this task was from October 1, 1988, through September 30, 1993. Currently, a systems programmer, a senior systems engineer, and a senior engineer are assigned to this task. Major highlights of task activity are:

- Data were handled and analysis graphics support was provided for AC and DC electric field studies from Flights 21.097, 21.100, and 21.096 (Auroral Zone).
- Software for the decommutation of Pulse Code Modulated (PCM) data was modified and improved.
- Specialized graphics and analysis software were produced to support Flight 31.057 Noctilucent Cloud studies.
- Data quality of equatorial electric field data from Flights 29.028 and 29.029 (Kwajalein Atoll) were decommutated and analyzed.
- A major VAX-to-Unix software conversion effort was completed.
- Software was developed for the access of data from the high data rate channels of 21.103.
- Interactive Data Language (IDL) utilities were developed for the efficient production of standard and specialized graphics utilities.
- Support for numerous meetings attended by the ATR was provided.
- E-field flight computer was completed for the upcoming PULSAUR campaign.
- Specialized technical expertise was provided during the fabrication of payloads for the PULSAUR, ARIA, and Brazil campaigns.

Current work involves the development of a software environment to fully use existing capabilities, analysis graphics support for Flight 33.044 data, the design, fabrication, and integration of the ARIA E-Field instrument, and support for the PULSAUR launch in January 1994.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff responded to specialized code implementation, graphics production, and data reduction requests for rocketborne electric field studies; provided support for the analysis of DC Electric Field data from Flights 21.105, 21.102, 31.057, and 33.044; continued to develop utility software for the handling and ingest of data in a Sun/VAX environment; continued the development of decommutation software for a X11-based PCM data interface; provided system-level support for Sun-related software and hardware requests; completed the E-Field flight computer for PULSAUR; continued to develop

E-Field instrumentation for the ARIA rocket to be flown next year; and provided critical management and technical support for the fabrication of payloads for the PULSAUR, ARIA, and Brazil campaigns.

WORK PERFORMED

100 MAINTENANCE

HSTX personnel provided backup and routine maintenance on the ELDYN MicroVAX II of all software used on this task.

200 ENHANCEMENTS AND DEVELOPMENT

210 General Programming Support

212 General Data Handling Utilities

Staff continued implementation and installation of software for the transfer and processing of data in a VAX/Sun environment.

214 Rocket Data Processing Software

FORTRAN program READPCM was modified to enable the ingest of Flight 21.102 (NEED II) PCM data. Task members created code for creating an array of time and altitude to be used for placing altitude tickmarks on the top of sonograms. Staff created PCM description files for Flight 33.044 data.

216 Systems Activities

A task member and the ATR continued to move data tapes from various locations in Bldg. 2 as part of a division-wide effort to consolidate data tape storage. A reorganization of the tape library is nearly complete.

Staff attempted to install software on the ATR's recently acquired Powerbook 180. Staff was unable to boot the system and shipped it to the vendor for repair.

220 Spectrogram Displays

Staff produced calibration plots for the instruments that will be placed aboard Flight PULSAUR II (36.110).

230 Attitude Data Handling

Magnetometer and gyroscopic data for Flight 21.105 Mother and Daughter payloads were stripped and plotted to aid in the confirmation of the gyroscopic data.

240 Calibration Data

Staff completed PCM description files for Flights 21.102 and 33.044.

290 Documentation

Staff completed a preliminary, brief user's guide to data handling utilities used on this task.

300 ANALYSIS GRAPHICS SUPPORT

Staff provided data decommutation and specialized graphics support for the analysis of DC Electric Field data from Flights 21.105, 21.102, 31.057, and 33.044.

400 ONBOARD PROCESSING DEVELOPMENT

A senior engineer assigned to this task completed the E-Field flight computer for PULSAUR that included a Digital Signal Processor (with flight firmware), 16-bit A/D converter, Actel-based telemetry serial communication board, and the regulator board for the E-field instrument for the PULSAUR II sounding rocket. The onboard processor receives data from two channels at 64k samples/second, performs a FFT, power, cross-spectra, phase, and coherency calculations and interfaces to the telemetry so these data can be received and later processed. The instrument was taken to the Univ. of Bergen, Norway, for integration. The instrument will be flown out of Andoya, Norway, in early 1994.

Additionally, staff has been developing the instrumentation for the digital E-field instrument for the ARIA rocket, planned to be integrated in November 1993 at Wallops Island, VA, and launched from Poker Flat, AK. This project has multiple low-speed A/D converters, a high-speed converter, a DSP board, and a regulator board. The entire staff is involved in the quality assurance of the algorithms to be exercised onboard the payload.

A senior technician was temporarily assigned to this task to assist with the fabrication of payloads for PULSAUR, the Brazil campaign, and the ARIA rocket. The senior technician's responsibilities included the stuffing of the boards, wiring of the harness and booms, mechanical assembly of parts, and general assistance around the lab. The senior technician is critical to the success of these rockets.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work on this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Pending the completion of an approved Work Control Plan, modifications to improve the efficiency and throughput of standard data processing and migration of standard analysis programs to a Sun workstation will be continued. Work on the development of onboard processing capabilities will continue, the design, fabrication, and integration of the ARIA E-field instrument will be completed, and requests for data products will be fulfilled at the request of the ATR.

DELIVERABLES SUBMITTED

Data: Files of low-pass filtered electric field data from Flight 21.105 Daughter for channels V1-2H, V3-4H, V5-6H, and V3-5H
Originator: P. Marionni

Data: DC (vector) electric field solutions for Flight 21.105 for channel V1-2H Daughter from 80 to 290 seconds after launch
Originator: P. Marionni

Data: Plot VLF12 and the AGC states for Flight 21.102
Originator: S. Cobb

Data: Plots data for Flight 33.044 from 60–310 seconds after launch

Channel	Frequency	Avg.	Units	Range
V910M	461	4	TM Volts	–2.5 to 2.5
V109H	230	2	TM Volts	–2.5 to 2.5
Ni11	230	2	TM Volts	0.0 to 5.0
V24M	461	4	TM Volts	–2.5 to 2.5
V56M	230	2	TM Volts	–2.5 to 2.5
V78M	230	2	TM Volts	–2.5 to 2.5
V12M	461	4	TM Volts	–2.5 to 2.5
V14M	230	2	TM Volts	–2.5 to 2.5
V23M	230	2	TM Volts	–2.5 to 2.5
Ni11	230	2	TM Volts	0.0 to 5.0
Ni12	230	2	TM Volts	0.0 to 5.0
V5S	230	2	TM Volts	–2.5 to 2.5
Mag Pitch	57.7	1	TM Volts	0.0 to 5.0
Mag Roll	461	4	TM Volts	0.0 to 5.0
Mag Yaw	57.7	1	TM Volts	0.0 to 5.0
Mag Pitch	57.7	1	TM Volts	–1.0 to 5.0
Mag Roll	461	4	TM Volts	–1.0 to 5.0
Mag Yaw	57.7	1	TM Volts	-1.0 to 5.0
V910M	461	4	mV/m	–100.0 to 100.0
V109H	230	2	mV/m	–100.0 to 100.0
Ni11	230	2	TM Volts	0.0 to 5.0
V24M	461	4	mV/m	–100.0 to 100.0
V56M	230	2	mV/m	–100.0 to 100.0
V78M	230	2	mV/m	–100.0 to 100.0

V12M	461	4	mV/m	−100.0 to 100.0
V14M	230	2	mV/m	−100.0 to 100.0
V23M	230	2	mV/m	−100.0 to 100.0
Ni11	230	2	TM Volts	0.0 to 5.0
Ni12	230	2	TM Volts	0.0 to 5.0
V5S	230	2	Volts	−30.0 to 30.0

Originator: S. Cobb

Data: 23,000-line sonogram of Flight 21.102 electric field data from channel VLF12 (1,024 point FFT; overlap 512; 4 x 4 pixel; no frequency averaging; no time averaging; frequency bins 1 to 513; −70 to −40 dB) for 50 to 510 seconds after launch

Originator: S. Cobb

Data: 458-line sonogram of Flight 21.102 electric field data from channel VLF12 (1,024 point FFT; overlap 512; 4 x 4 pixel; time average 50; no frequency averaging; frequency bins 1 to 513; −70 to −40 dB) for 50 to 510 seconds after launch

Originator: S. Cobb

Data: 1 14,000 line sonogram of Flight 21.102 electric field data from channel ELF12 (1,024 point FFT; overlap 512; 4 x 4 pixel; no frequency averaging; no time averaging; frequency bins 1 to 513; −70 to −40 dB) for 50 to 510 seconds after launch

Originator: S. Cobb

Data: 1 14,000-line sonogram of Flight 21.102 electric field data from channel ELF12 (1,024 point FFT; overlap 512; 4 x 4 pixel; no time averaging; no frequency averaging=50; frequency bins 1 to 513; −80 to −50 dB) for 50 to 510 seconds after launch

Originator: S. Cobb

Data: 7 586-line sonograms for selected channels of Flight 21.105 electric field data, (1,024 point FFT; overlap 896; 4 x 4 pixel; no frequency averaging; no time averaging; frequency bins 1 to 513) for 90 to 120 seconds after launch:

Data	Threshold (dB)
ELF12	−40 to −10
ELF12	−55 to −20
ELF35	−45 to −15
ELF35	−55 to −20
ELF54	−45 to −15
ELF54	−55 to −20
Delta N/N	−60 to −30

Originator: S. Cobb

Data: 7 586-line sonograms for selected channels of Flight 21.105 electric field data 1,024 point FFT; overlap 896; 4 x 4 pixel; no frequency averaging; no time averaging; frequency bins 1 to 513) for 250 to 280 seconds after launch:

Data	Threshold (dB)
ELF12	-40 to -10
ELF12	-55 to -20
ELF35	-45 to -15
ELF35	-55 to -20
ELF54	-45 to -15
ELF54	-55 to -20
Delta N/N	-60 to -30

Originator: S. Cobb

Data: 3 3-panel plots of mag x, mag y, and mag z for Flight 21.105 Mother, from -10 to 285 (loss of signal) seconds after launch:

Data	Range in Gauss
Mag x	-0.4 to 0.3
Mag y	-0.25 to 0.0
Mag z	-0.4 to 0.4

Originator: S. Cobb

Data: Plot of the fit of V12H for Flight 21.105 Daughter, from 50 to 300 seconds after launch
Originator: S. Cobb

Data: 2-panel plot (upleg and downleg) of data vs. altitude of V12H for Flight 21.105 Daughter (altitude 70 to 130 km; -40 to 40 mV/m)
Originator: S. Cobb

Data: 2-panel plot (upleg and downleg) of data vs. altitude of V12H for Flight 21.105 Daughter (altitude 70 to 130 km; 0 to 5 TM Volts)
Originator: S. Cobb

Data: 2-panel plot (upleg and downleg) of data vs. altitude of V12H for Flight 21.105 Mother (altitude 70 to 130 km; 0 to 5 TM Volts)
Originator: S. Cobb

Data: 2-panel plot of V12H filtered and mag x data for Flight 21.105 Daughter from 162 to 172 seconds after launch (+/- 20 mV/m; -0.2 to 0.3 Gauss)
Originator: S. Cobb

Data: 2-panel plot of V12H filtered and mag x data for Flight 21.105 Daughter from 162 to 172 seconds after launch (+/- 20 mV/m; -0.2 to 0.3 Gauss)
Originator: S. Cobb

Data: 2-panel plot of V12H filtered and mag x data for Flight 21.105 Mother from 162 to 172 seconds after launch (+/- 20 mV/m; -0.2 to 0.3 Gauss)
Originator: S. Cobb

Data: 25 plots of calibration data for flight PULSAUR II (36.110).
Originator: S. Cobb

Hardware: Onboard flight computer for the E-field instrument to be flown aboard PULSAUR II
Originator: C. Rogers

NONLOCAL TRAVEL

A senior engineer assigned to this task attended the integration test in Bergen, Norway. The duration of travel was August 8–20, 1993.

COMPUTER USE

Minutes	Computer
Dedicated	Sun (LEPROC)
20,000	MicroVAX II (ELDYN)
3,000	LEPVAXcluster
Dedicated	Sun (LEPROC)
Dedicated	Macintosh Quadra (LEPPAM)

NASA Task 92-373-00: Data Analysis, Communication, and Display Support

GSFC ATR: *Dr. J. Nuth*

Hughes STX Task Leader: *C. Meetre*
Hughes STX Task Number: *966*

This task provides data entry, computer programming, and communication assistance to support scientific research and presentations for the Laboratory for Extraterrestrial Physics (Code 690).

FINAL CONTRACT SUMMARY

Staff generated functional diagrams and graphics for the SAC-B, DMSP, and GGS missions for various public relations purposes. Staff efficiently organized and supported GGS and CLUSTER Science Working Groups (SWG's), as well as ad hoc meetings, and distributed minutes of meetings. A task member traveled to London three times to deliver CLUSTER and WIND printed circuit boards. Staff updated Mars Observer documents, the viewgraph library, and the data base. To disseminate information efficiently, a staff member compiled GGS instrument summaries and Mars Observer public relations information and related papers. Staff's editing task included translating Spanish communications and rewriting letters of foreign nationals. A task member fielded communications to the ATR and provided SPAN/NSN electronic communications support for the ISTP investigators. Staff prepared and edited all papers, abstracts, proposals, and similar documentation and supplied administrative support to the ISTP, Laboratory for Extraterrestrial Physics, and Astrochemistry groups to efficiently maintain schedules.

Staff plans to continue all administrative, technical, and graphic support through the duration of contract NAS5-32350.

SUMMARY FOR CURRENT REPORTING PERIOD

A Hughes STX task member prepared and edited proposals, a paper, and a proposal evaluation for the Origins of Solar Systems team (Code 691). Because of a shortage of administrative staff, the task member also assisted the Division Secretary (Code 690) with preparation and editing of Research and Technology Objective and Plans (RTOP's) for Codes 690, 691, and 693.

A task member created block diagrams and graphics for various missions. HSTX personnel updated the GGS viewgraph library. Staff also assisted in creating and compiling public relations information for different missions. The task member continued editing text as needed. The task member traveled to London, England, to deliver components for instrument delivery purposes. The team member organized and supported SWG meetings.

WORK PERFORMED

An HSTX task member prepared and edited proposals titled "Nucleation and Coagulation of Single Magnetic Domain Iron Grains," by Dr. J. Nuth (Code 691), "The Temperature Dependence of the Reaction Between O(3P) and OClO Low Pressure," by Dr. L. Stief (Code 690), and the "Upper

Atmosphere Research: Reaction Rate and Reaction Product Measurements," also by Dr. Stief. The task member edited a paper also to be submitted as a proposal titled "Magnetically Enhanced Coagulation of Very Small Iron Grains," by Dr. Nuth.

Staff prepared and edited RTOP's FY '93-94 for Codes 690, 691, and 693.

A task member generated functional diagrams for the SAC-B mission and graphics for a general ISTP lecture. The team member organized and supported the 1-day GGS SWG meeting for approximately 50 people. HSTX personnel updated the GGS viewgraph library. Staff also assisted in creating press release information for GGS instruments. The task member created block diagrams for SAC-BU's and Magnetic Fields' electrical layout. Staff supported the CLUSTER SWG. The task member traveled to London twice to deliver CLUSTER and WIND printed circuit boards. Staff assisted in compiling educational information for the public affairs office on the Mars Observer project.

A task member created graphics and block diagrams for the DMSP/SSM Magnetometer Handbook. The task member also edited and prepared text for the same handbook. Staff continued organization of the GGS SWG meeting to be held in October. The team member assisted in compiling information for the Mars recovery mission.

SIGNIFICANT ACCOMPLISHMENTS

HSTX task members completed all assigned tasks prior to their required deadlines.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX task members will continue to provide any/all administrative, documentation, editing, meeting, and communications support to the following groups: ISTP, Laboratory for Extraterrestrial Physics, and Astrochemistry. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Scripts: Several proofed and edited typescripts of technical papers
Originators: C. Johnson and S. Stacy

COMPUTER USE

Minutes	**Computer**
Dedicated	Macintosh IIx
Dedicated	Macintosh IIsi
Dedicated	VAX 11/785
Dedicated	MicroVM V4.5

NASA Task 92-375-00: Magnetometer Data Processing and Analysis

GSFC ATR: *W. Mish*

Hughes STX Task Leader: *S. Kramer*
Hughes STX Task Number: *968*

This task provides data processing, data management, and software support for a number of ongoing magnetic field and plasma studies involving data from several spacecraft.

FINAL CONTRACT SUMMARY

This task of 5 years' duration has employed two full-time data technicians and recently acquired one full-time programmer/analyst. During the life of this task, staff has supported data production operations for the Voyager, IMP-ISEE, and Ulysses projects. Hughes STX staff has been instrumental in streamlining data production operations by cleaning, condensing, documenting, and ordering data libraries. Staff members have performed exceptionally well in answering special data inquiries and requests. Task personnel worked effectively to upgrade production procedures and increase the overall efficiency of operations. Staff was recently directed to rewrite the entire Voyager Magnetometer EDR Production System (Voyager Production). At the close of this task, the Voyager Production rewrite has reached a major milestone with the commencement of base production system testing.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff continued with the Voyager Production rewrite. Staff completed the first stage of software development with code that processes EDR's to yield a Summary Format Data Product (Summary Data). Task personnel began testing of newly developed software by comparing Summary Data produced by old and new Voyager Production processing of an identical EDR. Staff demonstrated improved results in processed data quality using new software and showed the need for a review of the current Voyager Production software and data results.

Staff members received and installed a new RISC-based workstation dedicated to Voyager Production for faster data processing. Staff installed and configured system software necessary for Voyager Production operations on the newly dedicated RISC workstation. Staff transferred FORTRAN 77 Voyager Production source code from the dedicated VAX/VMS Voyager workstation (LEPVOY) to the new AXP/VMS Voyager RISC workstation (LEPVGR). Task members successfully recompiled and executed Voyager Production source code on the new AXP/VMS platform. Staff upgraded system software on the AXP/VMS platform to provide improved system performance and reliability. Task personnel supported the development of Voyager data conversion software on LEPVGR by providing HSTX Code 932 personnel with system and technical assistance.

Task personnel received recovery EDR's from JPL to replace Voyager data lost on damaged tapes. Staff completed concatenation of Voyager-1 EDR's from tape reel to tape cartridge. Staff also finished most of the Voyager-2 EDR concatenation pending the receipt of missing EDR's from JPL. Task members ran full Voyager Production to process the Voyager-2 1991 period days 76 through 355. HSTX staff continued retrieving and plotting EDR quick-look data.

HSTX staff processed IMP–J EDR's for periods January 1991 through December 1991 and December 1992 through April 1993. Staff continued with the development of a menu-driven IMP–J Production interface. Staff members satisfied data requests from the IMP-ISEE, Ulysses, and Voyager projects.

