

Summary Report
for

**Joint Interdisciplinary Earth Science Information
Center**

A
Cooperative Agreement
Between

**NASA Goddard Space Flight Center
And
George Mason University**

2001 – 2003

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Introduction

This report is submitted to NASA by GMU and serves as a summary of activities under the Joint Interdisciplinary Earth Science Information Center (JIESIC) Cooperative Agreement. The report spans the three year period beginning in June of 2001 and ending June of 2004.

JIESIC's primary purpose has been to carry out research in support of the Global Change Data Center and other Earth science laboratories at Goddard involved in Earth science, remote sensing and applications data and information services. The purpose is to extend the usage of NASA Earth Observing System data, microwave data and other Earth observing data. JIESIC projects fall within the following categories: research and development; S/W and H/W prototyping; science data, information products and services; and science algorithm support.

JIESIC facilitates extending the utility of NASA's Earth System Enterprise (ESE) data, information products and services to better meet the science data and information needs of a number of science and applications user communities, including domain users such as discipline Earth scientists, interdisciplinary Earth scientists, Earth science applications users and educators.

George Mason University (henceforth the University) has one of the few academic units in the US that focuses research on the combination of computational and physical science, the School of Computational Sciences (SCS) and within it a large center, the Center for Earth Observing and Space Research (CEOSR) that focuses work in Earth system science, remote sensing and associated technologies. As part of its mission and funding efforts, CEOSR has developed an important role in research within the Federation of Earth Science Information Partners (ESIPs), and more recently REASoN, works with several other agencies (NOAA, USGS, USDA, FS, etc.) complementing the work with NASA and therefore focuses on many different science and applications data systems to form effective and perhaps cost efficient physical and virtual centers, extending their services and products. In the last years, the University has played an important role in extending usage of NASA ESE data through its VAccess/MAGIC project. In recognition of its role and expertise, the University has been selected as the lead institution of VAccess/MAGIC (Mid-Atlantic Geospatial Information Center) by Congress in a very large part because of the contributions CEOSR has made in the areas of Earth science research, data systems and products and the computational needs associated with these. These new efforts, emphasizing regional usage of Earth science data and information products can be beneficial to NASA's ESE efforts to extend the usage of its data beyond traditional ESE science users.

University scientific staff has worked on research important for NASA's present and future data systems efforts and have also been involved in Earth system science, remote sensing and data information technologies teaching and research.

This report contains three major sections, one for each of the three main projects under the Grant; Satellite Microwave Remote Sensing Research and Data System Support, Ground Validation and Goddard Distributed Active Archive Center (GDAAC) Support. The University has also provided support through scientific and technical staff residing at the Fairfax CEOSR facilities. Along with major accomplishments, a list of personnel and select publications is also included.

Satellite Microwave Remote Sensing Group

The Microwave Remote Sensing effort is concentrated around one current and two planned NASA Earth Observing Satellite (EOS) missions. In each case, the group provides software prototyping, experimental system hardware support and scientific analysis capabilities to the data systems.

The GMU group has been involved with the Tropical Rainfall Measuring Mission (TRMM) and the TRMM Science and Data Information System (TSDIS) since before launch in Nov. 1997. Of the three main instruments on TRMM, Visible Infra-Red Scanner, Thermal Microwave Imager (TMI) and Precipitation Radar (PR), the latter two are microwave instruments. The TMI is a passive radiometer much like the current SSM/I with enhanced resolution and frequencies. The PR is an active sensor giving direct measurements of vertical precipitation profiles. TRMM continues to operate and current predictions have the spacecraft lasting until 2006.

Our group is also involved in two NASA missions that are currently in the planning stages. The first is the NASA Aquarius mission that will provide estimates of sea surface salinity. The Aquarius satellite will host both passive and active microwave instruments and is planned for launch in 2006. The second mission is an evolution of TRMM into the Global Precipitation Measurement (GPM) mission. This mission will include a core satellite with a microwave instrument package similar to that used in TRMM. In addition to the core, there will be several drone satellites with passive microwave instruments to provide additional coverage and sampling. Some of the drone assets will be provided by NASA while others will be supplied by GPM partners from other U.S. and non-U.S. agencies. The international cooperation that will be required for GPM provides many challenges for the design and implementation of the data system..

Our group is involved with many facets of the current TRMM project. Science analysts are responsible for the integration and testing of retrieval algorithms for the three main TRMM instruments mentioned above. The science analysts also work closely with the TRMM Science Team to coordinate algorithm issues. In addition, custom data products have been created in collaboration with other universities. Analysis of the retrieval algorithms by our group has proven very useful in improving the TRMM results that are being used more and more by the international scientific community.

