DATA CATALOG SERIES FOR SPACE SCIENCE AND APPLICATIONS FLIGHT MISSIONS

Volume 4A

Descriptions of Meteorological and Terrestrial Applications Spacecraft and Investigations

July 1985
Categories of Spacecraft Used in This Series

PLANETARY AND HELIOCENTRIC

This category includes probes to the various planets of the solar system and probes designed to make measurements of the characteristics of interplanetary space. Included are also the probes which will pass out of the solar system into interstellar space.

METEOROLOGICAL AND TERRESTRIAL APPLICATIONS

This category includes geocentric spacecraft whose primary mission is to make remote sensing measurements of the earth and its atmosphere. Spacecraft which carry instrumentation to make geodesy and gravimetry measurements are also included. Technology, engineering, and communications spacecraft or investigations are not included because NSSDC does not archive such data.

ASTRONOMY, ASTROPHYSICS, AND SOLAR PHYSICS

This category consists of scientific satellites designed to conduct investigations of the sun, stellar objects, nonstellar sources, and interstellar phenomena. These satellites are geocentric except for the selenocentric RAE-B.

GEOSTATIONARY AND HIGH-ALTITUDE SCIENTIFIC

This category includes those satellites designed to conduct investigations of the characteristics of near-earth space from orbits with apogees near geostationary altitude and higher. Three of the spacecraft are selenocentric. Communications satellites are not included because NSSDC does not archive such data.

LOW- AND MEDIUM-ALTITUDE SCIENTIFIC

This category includes those spacecraft whose apogees are well below geostationary altitude and whose primary purpose is to conduct investigations in the near-earth environment.
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86N13865** ISSUE 4 PAGE 650 CATEGORY 47 RPT#: NASP-TM-87501

NSSLDC/WDC-H-K/85-05-VOL-4H NAS 1.15-87501 85/07/00 11 VOL5 126

**UTTL:** Data catalog series for space science and applications flight missions.

**Volume 4H:** Descriptions of meteorological and terrestrial applications
spacecraft and investigations


**CORP:** National Aeronautics and Space Administration. Goddard Space Flight
Center, Greenbelt, Md. HVHIL.NTIS

**SHF:** HC HV7/HF HV1

**C01:** UNITED STATES

**MHJS:** ^DTH BASES/ ^EARTH RESOURCES/ ^GEODETIC SURVEYS/ ^METEOROLOGICAL SATELLITES
^SELECTIVE DISSEMINATION OF INFORMATION

**MINS:** ^EARTH ATMOSPHERE/ EARTH OBSERVATIONS (FROM SPACE)/ SPACEBORNE

**HSB:** E.A.K.

**HBS:** The National Space Science Data Center (NSSDC) provides data from and
information about space science and applications flight investigations in
support of additional studies beyond those performed as the principal part
of any flight mission. The Earth-orbiting spacecraft for investigations of
the earth and its atmosphere is discussed. Geodetic tracking data are
included in this category. The principal subject areas presented are
DATA CATALOG SERIES FOR SPACE SCIENCE
AND APPLICATIONS FLIGHT MISSIONS

Volume 4A

DESCRIPTIONS OF METEOROLOGICAL AND TERRESTRIAL APPLICATIONS
SPACECRAFT AND INVESTIGATIONS

Edited by

Carolyn Y. Ng
Yi-Tsuei P. Sheu

July 1985

National Space Science Data Center (NSSDC)/
World Data Center A for Rockets and Satellites (WDC-A-R&S)
National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt, Maryland 20771
This volume is part of a series which will describe data sets and related spacecraft and investigations from space science and applications flight missions. The series will describe the data sets held by NSSDC, some of the data sets held by NASA-funded investigators, and some of those held by foreign investigators. The series will also serve as pointer documents for extensive data sets held and serviced by other government agencies.

We would like to thank the many investigators who have submitted their data for archiving at NSSDC. Their cooperation in supplying current status information is gratefully acknowledged. We are particularly indebted to the many past and present NSSDC personnel who interacted with the investigators in bringing to NSSDC the flight data and who provided the initial input for many of the descriptions appearing in this catalog. Thanks are also extended to the other NSSDC personnel, employees of the on-site contractor, Sigma Data Services Corporation, who have been involved in the information handling necessary to produce this volume. Special acknowledgment is given to Mary Elsen for her extensive editorial assistance.

The Data Center is continually striving to increase the usefulness of its data, and associated indexes and documentation held at NSSDC, as well as its information base about data sets held at, and accessible from, other institutions. Scientists are invited to submit their space science data and related documentation, or information about accessible data to NSSDC. Their comments on and corrections to the present catalog will be greatly appreciated. Catalog recipients are urged to inform potential data users of its availability.