WORK PERFORMED

001 VOYAGER PRODUCTION SOFTWARE

Staff received a DEC Alpha workstation to replace the current dedicated DEC VAXstation. Task members unpacked and set up the new DEC Alpha workstation dedicated to Voyager Production. DEC technical staff assisted with the installation of peripheral devices. Staff installed and configured the OpenVMS AXP 1.0 operating system, DEC FORTRAN 6.0, DEC Motif 1.1, and Multinet software; configured and enabled DECnet, Multinet TCP/IP, and LAT network software; created and enabled a batch queue for the submission of background jobs; established user accounts; provided technical and system assistance to new users; and upgraded operating system software to provide improved performance and reliability.

Staff completed SEDR processing routines for Voyager Production, wrote a data averaging routine to produce Summary Data averages in the same format as that of the old Voyager Production system, and modified Voyager Production averaging routines to be generic instead of VIM-5 mode specific.

Staff transferred Voyager Production source code from the VAXstation, LEPVOY, to the Alpha workstation, LEPVGR. Voyager Production code successfully recompiled and ran under the new Alpha hardware architecture.

Staff began preliminary testing of Voyager Production on LEPVGR examining the Summary Data Product (Summary Data) output. Initial results showed significant improvement in the quality of processed data and raised questions concerning the reliability of old Voyager Production software.

The task leader attended a 1-week computer symposium in Atlanta, GA, sponsored by the DEC User's Society (DECUS). A variety of presentations attended by the task leader covered DEC hardware and software issues.

Staff accessed and plotted new Voyager plasma data from the MIT UniTree account on DIRAC. This work demonstrated the effective exchange of data between the now separately processed Voyager plasma and magnetometer projects. Staff members created hourly averages of high-resolution (192-second) MIT plasma data.

Staff provided newly processed 1991 Voyager–2 magnetometer daily and hourly averages to Dr. F. McDonald (University of Maryland), at the request of Dr. L. Burlaga (Code 692); provided IMP 1969 plasma and field hour averages for February 10–12 to Dr. C. Farrugia (Code 692), at the request of Dr. L. Burlaga; and requested high-resolution (5-min averages) IMP plasma data tape from the NSSDC for Dr. Burlaga.

100 VOYAGER DATA PROCESSING

Task personnel ran Voyager Production to process Voyager-2 1991 data. After the second production run, project scientific staff was satisfied with software corrections and declared 1991 data production complete.

Task personnel obtained Voyager-1 and -2 EDR's and quick-look data from JPL on a weekly basis, plotted quick-look data for Dr. Burlaga, and continued to obtain Voyager-1 and -2 EDR data for the 1993 period from JPL.

Task personnel continued to recover damaged Voyager EDR's from JPL and to merge Voyager reel tape EDR's onto tape cartridges. Task personnel completed the recovery and concatenation of Voyager-1 EDR's and nearly finished this task with Voyager-2 EDR's.

200 IMP AND ISEE DATA PROCESSING

Staff began to process IMP-J magnetometer 1-minute averaged data. Staff members successfully completed processing of 1991 IMP-J data, completed processing of December 1992 through February 1993 IMP-J data, and processed new IMP-J data through April 1993.

Task personnel satisfied IMP-J special data requests from Code 694 senior scientific staff and offsite research personnel.

HSTX staff continued with the development of a menu-driven IMP-J Production interface.

275 ULYSSES (SWICS) Data Processing

Staff performed daily operations to transfer Ulysses QEDR data through the SWICS account. All data received were forwarded to the University of Maryland.

300 LIBRARY MAINTENANCE

Task personnel removed all Voyager EDR tape cartridges from the storage room (W-20) in Bldg. 2 and relocated these tapes in Rm. W-124, Bldg. 2. HSTX personnel assisted in the removal of all Voyager Project materials from Rm. W-10.

SIGNIFICANT ACCOMPLISHMENTS

Task personnel made exceptional achievements in recovering lost Voyager EDR's with JPL replacements and restoring the entire Voyager-1 and -2 EDR libraries with the exception of a few Voyager-2 EDR's not yet posted by JPL.

Staff expeditiously satisfied a high volume of special data requests while maintaining an expedient schedule of IMP-J processing.

Staff worked quickly to deliver the dedicated Voyager AXP/VMS computer system, LEPVGR, to service and support new user accounts.

PROBLEM AREAS

Initial testing of new Voyager Production software reveals offsets in output data values when compared to old Voyager Production processing of an identical EDR. Staff will analyze intermediate processing stages to determine the nature of the conflict in Summary Data output and apply the appropriate fixes to Voyager Production software.

Staff is awaiting the posting of the few remaining replacement Voyager EDR's needed from JPL for completion of the Voyager-2 EDR library.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff plans to work on several activities. Testing of phase 1 Voyager Production software will be completed. Porting of postdecommutation filtering and roll processing routines and graphics software will begin after completion of phase 1 software testing and debugging. Current Voyager Production will continue while the new Voyager Production software is being developed. IMP-J processing will continue on schedule. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

The FORTRAN 77-bit manipulation program MOVBIT was made available to Code 694 personnel who wanted to replace the original VAX assembly module with a routine that is not machine architecture dependent.

The task leader traveled to Atlanta, GA, June 7-12, to attend a 1-week computer symposium sponsored by DECUS. A variety of presentations attended by the task leader covered DEC hardware and software issues.

NONLOCAL TRAVEL

The task leader traveled to Atlanta, GA, June 7-12, to attend a 1-week computer symposium sponsored by DECUS. A variety of presentations attended by the task leader covered DEC hardware and software issues.

COMPUTER USE

Minutes	Computer
1,500	IBM 9021 (Gibbs)
Dedicated	LEPVGR

NASA Task 92–376–00: Interplanetary Magnetic Cloud Modeling

GSFC ATR and Cognizant NASA Scientist: ***Dr. R. Lepping***

Hughes STX Task Leader: ***J. Jones***
Hughes STX Task Number: ***969***

This task provides software support and analysis for an effort to develop a formal scheme to fit a model of interplanetary magnetic clouds to spacecraft observations of the clouds.

FINAL CONTRACT SUMMARY

This task was a follow-on to a task under the previous contract, and it lasted the duration of the present contract. A senior analyst programmer was assigned half-time until February 1990, and worked on an as-needed basis after February 1990. Since 1992, a senior data technician has been assigned quarter-time to this task.

During the previous contract period, HSTX personnel developed a method of fitting a proposed model for interplanetary magnetic clouds to observations of these phenomena. In this period, staff refined the algorithm and the software, and applied these to a number of cases. Two publications, with the task leader as a coauthor, resulted from this work in 1990. The analysis procedures developed for magnetic clouds were also applied to several other magnetospheric and interplanetary magnetic phenomena.

Since 1992, Hughes STX staff has provided support for the IMP–8 magnetometer experiment under this task.

Task personnel supported the development of a new IMP–8 data processing system, to run on a VAX, that will replace one that has been used on the IBM mainframes for more than a decade; this support will continue. Staff developed an online data base file containing information about IMP–8 data users and data requests. Under the follow-on contract, staff will extend the database with a history of IMP–8 data requests. Task personnel assisted with an analysis of IMP–8 spacecraft telemetry problems that arose during 1992.

Staff also supported an analysis of Voyager data by providing IDL programming and mathematical analysis. This support will continue under the follow-on contract.

SUMMARY FOR CURRENT REPORTING PERIOD

Task personnel continued a direction-finding analysis of Voyager data.

WORK PERFORMED

Task personnel continued a direction-finding analysis of Voyager data to supplement data analysis done at other institutions. This support included IDL programming and mathematical analysis, for which the ATR provided the necessary information and parameters.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Development of a new Voyager plotting routine will continue. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
5,000 (wall clock)	VAX Workstation

NASA Task 92-379-00: Plasma Electrodynamics Studies: Plasma Wave and Electric Field Data Analysis Software Development

GSFC ATR: ***Dr. R. Pfaff, Jr.***

Hughes STX Task Leader: ***Dr. P. Marionni***
Hughes STX Task Number: ***970***

This task provides advanced software development support for the analysis of plasma wave and electric field data. Specific activities include the development of software for the display of geophysical sonograms; image processing and enhancement of sonograms and correlograms; development of spectral matrix, coherency, and phase analysis software; and DC electric field analysis of data obtained via rocket-borne instrumentation.

FINAL CONTRACT SUMMARY

The period of performance on this task was from February 17, 1989, through September 30, 1993. Currently, there is a senior systems engineer assigned part-time to work on this task. Overall work for on this task concentrated on the development of analysis and visualization software for the study of AC and DC geoelectrodynamic phenomena, and the analysis of data from rocket-borne electric field instrumentation. In summary, staff performed the following:

- Developed and improved high data compression techniques and software for the production of grey-scale sonogram images (dynamic spectra).
- Completed a major software implementation to provide electric field phase and coherency analysis capabilities and developed corresponding capabilities for the image display of phase and coherency data.
- Completed magnetometer/gyroscopic attitude analyses for Flights 21.097, 21.100, 21.096, and 21.105.
- Completed vector DC electric field solutions for Flights 21.097, 21.100, and 21.096.
- Derived filtering and waveform fitting techniques for the analysis of DC electric field data from Flights 29.028 and 29.029.
- Performed a plasma phase and coherency analysis of AC electric field data from Flight 21.097.
- Performed single boom solutions for the DC vector electric field obtained during Flight 21.105.
- Initiated the development of software for the analysis of attitude data obtained via star sensors (in progress).
- Calculated high-accuracy magnetic dip equator solutions for the planning of numerous proposed and completed rocket campaigns.
- Completed image processing utilities for the creation of integrated spectra, the averaging of data, the nonlinear transformation of frequency vs. time-to-frequency vs. altitude, and the selection of image subsets.
- Developed file structures for high-efficiency I/O operations applicable to both IDL and FORTRAN-based software.
- Ported analysis and graphics software to a RISC-based coprocessor that resulted in a 30-fold increase in computational speed.
- Calculated atomic parameters and dominant plasma frequencies as part of a critical ionization velocity study.

- Initiated the conversion of grey-scale image processing software from the QMS QUIC to PostScript language (in progress).
- Provided geomagnetic/orbit calculations as part of several research proposals.
- Undertook a thorough analysis of Flight 31.057 AC and DC noctilucent cloud data (in progress).
- Provided specialize graphics products for presentations, meetings, and proposals.
- Developed procedures and approaches to couple Macintosh-based visualization tools to VMS/Sun-based processing.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff provided software development support for the analysis of plasma wave and electric field data obtained via rocket-borne instrumentation on Flights 21.105 and 31.057: developed rotational analysis procedures for the determination of wave polarization in Auroral-E electric field data; completed high-accuracy magnetic dip equator calculations for the planning of rocket campaigns in the South Pacific; performed an analysis of Flight 21.105 magnetometer, gyroscopic, and DC electric field data; continued to enhance Macintosh-based color image display and analysis capabilities and to establish standard color image production procedures; and continued to develop PostScript-based software for the production of geophysical sonograms.

WORK PERFORMED

100 MAINTENANCE

Routine backup activities were performed on the ELDYN MicroVAX II.

200 ENHANCEMENTS AND DEVELOPMENT

210 DC Field Analysis

Staff confirmed the definition of payload coordinates about onboard gyroscopes for Flight 21.105. To resolve any ambiguities, staff:

- Compared the Daughter magnetometer and the simulated Daughter magnetometer for 75 to 290 seconds with the direction of the mag axes based on the deployed I boom.
- Compared the Daughter magnetometer and the simulated Daughter magnetometer for –5 to 95 seconds with the direction of the magnetic axes based on the undeployed I boom.
- Compared the Mother magnetometer and the simulated Mother magnetometer for –5 to 95 seconds with the direction of the magnetic axes based on the position and alignment of the Mother magnetometer.

Staff continued their attempt to extract usable electric field data from the DC channels of Flight 21.105. The channels that were examined were V1-2H, V3-4H, V5-6H, and V3-5H. All channels were severely degraded by high frequency noise. For V3-4H, V5-6H, and V3-5H, attempts to apply low pass digital filters resulted in attenuation of the DC waveform. Filtering of channel V1-2H appeared to be more successful, and a single boom vector electric field solution was attempted at peak values of the sinusoidal signals. Comparing the resulting fields with the induced V x B components due to payload motion, suggested that either: 1) the filtered V1-2H data was attenuated; or 2) there was an attitude roll error. Staff was fairly confident that the roll error was unlikely based on the analysis of observed and simulated magnetometer data. Further analysis efforts were postponed, although staff expects to perform investigations of the V1-2H and V3-4H channels at selected times of flight.

230 Image Processing and Enhancement

An attempt was made to complete the conversion of the primary grey-scale production program, IMLASER, from the QMS QUIC language to PostScript. Several dictionary definitions were identified that will facilitate further data compression. Because of higher priorities, further work on image trailers and histograms was postponed.

Several new strategies for the production of color images on a Macintosh system were developed during the processing of Geotail data. Software between Sun and VAX platforms has been refined to allow the efficient processing of the primary data using IDL. IDL possesses the capability to produce TIFF formatted images that are directly transportable to Macintosh platforms. Initial image rectification is performed on the Macintosh using NIH Image. Subsequent application of color palettes and additions of color bars, axes and labels are performed using the Spyglass Format package. Final labelling, layout, and printing functions are performed using Deneba Canvas.

240 Sonogram Images

A sonogram image of Flight 21.105 electric field data from DC channel V12H was created to assess the effects of high frequency noise on the DC data. The image was subsequently used to determine cutoff frequencies for data filtering.

300 ANALYSES AND SPECIAL STUDIES

310 Wave Polarization Studies

Analyses and code development are continued to establish procedures to determine electric field wave polarization. As reported during the last triannual evaluation period, an initial investigation using Flight A10.903 (Auroral E) data produced an exceptionally well-defined wave polarization result by analyzing interactively applied single axis rotations to the vector E-field data. Dual axis rotations and various filtering techniques were applied to Flight 31.057 data; these results are still being studied. Data files and records are currently being collected to begin polarization studies of Flight 33.044.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

Pending completion of a Work Control Plan, the analysis of DC electric fields will continue, image analysis activities will continue, and software will be developed and enhanced at the request of the ATR.

DELIVERABLES SUBMITTED

Data: Plots of observed and simulated Flight 21.105 magnetometer data
Originator: P. Marionni

Data: Single boom vector DC electric field solution for 21.105 (preliminary)
Originator: P. Marionni

Software: IDL procedure ROT for the rotation of large arrays
Originator: P. Marionni

Software: IDL procedure AVARRAY for the efficient averaging of large arrays
Originator: P. Marionni

COMPUTER USE

Minutes	Computer
12,000 (wall clock)	MicroVAX II (ELDYN)
20 (CPU)	VACCELERATOR/MicroVAX II (ELDYN)
3,000 (wall clock)	LEPVAXcluster
1,000 (wall clock)	Macintosh IIsi (private)
12,000 (wall clock)	Macintosh Quadra 700 (dedicated)
1,000 (wall clock)	Sun Sparc II (dedicated: LEPPCA)

NASA Task 92-381-00: Instrument for GGS/Polar and Mars Project

GSFC ATR: ***Dr. E. Sittler***

Hughes STX Task Leader: ***M. Kirsh***
Hughes STX Task Number: ***971***

This task supports development of instrumentation for the GGS/Polar and Mars Observer magnetometers. Specific support activities include computation and testing of instruments and maintaining laboratory equipment. Also, this task will support the Parallel Plate Analyzer (PPA) development. The PPA is a subsystem of the HYDRA experiment conducted on the Polar spacecraft for tuning the electron optics to optimize the shape of the detected pattern onto a microchannel plate detector.

FINAL CONTRACT SUMMARY

Three employees supported this task during its lifetime. Recently, only two employees worked on this task. In July 1993, one employee joined the Government and another employee was transferred to another Hughes STX department to continue supporting this project. This task has been closed.

During the past few years, the following activities were completed:

- Design of the onboard spectrum analyzer for the CAPS instrument on Cassini.
- Building of flight cables, transformer coils, clusters of magnetic simulator T-cables, sets of stimulus interface assemblies, power converter assembly cables and transformers.

SUMMARY FOR CURRENT REPORTING PERIOD

The following activities for the reporting period are:

- Printed circuit boards and transformers were assembled.
- Cables for a magnetometer simulator were fabricated.

WORK PERFORMED

Staff assembled three sets of DMSP2 printed circuit boards and interface cables. Staff fabricated cables for the magnetometer simulator, the DMAG boom, and the DMSP2 ground support equipment.
Task member handwound and tested one complete set of coils and transformers for Cluster and fives sets of coils and transformers for XTE/TRMM. Staff also fabricated and assembled three sets of sensor simulator driver boards and interface harnesses.

Task member also repaired a failed sensor test box unit.

SIGNIFICANT ACCOMPLISHMENTS

Even though task requirements had changed several times, HSTX employee completed the fabrication of the sensor simulator driver board on schedule.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

COMPUTER USE

None.

NASA Task 92-383-00: Neural Network Software Development for WIND

GSFC ATR: ***M. Kaiser***

Hughes STX Task Leader: ***C. Meetre***
Hughes STX Task Number: *972*

This task provides development, testing, and implementation of neural networks software and coefficient tables to enable onboard pattern recognition for the Thermal Noise Receiver (TNR) and Time Domain Sampler (TDS) instruments in the WAVES experiment on the WIND spacecraft.

FINAL CONTRACT SUMMARY

During the lifetime of this task, HSTX staff worked with the instrument development team to define and construct an innovative neural network-based strategy to determine the frequency of the thermal noise peak in incoming Thermal Noise Receiver (TNR) data to determine which of the TNR bands should be selected by the instrument in real time onboard the spacecraft. A similar methodology was studied for the Time Domain Sample (TDS) and awaits implementation as a RAM function. HSTX staff worked with flight software development engineers to implement the algorithm on the flight model of the experiment. The algorithm successfully determined over 95 percent of spectra based upon Ulysses data.

HSTX staff contributed toward the concept, design, and implementation of the data base-driven telemetry handling software from its inception, providing the initial prototype, and maintaining and extending the concept as required. In addition, HSTX staff began developing of the KPGS software, basing the implementation on the data base-driven core of the GSE software rather than developing completely new underlying software. Task analysts developed strategies that also reuse this core for postlaunch data processing and display.

Task analysts developed software to display and monitor instrument science and housekeeping data during testing. This software is being used successfully and will continue to be employed after launch as a way of monitoring instrument health and safety during the mission.

SUMMARY FOR CURRENT REPORTING PERIOD

A task member traveled to France to perform intensive work on neural network development immediately prior to the final encapsulation of the flight software and onboard neural network coefficient tables. The analyst was able to create a table that correctly classifies more than 95 percent of incoming spectra by frequency of the plasma peak, and demonstrated that the integerized form of the table produced an accurate assignment. In addition, HSTX personnel provided extensive software support during environmental testing, developing software to display housekeeping health and safety parameters with audible and visible alarm capabilities.

WORK PERFORMED

Neural Networks

HSTX staff produced a tabulation of neural network coefficients, suitably integerized for use in flight software. These coefficients will be placed in the instrument ROM and will form the default set. HSTX staff is currently testing the implementation of the neural network metastructure by simulating a period of WIND data (based on data from the Ulysses Radio Astronomy Receiver) and analyzing the switching activity of the TNR based on several different algorithms for band selection. Much of this work was performed at the Observatoire de Paris, Meudon, France, in cooperation with colleagues from there and from the Univ. of Minnesota.