Software support for the TRMM data system is provided by a database specialist and programmers involved in data format issues and scheduling software. Hardware support is given in the form of system administrators that beyond their normal duties are

investigating novel storage and multi-processor systems capable of handling the large data and intensive computational needs of TRMM and future missions.

A major activity within the group has been the evolution of TSDIS to support the Global Precipitation Mission. Within this venue, we are designing and prototyping the Microwave Data System (MDS). MDS is a flexible, configurable system capable of supporting the science processing environment of any microwave based remote sensing system. MDS has been selected to support the Precipitation Processing System (PPS) that is the science processing component of GPM, as well as the Aquarius mission. The MDS design and prototypes are based on the current TSDIS system and lessons learned pertaining to processing needs and configuration. The first presentation and demonstration of the Precipitation Processing System took place in November of 2002. The second demonstration took place in May of 2004 and outlined our progress towards a usable and flexible Microwave Data System. Participants in both cases included TRMM and GPM representatives from the Goddard Space Flight Center, NASA headquarters, and members of the science community. Key components of the MDS were presented and demonstrated including, database design and support utilities, hardware installations, a flexible, configurable toolkit package, generic data format and definition tools, a prototype processing scheduler and user interface, a SOAP service, generic message handler, and visualization and outreach products.

Personnel

Joyce Hui-Yun Chou, Assistant Research Scientist

M.S. Computer Science 1993, South Dakota School of Mines and Technology

M.S. Meteorology 1991, South Dakota School of Mines and Technology

Science programmer/analyst for the Global Precipitation Mission (GPM). Primary responsibilities include the development of algorithms for the GPM data system, and the maintenance and modification of the existing L1 VIRS and TMI code. Currently working on the global land/sea mask and topographical data sets that will be used in both GPM and Aquarius, also the installation and execution of the AMSR-E data processing software.

Robert V. Hamilton, Research Scientist

BA, Political Science, 1982 Univ California at Berkeley

MA, International Relations/Economics, 1991 Univ. California at San Diego BS, Computer and Information Science, 1994 Univ. Maryland University College International Coordinator, NASA Global Precipitation

Measurement Mission (GPM) Data System. Supports the NASA GPM Data System in its data system interfaces with NASA GPM's international partners, primarily Japan's space agency (NASDA) and the European Space Agency (ESA), in addition to other international partners. Duties include support in identifying and rectifying technical and

organizational issues related to data system interfaces, with a goal toward optimizing the worldwide transfer and use of GPM data for earth science research purposes. Since joining GMU on September 10, 2002, helped plan and execute GPM international data working group meetings held in Tokyo, Japan in December 2002, and College Park, Maryland in February 2003.

Yimin Ji, Associate Research Professor

Ph. D, Meteorology, 1995 University of Maryland

Science analyst for TRMM level 2&3 microwave products. Algorithm developer and science analyst for TRMM level 1 microwave and visible/infrared products and TRMM fire product. Primary responsibilities since June 2002 include the integration, testing and analysis of version 6 TRMM microwave rain retrieval algorithms. Also has the responsibility for the development and testing of version 6 TRMM TMI and VIRS level 1 algorithm and products. Additional research activities include comparisons of TRMM rainfall products with ground estimates, inter-comparison of microwave rain estimates from multi-sensors, fire-aerosol interaction, and tropical rainfall variability.

Owen Kelley, Assistant Research Scientist

M.S. Applied Physics, 1996 George Mason University.

At the first demonstration of the Precipitation Processing System (PPS), Kelley showed how he modified the Orbit Viewer visualization software so that it could display HDF and binary files created by the PPS I/O Toolkit. This demonstration showed the progress that has been made in preparing for the Global Precipitation Mission (GPM). In addition, Kelley wrote an eighty-page tutorial for the Orbit Viewer that is distributed as a PDF document. Kelley has also designed a two-by-three foot poster that summarizes the Orbit Viewer's capabilities.

Kelley continues to answer researchers' questions about how to visualize TRMM data using the Orbit Viewer and to take suggestions for future enhancements to the Orbit Viewer. Recent contacts include researchers at the University of New Mexico, Hofstra University in New York, MIT, and University of Iowa. In addition, Kelley responded to questions from researchers in Brazil, Canada, China, Germany, India, and Japan.