Carolyn Y. Ng
Yi-Tsuei P. Sheu

July 1985
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Introduction
1.1 PURPOSE

The National Space Science Data Center (NSSDC) was established by the National Aeronautics and Space Administration (NASA) to provide data from and information about space science and applications flight investigations in support of additional studies beyond those performed as the principal part of any flight mission. This volume is one of a series of eleven that will describe (1) all spacecraft flight investigations for which NSSDC possesses data or can direct people to the data source, (2) all data sets held by NSSDC, (3) some of the data sets held and serviced by NASA-funded investigators, and (4) some of the data sets held and serviced by foreign investigators. The series will serve as pointer documents for extensive data sets held and serviced by other government agencies, particularly the National Oceanic and Atmospheric Administration (NOAA). There is one major omission from this series: the extensive set of data obtained from the lunar missions conducted by NASA, supplemented by a few small photographic data sets from Soviet missions. These are described in the Catalog of Lunar Mission Data (NSSDC/WDC-A-R&S 77-02) and will not be repeated in this series, except for a few cases. The data from IMP-E, Apollo 15 subsatellite, and Apollo 16 subsatellite are included in the series, since these data are important to disciplines other than those connected with lunar studies. Some of the experiments of the Apollo ALSEP missions also yielded useful data for magnetospheric and interplanetary physics, but these are not included in the series, since the instruments were confined to the surface of the moon. Readers should consult the Catalog of Lunar Mission Data if they are interested in such data sets.

The series consists of (1) five volumes that describe the spacecraft and their associated investigations separated into various categories, (2) five corresponding volumes that describe the various orbital information and investigation data sets, and (3) a master index volume. The five categories of spacecraft are (i) Planetary and Heliocentric, which include planetary flybys and probes, (ii) Meteorological and Terrestrial Applications, (iii) Astronomy, Astrophysics, and Solar Physics, which are all geocentric except the selenocentric RAE-B, (iv) Geostationary and High-Altitude Scientific, and (v) Low- and Medium-Altitude Scientific. It is impossible to provide an organization of categories that separates the investigations cleanly into scientific disciplines, since many missions were multidisciplinary. With the above organization, that is partly discipline-oriented and partly orbit-oriented, it was found that in nearly all cases a given spacecraft belonged clearly to only one of the above five categories. The few exceptions encountered have resulted in some data sets appearing in more than one data set volume.

Each volume is organized in a way that is believed to be most useful to the user and is described for each such volume in the Organization Section. For the standard types of orbital information, given in the data set catalogs, i.e., predicted, refined, and definitive, the information will be given in a tabular form to avoid repeating the same brief description an inordinate number of times. The standard description of a data set from an investigation is a free text brief description, since the wide variety of instruments precludes using a tabular format in most cases.
1.1 PURPOSE (continued)

This catalog series has been prepared following a 2-year survey and follow-up activity by NSSDC personnel to obtain information about the completeness of the NSSDC holdings and to solicit the description of data sets that will be archived by individual investigators; these latter data sets are referred to as directory data sets. This survey was conducted only for NASA missions launched after December 31, 1962, but it includes the majority of NSSDC holdings. Of the 100 investigators surveyed, representing 346 inactive (no longer associated with an active science working team or equivalent) experiments, a small percentage failed to respond in 17 months of concerted solicitation for information. Consequently, there are now 20 investigations for which NSSDC has no data that will be dropped from this catalog series, since it would be irresponsible for NSSDC to send requesters to a possible data source that no longer has data or is nonresponsive. The surveyed investigations that are being dropped from the NSSDC catalogs are identified in the appropriate volumes in the series. A small, but nontrivial, number of investigations were identified for which data no longer exist or for which the instrument failed at launch. These investigations are included in the spacecraft/investigation volumes so that users will know that it is fruitless to try to obtain such data anywhere. Also included in the spacecraft/ investigation volumes are descriptions of recent spacecraft and investigations from which NSSDC expects to receive data.

The main purpose of this series is to identify the data and the contact from whom the data can be obtained within the scope previously defined. In addition, we have tried to identify the personnel involved with the investigation, and to provide their current affiliation so that a user will know whom to contact for additional information relative to a given data set that NSSDC archives. In some cases we know that people have retired or have gone into different areas of endeavor. The latter case is treated by showing the last affiliation of such an individual and denoting that he is no longer affiliated by printing NLA after the individual's name. The spacecraft/mission personnel are identified at the institution where they performed their relevant duties since this is the place where the original project records are most likely to be found. The term NLA is printed with the names of these personnel if they are no longer associated with the given institution.