Testing and Monitoring

A task member assisted monitoring the instrument's health and safety during environmental testing at the Martin Marietta Astro Space facility in New Jersey. The analyst created and enhanced software to provide automatic monitoring of instrument parameters.

SIGNIFICANT ACCOMPLISHMENTS

HSTX staff developed a neural network capable of better than 95 percent successful recognition of incoming thermal plasma peaks. The use of this network as a means of controlling, in real time, an active spaceflight experiment, represents an important innovation in the real time control of tuneable and responsive space instrumentation.

This task will not continue under the new contract.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

None.

NONLOCAL TRAVEL

A task member traveled to the Observatoire de Paris, France, to work intensively on neural network development. An appropriate network was successfully developed.

A task member also traveled to New Jersey to assist in instrument testing.

COMPUTER USE

Minutes	Computer
9,000 (wall clock)	VAX 4000/200

NASA Task 92-385-00: Non-LTE Modeling of Jovian Atmosphere in the Infrared

GSFC ATR and
Cognizant NASA Scientist: ***Dr. J. Allen, Jr.***

Hughes STX Task Leader: ***Dr. R. Halthore***
Hughes STX Task Number: 974

This task supports data acquisition and analysis of an ongoing laboratory experiment that uses the photoacoustic technique to measure the collisional quenching rates of the 7.8-μm emission of methane as a function of pressure and temperature. This includes using the data to properly model, including non-Local Thermodynamic Equilibrium (non-LTE) effects, the hot spot in Jupiter's atmosphere. Additional support includes planning complementary experiments using the Laser Induced Fluorescence (LIF) technique to obtain similar information. Assistance will be provided in designing and conducting these experiments.

FINAL CONTRACT SUMMARY

This task began in 1989 when the task member joined ST Systems Corporation. This task has required one person at the Ph.D. level working 40 percent of the time to accomplish the following:

- The color center laser system was assembled and tested to conform to specifications.
- The FCL was used in spectroscopy including simple absorption spectroscopy, first and second derivative spectroscopy, and opto-acoustic spectroscopy.
- Using opto-acoustic spectroscopy, relaxation signatures from methane and CO_2 were obtained with the former using two mixtures—methane in hydrogen and methane in helium.
- Measured methane relaxation traces were analyzed with the help of models to obtain methane relaxation times that agreed with previously published values.
- Using the previously measured of methane relaxation times, a three-level non-LTE model has been used to explain the nondetection of methane v3 band on Jupiter.
- At least six abstracts have been written and presented in meetings of the American Astronomical Society and other professional society meetings.
- Two journal papers will summarize the above work.
- Other projects are being pursued; for example, the infrared sunphotometer project.

SUMMARY FOR THIS REPORTING PERIOD

Staff submitted an abstract of the paper "On the Nondetection of V3 Band of Methane on Jupiter" for presentation at the annual meeting of the American Astronomical Society's Division of Planetary Science meeting to be held in Boulder, CO, from October 18–22, 1993. This paper will also be submitted for publication to *Icarus*. Staff continued work on the infrared sunphotometer project and submitted a proposal to GSFC for review.

WORK PERFORMED

An abstract of the paper "On the Nondetection of V3 Band of Methane on Jupiter" was submitted for presentation at the 25th annual meeting of the Division of Planetary Sciences of the American Astronomical Society to be held in Boulder, CO, from Oct 18–22, 1993.

The paper with the above title will be submitted to *Icarus*.

Work was done on the infrared sunphotometer project. Atmospheric gaseous absorption was obtained using an InAs detector with a circular variable filter when the sunlight was chopped to minimize stray sky light, and the chopped signal was analyzed with the help of a lock-in amplifier.

A proposal was submitted for review by GSFC, and a copy of this proposal was given to the ATR and all involved individuals.

SIGNIFICANT ACCOMPLISHMENTS

The abstract "On the Nondetection of V3 Band of Methane on Jupiter" was accepted for presentation at the Division at Planetary Sciences meeting.

Staff obtained proof-of-concept for the infrared sunphotometer.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

NASA Task 92-386-00: Inner Magnetospheric Studies

GSFC ATR: ***Dr. D. Fairfield***

Hughes STX Task Leader: ***J. Jones***
Hughes STX Task Number: 975

This task supports the Inner Magnetosphere Project to collect, analyze, and disseminate data from non-NASA spacecraft in the inner magnetosphere. The support includes manipulation of large data files and scientific analysis of the data.

FINAL CONTRACT SUMMARY

One senior programmer analyst has been assigned to this task since February 1990. The major focus has been to merge, analyze, and display data from various sources relating to Earth's magnetosphere. Hughes STX staff developed code to average and display data from a magnetometer on the GOES spacecraft and to plot the GOES data along with AE indices and a magnetospheric model. Task personnel generated a large data base of magnetospheric data by creating merged files, with a common format, combining magnetic data from a number of spacecraft—IMP, HEOS, and ISEE—with solar wind data and AE indices.

SUMMARY FOR CURRENT REPORTING PERIOD

An HSTX analyst began analysis of geotail magnetic field data. Staff began work to derive an empirical relation between the lobe field strength and the geocentric distance.

WORK PERFORMED

Various investigators have found empirical relations between the magnetic geotail lobe field and the geocentric distance. Using an extensive data base, compiled in part under this task, staff may find a more accurate relation, valid over a wider range of distances. Previous relations have been in the form of a power law; a more complex functional form, such as a power law plus a linear term, is being considered. An HSTX analyst began setting up an IDL procedure to compute the relation using nonlinear least squares. Analysis is continuing to debug the procedure and understand its limitations.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue analysis of the relation between the geotail lobe field and other parameters. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
1,000 (wall clock)	LEPDHF Sun Workstation

NASA Task 92-388-00: Rocket-Flight Data Support

GSFC ATR: ***Dr. R. Goldberg***

Hughes STX Task Leader: ***P. Twigg***
Hughes STX Task Number: ***976***

The objective of this task is to provide programming and analysis support for the reduction, analysis, and archiving of particles and fields data from NASA rocket investigations and other data such as that from El Niño rainfall and lightning.

FINAL CONTRACT SUMMARY

On July 1, 1990, contract NAS5-28752 was transferred to this current task. Over the lifetime of this task, one senior programmer/analyst has been working from 0.5 to 1 FTE, and two data technicians have worked from 0.25 to 1 FTE. Some of the major milestones and accomplishments over the lifetime of the task follow. Timely and effective support was provided to the ATR during the preparation of proposals, papers, and presentations. New software was prepared to analyze and plot new rocket data as soon as these arrive from the processing facility. Other software for rocket data was prepared as needed in a timely manner. Documentation of software and analysis procedures was written, updated, and improved. Programming support for the analysis of El Niño data was provided as needed. The analysis of lightning data continued in a timely manner, and is expected to continue into the next contract because of the ongoing nature of this study. New plotting software was learned and applied to existing programs. Assistance was given the ATR in organizing and running a 2-day workshop to discuss rocket data results. Data were provided consistently and on time to colleagues of the ATR at GSFC and at other institutions. All old rocket data were archived onto magneto-optical disks.

Remaining objectives to be accomplished include the continuation of the lightning data analysis and the ongoing rocket data analysis.

SUMMARY FOR CURRENT REPORTING PERIOD

Work was completed on the transfer of all data from magnetic tapes to magneto-optical disks and 8-mm cartridge tapes.

The ATR was assisted with preparation of papers for submission to journals, a poster presentation, and two proposals, respectively.

Previous data analyses work was reviewed, continued, and expanded. This work involved the making of many plots and data sets, and software writing and revision.

Data from past rocket flights were provided to colleagues of the ATR. This required program modification to accommodate their needs.

WORK PERFORMED

The transferring of old rocket data from tapes to magneto-optical disks was completed. This has been a primary project for the past few months, because a deadline was associated with it.

The ATR was assisted with preparation of papers for journals. This assistance involved proofreading, editing, submitting figures to graphic arts, reviewing and correcting the figures, and duplicating and mailing copies to the journals as well as to coauthors. Further assistance was in the form of reducing figures, measuring text, and making color copies of figures because one paper that had been accepted for publication required a camera-ready copy of a certain length. Assistance was also given in the preparation and distribution of two proposals. This work involved proofreading, editing, reducing figures, inserting figures in text, and duplicating. Assistance was also given in duplicating a poster presentation to be given by the ATR.

The ATR and his colleagues decided to review some previous data analyses because of questions about the results. This review involved researching programs written by other staff members and finding copies of previously made plots.

Further analysis is being done on the pitch angle dependency of the solid-state count rates on rocket 33.059. This analysis was previously done 2 years ago, but is currently being expanded further. This work involves making plots and data sets and program modification and development to achieve desired formats.

A colleague of the ATR requested probe data and trajectory data from rockets 33.052, 33.053, and 31.042. These data sets were prepared and sent with a short turnaround.

Staff performed the weekly update of the Fredericksburg A index.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Two Macintosh Centris 660AV's have been purchased and should arrive within 1–2 months. Learning how to use the Macintoshes will be a major part of the task's effort upon their arrival. Assistance in preparing proposals, papers, and presentations will be given.

Work will continue on the data from 21.103 and 21.104, 31.077 and 31.078, and 33.059 and 33.060. Work will also continue on the lightning data analysis.

A Work Control Plan will be prepared for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Tapes Copied: 129 rocket data tapes copied to files on magneto-optical disks
Originator: P. Twigg

Data Sets: 45 solid-state data sets for rocket 33.059
Originator: P. Twigg

Plots: 522 solid-state plots of count rates versus pitch angle for rocket 33.059
Originator: P. Twigg

COMPUTER USE

Minutes	Computer
33,000	ELDYN MicroVAX
20,000	LEPVAX 11/780
50	IBM AT
700	Macintosh IIx
250	NSSDC VAX 11/780 and 8650

NASA Task 92-389-00: IR Grating Spectrometer Development

GSFC ATR: ***Dr. D. Reuter***

Hughes STX Task Leader: ***G. McCabe***
Hughes STX Task Number: 977

This task provides support for an infrared (IR) array grating spectrometer development program at GSFC. It involves optical design and measurement data analysis by close interaction with GSFC scientists and engineers during the design and construction phases of several currently funded cryogenic IR spectrometers/cameras, and the design phase of future systems.

FINAL CONTRACT SUMMARY

Task personnel helped NASA scientist D. Jennings finish constructing and testing the Large Cryogenic Grating Spectrometer (LCGS). This instrument was supported by staff at several large optical observatories during valuable studies of planets and stars; perhaps the most notable of which is the July 1991 total solar eclipse experiment at the Infrared Telescope Facility, Mauna Kea, HI. The performance of the LCGS continues to be improved with the help of staff. It is a fully functioning high-resolution grating spectrometer, routinely employed for observations between 5 and 25 microns, as in the most recent observing run at the Hale 200-inch telescope, Mt. Palomar, CA, from where the spectra of several IR stars in the region of the Zeeman-sensitive 12-micron Mg line were recorded.

Task personnel helped realign and refit the Kitt Peak Postdisperser, a medium-resolution grating spectrometer designed to work with the Fourier Transform Spectrometer of the 4-m Mayall Telescope, Kitt Peak, AZ. This instrument was used during several observing runs, including two at the McMath Solar Telescope FTS for unique simultaneous measurement of solar magnetic field at two different depths in the solar atmosphere. Scientists D. Deming and T. Moran are the Principle Investigators for this research.

The Goddard Postdisperser was supported during many runs at Kitt Peak National Observatories and Mauna Kea Observatories. Staff designed a new set of parabolic mirrors to improve the imaging characteristics of this Ebert-Fasty-like system, which should provide more effective mapping of planets.

Task personnel are helping to build the 12-micron solar camera at GSFC. It is a wide-field, high-resolution Fabry-Perot camera that will be employed for mapping the Sun in the region of the 12-micron emission feature of the solar spectrum.

Task personnel have been involved with the development of the Linear Etalon Imaging Spectral Camera (LEISA) for the Pluto Fast Fly-By mission satellite. A working model of the instrument will be ready in March 1994 to be resubmitted to the review process for all potential members of the scientific instrument payload.

SUMMARY FOR CURRENT REPORTING PERIOD

Task personnel provided support for the LCGS during our preparations in the lab for the August 1993 observing run at the Hale 200-inch Telescope, Mount Palomar, CA. During the 3 nights of the run, task personnel helped record the spectra of several bright infrared stars in the region of the 12-micron wavelength. Data collected on these sources are being reduced by staff. Development of the 12-micron solar camera continues. Assembly of the optical section and array detector circuit is nearing completion. Task personnel provided support during the initial stage of development of the LEISA for the Pluto Fast Fly-By mission spacecraft. Task personnel assisted NASA scientist Dr. G. Bjoraker and Meudon scientist Dr. E. Lellouch whom are working with LCGS/DSYS data from past planetary observing runs.

WORK PERFORMED

Task personnel are supporting the LEISA for the Pluto Fast Fly-By mission spacecraft. Staff accompanied GSFC scientist Dr. D. Jennings to Optical Coating Laboratory, Inc. (OCLI), in San Jose, CA, to be present at discussions pertaining to the Linear Variable Etalon (LVE)/Linear Variable Filter (LVF) for the LEISA. The Pluto mission kickoff meeting at the Jet Propulsion Laboratory (JPL) in Pasadena, CA, took place immediately following the OCLI discussions. Task personnel helped design air-gap etalon plates and metal surface coatings that could be fabricated at GSFC and made available for the first lab tests of the LEISA spectrometer concept (a thin, polished layer of sapphire or other dielectric was thought too difficult to make in a short time). Infrared transparent epoxies, which can be used to mount the LEISA filter on the detector array surface, were ordered by staff and will be comparatively tested in the lab.

Task personnel assisted with preparations for the August 1993 observing run at the Hale 200-inch Telescope, Mount Palomar, CA. The input optical layout for the Coude output of the 200-inch telescope (including focal reduction and sky chopping at an intermediately formed pupil) was designed with the help of staff. The Dewar was checked for helium leakage before shipment to CA. The galvanometer scanning mirror for sky chopping in the Palomar setup was tested with the DSYS electronics in the lab before the run. Staff supported the LCGS during the setup and observation phases of the run. The array detector system computer was linked to the 200-inch telescope control system to communicate remote nodding commands. The DSYS computer failed on the second night of the run and was repaired by staff. Data were collected during most of the three scheduled observing nights on the following IR bright stars: α-Ori, α-Aur, α-Boo, α-Tau, α-CMi, and R-Aqr. These data are being reduced by task personnel using the Cornell RSYS reduction system software and several other similar FORTRAN programs. Staff drafted a program that corrects the orientation of the spectral data on the array caused by tilt of the star image in the grating spectrometer, and updated other RSYS utility programs. Because the 200-inch cassegrain output is a potentially advantageous mounting position for the instrument, task personnel helped design an input optical layout for the cassegrain mounting of the LCGS. Staff wrote a Lotus 1-2-3 program to randomly search a range of effective focal length optics and tabulate lens pairs to fit requirements of the system (the solution to this set of linear equations is not explicit).

Staff continues to support the construction of the 12-micron solar camera. The design of two printed circuit boards for the 58-x-62 BIB arrays was completed, and the drawings and specific plotter files were delivered to the PCB manufacturer. The cold (4° K) characteristics of the electrical components for the surge protection circuit were measured. Staff helped design and assemble parts for the feed-through mechanisms that adjust the positions of three optical elements within the cooled Dewar.

Task personnel provided assistance to scientists working with LCGS/DSYS data from past planetary observing runs as follows: Dr. G. Bjoraker, NASA, molecular hydrogen spectra recorded in January 1992 and March 1993; and Dr. E. Lellouch, Meudon, spectra of Jupiter and Io from March 1993. The Zeos 486/50 was repaired (motherboard replaced) and upgraded with an additional hard disk.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5–32350.

WORK PLANNED NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

CONFERENCES

Task members attended the June 23–24, 1993, Pluto Fast Fly-by kickoff meeting, at JPL, Pasadena, CA.

NONLOCAL TRAVEL

Task members attended the June 21–25, 1993, OCLI in Santa Rosa, CA; and JPL, Pasadena, CA.

From August 17-31, 1993, task members assisted at Hale Telescope, Mount Palomar, CA.

COMPUTER USE

Minutes	Computer
3,600	VAX/VMS
1,080	IBM compatible/MS-DOS
2,400	Apple Macintosh

NASA Task 92-390-00: Cluster Beam Data Acquisition and Analysis

GSFC ATR: ***Dr. J. Nuth***

Hughes STX Task Leader: ***Dr. A. Ali***
Hughes STX Task Number: ***978***

The objective of this task is to design and conduct supersonic cluster beam experiments to determine the relative thermodynamic stabilities of size selected cluster for use in modeling the refractory nucleation process in interstellar dust.

FINAL CONTRACT SUMMARY

The Cluster Beam Data Acquisition and Analysis task started in January 1991. This is a long-term experimental research effort, pursued by the task leader only. Major milestones and accomplishments for the 3-yr period were the following: 1) designed, set up, and executed the cluster-beam system; 2) performed significant improvements on the high vacuum systems of the individual chambers of the molecular beam setup; 3) interfaced the mass spectrometer with counting electronics; 4) designed liquid nitrogen collimation; and 5) achieved molecular beam detection. In the future, using the molecular cluster beam system, staff will attempt to detect clusters in thermodynamic equilibrium—a unique experiment. The cluster beam system will also be interfaced with high-quality spectroscopic data acquisition electronic equipment during the next period.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff continued efforts that involved instrument design, multiple stages of experiment setup and detection, and exploration of properties of atomic clusters. Staff recently designed two contoured nozzles and a skimmer. The skimmer was mounted at the entrance of the quadrupole mass spectrometer chamber. Staff performed laser alignment to ensure that the molecular beam axis and the quadrupole axis intercept orthogonally. Staff installed counting electronics, an amplifier and a discriminator, that will eventually permit real-time measurements of weak intensity cluster distributions in a multichannel sealer using a 486-based computer through the IEEE-488 GPIB system. A tube holder was designed and installed for alignment of the nozzle inside the cluster beam machine. Currently, the mass spectrometer chamber is differentially pumped with respect to the source chamber. Staff is engaged in this long-term research effort on the nucleation process in interstellar dust.

WORK PERFORMED

The primary emphasis of this long-term experimental research effort is to determine the relative thermodynamic stabilities of size-selected clusters for use in modeling the nucleation process in interstellar dust. This effort involves instrument design, multiple stages of experiment setup, and detection and exploration of properties of atomic clusters using sophisticated spectroscopic techniques. Briefly, the system consists of a vacuum chamber that is pumped by a 20-in. diffusion pump. A steel furnace tube is inserted into the vacuum chamber. A contoured nozzle is placed into the end of the tube, which contains small quantities of refractory metals in a large excess of argon. The furnace can be heated at $1{,}000^{\circ}$ K so that the cluster distribution within the tube can be measured as a function of temperature. The measurement was recently made using the quadrupole mass spectrometer that samples gas after it has expanded, cooled, and formed into a molecular beam through differential pumping. Hughes STX staff plans to pursue all aspects of experiment design, setup, and execution on a continuous basis.