Peter S. Kim, Asst. Research Scientist

B.A. Art Studio, 1999 University of Maryland

CompTIA certified A+ professional

Intranet web designer, visual graphics designer, and documentation specialist for the GPM data system. Primary responsibilities include design and implementation of the GPM intranet. Design and creation of both vector and raster images for visual presentations and web viewing as well as Macromedia Flash animations. Daily responsibilities include the launch and monitoring of UNIX and Linux based programs. Archivist for the Precipitation Processing System documentation via Xerox DocuShare.

Patrick V. Kolbe, Research Associate

B.S. Computer Science 1996, University of Maryland, College Park.

B.S. Mathematics 1985, Franciscan University of Steubenville, Ohio.

Kolbe is currently the Analyst and Technical Lead for the Toolkit segment of the TRMM Science Data and Information System (TSDIS). He is the Analyst and Technical Lead for the Resource Manager component of the Microwave Data System (MDS). He has made code changes to the Toolkit required by the Version 6 algorithm formats for reprocessing the TRMM mission. He has designed, coded, and tested a Perl interface to the new TSDIS Archive Manager. He has designed, coded, and tested the cgi Perl segment of the Precipitation Dynamic Web Server to be used by MDS. He has begun researching the Java File Manager to be used by MDS.

John Kwiatkowski, Research Scientist

Ph.D. Applied Physics 1995, Michigan Technological University.

Science analyst for the TRMM Precipitation Radar at the TRMM Data System. Primary responsibilities include the integration, testing and analysis of rain retrieval algorithms used in the operational data system. Contributes to the development and analysis of rain retrieval algorithms including sensitivity studies on the assumed precipitation drop size distributions assumed in the retrievals. Data system science contact to both the Precipitation Radar and Ground Validation science teams.

Developed and implemented a method for estimating the TRMM spacecraft attitude using data directly measured by the Precipitation Radar. In this case, the spacecraft roll in the across track plane. The method has turned out to be very reliable and is independent of on-board attitude errors. This technique was used extensively during and after the TRMM altitude boost when the TRMM Earth sensors failed and alternate means of attitude control were implemented. The data was used extensively by the TSDIS geolocation team and TRMM Flight Operations to monitor modifications to correct attitude errors. The data are also being used to correct errors introduced in retrieved quantities such as sea surface temperature measurements which are very sensitive to correct attitude information.

Constance Y. Li, Research Associate

M.S. Computer Science 1994, George Washington University

Software Engineer responsible for the design, prototype, implementation, and testing of components supporting the Microwave Data System (MDS). Designed and implemented a message handling system to include: a (Java) message server that accepts log/get/subscribe/notify requests, in addition to maintaining and archiving message log; client components (in C and Java) that can communicate to the message server through a pre-defined set of request formats. Attended the Precipitation Processing System (PPS) meeting in November 2002 and presented a demonstration of the Message Handler component as accessed by the Scheduler and the Console components. Upgraded the

Message Handler System to Java SDK v1.4.x and utilized the regular expression and logging packages. Also upgraded the Java client component to enable non-blocking requests via the use of a queue and multiplexed request types with a single server connection. Provided some technical support to other MDS software personnel.

Patricia McCaughey, Database Specialist

BS Physiology, 1983, Michigan State University

Database Administrator and Technical Lead for the Information Manager (IM) and Data Manager (DM) segments of the TRMM Science Data and Information System (TSDIS). Database Administrator and Technical Lead for the IM and Console components of the Microwave Data System (MDS). Member of the senior design team for MDS. Responsibilities include system design, database design, development and administration, software development for database access, user interface design and development, and mentorship of junior personnel.

Designed, coded and tested perl/database scripts to support algorithm and processing changes to the TSDIS version 6 science algorithms. Assisted operations team in set up secondary database and processing environment to run a 14 month processing test of the version 6 algorithms. Designed changes to the data retrieval system to function with the local TSDIS archive. Designed and developed a prototype console user interface in Java for MDS. Assisted MDS team members with preparation of demonstration materials, graphics, and software setup including configuration of a separate database and client laptop PC. Participated in the Precipitation Processing System Demonstration #1 by presenting current database design and demonstrating the java database generation code and prototype user interface.

Jonathan Mitchell, Assistant Research Scientist / Instructor

B.S. Physical Sciences 1990, University of Maryland, College Park

Software analyst for the Global Precipitation Mission data system. Primary responsibilities include the architecture, implementation, and integration of the PPS data processing scheduler subsystem. Provides technical assistance in design of other subsystems. Research technologies to be used by the PPS project. Designed and coded preliminary version of scheduler. Presented this version at the PPS demonstration meeting.