PROBLEM AREAS

Staff has been able to overcome most of the initial setbacks that are common in the field of molecular cluster beam experiments and looks forward to the future detection of molecular clusters.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

HSTX staff plans to implement an adequate amount of differential pumping between source and detector using a novel liquid nitrogen collimation system. Staff also plans to detect and analyze cluster mass distribution as a function of experimental parameters. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Staff plans to perform real-time measurements in a multichannel scaler using the IEEE-488 GPIB system interfaced with a 486-based IBM-compatible PC.

NASA Task 92-391-00: Planetary Radiative Transfer Support for Voyager and Other Missions

GSFC ATR: *Dr. R. Samuelson*

Hughes STX Task Leader: *Dr. N. Nath*
Hughes STX Task Number: *979*

This task provides software and data analysis support for Voyager and other planetary missions in the general area of infrared atmospheric radiative transfer investigations. It includes the following: 1) determination of gas abundance in cloud-free regions for Jupiter and Neptune; 2) extraction of associated cloud parameters from cloud regions for ammonia or methane clouds as appropriate; 3) revamping of the current, plane parallel multiple scattering software to accomplish the previous subtasks; 4) development of software for treating radiative transfer in spherical atmosphere for analysis of Voyager–1 data and for project planning for Cassini; and 5) development of heating rate algorithms for radiative equilibrium studies.

FINAL CONTRACT SUMMARY

The Planetary Radiative Transfer Support task started in March 1991. A full-time senior analyst worked on this task until September 1992, then the assignment was changed to part time because of limited funding. The primary driving force in the task was the development of a general purpose, multiple scattering radiative transfer software system for plane-parallel planetary atmospheres. The work started by porting all existing radiative transfer software from IBM 3081 and VAX environment, to a Sun workstation environment. On the theoretical side, a close examination of different radiative transfer methods determined that the so-called doubling and adding method was most suited for a general implementation. The existing software had the same method as its basis, but it was found to be inadequate for the purpose; additionally, it suffered from many internal inconsistencies. A totally new software system was envisaged at this point. To date, most of this system involving 75 high-level and utility routines was designed, coded, documented, and tested. Major subsystems of this system are: a core subsystem that solves the plane-parallel problem as a set of outgoing intensities at the atmosphere boundaries, by starting at given total optical depth distribution across the atmosphere because of gases and particle clouds, scattering phase function distribution due to clouds, and incoming intensities at the atmosphere boundaries; Mie scattering routines; intermolecule (between hydrogen, helium, nitrogen, and methane) collision-induced absorption routines for gaseous absorption; and a variety of initial setup routines. Mie scattering and intermolecular absorption routines were imported from extraneous sources, but they required extensive familiarization and modification. The major application to date has been in the determination of hydrogen abundance in the atmosphere of Titan using Voyager InfraRed Interferometer Spectrometer (IRIS) data; this work will be presented at the forthcoming American Astronomical Society Division for Planetary Sciences (DPS) meeting, at Boulder, on October 18–22. Two small investigations that were carried out in this task are: scattering from a dicyanoacetylene (C4N2) particle cloud for the atmosphere of Neptune (presented at the 1991 DPS meeting in Europe); and a two-D treatment of the contribution function for limb scanning of Titan for the Cassini Composite Infrared Spectrometer (CIRS) instrument. Future objectives for this task will entail: developing other software systems (e.g., extension of the present system to spherical atmosphere, and radiative equilibrium studies); and extracting information from planetary data, especially Voyager IRIS data, by using these systems.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX staff systematically pursued the development of plane-parallel multiple scattering radiative transfer software for planetary atmospheres. Staff designed, coded, and fully tested several initial setup routines, involving atmospheric pressure-height-scale height relationship, particle cloud parameterization, spline fitting of Planck function, and Gauss-Legendre positions and weights. At the request of the ATR, staff discontinued work on the general problem and intensely pursued an application for the atmosphere of Titan related to its hydrogen abundance by using Voyager Infrared Radiometer Spectrometer data. Staff completed the design, development, and testing of the necessary software, and produced numerical results and plots for a presentation at the October meeting of the American Astronomical Society Division for Planetary Sciences in Boulder, CO. This work involved interaction with several GSFC scientists, modification of several molecule-molecule (between nitrogen, hydrogen, and methane) collision-induced absorption routines developed by an outside investigator, and overall development of about one and half dozen routines. A scientific publication will emerge from this work.

WORK PERFORMED

HSTX staff focused first on the completion of the input data and initial calculation subroutines for the general purpose, doubling-and-adding radiative transfer program. At the request of the ATR, staff then moved completely into software development and scientific investigation pertaining to the abundance of hydrogen in the atmosphere of Titan. At this writing, work has progressed sufficiently on the second problem to form the basis of a presentation by the ATR in the forthcoming American Astronomical Society Division for Planetary Sciences (DPS) meeting, at Boulder, on October 18–22.

100 PROBLEM DEFINITION AND ANALYSIS

With respect to the Titan hydrogen abundance problem, HSTX staff fully took over the analysis and software design of the various aspects of the problem, after initial discussions with the ATR. The discussions with the ATR and other (Code 693) scientists progressed throughout this development.

The essential points in this problem are the following:

- Start with a desired surface temperature (T0).
- Assume the presence of two particle clouds, one in the stratosphere and the other in the troposphere. Assign values for standard four parameters for the clouds; for simplicity, choose absorption crosssection = 1 and particle density at cloud base = 1 and fix cloud bases and tops.
- Assume judicious values for hydrogen and methane mole fractions (q(H2), q(CH4)). Titan atmosphere is primarily constituted of nitrogen (N2). The aim of the investigation is to find q(H2) and, if possible, q(CH4).
- Scale atmospheric height, pressure, and temperature data presented by Lindal et al., Icarus 53, 348, 1983, to accommodate hydrogen, methane, and an amount of argon, such that (1) methane is never saturated and (2) the argon mole fraction (q(ar)) is adjusted so the surface temperature equals T0. Lindal's atmosphere refers to nitrogen only.
- Compute the two cloud opacities as a function of height based on the above assumptions.
- For a set of wavenumbers in the 200 to 600 (inverse cm) range, compute gas opacities as a function of height for N2-N2, H2-N2, N2-CH4, H2-CH4, and CH4-CH4 collisions.

- Adjust two overall constants, c1 and c2, for the stratospheric and tropospheric clouds, that multiplies the opacities, such that the average intensities of two sets of observed, Voyager IRIS data, agree with the computed intensities. Obtain the computed intensities by solving the radiative transfer problem, without any scattering.
- Plot overall opacities for the two clouds as a function of wavenumber and look for bumps corresponding to broad hydrogen lines near wavenumbers 360 and 590. Adjust hydrogen abundance and repeat above steps until the bumps are smoothened out. That should give a fair estimate of q(H2). (It is possible that both para- and ortho-hydrogen, which are separately responsible for the two peaks, may be determined through this procedure.)
- Repeat the above steps with different values of methane and look for flat bebavior of tropospheric cloud opacity as a function of wavenumber. Hopefully, this will determine a range of values for q(CH4).
- Argon mole fraction is not determined in any meaningful way through this procedure. It is put in somewhat artificially to have a control on the surface temperature.

200 SOFTWARE DEVELOPMENT

Software design, development, and testing activities proceeded in two directions, those pertaining to the general-purpose radiative transfer system and those immediately relevant for the Titan hydrogen abundance problem. The former includes scattering, whereas the latter is an all-absorption model. All developed routines conformed to previously established disciplines and included online documentation, allowed by the available time.

The developed routines in the general category are the following:

- Cld_model: This routine computes average number densities of a cloud for different atmospheric layers, based on input heights, temperatures, pressure scale heights, and four cloud parameters top and bottom-layer indices, ratio of cloud scale height to pressure scale height, and number density at the cloud base.
- Atmos1, Atmos2: These routines convert atmospheric heights into pressures, or vice versa, starting with pressure scale heights, molecular weights, and temperature distribution of the layers.
- Coeff_b: This routine computes polynomial expansion coefficients of the Planck function with respect to the optical depth for all atmospheric layers. These coefficients are needed, in the general radiative transfer model, to compute thermal emissions of layers. The derived polynomial is either cubic spline or piecewise linear.
- Spline: General-purpose cubic spline routine; written earlier, currently modified.
- Gauss: General-purpose Gauss-Legendre quadrature positions and weights; written earlier, currently modified.

The developed routines for the Titan hydrogen abundance problem are many, but the ones to survive are the following:

- H2_abun: This is the high-level routine for determining Titan hydrogen abundance starting with given mole fractions of hydrogen and methane and using Voyager IRIS data in two different regions. (Details of the overall model are outlined above.)

- Composn: This routine determines atmospheric pressure, temperature, and gas composition distribution, that simultaneously satisfy scaling of Titan data given by Lindal et al., and inclusion of methane not exceeding saturation. (See 'scaling' and 'gas_composn'.)
- Scaling: This routine performs scaling of atmospheric pressure and temperature data from one set of atmospheric gas composition to another. It is especially geared to scaling of Titan data, based on radio occultation measurements as given by Lindal et al.
- Gas_composn: Given atmospheric pressures and temperatures, and level-independent mole fractions of several constituent gases, including a condensable gas, this routine recomputes level-dependent mole fractions of all the gases such that the condensable gas never gets supersaturated.
- H2N2, N2N2, N2CH4, H2CH4, and CH4CH4 (and several versions of each routine): These routines compute the collision-induced absorption by the pair of gases in each case. These routines were obtained from Dr. A. Borysow of Michigan Technological University, and were modified to suit our needs. Arbitrary para- and ortho- hydrogen fractions were incorporated into H2N2 and H2CH4. Production versions of these routines were used to create tables of absorption coefficients for many wavenumbers and temperatures. The calculations in 'h2_abun' use linear interpolation on these numbers and significantly reduce run time.
- Noscatter: A non-scattering version of the radiative transfer program, previously developed and currently modified.
- Radfit: A two-D fitting program to determine stratospheric and tropospheric cloud opacities.
- Several plotting routines using the Mongo plotting package.

300 SCIENTIFIC INVESTIGATION

HSTX staff actively participated in all phases of the data analysis activities pertaining to the Titan hydrogen abundance problem. The scientific expertise provided by the staff played a vital role in the design, fast development, and execution of the underlying software system.

400 MISCELLANEOUS

Routine system management activities (e.g., file transfer between different machines, system cleanup and setup) were performed.

Regular tape backups of the hard disk contents were made.

SIGNIFICANT ACCOMPLISHMENTS

In a timely and efficient manner, HSTX staff designed, coded, and executed the necessary software for the investigation of the hydrogen abundance problem for the atmosphere of Titan. The problem was posed by the ATR, but major succeeding analysis and development were provided by the staff. Several routines developed earlier for the general-purpose planetary radiative transfer problem and the scientific expertise of the staff were crucial for this work. The preliminary results of this investigation will be presented by the ATR in the forthcoming American Astronomical Society Division for Planetary Sciences (DPS) meeting, at Boulder, CO, on October 18–22. The final results will be published in a journal.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Staff will continue investigation of the Titan hydrogen abundance problem. Upon completion of that work, further development of the radiative transfer software for a plane-parallel atmosphere and its application to outer planets will continue.

COMPUTER USE

Minutes	Computer
Fully dedicated	Sun Sparcstation 2
Dedicated	LEPVAX/LEPVX2 (VAXcluster)

NASA Task 92-392-00: Cassini/CRAF Support

GSFC ATR: *E. Sittler*

Hughes STX Task Leader: *S. Bakshi*
Hughes STX Task Number: *980*

This task provides Instrument Engineering Support to lead the engineering design effort for the development of the Cassini CAPS instrument. Additional technical support will be provided for the development of simulation codes, design of flight hardware systems, high-voltage power supply design, flight software development, missions operation and data analysis software, and the development of the Ground Data Analysis Facility. Programming support will be provided for Neptune Data Analysis; Sun workstation system support will also be provided.

FINAL CONTRACT SUMMARY

This task has been active since 1990 and has been staffed by one principle engineer and one software engineer. During this time, staff presented the spectrum analyzer module (SAM) development status and plans at several Cassini CAPS team meetings. The design was first presented at Southwest Research Institute on October 11, 1991. The team response to the proposed design was overwhelmingly positive. As the design progressed, staff presented the SAM baseline design at a software meeting held March 17–18, 1992, at Southwest Research Institute and at the Cassini CAPS team meeting held March 27–30, 1992, at Mullard Space Science Center in Surry, England. Approval was granted to continue planned development activities. A task member also prepared documentation of SAM and HVPS development activities for presentation at the October 5–9, 1992, Cassini CAPS team meeting in the Netherlands and presented SAM and HVPS development activities at the September 24–25, 1992, CAPS preliminary team meeting at GSFC. Finally, the Cassini CAPS team conveyed unanimous approval of the SAM design and development activities at the preliminary design review during the week of March 8, 1993. Following this meeting the SAM breadboard was released for fabrication.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff continued support for SAM design and development. Optimization of the gate array-based controllers, integration of the controllers into the SAM processing modules, and breadboard evaluation are proceeding. The software package, Plasma Science (PLS) Data Analysis System, for analyzing Voyager and Neptune data was completed. Task members are currently working on the SAM Development System, a software package to develop spectral analysis algorithms.

WORK PERFORMED

A task member continued simulation-based testing and optimization of SAM. Staff then programmed gate arrays for the Input/Output Processor (IOP) and the FIFO module, and assembled peripheral circuitry onto the SAM prototype board.

Staff continued fabricating SAM ground support equipment (GSE) by coding the C language-based data processing unit interface and time-to-digital converter interface functional simulators. The task member then configured the GSE to exercise the operation of the FIFO and IOP modules, which performed as designed.

Task personnel completed development of the Plasma Science (PLS) Data Analysis System, a software package to analyze Voyager and Neptune data. The window-based integrated system is written in IDL (Interactive Data Language) and provides a menu-based user interface to allow scientists to perform data analysis, simulation, fittings, and current computations using Pmodel. To achieve reliability, the development of the PLS analysis system involved understanding various models written in FORTRAN (Simulation, Pmodel, Fitting), and their input and output data formats. A task member debugged and modified several of these routines to meet the requirements, and wrote C routines to interface these models with the IDL analysis system.

Task personnel transferred several days of Voyager and Neptune data sets from the IBM to the Sun. The transferred data sets were then converted to Sun format to be used by various analysis programs. The converted data sets are archived on 8-mm data cartridges for future use.

Staff worked with GSFC personnel in debugging the Voyager Electron Analysis program, and scripts to automate the analysis process and several IDL routines to plot various energy spectral plots for Voyager and Neptune data analysis were developed.

A task member worked with GSFC personnel in defining the requirements for the SAM Development System that will be used to develop the spectral analysis algorithms to be used by SAM. Staff will assist the design and development of various modules in the CAPS project after developing the SAM Modeling System, a window-based integrated system using IDL and IDL Widgets to simulate data. Seventy-five percent of the code for the Manage Master_Ion Table section of the SAM Modeling System is complete.

Staff performed routine maintenance on the lepecs Sun workstation daily and did monthly backups of all file systems. Staff also installed software for the Talaris printer, wrote Unix shell scripts to back up CADRE (TEAMWORK) data sets, and performed other routine system maintenance functions.

A task member upgraded the operating system on Sparcstation lepswe, including partitioning the disk file subsystem, installing the 4.1.3 version of the operating system and patches for it, installing a FORTRAN compiler, and installing IDL software.

SIGNIFICANT ACCOMPLISHMENTS

The SAM breadboard was fabricated. The IOP and FIFO modules have been assembled and successfully tested.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
1,200	Macintosh IIsi
30,000	IBM compatible
30,000	Sun workstation

NASA Task 92-394-00: AMPTE Analysis

GSFC ATR: ***Dr. M. Smith***

Hughes STX Task Leader: ***E. Mazur***
Hughes STX Task Number: ***982***

This task provides science analyst, programmer, and data technician support for Code 696 data analysis activities in magnetospheric physics. These activities include development of software for AMPTE and related missions, production of higher order data products, and maintenance of active data bases.

FINAL CONTRACT SUMMARY

This task, initiated in October 1991, had one task member for its entire lifetime. Because of the undergraduate background of the task member, she not only wrote programs for data manipulation and presentation, but she was also given the opportunity to participate in some of the data analysis. This resulted in the coauthorship of two published papers, the most recent of which was published in the *J. Geophys. Res.*, September 1, 1993, and two talks presented at the AGU meetings. Toward the end of the task, the task member took on the added responsibility of helping with the Dynamics Explorer (DE) magnetometer data processing.

As this task continues under the new contract, the DE magnetometer processing will be completed. The task member also hopes to begin a study of flux transfer events and to present the results at an AGU meeting.

SUMMARY FOR CURRENT REPORTING PERIOD

The task member continued with DE MAGA processing. This work involved the creation of daily files, copying the data to tape, making copies of the tapes to send to Japan, and fulfilling data requests.

The task member continued to assist the ATR with the study of nightside gap crossings using the DE magnetometer data. Program SPC_TO_GMS was modified to create output that could be used by the field-aligned current program to make plots of J parallel. Program JP_SZ, a program that calculates and plots the Poynting flux and the field-aligned current, was originally written for a data request but will also be used for the gap crossing study.

Using the combined VEFI/MAGB data set, the task member wrote program VEFIMAG to create plots of electric and magnetic fields. The program filters the data for user-requested intervals and has four types of plot output. The program was written to be user friendly, but the task member wrote documentation to provide a better explanation about how to use the program.

During this triannual period, the task member began making comparison plots of the MAGA data processed originally and recently processed bits and pieces. The comparisons were being done to determine whether the new pieces were worth adding to the previously existing files. The ATR has decided not to combine the extra data files.

WORK PERFORMED

100 PRODUCTION SUPPORT

The task member filled plotting requests by creating DE-A and DE-B magnetometer files and plots and produced the following MAGA daily files and tapes:

- 21 daily files created.
- 5 daily tapes created.
- 57 tape copies (sent to Japan).
- 30 MAGB, delta spacecraft, 1/2 second averaged, J parallel ASCII data files.
- 3 MAGB, field-aligned current (J parallel), 1/2-sec averaged plots.
- 3 field-aligned current (J parallel) and Poynting flux, 1/2-sec averaged plots using spline magnetometer data.
- 12 MAGA, delta GMS, 6-sec averaged data files.
- 18 plots of VEFI/MAG, delta GMS, 1/2 second averaged, Btheta and Bphi vs. time.
- 12 plots of VEFI/MAG, delta GMS, 1/2 second averaged, Ex and Bphi vs. time.
- 18 polarization plots of Ex vs. Bphi and Bphi vs. Btheta.
- 101 MAGA, delta GMS, 1/2-sec averaged comparison plots.