Currently working on an enhanced version of the scheduler.

Quyen B. Nguyen, Senior Systems Administrator

M.S. Computer Science w/ concentration in Telecommunications 1996, Johns Hopkins University

Quyen provided lead support tasks on systems and network administration for TSDIS/TRMM operation. His primary responsibilities included maintaining heterogeneous servers (which included SGI, HP, Sun, and Redhats) and network for

TSDIS operation. Quyen heavily involved in the ongoing upgrades for TSDIS facilities which included hardware and software upgrades, data storage migration, security implementation, and network infrastructure.

Olga G. Richardson, Assistant Research Scientist

M.S. in Computer Science, 1993, Dnepropetrovsk Institute of Railway Transport Engineers, Ukraine

Computer Programmer for PPS/GPM. Primary responsibilities include developing a web applications for SOAP server based on XML SOAP messaging using Java Web Technology tools (J2SE 1.4.1, JAXM 1.0(servlet 2.2 and JSP 1.1), J2EE 1.4) . Installed and configure Apache Tomcat 4.1.18. for SOAP server development purposes. Implemented a prototype for the Parameter Subsetting Web Service using J2SE API and presented it at the PPS/GPM Demonstration in November 20, 2002.

Angela Sigmund, Assistant Research Scientist

M.S. Mathematics, Johns Hopkins University, 1996

Currently working on an I/O Toolkit for PPS (Precipitation Processing System). The I/O toolkit is being designed to make the reading and writing of algorithm data products quick and hassle-free. The I/O Toolkit can handle multiple data formats and languages. It can be run as part of a satellite data processing production system or on an individual scientist's PC. Flexibility is built in by having each data product defined in a configuration file. The configuration file, along with the requested data format (ex. HDF) and language (ex. C), is then run through a program called TKJAVA. TKJAVA (written in JAVA) generates code to read and write the data product as described by the specified format, language, and configuration. Currently the I/O Toolkit can read and write data products in 'C' in an HDF4.1r5 format and in a binary format. The FORTRAN HDF4.1r5 is in a testing phase. Future plans include other languages—C++, PERL, and other formats - HDF5, netCDF.

Anton K. O. Stocker, Research Associate

B.A. 1994, University of Maryland Baltimore County

System administrator for the TRMM Science Data and Information System (TSDIS). Primary responsibilities include the maintenance of science production servers' hardware and software, assisting in the creation and implementation of system security policies, assisting project management with ad hoc data production needs, and providing assistance to system users. Worked as the lead hardware designer and integrator for the Microwave Data System (MDS) prototype Beowulf cluster including development of system software tools.

John Stout, Research Associate

M.S., Meteorology, 1983, University of Wisconsin

Stout performed integration and testing for new versions (Version 6) of regular TRMM algorithms: combined (2B31) and TRMM and Others Combined (3B42, 3B43). Stout also integrated and tested new algorithms: the TRMM Real-Time Multi-Satellite Precipitation Data Set (3B40RT, 3B41RT, 3B42RT) which is currently running in the TRMM Realtime System and a Level-3 Latent Heating Algorithm (LHUSA) which will be produced offline in Version 6 processing. One of the tests is intercomparison of the zonal averages of the different rain algorithms. Another test is the joint probability distribution between the TMI and PR rainfall estimates. For example, Figure X shows distributions over land and ocean. Both ocean and land distributions show an improved relationship between TMI and PR rainfall in Version 6.

Stout developed a prototype format system for the Precipitation Processing System (PPS) and presented it at the PPS Demonstration November 20. The logical data format is entered once in an XML blueprint file. Software then creates four outputs: a File Specification Document, Data Volume Estimates, a Display Program Configuration File, and an I/O Toolkit Configuration File. The I/O Toolkit inputs the Configuration File and creates read and write code which algorithms use to create data products in various (HDF, binary, etc.) physical formats. This method is more efficient than creating each of these four outputs separately and guarantees consistency between the four. Stout applied this system to create strawman formats for possible Global Precipitation Mission (GPM) products and presented them at the First GPM Data Working Group meeting February 20.

Balendran Velauthapillai, Research Assistant

ACMA UK 1985 MsCIS 1988, MBA 1988, MPA 1989 University of Miami, Florida, CPA 1990 USA

Primary responsibilities include Risk Management for GPM project. Monitor and maintain the Risk Watch List. Conduct Risk Assessment meetings. Monitor Real Time System for any error and notify Program Manager of any problems. During the year Produced and Managed GPM internal web site until it was handed over to another GMU staff member. Helped Program Manager with the GPM Project Scheduling and costing. Carried out a Inventory check of all computer equipment and parts in the operations room and created a list of excess items. Currently developing a web site for Precipitation Processing System. Assisting GPM development staff with HTML code.

Publications

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- Stocker, E., J. Kwiatkowski, O. Kelley. "TRMM Gridded Hourly Products: A Data Reduction Approach." IGARSS. Sydney, Australia. July, 2001. v. 2, pp. 658-60.

Ground Validation Group

During the 2001-2004 period, GMU actively participated with the Laboratory for Atmospheres and the Satellite Validation Office at GSFC (Code 912) in the acquisition, quality control, product generation, and validation effort. These activities have been supporting the TRMM Ground Validation (GV) requirements, and were expanded for the Global Precipitation Measurement (GPM) validation program.

During this grant period, GMU researchers and analysts received validation data from ground-based radars and rain gauges at Melbourne, Fl., Kwajalein Atoll, RMI, Houston, Tx., and Darwin, AUS. as part of the routine TRMM validation program. In addition, validation was expanded to include data from Key West, Fl., Sterling, Va., and Wallops Island, Va. both for the proposed GPM mission, and for broader precipitation measurement and validation research. An independent validation effort for the Aqua satellite mission was also initiated, in which radar and rain gauge data from Eureka, Ca. were received and quality-controlled at GSFC. A suite of radar-based rainfall estimation products, in addition to classification and radar analysis products, were routinely generated per GV and grant requirements. GMU personnel provided data and products to those involved in direct satellite validation efforts and all interested parties by electronic transfer to the TRMM Data Systems and the Goddard DAAC.

GMU researchers were actively involved in GV product validation to ensure that quality products were generated. Techniques and software were developed to provide independent validation of rainmap products against rain gauge data. These techniques were continuously refined as validation products improved. GMU personnel have ensured that the computing hardware and software environment was properly maintained for the research effort, and have been adapting these environments in response to the evolving demands of the GPM program.

Domestic and international field experiments were conducted to gather precipitation measurements from radar, rain gauges (tipping bucket and acoustic), and disdrometers for rainfall estimation and subsequent comparison with satellite retrievals. Rain gauge data have been collected over extended periods of time from several validation sites in Florida. Collaboration between GMU participants and other agencies in these activities has proven vital to experiment completion and attainment of research objectives.

Personnel

David A. Marks, Assistant Research Scientist

M.S. Meteorology 1998 (Research), Saint Louis University, Saint Louis, Missouri

Primary responsibilities have expanded to include operational, evaluation, and supervisory tasks as the senior radar analyst of the quality control operations in support of the NASA TRMM Ground Validation (GV) program. Responsibilities include quality control of meteorological radar data and validation product generation from four primary GV sites, cataloging, evaluation, and archiving all validation data and products, and participation in discussions and presentations regarding product development and evaluation. Additional responsibilities include contact with university, contractor, and NWS officials regarding radar and data issues, and validation software building, testing, and performance evaluation. Extensive product analysis and validation with independent data was performed in preparation for the TRMM International Science Conference (July 2002). In September 2002, rain gauge data were collected in the Florida Keys through participation in the Keys Area Precipitation Project (KAPP). Validation products since the beginning of the TRMM mission are being reprocessed to version 5. Dependent and independent validation of version 5 products is being performed both for submission to the Goddard DAAC and in preparation for the 31st AMS Conference on Radar Meteorology.

David S. Silberstein, Research Analyst

M. S. Meteorology 1983, Pennsylvania State University

Responsibilities continued to include internal validation of Tropical Rainfall Measuring Mission (TRMM) Ground Validation (GV) software to isolate, identify and resolve issues that were affecting the radar- gauge adjustment process. Radar-rain gauge scatter plots for the Melbourne, Florida area illustrating the progress made were displayed at the TRMM International Science Conference held July, 2002 in Honolulu, Hawaii. In addition, problems related to radar data collection from Eureka, California were addressed as collaborations with investigators defined requirements in conjunction with the launch of the AQUA satellite on May 4, 2002. Staff developed software to incorporate adjustments to Eureka radar reflectivity data in order to obtain more realistic rainfall estimates. In the summer of 2002, staff provided on-site support for the Keys Area Precipitation Project (KAPP) with disdrometer and raingauge data collection during Florida's tropical season.