200 DATA ANALYSIS SUPPORT

For the ATR's DE-2 Nightside Gap Crossing Study, program SPC_TO_GMS was modified to create output for use with the field-aligned current program written by J. Byrnes (Code 694). Spline fitting of magnetometer data from the list of events continued. Program Jp_Sz was written to calculate the Poynting flux and plot it as a two-panel plot along with the field-aligned current, J parallel. As new programs are written, the documentation for the gap study processing is updated.

A temporary version of program ISEE was written for a special plot request for the ATR.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

All work under this task has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The task member plans to create a plotting package for the VEFI/MAG data set. Also starting this period, the task member hopes to begin a study of Flux Transfer Events, working with Dr. M. Smith (Code 696). The task member will continue to help the ATR with his study of nightside gap crossings and will continue to work on the MAGA production. As part of the MAGA production, staff will begin to create a standalone data set containing magnetometer and OA information for the entire MAGA data base. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Data:
30 MAGB, 1/2-sec averaged, delta spacecraft, J parallel ASCII files
6 MAGB, 1/2-sec averaged, delta SPC, spline-corrected plots and files
5 MAGA, 6-sec averaged delta GMS files
101 MAGA, 1/2-sec averaged, delta GMS comparison plots
7 MAGA, 6-sec averaged, delta GMS files
12 VEFI/MAG plots of Ex, Bphi, and Btheta
18 VEFI/MAG polarization plots
24 VEFI/MAG plots of Btheta and Bphi vs. time
18 VEFI/MAG plots of Ex and Bphi vs. time
1 plot of ISEE-3 magnetometer data
3 plots of MAGB, J parallel, 1/2 second averaged
3 plots of MAGB, J parallel, and Poynting flux

Originator: E. Mazur

Software:
SPC_TO_GMS
VEFIMAG
VEFIMAG_AVE
ISEE_TEMP
JP_SZ

Originator: E. Mazur

COMPUTER USE

Minutes	Computer
Dedicated	MicroVAX II (MAGSPA)
Dedicated	MicroVAX II (DE696)
Dedicated	Macintosh IIsi
Dedicated	Sun SPARCstation 1+ (LEPJAS)

NASA Task 92-395-00: Plasma Electrodynamics Studies: ISTP/GGS Support

GSFC ATR: *Dr. R. Pfaff, Jr.*

Hughes STX Task Leader: *Dr. P. Marionni*
Hughes STX Task Number: *983*

This task provides general software support for the processing, display, and analysis of electric field data acquired from the CRRES, POLAR, and Cluster spacecraft.

FINAL CONTRACT SUMMARY

The period of performance on this task was from July 1, 1991, through September 30, 1993. Currently, a systems programmer and a senior systems engineer are assigned part time to this task. Highlights of task activity under this contract are:

- SunOS, FORTRAN, Interactive Data Language (IDL), and printer interfaces were installed on the three Sun workstations supporting this task.
- A major software subsystem (FICHE) for the interactive access and display of CRRES telemetry data was examined and installed.
- The ATR was accompanied to the Univ. of California, Berkeley (UCB), to review general aspects of CRRES/ISTP data handling.
- Interactive power spectral and sonogram computation and display capabilities were completed and staff traveled to UCB to install these capabilities.
- Actions were initiated to access requested CRRES data.
- Macintosh/Sun interactive display capabilities were initiated.
- GSFC scientists were assisted in accessing CRRES data.
- The efficiency of IDL I/O in Sun/VAX environments was greatly improved.
- Staff worked with UCB engineers and investigators in verifying onboard processing procedures.

Work is expected to continue in all of the above areas.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff continued to provide general software support for the processing, display, and analysis of electric field data acquired from the CRRES, Polar, and Cluster spacecraft; met with the ATR and UCB investigators to review the current implementation of interactive graphics tools; initiated the design of an improved IDL user interface for the simultaneous display of color sonograms i.e., dynamic spectra, integrated spectra, and individual power spectra, for use in ISTP missions; attended local Sun/Unix administrators' meetings; demonstrated technical expertise in the production of color and grey-scale sonogram images of Geotail data; and provided parallel computational algorithms to ensure the quality of onboard processing of E-Field data for the FAST spacecraft.

WORK PERFORMED

100 MAINTENANCE

Regular maintenance of all accounts relevant to this task was performed on the ELDYN MicroVAX II.

200 ENHANCEMENTS AND DEVELOPMENT

210 General Programming Support

J. Vernetti of the Space Sciences Lab at UCB installed the latest version of FICHE on LEPROC. FICHE provides the main interactive data interface to CRRES and, ultimately, FAST data. Several problems were found and these will be corrected when the local Sun workstations are upgraded to the 4.1.3 operating system and OpenWindows 3.

220 Spectrogram Displays

After a review of existing interactive sonogram capabilities by the staff, UCB investigators, and the ATR, a redesign of the subsystem was initiated. The new design will allow the simultaneous display of a color sonogram, integrated spectra, time domain data, selected power spectra, and a histogram of the sonogram image. The overall design consideration is to minimize the number of windows and the number of window layers. An iteration of the new design has been reviewed, and limited implementation has been initiated.

230 Sun/Unix Development

A primary utility for IDL I/O and VAX/Sun data transfer, WRITEBBN, was found to produce unusable files for VAX-to-Sun data transfer under some circumstances. The problem was traced to an incorrect VMS file attribute (carriage control). The addition of a "/NONE" to the IDL OPEN statement corrected the problem.

300 ANALYSES AND SPECIAL STUDIES

310 Sun Workstation Environment

Modifications were made to LEPROC to accommodate a new IP address.

The LEPPCA Sun workstation was moved from Bldg. 2 to a temporary location in the task leader's office in Bldg. 1. The move was made to accommodate further development of interactive sonogram capabilities and to test several Macintosh/Sun interface options.

330 Meetings

A task member attended several local Sun/Unix administrators' meetings.

340 Data Analysis

CRRES data from the Space Sciences Laboratory at UCB, was received by Code 696. Staff had requested these data during the last triannual evaluation period.

At the request of the ATR, Geotail data were analyzed to provide UCB investigators with a survey with current grey-scale and color sonogram analysis and display capabilities that have been developed at GSFC. Sonograms displaying various averaging and time-overlap options were produced. One image was processed in IDL to produce a TIFF file, and then transferred to a Macintosh where a color sonogram was produced. The ATR provided final documentation of the effort by describing the usefulness of the available options.

350 Onboard Processing Development

An effort is underway to confirm the UCB onboard processing algorithms for FAST.

Staff reviewed an algorithm developed by R. Ergun and R. Abiad (UCB) for finding the arctangent during onboard calculation of phase. Although the polynomial fulfilled the error requirement of one degree, a discontinuity was in the solution for an argument of 1. It was suggested that a polynomial expansion containing only odd powers of the argument would yield a better result, but this might be too costly computationally. After an investigation of the instruction timings of the DSP32 digital signal processor, it was determined that the floating point division required by the original algorithm would negate any advantage over using preexisting algorithms provided in the DSP library.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Software: Redesign of interactive color sonogram (dynamic spectra) display capabilities
Originators: S. Cobb and P. Marionni

Software: Corrections to IDL I/O utility WRITEBBN
Originators: S. Cobb and P. Marionni

Data: Color and grey-scale sonograms of Geotail electric field data
Originator: P. Marionni

COMPUTER USE

Minutes	Computer
Dedicated System	SPARCstation II (LEPROC)
Dedicated System	SPARCstation II (LEPEFI)
Dedicated System	SPARCstation II (LEPPCA)
Dedicated System	Macintosh Quadra 700 (LEPRFP)
Dedicated System	Macintosh Quadra 700 (LEPPAM)

NASA Task 92-396-00: Planetary Geosciences Programs Support

GSFC ATR: *Dr. J. Nuth*

Hughes STX Task Leader: *T. Dickinson*
Hughes STX Task Number: *984*

This task supports the daily operations of the Planetary Geosciences Programs (PGP) office by providing two staff scientists to assist the Discipline Scientist (DS) for Planetary Geosciences and the Discipline Scientist for the Planetary Geology and Geophysics (PGG) program in the planning and implementation of these programs.

FINAL CONTRACT SUMMARY

This task, covering the period of performance from September 3, 1991, to September 30, 1993, supported two individuals at the principal scientist and senior scientist levels to support the Solar System Exploration Division at NASA Headquarters in Washington, DC. Hughes STX personnel contributed significantly to various programs in the division. Staff members organized and successfully completed major proposal review activities (e.g., Lunar and Planetary Geoscience Review Panel [LPGRP] and Venus Data Analysis Program [VDAP] Review) that annually review approximately 750 proposals for several major NASA programs. Task personnel assisted in the management of several major R&A and MO&DA programs including technical and budget analysis and recommendations to the Planetary Science and Planetary Astronomy branch chiefs. HSTX task members were major participants and gave oral presentations at over 30 conferences and meetings. Because of their efficiency and performance, staff members were given increased responsibilities in the division that included appointing a discipline scientist for the Origins of Solar Systems program and the PMG program, and management duties associated with the Lunar Exploration Science Working Group (LEXSWG).

Remaining objectives include: 1) Continuing support to the division as described above including daily operations of the PGG, PMG, VDAP, and Origins programs; 2) organizing and participating in various proposal and facility reviews; and 3) continuing support to the flight programs branch throughout the Magellan project and support the Advanced Studies Branch throughout the mars and lunar activities.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX personnel continued to support the Planetary Science Branch at NASA Headquarters by assisting with PGG, PMG, Magellan, VDAP, and Advanced Planning activities, including MESUR (Mars Environmental Survey) and LEXSWG. The main activities for this period included preparing for the Origins Review Panel meeting, the Group Chief's meeting, the Lunar and Planetary Geoscience Review Panel meeting, and various facility reviews.

WORK PERFORMED

100 PLANETARY GEOLOGY AND GEOPHYSICS

HSTX personnel organized and participated in a review for the Reflectance Experiment Laboratory (RELAB) facility at Brown University. Staff will report to PGG Management Operations Working Group in November.

HSTX staff participated in a Planetary Science Data Steering group (PSDSG). Task members discussed the PGG program relationship and coordination of the Planetary Data Systems with Regional Planetary Image Facility (RPIF). Task members also discussed the possibility of the PSDSG serving as a review panel for RPIF's.

Staff personnel developed the PGG program plan for FY '94.

Task personnel developed the schedule for the 1994 LPGRP review process, that included selecting members for the Group Chief's meeting and establishing proposal deadlines, etc.

Task personnel conducted a mapping meeting to review the progress for the former Mars Geologic Program that was consolidated into the PGG Core Program.

Task members are planning a facility review for the Vertical Impact Gun at Ames.

HSTX personnel met with J. Zimbelman and R. Steinat, National Air and Space Museum (NASM) to discuss the upcoming RPIF meeting and priorities for future RPIF data acquisition. Within this meeting, staff appointed J. Zimbelman as the new RPIF Director's Steering Group Chairman. Task members met with L. Pieri (JPL RPIF) to discuss RPIF FY '94 funding needs (JPL does not currently support their RPIF data manager).

HSTX personnel met with SAIC to discuss the Procurement Tracking Data Base.

200 PLANETARY MATERIALS AND GEOCHEMISTRY

HSTX staff held their first Curation and Analysis Planning Team for Extraterrestrial Materials (CAPTEM) on June 2–3 at LPI. The committee approved new allocation guidelines, decided to keep Brooks Air Force facility open, and started working on lunar sample return requirements.

Task personnel attended LPGRP and reviewed 86 full and 45 progress report proposals. Outstanding issues include: The need to carefully rewrite the NRA, the need for a facility program not to include a core program, and site visits as needed at Washington University, University of Chicago/Argonne, and University of Arizona.

Staff personnel met PMG MOWG on June 24–26 at LPI, to review JSC "Institutional Funds." As a result, more funds will be moved into PI Peer Reviewed Proposals.

HSTX personnel and PMG MOWG started "White Paper" on Advanced Instrumentation and Facilities R&A initiative for FY '96.

Task members met with Dr. B. French (NASA HQ) to discuss cosmic dust research and 1994 JSC RTOP for Dust Collector Development and Light Gas Gun facility. As a result, these programs will be incorporated into the PMG Core Program and will be peer reviewed in FY '95.

Staff members attended Meteoritical Society meeting in Vail, CO, July 18–23. Staff members also attended the MSATT workshop, "Early Mars: How Warm?, How Wet?" in Breckenridge, CO, July 25–28.

HSTX personnel sent "Dear Colleague" letters to selected PI's requesting science highlights for Office of Space Science (OSS) reviews.

Task members began preparing for FY '95 proposal reviews by revising the NRA and contacting people to serve on the 1994 LPGRP.

HSTX personnel worked on the FY '94 program plan including sending termination letters to PI's.

Staff members prepared for a site visit at Washington University to address issues on the direction of lunar research and support for ion probe facility proposals.

HSTX personnel prepared FY '94 RTOP authorizations, and calculated new FY '94 baselines for JSC grants incorporating "institutional funds" into individual grants.

Staff members attended the SBSWG sample return subgroup meeting in Tucson, AZ, (August 12–13) and were briefed on the APL and JPL "weekend study" on $50M sample return missions. Recommendations included: 1) Support further definition of low-cost sample return concepts; 2) support development of new technologies for sample return missions; and 3) support ground-based observations of easily accessible targets.

Staff members met with SAIC to discuss a proposed new procurement data base.

HSTX personnel met with T. Lawrence (LLNL) to discuss the potential of using Condor for cosmic dust collection.

300 ORIGINS OF SOLAR SYSTEMS PROGRAM

HSTX personnel received approximately 130 proposals. The Group Chief's meeting, to assign reviewers, was held on July 31–August 2. The Origins Panel Review will be held on October 4–8 and will be augmented to handle the unanticipated number of proposals.

HSTX personnel sent abstract volumes to publications.

Staff members attended the Gordon Conference on Origins of Solar Systems, that was held on July 4–9. Approximately 30 percent of the attendees were current Origins PI's. Others expressed much interest in the program.

Task personnel developed a tentative NRA/Review schedule for FY '94 to be released February 1, 1994. HSTX personnel attended the Steering Group meeting held on July 4, and discussed: Funding history; TOP's association; future workshops; and the upcoming review.

HSTX personnel discussed several concerns of the Origins community with A. Cameron (Steering Group Chairman) including community concerns about the need for increased communication among PI's.

400 VENUS DATA ANALYSIS PROGRAM

Task personnel participated in the Venus Mapping meeting held July 28–August 2 at USGS/FLAGSTAFF with a tutorial on radar data analysis and USGS mapping procedures.

HSTX personnel wrote letters requesting VDAP progress reports that are to be sent out in October, with a due date of December 15.

Task personnel and LPI are preparing a VDAP Abstract Publication.

HSTX personnel distributed a special issue of Sky and Telescope (August 1993) , with Venus articles by E. Stofan (VMAP Steering Group Chairperson) and J. Plaut (VDAP PI) to VDAP PI's and RPIF's.

500 MAGELLAN FLIGHT PROGRAM SUPPORT

HSTX personnel attended Magellan PSG, RADIG, and associated Working Group meetings on August 9–10 at JPL. Topics discussed included: final aerobraking experiment results and an upcoming Icarus special issue.

600 ADVANCED STUDIES SUPPORT

610 Lunar Activities

Staff members met with D. Stetson and H. Brinton (NASA HQ) to discuss the future of LEXSWG and lunar missions.

Task members met with G. J. Taylor (University of Hawaii) to discuss the August 16–17 LEXSWG meeting. Staff members attended the LEXSWG meeting in Washington, D.C. on August 16–17 that looked at alternate ways to meet lunar orbital science objectives in today's political and budgetary climate.

HSTX Personnel drafted a document on the LEXSWG FY '94 meeting schedule, budget, activities, and products.

620 Mars Activities

HSTX Personnel attended the MESUR SDT, that was redesigned to fit within cost cap.

Staff members attended the JPL Briefing on the Mars Small Sample Return Study.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the contract to meet the requirements of this task. Support functions will proceed with a full staff. During the next period, HSTX personnel will finalize arrangements for the Lunar and Planetary Geoscience Review Panel meeting, attend Magellan and MESUR meetings, and support the Planetary Science Branch, the Planetary Astronomy Branch, the Advanced Studies Branch, and the Mission Operations Branch on science issues.

HSTX personnel will attend the following activities planned for September through November 1993:

SEPTEMBER

- Site visit University of Arizona, September 20 and 21.
- MARSWG meeting at JPL, September 23.
- CAPTEM, at LPI, September 25 and 26.
- IDP technology workshop at LPI, September 27 and 28.

OCTOBER

- Science at JSC, October 2–8.
- Origins Panel Review at LPI, October 3–7.
- PMG MOWG subgroup, Washington, D.C., October 8.
- Meteorite Working Group, Washington, D.C., October 15 and 16.
- Geological Society of America, Boston, MA., October 24–29.

NOVEMBER

- RPIF meeting, Washington, D.C., November 4 and 5.
- PMG MOWG, Washington, D.C., November 15 and 16.

CONFERENCES

HSTX personnel attended the following conferences:

- Origins of Solar Systems Gordon Conference, NH, July 4–9.
- Meteoritical Society Meeting, Vail, CO, July 18–23.
- MSATT—Early Mars, Breckenridge, CO, July 26–28.

NONLOCAL TRAVEL

HSTX personnel traveled to the following:

JUNE

- CAPTEM at LPI, June 2 and 3.
- LPGRP, at PI, June 4–10.
- PMG MOWG review of JSC support, June 24-26.
- Planetary Geologic Mapping Workshop, at Flagstaff, AZ, June 27–30.

JULY

- Planetary Geologic Mapping Workshop, at Flagstaff, AZ, July 27–30.

AUGUST

- Origins of Solar System Group Chefs, at LPI, August 1 and 2.
- Sample return Sub-Group of SBSWG, Tucson, AZ, August 12 and 13.
- Washington University site visit, St. Louis, MO, August 30 through September 1.

SEPTEMBER

- Last meeting of PVSSG at ARC, September 13 and 14.
- Planetary Astronomy MOWG, New Mexico, September 20 and 21.
- University of Arizona site visit, Tucson, AZ, September 20 and 21.
- MARSWG at JPL, September 22 and 23.
- Captem at LPI, September 25 and 26.
- IDP Technology Workshop at LPI, September 27 and 28.

COMPUTER USE

None.

NASA Task 92-397-00: ISTP/SMEX Energetic Particle Experiments

GSFC ATR: *Dr. D. Baker*

Hughes STX Task Leader: *Dr. S. Kanekal*
Hughes STX Task Number: *985*

This task provides support for data processing and analysis software development, and hardware testing of energetic particle detectors on SMEX/SAMPEX and ISTP/POLAR spacecraft.