J. David Augustine, System Administrator

As the systems administrator for the TRMM Ground Validation Office duties and responsibilities include maintaining the group server and individual users machines. Also responsible for researching and recommending new equipment when needed, installing hardware and software, tape backups of user machines. Programming support, both scripts for automating data processing and application programming. Recently been assigned additional tasks pertaining to the service and installation of rain gauges, this includes ordering data loggers and enclosures as necessary, travel to proposed gauge locations to determine suitability for gauge placement and installation and testing of gauges in the field.

Bart Kelley, Assistant Research Scientist

B.S. Computer Science 1994, University of Maryland University College

Programmer/analyst for TRMM Ground Validation. Responsibilities include maintaining GV software and systems, analyzing and correcting software problems, developing and testing new applications, maintaining on-line documentation of GV software, and providing technical support to TRMM GV scientists and remote users. Currently working on development of RSL in IDL, which is modeled on the C-based Radar Software Library (RSL), but is written in the Interactive Data Language (IDL) to provide users with interactive access to weather radar data in a variety of formats. Participated in the Keys Area Precipitation Project (KAPP) in Florida keys, where primary responsibilities involved collecting and reporting rain gauge data.

Jason Pippitt, Research Analyst

B.S. Meteorology 2001, Millersville University.

Responsibilities at the TRMMGV office include the quality control of radar data from the following sites Houston, Melbourne, Kwajalein, and Darwin.. The first step of QC is to implement GV default parameters on the raw radar data from each site. The second step is the final QC process which includes manually looking through each scan from the radar for false echo and removing it and creating monthly site logs to depict the daily weather situations at the radar sites. After the Final QC process is complete the final step is to create higher level products (ex. Rain Rate Map, Monthly Site Rainfall Map, etc.) from the QC'd data. Recently the higher level products have been updated to version 5 through many reprocessing tasks. Responsibilities also include the maintenance of the TRMM Ground Validation Climatological Product Development web site. Finally, on-site support was provided for KAPP, the Keys Area Precipitation Project with data collection, rain gauge setup, and rain gauge calibration during Florida's tropical season.

Eyal Amitai, Senior Research Scientist

Ph.D. Atmospheric Sciences 1996, The Hebrew University of Jerusalem, Israel.

Joined GMU on January 2003. Research is performed at the NASA/GSFC Laboratory for Atmospheres, TRMM Satellite Validation Office. Lead Scientist of the NASA/TRMM Ground Validation Climatological Processing and Product Development Group and a Member of the TRMM Science Team. Contributes to improving the TRMM surface-based validation rainfall products and determining their uncertainties. Developing methodologies for evaluating the product of interest. Developing a long-term field experiment for breakthroughs in radar hydrology and evaluating precipitation estimates from satellite observations by utilizing a super dense gauge network in Florida. PI on a pending proposal submitted to NASA/HQ in response to NRA 02-OES-05: Research Opportunities for Precipitation Measurement Missions (2003-2006) entitled: Advances toward a primary calibration standard at a precipitation Ground Validation site. Became a principal scientist for the European Commission project Validation of multisensors precipitation fields and numerical modeling in Mediterranean test sites (VOLTAIRE). This project, based on collaboration of scientists from nine institutions, would permit:

validation of TRMM precipitation data in a European land (Cyprus) for the first time; improved accuracy of surface-radar-derived precipitation fields based on the experience gained from the TRMM Ground Validation Program; and development of a validation supersite for GPM mission in the Western Mediterranean (Catalunya, Spain). PI on a proposal submitted to NSF entitled: Collaborative research: Spatial averaging of oceanic rainfall variability using underwater sound (2003-2006). Proposes a field experiment in Greece in which for the first time underwater acoustic rain gauges, a high-resolution dual-polarization radar, a dense rain gauge network, and a disdrometer, will be deployed to investigate a comprehensive set of objectives associated with underwater acoustic rainfall measurements, and to permit an examination of the validation potential of acoustic measurements for rainfall estimates derived from other remote sensing data (e.g., radar and satellite sensors). It will also permit the examination of the spatial averaging of rainfall variability by deploying several acoustic gauges vertically separated on a mooring placed in deep water.

Publications

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Goddard Distributed Active Archive Center (GDAAC) Support Group

The GMU GDAAC support group involved actively in GDAAC data support activities to best serve the data user community. During this grant period, group members have been working in four GDAAC science data support teams and three application research projects: the Ocean Color Data Support Team, the Hydrology Data Support Team, the MODIS Data Support Team, the Atmospheric Data Support Team, the Remote Sensing Information partner (RSIP), the Bayesian Classification project, the REASoN Agricultural DSS project, and the GES-DISC Interactive Online Visualization and ANalysis Infrastructure (Giovanni) project.