FINAL CONTRACT SUMMARY

This task spanned 1-1/2 years, and the HSTX personnel consisted of the task leader. The major objectives of this task were to write software to produce Browse data, complete the PET detector calibration, and analyze data collected by the SAMPEX mission. The Browse file software was completed and is running at UMSOC. Browse files are routinely produced and distributed for use among the SAMPEX collaborators. The latest version (4.0) comprises more than 20 subroutines and is fully modular and flexible. The Browse files contain data from all SAMPEX detectors, positional information, and corrections for particle loss and misidentification. The PET detector calibration has been completed. Response curves for ELO, EHI, and P1 rates have been obtained. Both accelerator and beta spectrometer data have been analyzed. Bow-tie analysis has been completed, resulting in thresholds and geometry factors for the above rates. SAMPEX data analysis has yielded results on magnetospheric particle acceleration, and work on the polar cap boundary survey has commenced. It is expected that the SAMPEX data analysis will soon result in a journal publication and the polar cap boundary survey may also be published. HSTX staff successfully evaluated and procured dedicated computing for SAMPEX.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff worked on the rate averaging software, PET detector calibration, and SAMPEX data analysis. The rate averaging software (Version 4.0) now includes corrections for particle misidentification in PET rates. The correction factors are obtained statistically from PET events. In addition, new features were introduced and bugs in the package were rectified. PET electron response curves for different rates and all PET channels were generated using both the accelerator and the beta spectrometer data. Bow-tie analysis resulted in effective geometry factors and energy thresholds. SAMPEX data analysis included producing L-sorted daily and orbital averaged data and performing epoch analysis to study particle acceleration in the magnetosphere. A study to survey the polar cap boundary was initiated. In addition, staff continued collaborative efforts and participated in the SAMPEX team meeting at the University of Maryland.

WORK PERFORMED

The rate averaging package was upgraded. The Browse file now includes corrections for particle misidentification in PET rates. The correction factors are obtained from statistics collected from PET events that contain the full pulse height information. A new feature to loop over input MDF's producing a separate Browse file for each input MDF was added. A bug in the HILT high-resolution rate decompression routine was corrected. The set descriptor was upgraded to incorporate the rate correction factors.

PET electron response curves were generated using both the accelerator and the beta spectrometer data. The geometry factors obtained integrated the effective areas over all angles of incidence. Furthermore, geometry factors for each PET channel were calculated to obtain electron spectra from PET events. A bow-tie analysis resulted in effective geometry factors and energy thresholds for both power and exponential spectra.

SAMPEX data analysis comprised coding and debugging software to produce data files with data sorted in L value and averaged over day or orbit for all the detector rates. IDL programs to manipulate and display these data were written. Epoch analysis of the L-binned data was conducted to study particle acceleration in the magnetosphere and its possible relation to solar wind velocity enhancements. It is expected that this work will result in a journal publication with HSTX staff as a coauthor. A survey to determine the polar cap boundaries using the SAMPEX sensors LEICA and PET was initiated; an abstract was then submitted to the fall '93 AGU with HSTX staff as the principal author.

Routine system maintenance of the SAMPEX-dedicated VAX workstation was carried out.

Staff also attended the SAMPEX team meeting at the Univ. of Maryland and presented PET calibration results.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

SAMPEX data analysis will continue in several areas. The PET calibration work will be completed. POLAR HIST calibration and related work will begin. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	VAX 4000-90 Workstation

NASA Task 92-398-00: Magnetic Field Software Conversion

GSFC ATR: ***W. Mish***

Hughes STX Task Leader: S. ***Hsieh***
Hughes STX Task Number: ***986***

This task provides software development support for the Science Planning and Operations Facility (SPOF) for International Solar-Terrestrial Physics (ISTP) missions.

FINAL CONTRACT SUMMARY

Work was performed on this task from April 1, 1992, to September 30, 1993. One senior programmer analyst was involved in this task. On this task, Hughes STX staff first presented prototype key parameter visualization software written in IDL. Staff then developed the generic algorithms to process the key parameters from the files in Common Data Format (CDF) and built the interface between IDL and the CDF library. The development of the ISTP Key Parameter Visualization Tool (KPVT) of generic Version 1.1 was successfully completed and intensively tested on both Sun and DEC workstations. This software package was also implemented on the VAX of the Central Data Handling Facility (CDHF) with documentation prepared for release to the ISTP community. Staff also completed and delivered the software for generating the IMP–8 magnetometer and plasma plots in custom formats. Numerous key parameter (KP) plots and data sets in ASCII from the CDF files were produced by using these packages. Staff also cooperated with a GSFC scientist to determine the proper numerical ranges of each IMP–8 CDF variable and assisted GSFC technical personnel with implementation of the proper attribute values in the skeleton table. Staff performed a number of successful demonstrations of KPVT for various groups from the ISTP community including the project scientists and a NASA HQ representative. HSTX staff began development of the PC version of KPVT, and the new features for the KPVT continued to be developed. Staff participated in the 1992 Solar-Terrestrial Energy Physics Symposium and ISTP/GGS Science Working Group meetings. Staff attended the spring AGU meeting in Baltimore to present a joint poster and demonstrate the visualization software. A coauthored paper was completed for publication. Staff attended and completed ORACLE's data base management training courses in Bethesda, MD.

SUMMARY FOR CURRENT REPORTING PERIOD

HSTX staff completed and delivered the software for generating the IMP–8 magnetometer and plasma plots in custom formats. Staff also modified and enhanced the existing KPVT. Staff started to work on the PC version of the KPVT. Many IMP–8 magnetometer KP plots and plasma KP data sets in ASCII formats were produced. Staff also attended ORACLE's data base management training courses. A coauthored paper was completed for publication.

WORK PERFORMED

HSTX staff completed the software development for generating the IMP–8 magnetometer and plasma plots in custom formats. This software package was intensively tested and implemented on both DEC and Sun workstations. Many IMP–8 magnetometer KP plots and plasma KP data sets in ASCII formats were produced for the GSFC scientists as requested. The existing package of the KPVT was also modified and enhanced. Staff attended ORACLE's data base management training courses at Bethesda, MD. A joint paper was completed for publication. Staff started the development of the PC version of the

KPVT. However, the development was discontinued because some external problems occurred. Staff carefully examined the situation and found that the problems could result from incorrect installation of the necessary FORTRAN compiler by GSFC personnel/unclear requirements of the CDF library from the NSSDC. The development can be resumed only after these problems are resolved.

SIGNIFICANT ACCOMPLISHMENTS

HSTX staff successfully delivered the software for creating the IMP-8 KP plots in custom formats. The generic structure of KPVT was applied in this software. It cannot only be integrated into the KPVT but also integrated into an independent package. It can plot magnetometer and plasma KP data simultaneously or plot them separately. As a result, plotting efficiency was greatly improved.

PROBLEM AREAS

Some external problems were detected during the development of the PC version of the KPVT. The possible problem areas could be incorrect installation of the FORTRAN compiler/unclear requirements of the CDF library from the NSSDC. The development has been discontinued until these problems are resolved.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will continue work on developing the new features and the enhancement for the KPVT. The development of the PC version of the KPVT will be continued if problems are resolved. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Software: The software for generating IMP-8 KP plots from CDF files
Originator: S. Hsieh

Plots: IMP-8 magnetometer KP plots
Originator: S. Hsieh

Data: IMP-8 plasma KP data sets in ASCII formats
Originator: S. Hsieh

Joint Paper: A joint paper with GSFC staff for publication
Originator: S. Hsieh

COMPUTER USE

Minutes	Computer
6,000	LEPVAX
8,000	ISTP1
Dedicated	SPOF Sun SPARCstation 2 (SPOF01)
Dedicated	SPOF Sun SPARCstation 2 (SPOF02)
Dedicated	SPOF Sun SPARCstation 10 (LEPSAC)
Dedicated	SPOF DEC Workstation (ISTPS1)
Dedicated	SPOF DEC Workstation (ISTPS2)
Dedicated	IBM-Compatible PC
Dedicated	Macintosh IIsi

NASA Task 92-399-00: ISTP/SPOF

GSFC ATR: ***Dr. S. Curtis***

Hughes STX Task Leader: ***Dr. M. Peredo***
Hughes STX Task Number: ***965***

This task provides scientific, programming, and analysis support for the Science Planning and Operations Facility (SPOF) of the International Solar Terrestrial Physics (ISTP) Mission. Specific activities include: (1) coordination of the science activities of the ISTP satellites, (2) implementation and development of analysis software, (3) participation in research activities related to the ISTP mission, and (4) participation in ISTP GGS Theory Workshops.

FINAL CONTRACT SUMMARY

The ISTP-SPOF task was instituted October 16, 1991, and lasted through the end of September 1993. Initially, the task was staffed by one senior scientist; for the past 6 months of this task, the equivalent of 40 percent of one principal scientist has been added to the effort. Major milestones and accomplishments over the life of the task include:

- Installation and configuration of the SPOF Workstation.
- Porting of Satellite Situation Center software to SPOF.
- Continuous evaluation of SPOF's software and hardware needs, and coordination of appropriate purchases to address these needs as resources were available.
- Generation and subsequent revisions of SPOF Requirements Document.
- Participation in ISTP-GGS SWG meetings.
- Active involvement with the ISTP-GGS Theory Group.
- Active involvement with the GSFC Magnetospheric Modeling Group.
- Coinvestigator role in magnetospheric modeling grant at GSFC.
- Participation in AGU meetings.
- Participation in the STEP '92 Symposium.
- Participation in the IACG meetings.
- Participation in the GSFC Modeling workshop.
- Publication of 10 articles (4 in refereed journal).
- Review for publication of four additional manuscripts.
- Preparation of three additional manuscripts to be submitted to the *J. Geophys. Res.*
- Presentation of nine papers at AGU meetings.
- Presentation of two papers at STEP symposia.
- Presentation of one paper at GSFC Modeling workshop.
- Development of Visualization Tools for ISTP (in collaboration with Univ. of MD/Audio Visual Laboratory [AVL]) including generation of several SPOF movies.
- Supervision of the development of the SPOF Key Parameter Visualization Tool.
- Participation in review and evaluation of TRISTAN code by the GSFC Modeling Working Group.
- Development of a core set of test for calibration/evaluation of global MHD simulation—ongoing coordination of tests.
- Derivation of new Tsyganenko-type models based on data binned by solar wind and IMF conditions.
- Compilation of new GEOPACK93 library of magnetospheric models and distribution to multiple scientists around the world.

- Active role in development of the next generation of magnetospheric models, including derivation of a new technique to model the tail field, and an ongoing effort to represent the field due to Birkeland currents using tangent-sphere coordinates.
- Research collaborations with multiple ISTP and non-ISTP space scientists.

The key remaining objective is the completion of all necessary developments to achieve an operational SPOF prior to WIND launch. Additional objectives to be accomplished under the new contract include completion of the testing and calibration of the MHD models and final derivation of the next generation of Tsygnaneko models.

SUMMARY FOR CURRENT REPORTING PERIOD

Research activities during this period include 1) preparation and submission to *J. Geophys. Res.* for publication of a manuscript on a new technique to model the magnetic field from the magnetotail current system, 2) preparation and submission for publication in the *STEP International Newsletter* of an article on the proposed interval for detailed study by the ISTP community, 3) submission of three abstracts for the fall 1993 AGU meeting, 4) final revision and review of galleys for paper on the accuracy of existing models (appeared in the September issue of *J. Geophys. Res.*), 5) reply to referees' comments and revision of two papers to appear in the *Proceedings* of the STEP '92 Symposium, 6) presentations to the ISTP/GGS/SWG on SPOF activities, 7) continued involvement with the ISTP/GGS Theory Group and the GSFC Modeling working group, and 8) initial use of SPOF-developed tools to monitor Key Parameter data and identify problems or deficiencies. Activities supporting the development of the ISTP/SPOF facility include 1) coordination of all SPOF development activities and SPOF's interaction with other ISTP and IACG facilities, 2) coordination of first test of SPOF's activities in the area of "event" identification, including extensive interaction with ISTP and non-ISTP scientists to aid in the evaluation of the scientific interest in the proposed intervals, 3) preparation and submission for publication of two manuscripts describing the tools developed by SPOF and the Univ. of MD/AVL for mission planning and data analysis, 4) continued work on improvement of visualization tools for SPOF in collaboration with the AVL, 5) preparation and submission for publication of a joint article with SSC staff on the mission planning tools available at SSC and SPOF, 6) preparation of multiple plots for D. Fairfield (Code 695) to be presented at the GEOTAIL SWG meeting, and 7) participation in ISTP/GGS/SWG and Cluster meetings held at GSFC. Collaboration with the ISTP Theory Group has continued, where a series of three studies have been formulated for calibration and comparison of the global MHD simulations. A staff member continues to oversee the coordination and development of these three tests. Work has continued on developing operational concepts for the SPOF, and its interaction with other ISTP facilities in particular pertaining to various testing schedules. A staff member also has participated in planning sessions for coordination of IACG campaigns. Appropriate revisions to ISTP documents including the ISTP Key Parameter Summary document were made. The ISTP Science Data Systems and Products manuscript submitted for the special Space Science Reviews issue devoted to GGS was also revised in response to the referees' comments.

WORK PERFORMED

Coordination of Science Activities

Work continued on development of the requirements for coordination of science activities in the ISTP/SPOF. Close interaction with other elements of the ISTP project continued through weekly project meetings and independent meetings with SPOF. Several updates to the ISTP Key Parameter Summary Tables were prepared by task personnel as the individual investigators have provided new information. Task personnel continued to oversee the SPOF's participation in various ISTP system-readiness tests. Task personnel participated extensively in the plans for a test IACG campaign under the supervision of Dr. J. Green (Code 630). Preliminary plans for the test campaign were presented at the GEOTAIL SWG, and it was decided to postpone the test campaign. Plans for coordination between SPOF and NSSDC's SSC continue to be developed by task members and representatives from NSSDC. Discussions regarding science coordination also were held with Dr. V. Sergeev (Univ. of St. Petersburg, Russia), who is in charge of the ground-based component of the Interball program, during his visit to GSFC. At the request of Dr. D. Fairfield, several computations of magnetic conjunctions and spacecraft distance to the magnetopause were carried out for Dr. O. de la Beaujadiere (Stanford Research Inst.) and served as the basis for declaration of a GEM observation campaign coordinating Sondrestrom and GEOTAIL measurements.

Task personnel attended the SWG and presented results from a preliminary evaluation of a proposed "event" period for detailed study by members of the ISTP community. Following suggestions by several of the PI's, a second time period was considered, and all available key parameter data for these two periods have been investigated; information has been obtained on additional data sets during these periods of interest, and articles have been written for the *STEP International Newsletter*, and the *ISTP/CDHF Newsletter* describing the proposed "event" periods and requesting comments on their scientific merit and availability of additional data sets to complement ISTP observations. A task member discussed the proposed "event" periods and the associated observations with Dr. T. Mukai (ISAS, Japan) during his visit to GSFC. Task personnel continued to coordinate the use of ephemeris data from the SSC data base; a comparison of GEOTAIL ephemeris obtained from the SSC and via the CDHF has been carried out and revealed differences $\sim$40 km (for periods when the spacecraft was at $X \sim -180$ Re). Task personnel contacted the LANL PI's to coordinate the inclusion of ephemeris predicts for the LANL spacecraft into the SPOF planning activities. LANL personnel are unable to produce ephemeris predicts, and thus a SPOF-proposed alternative will be implemented; namely, the SPOF will extract the position of the LANL spacecraft from the key parameter files on a routine basis and will use these positions to generate the appropriate predicts.

At the request of W. Mish (Code 694), a task member reviewed the Requirements Document for the Cluster JSOC facility; comments on this review were given to W. Mish to take to the JSOC requirements review. A task member continues to collaborate with W. Mish, J. Green, and M. Reph (Code 694) on the preparation of an extensive manuscript describing the entire ISTP ground data system. Referees' comments have been received, and a task member is in charge of the manuscript revision. For this revision, a thorough review was carried out of all existing skeleton tables for key parameters and the list of key parameters compared against those listed in the key parameter summary tables. Task personnel attended the Cluster meeting held at GSFC on September 7 and 8, 1993, and gave presentations on the SPOF activities and tools; demonstrations of SPOF software were also carried out by a task member. An article describing the SPOF and its functions was prepared and submitted for publication in the *STEP International Newsletter*.

Mission Planning Software

Staff continued work to develop and consolidate mission planning software at the SPOF. Close coordination of efforts between SPOF and NSSDC groups continues. SSC personnel provided new ephemeris data, which were processed and incorporated into the SPOF data base by task personnel. Version 2.1 of the SSC software was delivered to the SPOF and installed on SPOF workstation(s). A task member had several meetings with SSC personnel to discuss and prioritize desired improvements for V. 2.2. A paper describing the capabilities of the SSC mission planning tools was submitted for publication in the special volume based on the visualization session at the Spring 1993 AGU; a task member is coauthor on the paper. Collaboration with members of the AVL continued to enhance visualization tools using AVS. Manuscripts describing the SPOF/AVL tools were submitted for publication in the *Proceedings of the AVS '93 Conference* and in the special visualization issue based on the AGU presentations. An article describing mission planning tools at SPOF also was prepared for the *CDHF Newsletter*. A task member is Coinvestigator in a proposal to NASA HQ submitted by Dr. C.C. Goodrich (Univ. of Maryland) to further the development of visualization tools for mission planning.

Data Base Management

Other SPOF personnel are in charge of the installation and maintenance of ORACLE on the SPOF workstations, but a task member continues to oversee these activity.

Mission Data Analysis Support

The major activity in the area of data analysis has been to exercise the SPOF's role in the "event" identification process. A task member has used the SPOF's key parameter visualization tool to review key parameter data corresponding to two proposed "event" periods identified in collaboration with scientists from the GEOTAIL, IMP-8, and Freja missions. Task personnel have collected observations made during these periods and presented them to the SWG for comments. An article was written for the *STEP International Newsletter* summarizing the two periods and requesting comments on their merit and issuing a call for complementary observations or theory tools. An abstract has been submitted for the Fall 1993 AGU, where the proposed periods will be again presented for evaluation by the scientific community. A task member is in charge of collecting additional data and tool contributions and working with the PI's in the evaluation of these periods. Task personnel generated plots of the footprint from the geosynchronous satellites and their variation with time for Dr. D. Fairfield to take to the GEOTAIL SWG meeting. A task member prepared and submitted for publication a manuscript describing the visualization tools for mission planning and data analysis developed by SPOF using AVS; the article will appear in a special book based on the visualization sessions at the Spring 1993 AGU; a task member also reviewed the contribution to the same book by R. Kessel, et al., which describes the key parameter visualization tool also developed at SPOF. An article was prepared for the *CDHF Newsletter* describing data analysis tools developed by the SPOF.

Task personnel continued to perform spot checks of key parameter data. Several deficiencies were identified for key parameter files from the IMP-8 Plasma and the LANL/SOPA experiments; task personnel alerted the appropriate PI's of the deficiencies and required fix. For the IMP-8 plasma files, a task member further assisted the PI in the review and validation of the revised key parameter files. As part of the revision to the manuscript for "Space Science Reviews on the ISTP Data Systems and Products," a task member reviewed the skeleton files for all missions currently producing key parameters, and compared them to the existing information in the key parameter summary tables; task personnel are working with task staff and with the appropriate PI's to resolve the discrepancies found from this comparison. Task personnel are working with other SPOF members and with project staff on the extension of the SPOF's key parameter visualization tool to include displays of color spectrograms. A task member is overseeing these developments.

Research Activities

Galleys for the manuscript based on the results from the study of the north-south component of the magnetospheric field were revised and the article has now appeared in the *J. Geophys. Res.* Referees' comments for the two manuscripts submitted to the *Proceedings of the STEP '92 Symposium* ("An Evaluation of Magnetospheric B-field Models Based on IMP-HEOS and ISEE Data Sets," and "Multispacecraft Mission Planning/Analysis Resources at NSSDC/WDC-A R&S") were received, and the manuscripts were revised accordingly and returned for publication. A manuscript describing the results of the bow shock investigations carried out by task personnel is under preparation and will be submitted to *J. Geophys. Res.* for publication. A task member worked with Dr. N.A. Tsyganenko (Code 695 and Univ. of St. Petersburg, Russia) on the development of an improved technique to model the magnetic field due to the geomagnetic tail current system; a manuscript detailing this work has been submitted to *J. Geophys. Res.* for publication. An expanded and up-to-date version of the magnetic field modeling library (GEOPACK) has been compiled, extended, and documented by task personnel; copies of the new packet (called GEOPACK93) have been distributed to scientists all over the world. A task member worked with Dr. D. Sibeck (Johns Hopkins Univ./Applied Physics Laboratory) to transfer to SPOF expertise on the interpretation of data from the geosynchronous spacecraft.

Staff continued collaboration with the ISTP Theory Group, where a series of three studies were formulated for calibration and comparison of the global MHD simulations. A staff member continued to be in charge of coordination and development of these three tests. The three tests involve testing the degree to which the MHD simulations produce the zeroth-order topology of the magnetosphere. Specifically, the goal is to determine the location and shape of the bow shock, location and shape of the magnetosphere, and location of the auroral oval from the MHD simulations and to compare to observations or data based models. A task member has received from one of the ISTP Theory Groups a partial set of the boundaries to be used in the test. Work will resume as soon as the rest of the information is provided by the Theory Groups.

A task member continued to investigate Tsyganenko-type models parameterized by solar wind and IMF conditions. Several meetings between task personnel and Dr. D. Sibeck took place to discuss the comparison between the models and the potential implication for ISTP studies. Discussion with Dr. Sibeck also addressed the implications for erosion studies from changes in the IMF direction as deduced from the new field models; the quantitative investigation of dayside flux redistribution; and the comparison of magnetic field predictions to observations at geosynchronous distances.

Magnetospheric modeling activities continued and weekly research meetings were held with Drs. D. P. Stern (Code 695), N. A. Tsyganenko, and T. Sotirelis (Code 695) on the development and improvement of data based models. Notably, a new technique for modeling the tail magnetic field contribution has been devised (an article describing the technique has been submitted to *J. Geophys. Res.*). In addition, a task member is working with Dr. T. Sotirelis on the development of a new representation for the model of Birkeland currents using tangent-sphere coordinates; this approach is promising in that tangent-sphere coordinates provide a system similar to dipole coordinates, but in which Laplace's equation is R-separable, thus allowing construction of solutions as products of Eigenfunctions consisting of trigonometric and Bessel functions. An abstract for a joint paper by Dr. T. Sotirelis and Dr. M. Peredo has been submitted for the Fall 1993 AGU. In addition, the modeling group has submitted another abstract for the Fall 1993 AGU to present the first effort to construct the next generation of empirical, global magnetospheric models.

Task personnel continued to make all necessary arrangements for meetings of the ISTP Theory Group during AGU meetings.

Miscellaneous

Task personnel continued to supervise and direct SPOF software and hardware purchases, including preparation of all necessary purchase requests and associated paper work.

Task personnel installed the new Macintosh Quadra and all associated hardware and software at the SPOF. The Macintosh IIci previously used was returned to Dr. D. Stern after reconfiguration and backup of all files. Task personnel assisted Dr. D. Stern in the reconfiguration of the Macintosh IIci for his use.

Task personnel continued to assist members of the modeling group in setting up computers for network access and connectivity with the LEPSAC workstation.

Task personnel prepared a list of all necessary software maintenance requirements for the SPOF including timetable and cost descriptions.

Task personnel assisted other members of the SPOF and/or members of the modeling group with various software and hardware problems.

A task member participated in an evaluation group set up by Dr. M. Acuna (Code 695) to review the user interface for the CDHF system.

Task member attended a cmi (Hughes STX's version of TQM) training course.

Task personnel continued system administration duties on the LEPSAC workstation and LEPMP Macintosh, including application installation, backups, and troubleshooting.

Task personnel installed CDF2.3 on the SPOF PC. A task member also installed the Ethernet card on the SPOF PC and coordinated the installation of additional PC software.

A task member participated in various discussion with Dr. R. Clauer (Univ. of Michigan) during a visit to GSFC to discuss implementation of Dr. Samadani's (Stanford Univ.) auroral image analysis software by one of Dr. Clauer's students.

A task member analyzing the IMP-8 MAG key parameter data discovered some anomalies in the spacecraft position recorded in the CDF files, reported the abnormal positions to the IMP-8 team and helped them identify the source of the error.

A task member demonstrated use of the SPOF tools and CDHF interface to Dr. R. Nakamura (Code 690), who is joining the GEOTAIL/MGF team. A training session on the use of the CDHF software was also arranged.

Task personnel advised the project office of the availability of magnetic index reports from SEL; these reports contain information required by on the POLAR experiments to compute their key parameter data. A task member instructed project and CDHF on the mechanism to obtain these files via anonymous FTP from SEL and provided background material on the definition and use of magnetic indices.

At the request of the ISTP project scientists, a task member obtained Matlab for the Macintosh and installed it in a SPOF machine.

A task member organized and attended a CDF training session for new SPOF members.

A task member made arrangement with AVS, Inc., to transfer two AVS licenses originally purchased from DEC (which is no longer selling AVS for DEC—AVS, Inc., is now handling the sales of AVS for all platforms). Task personnel negotiated with AVS, Inc., to transfer and upgrade the licenses without additional cost beyond the yearly maintenance support.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Document: ISTP Key Parameter Summary (updated as appropriate)
Originator: M. Peredo

Document: "Are Existing Magnetospheric Models Excessively Stretched?" in *J. Geophys. Res.*, Vol. 93, 15343, 1993
Originator: M. Peredo (principal author)

Document: "An Evaluation of Magnetospheric B-field Models Based on IMP-HEOS and ISEE Data Sets" (in press, *Proceedings of the 1992 STEP Symposium*—revised copy returned for publication)

Originator: M. Peredo (coauthor)

Document: "Multispacecraft Mission Planning/Analysis Resources at NSSDC/WDC-A R&S" (in press, *Proceedings of the 1992 STEP Symposium*—revised copy returned for publication)
Originator: M. Peredo (coauthor)

Document: ISTP Science Data Systems and Products. Submitted to Space Science Reviews for special article on GGS project (revised copy returned to editor)
Originator: M. Peredo (coauthor)

Document: "Using AVS To Further NASA Space Science Research and Mission Planning" in *Proceedings of the AVS '93 Conference*
Originator: M. Peredo (coauthor)

Document: "Satellite Situation Center Data System for Magnetospheric Science Planning," submitted for special publication based on visualization session at Spring 1993 AGU
Originator: M. Peredo (coauthor)

Document: "Scientific Visualization Tools for the ISTP Project: Mission Planning, Data Analysis and Model Interpretation"
Originator: M. Peredo (principal author)

Document: "Analytical Models of the Magnetic Field of Disk-Shaped Current Sheets," submitted to *J. Geophys. Res.*
Originator: M. Peredo (coauthor)

Document: "Proposed Time Periods for Correlative Analysis," *STEP International Newsletter*, Vol. 3, No. 7, July 1993
Originator: M. Peredo (author)

Document: "The ISTP Science Planning and Operations Facility," *STEP International Newsletter*, Vol. 3, No. 8, August 1993
Originator: M. Peredo (author)

Document: "Proposed Time Periods for Correlative Analysis," *CDHF Newsletter*, Vol. 3, September 1993
Originator: M. Peredo (author)

Document: "SPOF Software Tools," *CDHF Newsletter*, Vol. 3, September 1993
Originator: M. Peredo (author)

Software: Subroutines to compare ephemeris files from the CDHF in the J2000 system with those from the SSC in the B1950 system
Originator: M. Peredo

Software: Revised and extended version of the Geopack library of routines for the Tsyganenko 1987 and 1989 models
Originator: M. Peredo

Presentation: SPOF presentation to the ISTP SWG on the proposed intervals for detailed study
Originator: M. Peredo

Presentation: SPOF presentation to the Cluster meeting
Originator: M. Peredo

Figure: Plot of magnetic field configuration from on of the Tsyganenko models for the Code 695 branch brochure
Originator: M. Peredo

Figures: Plots of the magnetic footprints for the geosynchronous satellites for presentation at the Geotail SWG
Originator: D. Berdichevsky

Abstract: Proposed ISTP "Event" Periods—abstract submitted for the Fall 1993 AGU
Originator: M. Peredo

Abstract: A Completely Shielded Data-Based Magnetospheric Field Model—abstract submitted for the Fall 1993 AGU
Originator: M. Peredo (coauthor)

Abstract: A Simple Model for the Magnetic Field due to Birkeland Currents—abstract submitted for the Fall 1993 AGU
Originator: M. Peredo (coauthor)

COMPUTER USE

Minutes	Computer
100	SPOF Sun Sparcstation 2 (SPOF01)
100	SPOF Sun Sparcstation 2 (SPOF02)
100	SPOF Sun Sparcstation 10 (SPOF03)
100	SPOF DEC Workstation (ISTPS2)
Dedicated	Sun Sparcstation 10 (LEPSAC)
15,000	ISTPCDHF VAX (ISTP1)
500	LEPVAX (LEPVAX and LEPVX2)
Dedicated	Macintosh IIsi
Dedicated	Macintosh Quadra
Dedicated	Powerbook 170

NASA Task 92-400-00: Engineering and Graphics Support

GSFC ATR: *F. Hunsaker*

Hughes STX Task Leader: *J. Kalb*
Hughes STX Task Number: *987*

This task provides engineering design, drafting, and graphic layout support for the Laboratory for Extraterrestrial Physics (LEP) (Code 690).

FINAL CONTRACT SUMMARY

This task lasted for 22 months under the current SES contract (NAS5-30440). Only one individual worked on this task. The task member has a technical/engineering background. A Hughes STX task member provided support to the Extraterrestrial Laboratory of Physics group as needed to keep projects on schedule. Projects completed under this contract include the MDS magnetometer: designing of test fixtures and parts for experiments to be on the Wind and Polar Spacecraft; tracking of such parties; graphic, photo, diagrams, and visuals for presentations and publications; and wire schematics for the Hydra experiment. The designing of the TAWRS experiment will continue under contract NAS5-32350. The task member was also self-trained to use of the Pro-Engineer software package.

SUMMARY FOR CURRENT REPORTING PERIOD

A HSTX task member continued to provide support to the Extraterrestrial Laboratory of Physics group. HSTX personnel prepared and completed charts and diagrams needed by the staff for reports and proposals. Photo and graphic work was prepared, coordinated, and delivered to members of the staff for presentations, meetings, proposals, and publication. The HSTX task member developed designs and fabrication drawings for the laboratory, and experiments. The support provided by task personnel allowed deadlines and schedules to be met and maintained.

WORK PERFORMED

A HSTX task member continued to design parts for the TAWRS experiment and develop assembly drawings of the Kel-f assembly area in the Strahl Experiment. Staff developed organizational charts for the Mars Observer and designed and developed fabrication drawings for the Diode Laser Cold Cell. A staff member coordinated with graphics staff and photo shops to develop diagrams, visuals, and pictures used for presentations and publications.

PROBLEM AREAS

Information needed for TAWRS development was difficult to obtain.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

A Work Control Plan will be updated for the new contract to meet the requirements of this task. Staff will continue to support the Laboratory for Extraterrestrial Physics by providing design layouts, fabrication drawings, graphics, and necessary routine tasks. Staff will also develop a model of the TAWRS Experiment.

DELIVERABLES SUBMITTED

Drawings: Kel-f assembly
Originator: J. Kalb

Drawings: Organization charts for Mars Observer
Originator: J. Kalb

Drawings: Vacuum chamber adaptor
Originator: J. Kalb

Figures: Conceptual layout
Originator: J. Kalb

Figures: Banner for poster talk
Originator: J. Kalb

Figures: Cloud passage
Originator: J. Kalb

Figures: IMP-8 and ISEE-3
Originator: J. Kalb

Figures: Titan atmosphere
Originator: J. Kalb

Figures: Photon yield
Originator: J. Kalb

Figures: Van Allen Belts
Originator: J. Kalb

Photographs: Pluto fast flyby
Originator: J. Kalb

Photographs: DDEIS experiment
Originator: J. Kalb

Photographs: Cassini
Originator: J. Kalb

Photographs: Voyager IO
Originator: J. Kalb

Photographs: Atmosphere
Originator: J. Kalb

Photographs: Plasmoid data
Originator: J. Kalb

Photographs: IR glow and ram angle data
Originator: J. Kalb

Photographs: Sunspots
Originator: J. Kalb

Photographs: Shuttle Bay
Originator: J. Kalb

TRAINING

Staff attended a metrication seminar.

COMPUTER USE

Minutes	Computer
Dedicated	Macintosh SE
Dedicated	ALR micro
Dedicated	Xterminal

NASA Task 92-403-00: Position-Sensitive Particle Detector Development and Support

GSFC ATR: *Dr. M. Smith*

Hughes STX Task Leader: *J. Miller*
Hughes STX Task Number: *990*

This task provides hardware and software development and analysis support for the development of position-sensitive particle detectors.

FINAL CONTRACT SUMMARY

Task 990, which was started in February 1992, has had one electrical engineer working on the task. The major milestones of the task are described in the following paragraphs.

The IMS and Temperature and Wind Rocket Spectrometer (TAWRS) instruments were launched successfully and on time on NASA 21.1105 and 36.064 sounding rockets in Puerto Rico. Staff designed, assembled, and tested the instruments and provided engineering support throughout the launch of the instruments.

Staff developed ground support software for the AREA instrument, to fly on the PULSAUR II sounding rocket (Norway 1994), which was vital for the testing and calibration of the instrument. Staff successfully completed engineering support for the integration of the AREA instrument onto the PULSAUR II payload.

Staff successfully completed design, assembly, and testing of PULSAUR II's digital E-field instrument electronics, including a high-speed digital signal processor board and a 16-bit analog-to-digital (A/D) converter board.

Staff managed summer students and ran the day-to-day operation of the Rocket Instrument Lab (Code 696).

The remaining major objectives to accomplished on this task are to complete engineering support for the launching of the AREA instrument; complete design, assembly, and testing of the Rocket Mass Spectrometer (RMS) and TAWRS instruments for launch on the LAYERS rocket in the summer of 1994; and complete electronic design of a new high-speed particle detector.

SUMMARY FOR CURRENT REPORTING PERIOD

The primary work done this period was in four areas: 1) designing, testing, and integrating instruments for the PULSAUR II rocket campaign (Norway, 1994), 2) providing managerial support for summer students, 3) providing engineering support for the Imager for Low-Energy Neutral Atoms (ILENA) particle detector, and 4) designing and testing the new high-speed particle detector's A/D board.

WORK PERFORMED

Staff completed the development and testing of ground support software for the AREA instrument, a low-energy particle detector, to fly on the PULSAUR II sounding rocket in January 1994. Staff also completed testing and integration of the instrument onto the rocket, at the Univ. of Bergen, Norway.

Staff completed design and testing of the new high-speed (70 MSBS) particle detector's A/D board. This new particle detector is part of a NASA's Director Discretionary Fund (DDF) project.

Staff managed two full-time and one part-time summer students, which included giving daily tasks and overseeing the completion of those tasks. One major task completed was the ILENA surface mount test equipment.

Staff completed the electrical and PC board design of the PULSAUR II's digital E-field instrument's regulator and backplane boards. Staff completed preintegration testing of the digital E-field instrument.

Staff completed the PC board design of the magnetometer interface board for the NASA sounding rocket to fly in Brazil the summer of 1994.

Staff completed final power, weight, and size estimates for the TAWRS and RMS instruments for the design review for the LAYERS rocket to fly in the summer of 1994, at Wallops Island, VA. Staff also completed the design and successful testing of the TAWRS filament power supply.

Staff continued to run the day-to-day operations of the Rocket Instrument Lab. This task includes running and maintaining the vacuum chamber and nitrogen dry box and performing other general duties.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work for this contract has ended. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will provide engineering support for the AREA instrument during the launching of the PULSAUR II rocket in January 1994. Staff will continue design work on the new high-speed particle detector. Staff will continue design work on RMS and TAWRS instruments electronics. A Work Control Plan will be prepared.

COMPUTER USE

Minutes	Computer
18,000	IBM PC

NASA Task 92-404-00: Equipment Data Base Management for Code 690

GSFC ATR: ***Dr. J. Hillman***

Hughes STX Task Leader: ***R. Barnes***
Hughes STX Task Number: ***993***

This task provides data entry, deletion, and general maintenance of PC-resident data base of property-tagged equipment for the Laboratory for Extraterrestrial Physics.

FINAL CONTRACT SUMMARY

This task, assigned to an associate programmer/analyst, was initiated in June 1992. A major milestone was the computerization of Code 690's property data base accomplished by updating the dBASE programs to more accurately handle the data. Acquisition of a bar code scanner improved the physical process of inventorying equipment. Authorization to access the NEMS data base to make some of the more routine changes (e.g., building, room, and user) should ultimately (i.e, following improvements) contribute to increased efficiencies. Hughes STX staff's advanced preparations for an upcoming inventory will greatly expedite the process.

SUMMARY FOR CURRENT REPORTING PERIOD

Staff continued to prepare for the triennial inventory, to be held from October to December 1993. Staff also continued to upgrade dBASE programs to improve the handling of data and decontrolling (removing) the bar code on controlled equipment.

WORK PERFORMED

The data base package used for this task is dBASE IV. With it, the following operations can be accomplished:

- Enter new data.
- Edit existing data.
- Print data as follows:
  - By location (building and room).
  - For a specific user.
  - For a specific building and room (indexed by ECN or user and ECN).
  - Equipment can be listed under any of these categories as well as new ones:
    - Overage or missing (found during the NEMS Inventory).
    - In field.
    - Off base (such as in home of user and at seminars).
    - To be excessed (removed from code and the data base).
    - Lost, decontrolled, or transferred.
    - On loan to or from.

- -- In storage.
- -- Under repair.
- -- To be calibrated.
- -- Listed for Sensitive Item Inventory.

- PC Maintenance list.
- All equipment for a specified code.
- Comparing two data bases.

PROBLEM AREAS

The NEMS procedure for making changes, in building, room, user, or branch, is cumbersome. One reason is that seven different user names and passwords are needed. The actual procedure for making changes does not enable the task leader to make all the possible changes in one step, or to make more than one change at a time. For example, if the task leader changes the building and room number for a piece of equipment in Code 690.0, he must go back to the beginning of the change procedure to make another change for Code 690.0. Then, the task leader must log off completely and log on, using a different user name and password if a change must be made for another code. Also, if the task leader wants a new 1602 form with the changes indicated, the request cannot be made after the changes but must be delayed until the changes have been authorized. Then, the task leader can log back on several days later, check to determine whether the changes have been authorized, and make the request for forms.