In general, each member has worked with more than one science data support team, involved in end-to-end data supports of five ongoing satellite instruments: SeaWiFS, TRMM, MODIS Terra, MODIS Aqua, and AIRS as well as historic satellite instruments and data collections: CZCS, OCTS, AVHRR, SIESIP, Health Initiative, and Interdisciplinary Dataset Collection. The support activities include data ingestion/distribution system monitoring and trouble shooting; software developing, testing, and maintenance; web page maintenance; user assistance; and outreach activities like presentations in conferences, creation of documents, including CD, for conferences and for general scientific and public information.

In addition to traditional data support activities, the GMU group is dedicated to promote the access and use of GDAAC data products by developing data analysis and visualization tools. Beginning with TRMM online visualization and analysis system (TOVAS) for precipitation, followed by MODIS online visualization and analysis system (MOVAS) for aerosol products, the system has been modified and generalized into GES-DISC Interactive Online Visualization and ANalysis Infrastructure (Giovanni). The first set of product implemented in Giovanni is the SeaWiFS Level 3 monthly ocean color data. These systems allow user to quickly study the data without downloading original data onto their local system. Other examples of value added data supports include TRMM data mining, Bayesian classification for data management, and Agriculture Information System (AIS) development.

The NPP data support is concentrated on activities to work with NPP SDS project scientists to understand and to acquire their issues, concerns, lessons learned, and needs regarding the development of a data management system that would be of optimum usefulness. This includes understanding: NPP SDS heritage instruments and their associated data management systems; Data system benefits and limitations made evident as a result of heritage instrument/data system history; Lessons learned from the scientists point of view; and Efficient alternative ways to operate that would best facilitate science. Selected Publication List for NPP Science Supporting:

The RSIP (Remote Sensing Information Partner) program provided participating institutions inexpensive access to the globally covered GES earth science data holding, and the ability to routinely acquire any/all of this data for local use. GDAAC University personnel were working closely with George Mason University's CEOSR and Rutgers University's Center for Remote Sensing & Spatial Analysis (CRSSA) to set up the mechanism to operationally provide customized earth science datasets, in particular MODIS, from NASA/GDISC for use in local applications; and processed MODIS land products for other RSIP partners.

The GMU group contributed greatly to GDAAC outreach activities: present papers in conferences; participate in business development by searching of opportunities to cooperate with outside organizations through joint proposal collaborations. During the last three years, about 14 papers were published in journals or as a book chapters; more than 40 papers were presented at conferences.

Personnel

Suhung Shen, Principal Research Scientist

Ph. D, Meteorology, 1991 University of Maryland

Suhung Shen has played key roles in data support activities with the Ocean Color Data Support Team (OCDST) and involved actively with the MODIS data support team at the GDAAC. She was responsible for the routine end-to-end support of ocean color data from sensors SeaWiFS, CZCS, and OCTS, including ingestion and distribution software development and maintenance; daily routine monitoring and trouble shooting of data ingestion, archive, and distribution as well as user services. Her major accomplishments during the last three years are: developed ingestion and distribution software for OCTS and archived all available nine months data from this sensor; successfully ingested and archived SeaWiFS 3rd and 4th reprocessed data; implemented a parameter search function that allows user specifying the percent of cloud over ocean and the percent of ocean pixels contained in Level 1A HRPT data files; designed and developed a prototype of MODIS datapool online data ordering system; designed and developed a interface for the on-the-fly multiple files downloading and subsetting; involved actively in data migration from V0 system to S4PA.

Suhung Shen participated and played an important role in application research works at the GDAAC. One project was to apply Bayesian classification method in data management. Her contribution to this project was In training and detecting sunglint from MODIS Level 1B products. The other was the Giovanni project that allows a user to analyze and visualize ocean color data through the internet without downloading data to their local machine.

Long S. Chiu, Associate Professor

Sc.D. Meteorology, 1980, Massachusetts Institute of Technology

As Member of Precipitation Data Support Team, responsible for end-to-end data support of TRMM and other hydrologic data, develop visualization and analysis tools and dissemination approaches to facilitate data access and promote use. Support outreach activities including presentations in conferences, organization of workshops or special sessions. Participate in business development such as proposal activities. Support development of Agricultural Information System (AIS).

John Qu, Assistant Professor

Ph.D. Atmospheric Science, 1996, Colorado State University

NPP Project Science Support: John Qu has worked as NPP/OMPS sensor facilitator to track the sensor specification changes and potential effects of ozone and aerosol retrievals. He also has been a Point Of Contact between NPP science team and NGST System Engineer (SE) team. He has facilitated a series of meetings between NGST and MODIS selected science team members at NASA/GSFC, University of Miami, University of Wisconsin at Madison and University of Maryland. Rosenstiel School of Marine and Atmospheric Science (RSMAS). The motivation for these visits was to obtain detailed information on the validation status of the MODIS products. This will help the NPP and NGST NPOESS teams in using MODIS products as "truth" in the pre-launch verification of the VIIRS algorithms that employ MODIS L1B data as proxy for VIIRS SDRs. An additional objective of the meeting was to help us gain insight on the validation efforts of ocean products, which would directly benefit the planning of NPOESS Cal/Val activities. Our first meeting was very productive. We found that feedback from the RSMAS team members on our approach for pre-launch verification was extremely valuable. All these meeting are productive. The meeting reports were posted on NPOESS web Page E-room Attached is a summary and key lessons learned from the sequence meetings. He is lead for AIRS-MOIDS-VIIRS simulation for NPP proxy datasets generating.

A white paper has been prepared for NPP SDS project. Science requirements and data support for NPOESS/NPP projects has been provided. In addition, John Qu has organized a very successful set of interactions between and MODIS investigators to discuss the complexities of MODIS algorithms and their validation.

Zhong Liu, Research Scientist

Ph.D., Atmosphere Science 1995, Ohio State University

Precipitation Data Support Team member supports TRMM and other hydrologic data access and user services. Zhong Liu has developed the TRMM Online Visualization and Analysis System (TOVAS) and the MODIS Online Visualization and Analysis System (MOVAS), participated in the activities of building the infrastructure of GES-DISC Interactive Online Visualization and ANalysis Infrastructure (Giovanni). Supported an

online visualization system for ocean color. He has provided data information services to the United Nations World Food Programme to support their decision support systems. Participated in the NASA REASoN CAN - Agriculture as a Co-Investigator. Provided user support for TRMM data products and developed web contents for the Hydrology Data Support web site. Wrote articles and prepared posters for conferences and journals. Attended conferences and seminars. Collaborated with scientists around the world in using DAAC data products.

Gilberto A. Vicente: Senior Research Scientist

Ph.D. Atmospheric Science, 1994, University of Wisconsin-Madison

As a senior research scientist, Gilberto Vicente is mainly active in three DAAC data support teams: (1) Supports the AIRS science team for maintenance and updates of the AIRS web site, user assistance and outreach activities like CD creation and documentation preparation for scientific and public deliveries of AIRS data/products and information. (2) Works closely with the hydrology data support team assisting in the creation of the Precipitation Data and Information Services Center (PDISC) and responsible for the web site maintenance, improvements and updates. (3) Member of the GDAAC Business Development Team, dedicated to the promotion of the GDAAC data/product and services to the scientific and public communities (through fact sheets and published material) and search of business/science opportunities of cooperation with outside organizations through joint proposal collaborations. He played the lead role in the preparation and submission of proposals in response to NASA NRA's as well as in the concept and organization of the GDAAC Internal Library of conference papers, presentations, posters and proposal documentation.

James McManus, Research Scientist

MA. Geography 1994, University of Maryland at College Park

As member of the Science Support team at the GES DAAC, he provides a wide range of support in various areas, including: MODIS, TRMM Data mining, Pathfinder AVHRR, SIESIP, Health Initiative, and Interdisciplinary Dataset Collection. Focus of work is directed towards collaborating with the Science user community, providing services that improve data access and help integrate data and information served by the GES DISC. Examples of work include redesign of large volume data sets, improving their usability for time-series studies and accessibility by FTP, collaborating with scientists in the design and development of algorithms to be run in the TRMM data mining system, and the promotion of XML and Semantic Web technology at the GES DISC, through example applications and presentations. Efforts have also included participation in the planning and governance of the ESIP Federation and the promotion of GES DISC data sets through example applications.

Kwang-Su Yang, Research Scientist

Ph.D. Computational Statistics 1995, George Mason University.

He is a research scientist in data mining for the Earth science area. Major works involved intelligent data understanding, Bayesian classification, and MODIS cloud mask quality assessment. Contributed to algorithm development and implementation.

Chai Lim, Research Scientist

Ph.D. Computational Science, 2004, George Mason University.

Chai Lim joined GDAAC group in November 2003, is responsible for algorithm verification and development of the Agricultural Information System for the NASA REASoN Agricultural DSS project.

Publications

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