SCHEDULE CONFORMANCE

Work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Staff will complete the triennial inventory as quickly as possible. Staff will also attempt to get a more user-friendly NEMS program in place. The Work Control Plan will be updated for the new contract to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	PC (Dell System 316)

NASA Task 92–405–00: Magnetospheric Theory and Analysis

GSFC ATR: ***Dr. M. Smith***

Hughes STX Task Leader: ***Dr. C. Owen***
Hughes STX Task Number: ***992***

This task provides support for ongoing AMPTE/ISEE/DE science activities in the GSFC Electrodynamics Branch. Both theory and data analysis studies of magnetospheric topics, ranging from the dayside magnetopause to the magnetotail, will be performed. Technical and computational support for appropriate Electrodynamics Branch activities relating to mission/science support planning will also be provided.

FINAL CONTRACT SUMMARY

This task has supported one Ph.D. scientist (Dr. C.J. Owen) for 10 months from December 1992 until September 1993. Most of the scientific work performed has involved analysis of data from the ISEE–3 deep tail mission. This has resulted in two published papers and an additional further three documents are currently being prepared for submission for publication. Task personnel gave a seminar on the work carried out and presented the main results at an international meeting in Argentina. Staff also were heavily involved in support of many activities at both Laboratory for Extraterrestrial Physics (LEP) and Electrodynamics Branch levels, from arranging seminars to writing proposals for future funding. Many of the projects included in this task will be continued and/or completed under the new contract, NAS5-32350.

SUMMARY FOR CURRENT REPORTING PERIOD

Hughes STX task personnel completed statistical analyses of ISEE-3 plasma sheet boundary layer encounters to assess magnetotail twisting. Results were presented at the IAGA General Assembly in Buenos Aires, Argentina, in August 1993. A survey of wavespeeds in the lobes of the distant magnetotail was completed. Several collaborations with scientists both within and outside the LEP continue to be pursued. Task personnel gave technical and general support to both LEP and Electrodynamics Branch activity.

WORK PERFORMED

100 AMPTE/ISEE/DE DATA ANALYSIS SUPPORT

HSTX staff completed a statistical analysis of ISEE–3 encounters with the plasma sheet boundary layer. For each encounter, the angle of inclination of the boundary to the ecliptic plane had previously been determined by remote sensing of energetic ions with 90° pitch angles. These ions are detected by the EPAS instrument on ISEE–3. This statistical evaluation has shown the degree of twist exerted on the magnetotail, and how this varies as a function of downtail distance, interplanetary magnetic field (IMF) direction, level of geomagnetic activity, and other parameters. Results from this study were presented at the IAGA General Assembly in Buenos Aires, Argentina, on August 19, 1993, and are presently being written up for publication in the *J. Geophys. Res.*

HSTX staff also collaborated on a number of projects with scientists both within and outside the LEP. A study of sound, Alfvén, and fast mode wave propagation speeds within the lobes of the magnetotail has been completed for Dr. J.A. Slavin (Code 696), and results also are presently being prepared for publication. Staff continued to participate in theoretical studies on tail twisting during northward IMF along with Dr. C.J. Farrugia (Code 692), and on a study of substorm association with energetic electron bursts in the geomagnetic tail with Dr. I. Richardson (Code 661) and others.

800 LABORATORY FOR EXTRATERRESTRIAL PHYSICS ACTIVITY SUPPORT

HSTX task members assumed responsibility for organizing the LEP weekly seminar series for 1993–94. The series runs each Friday from the start of September until the end of June. A program of speakers from both within and outside the LEP has been arranged for the period September 1993–January 1994.

900 ELECTRODYNAMICS BRANCH ACTIVITY SUPPORT

HSTX task members continued to support Code 696 branch activities. In particular, staff assisted in the writing of two proposals to NASA for new funding in the next financial year.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed; however, work on these projects will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Task personnel will complete the paper on the orientation of the plasma sheet boundary layer and submit it to the *J. Geophys. Res.* Staff will also assist in the preparation of a paper on wave speeds in the lobes of the tail. Other current collaborative tasks detailed above will be continued, with the eventual goal of publishing their results also. Staff will continue to support LEP and Electrodynamics Branch activities, in particular completing the arrangements for the spring schedule of the LEP seminar series.

DELIVERABLES SUBMITTED

Presentation: Magnetotail Orientation Determined by Remote Sensing the Plasma Sheet Boundary Layer with E > 35 keV Ions," at the IAGA General Assembly, Buenos Aires, Argentina, August 19, 1993

Originator: Dr. C.J. Owen

Document: "The Structure and Evolution of Particle Distributions Near the Dayside Magnetopause," proposal to NASA in response to NRA no. 93-OSS-01
Originator: Dr. C.J. Owen

Document: "A Multi-Spacecraft and Ground-Based Study of Magnetosphere—Ionosphere Coupling," proposal to NASA in response to NRA No. 93-OSS-01
Originators: Dr. M.F. Smith and Dr. C.J. Owen

Document: Referee Report on manuscript submitted to *Geophys. Res. Lett.*, reviewed on behalf of Dr. J.L. Burch, Editor-in-Chief
Originator: Dr. C.J. Owen

COMPUTER USE

Minutes	Computer
Dedicated	486 DOS PC
Dedicated	SUN SPARCstation 2

NASA Task 92-406-00: Mars Observer Magnetic Field Support

GSFC ATR: ***Dr. J. Connerney***

Hughes STX Task Leader: ***T. Reyes***
Hughes STX Task Number: ***994***

This task supports development of programs for generating Mars Observer (MO) instrument command sequences and processing, analyzing, and archiving magnetometer and Electron Reflectometer (ER) telemetry and development of a maintenance process for recording present and past instrument conditions.

FINAL CONTRACT SUMMARY

The Hughes STX task for the MAG and ER instruments on the Mars Observer spacecraft began in July 1992 and has spanned 14 months. One HSTX staff member has been assigned full time to this task. The staff member's work has been in a support role as a Unix and DOS programmer and Unix system manager.

The development of software programs and procedures for downloading and processing telemetry and generating and uplinking command sequences has been the primary objective of HSTX task personnel. The procedures developed have automated the daily download and decommutation of telemetry, the creation of status reports, and the output of 24-hour plots. Processes that previously would have been done manually by the computer programmer have become a turn-key system on the networked computers for the MO project.

With the daily tasks assigned to the computer, task personnel are responsible for quality control. An instrument status report and 24-hour plots are immediately available each morning to the task personnel for review. Instrument engineers and investigators are kept abreast of the performance of the instruments and the observations recorded.

HSTX personnel are responsible for the construction and uplink of instrument command sequences. Task personnel have designed a graphical user interfaced program for constructing command sequences; the construction is done by simple point-and-click selections with the mouse. The program minimizes the turnaround time for constructing and uplinking a command sequence. Furthermore, the chance of introducing human error into an uplinked command is minimized.

System management is performed by HSTX task personnel. Possible avenues for enhancing the project's Unix workstations have been presented, and the hardware has been procured and installed by HSTX personnel. HSTX personnel were responsible for installing the first CD-ROM recording system for the Code 690 branch.

To complete the processing of the MAG/ER data of MO, task personnel are assisting in the development of a model of the spacecraft magnetic field. The data set will become of research value only upon subtraction of this field from the measurements. The resulting program will be incorporated into the turn-key data processing procedure, and the staff members will assess the quality of the results and take any required steps to reprocess the data.

SUMMARY FOR CURRENT REPORTING PERIOD

In the final 3 months prior to Mars orbital insertion, HSTX personnel completed the integration of the software data processing tools into a turn-key system for the daily processing of telemetry. The decommutating program and the daily status report program have been refined. The IDL plotting routines were further upgraded to simplify use and widen the procedures application to MAG/ER data. The future hardware requirements of the MAG/ER instrument team were assessed by task members. Computer processor and data storage upgrades were selected and procured by staff.

WORK PERFORMED

The script procedures MODD, DAY_PRO, and DSR_PRO were joined into one turn-key procedure called TEL_PRO that is responsible for the daily processing of MAG/ER telemetry. A C program using remote procedure calls (RPC's) of IDL graphics functions was also incorporated into TEL_PRO.

Upon staff's arrival in the morning, the procedure TEL_PRO has executed all the programs necessary for processing the telemetry. Task personnel are presented printouts of 24-hour plots and a Unix window with the daily status report in a text editor. The status report is reviewed by task personnel, and, if all conditions are nominal, a keyword is set to TRUE and a comment statement is added to the report. The file is then saved, and the procedure TEL_PRO completes its execution by uploading the status report to the Jet Propulsion Laboratory's (JPL's) project data base.

Task personnel learned the Perl script language in order to design TEL_PRO with the desired sophistication. The Perl language was developed by a JPL system operator and has quickly become a favored tool for system managers and programmers on the major system platforms.

HSTX task personnel cooperated with the JPL project team in performing tests of the Project Data Base (PDB) and the MO network for data transfer to instrument SOPC workstations. Tests were completed, and staff members reported minor problems that were later resolved.

A CD-ROM disk directory format was designed by HSTX and GSFC personnel. The team's goal was to produce monthly data archival disks that present a quick-look data set through PostScript 24-hour plots and sequential time series (STS) files and also a complete set of procedures. Such procedures would allow the researcher to produce a subset of the data at any degree of refinement and any degree of time resolution. Two data file formats were designed for archival and as an efficient means of data input to processing routines. The STS file format is an ASCII file for the MAG/ER archives, and the GRAF binary file is optimized for efficient input into IDL and C processing programs.

SIGNIFICANT ACCOMPLISHMENTS

The software tools developed for downloading and decommutating telemetry, creating status reports and data plots, and creating instrument command sequences have been integrated into a turn-key system. The Perl script TEL_PRO is executed once and thereafter the script executes all necessary functions for processing data at the required time. Then, TEL_PRO places itself back onto the batch queue for the next day.

File formats have been constructed that satisfy the task's archival requirements and also are efficiently input into plotting routines of the IDL language. Other file formats have been designed for maintaining historical records of the command sequences uplinked to the instruments; the instruments' conditions can be determined at any past time. Also, HSTX task personnel have assisted MAG/ER team in designing a CD-ROM disk format that will store a comprehensive set of data so that future users of the data set can recover or reconstruct the data set at any level of refinement. Processing utilities can be executed from CD by running a simple setup routine.

PROBLEM AREAS

Without further data being downlinked from MO, the remaining problem to be resolved is the spacecraft field. Initial steps are being taken by HSTX task personnel to model the spacecraft field and incorporate the model into a processing procedure.

SCHEDULE CONFORMANCE

Work proceeded as planned. The processing of MO MAG/ER data and the data archiving will be completed under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

Since the apparent loss of the MO spacecraft (August 21, 1993), no further MAG/ER data have been downloaded. Telemetry data (180 days) have been received. To complete the processing of the MO MAG/ER telemetry, an analytic model of the spacecraft magnetic field must be constructed so that the spacecraft field can be subtracted from the overall field measured by the inboard and outboard instruments. Resolving this problem will also allow the ER team members (Univ. of California [UC], Berkeley) to further process their data. HSTX personnel will assist in the design of a cross-correlation transfer function for a multiple-input, single-output system.

Upon completing the analytic model of the spacecraft magnetic field, HSTX staff will incorporate the spacecraft model programs into the data processing procedure developed previously. The cruise data will be methodically processed by the automated procedures. Each daily telemetry file and processed data will be assessed by HSTX personnel for quality and completion.

CD-ROM archival disks of 1-month periods will be constructed and disseminated to MAG/ER coinvestigators.

The Work Control Plan will be updated for the new contract to meet the requirements of this task.

DELIVERABLES SUBMITTED

Programs: Automated Perl script procedure TEL_PRO, the IDL plotting procedure MP3, the automated data transfer program TEL2PUB, the automated tape backup procedure TARBACK, and utility Perl script procedures WS (multiple file word swap) and MOVER (multiple file name modifier) and MC (MAG/ER multiple file [by year/month] copy)

Originator: T. Reyes

NONLOCAL TRAVEL

From August 23-29, 1993, staff presented documents and a review of MAG/ER team data processing at Software Review #5, held at JPL, Pasadena, CA. Staff also participated in the Project Science Group (PSG) meeting and the activities associated with the Mars orbital insertion (communications failure, recovery scenarios, and MO II plans) of the MO spacecraft.

CONFERENCES

Staff attended the spring AGU meeting in Baltimore.

Staff also presented data processing documentation to JPL managers at the MAG/ER's Software Review #5.

TRAINING

A task member took the C++ Videotape course offered by the GSFC Learning Center.

COMPUTER USE

Minutes	**Computer**
Dedicated	SPARCserver 670MP (lepmom)
Dedicated	SPARC II Workstation (momag)
360 (CPU)	IBM-Compatible PC

NASA Task 92-408-00: Geotail Data Support

GSFC ATR: ***Dr. D. Fairfield***

Hughes STX Task Leader: ***T. Perry***
Hughes STX Task Number: ***996***

This task provides technical support for Geotail data on a daily basis. Specific activities include ongoing data processing and providing data base maintenance.

FINAL CONTRACT SUMMARY

This task was initiated in November 1992. One HSTX technical specialist/data technician was assigned half-time to the task. The HSTX task member produced 24-hr daily data plots, worked on user requests as needed, and maintained the system. The task member learned IDL using the Sun workstation and will continue to learn more about the GEOTAIL instrument characteristics.

SUMMARY FOR CURRENT REPORTING PERIOD

During this triannual period, the HSTX task member maintained the data base, ran new calibration files on the old and new files received, produced 24-hr daily plots, and ran system backups on a daily basis.

WORK PERFORMED

The HSTX task member continued producing magnetometer data files, creating plots and running backups daily.

100 PRODUCTION SUPPORT

The HSTX task member received deliveries on CD-ROM disks and extracted files of orbit and attitude data from them as they were received. Staff created daily magnetometer files, submitted calibration files, and from these files produced 24-hr daily plots: 5 CD-ROM disks were received; 300 calibration files were submitted; and 300 daily files were plotted.

200 DATA BASE SUPPORT

Data base maintenance work included removing files to keep the data base clean, backing up delivery files onto optical disk, and running system backups daily onto 8-mm tapes.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

User requests were completed on schedule.

Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

The HSTX task member will continue to support the GEOTAIL instrument as needed. Requested work will be enhanced and performed in a timely manner. A Work Control Plan will be updated to meet the requirements of contract NAS5-32350.

DELIVERABLES SUBMITTED

Data: 300 magnetometer daily files plotted
Originator: T. Perry

COMPUTER USE

Minutes	Computer
Dedicated	Sun Sparcstation (LEPMAG)

NASA Task 92–410–00: LEP System Support

GSFC ATR: ***M. Mumma***

Hughes STX Task Leader: ***R. Srinivasa***
Hughes STX Task Number: ***998***

This task provides system management of two Sun SPARCstation computers (LEP 693 and LEPGNE), which includes loading software updates, adding users, backing up the data and programs, and managing the networks and disk space.

FINAL CONTRACT SUMMARY

Hughes STX staff is currently supporting the system administration of the workstation to be used by the FCAS instrument that uses the speckle data acquisition and analysis program.

The speckle program was developed by HSTX personnel. This data acquisition program collects frames at different integration times from an InSb 2-D detector array. IDL routines were written to run mathematical processing of the data. Plotting routines were also developed by HSTX staff to plot a histogram of the data used from the speckle interferometer.

SUMMARY FOR CURRENT REPORTING PERIOD

Routine system maintenance and backups on workstations were performed. Changes were made to the speckle program to support the FCAS instrument's first observing trip.

WORK PERFORMED

HSTX personnel performed routine system maintenance and backups on the LEPECS, LEPGNC, and LEP 693 SPARCstations. Task personnel installed software for the Talaris printer and developed Unix shell scripts to back up Cadre (TeamWork) data sets. The operating system on SPARCstation LEPSWE was upgraded. Software to automate the execution of the speckle program on LEPGNC was set up.

SIGNIFICANT ACCOMPLISHMENTS

HSTX personnel made last-minute changes to the speckle program before the FCAS instrument's first observing trip.

PROBLEM AREAS

None.

SCHEDULE CONFORMANCE

Task work under this contract has been completed. Work will continue under contract NAS5-32350.

WORK PLANNED FOR NEXT PERIOD UNDER CONTRACT NAS5-32350

System administration work will continue. Changes and improvement of the speckle program will be made as necessary. A Work Control Plan will be prepared to meet the requirements of this task.

COMPUTER USE

Minutes	Computer
Dedicated	Sun Unix

NASA National Aeronautics and Space Administration

Report Documentation Page

1. Report No.

2. Government Accession No.

3. Recipient's Catalog No.

4. Title and Subtitle

Space and Earth Sciences, Computer Systems, and Scientific Data Analysis Support

5. Report Date

October 1993

6. Performing Organization Code

7. Authors

Ronald H. Estes, Editor and Project Manager

8. Performing Organization Report No.

10. Work Unit No.

9. Performing Organization Name and Address

Hughes STX
4400 Forbes Boulevard
Lanham, MD 20706

11. Contract or Grant No.

NAS5-30440

13. Type of Report and Period Covered

Final Contract and Triannual Progress Report

12. Sponsoring Agency Name and Address

National Aeronautics and Space Administration
Washington, DC 20546-0001
Goddard Space Flight Center

14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Technical support was provided to all Divisions and Laboratories of Goddard's Space Sciences and Earth Sciences Directorates on more than 250 tasks.

Types of support include: scientific programming, systems programming, computer management, mission planning, scientific investigation, data analysis, data processing, data base creation and maintenance, instrumentation development, management services.

Mission and instruments supported include: ROSAT, Astro-D, BBXRT, XTE, AXAF, GRO, COBE, WIND, UIT, SMM, STIS, HEIDI, DE, URAP, CRRES, Voyagers, ISEE, San Marco, LAGEOS, TOPEX/Poseidon, Pioneer-Venus, Galileo, Cassini, Nimbus-7/TOMS, Meteor-3/TOMS, FIFE, BOREAS, TRMM, SMM, AVHRR, Landsat.

Accomplishments include: development of computing programs for mission science and data analysis, supercomputer applications support, computer network support, computational upgrades for data archival and analysis centers, end-to-end management for mission data flow, scientific modeling and results in the fields of space and Earth physics, planning and design of GSFC V0 DAAC and V0 IMS, fabrication, assembly, and testing of mission instrumentation, and design of mission operations center.

17. Key Words (Suggested by Author(s))

scientific data processing, data analysis, multimission data archival and analysis, information extraction, computer systems management, systems programming, systems development, systems engineering, applications software development, data base creation, data archiving, production processing, telecommunications, ground support, user support, engineering support

18. Distribution Statement

Unclassified-Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of pages	22. Price
Unclassified	Unclassified		

NASA FORM 1626 OCT 86