It is hoped that this series will serve for many years as the source documents for data in the disciplines that NSSDC handles. The annual NSSDC Data Listing will be used to update the time intervals for which data are available and to identify in brief form the new data sets that become available in the future. The annual Report of Active and Planned Spacecraft and Experiments will be used to describe the new spacecraft and experiments which are placed in orbit.
1.2 ORGANIZATION

This catalog deals with the earth-orbiting spacecraft mainly for investigations of the earth and its atmosphere. Geodetic tracking data are also included in this category.

Section 2 contains research type spacecraft and experiments for which NSSDC has data sets, knows of their locations, or has been notified that no data exist. Section 3 contains operational type spacecraft and their experiments. TIROS 1-10 were R&D satellites, but they also served as semi-operational meteorological satellites. They are included in this section. Most of the operational meteorological data are archived at the Satellite Data Services Division (SDSD), National Climatic Data Center (NCDC), National Environmental Satellite, Data, and Information Service (NESDIS), National Oceanic and Atmospheric Administration (NOAA), Washington, D.C. 20233. The Satellite Data Services Division is mentioned widely in the text by the acronym SDSD. To avoid needless repetition, the address, which is given here, does not accompany the acronym in the text. On manned spacecraft Geminis 3-12, two earth-observation investigations were repeated. They are also contained in Section 3. Section 4 lists the names of the spacecraft which have provided geodetic tracking data. No descriptions of the spacecraft and experiments are presented.

The organization of the descriptions of the spacecraft in Sections 2 and 3 is mainly alphabetical by the NSSDC spacecraft common name. Under each spacecraft heading, the appropriate investigation descriptions are arranged alphabetically by name of the original principal investigator.

Each spacecraft description entry in Section 2 includes the spacecraft alternate names, NSSDC ID number (see Appendix A), launch information (date, site, and vehicle), spacecraft weight, orbit parameters (type, epoch date, period, inclination, periapsis, and apoapsis), sponsoring country and agency, personnel (project manager, "PM", project scientist, "PS", and their affiliation at the start of the project), and a brief description concerning the mission. Additional information concerning the PM and PS codes is given in Appendix A. The "NAL" code that sometimes follows a person's name is explained in Appendix A.

Each investigation description entry in Section 2 includes the investigation name (as used by NSSDC), NSSDC ID number (see Appendix A), the NASA Headquarters investigative program code, the investigation discipline(s) and the names and current affiliations of the principal investigator (PI) and of the associated other investigator(s) (OI). The principal investigators are listed first, but the other investigators are not listed in any particular order. The designation "/CO-OP" under the investigative program indicates a cooperative effort between NASA and another agency. The investigation brief description is immediately below each heading.

The description entries for spacecraft and investigations in Section 3 are different from the entries in Section 2. One spacecraft description entry is given to one satellite series, since spacecraft in the same series are very
1.2 ORGANIZATION (continued)

similar to one another. The launch date and orbit parameters are contained in
a table. The information regarding personnel is also presented in tabular
form. Then, a brief description states the general features of that series of
spacecraft. One investigation description entry is given to one experiment
which is possibly repeated on different flights within the same series. The
spacecraft on which the investigation has been carried, NSSDC ID numbers,
personnel, and one brief description are included.

The Index of Spacecraft and Investigations in Section 5 lists the spacecraft
and investigations described in this volume. Spacecraft common names and
alternate names are in numerical and alphabetical order. Included with each
spacecraft common name are the sponsoring country and agency, launch date,
NSSDC ID number, and the page where the spacecraft description may be found in
this volume. Grouped under each spacecraft name are the particular
investigations for that spacecraft which are to be dealt with in this volume,
arranged alphabetically by principal investigator's last name. Each of these
entries also includes the investigation name, NSSDC ID number, and the page
where the investigation description may be found in this volume. Certain
words, phrases, and acronyms used in this volume are defined in Appendices A
and B.

In this volume, the principal subject areas are meteorology and earth
resources survey, and the spacecraft selection is made according to those
subjects; but all experiments on board the spacecraft are described herein.
No attempt has been made here to reference investigations that are related to
the above disciplines but that are described in other volumes of this series.
1.3 NSSDC PURPOSE, FACILITIES, AND SERVICES

The National Space Science Data Center was established by the National Aeronautics and Space Administration to provide data and information from space science and applications (earth sciences) investigations in support of additional studies beyond those performed by principal investigators. As part of that support, NSSDC has prepared this series of volumes providing descriptions of archived data, divided into five categories as presented in Section 1.1 (see also inside front cover). In addition to its main function of providing selected data and supporting information for further analysis of space science flight experiments, NSSDC produces other publications. Among these are a report on active and planned spacecraft and experiments, and various user guides.

Virtually all the data available at or through NSSDC result from individual experiments carried on board individual spacecraft. The Data Center has developed an information system utilizing a spacecraft/investigation/data identification hierarchy. This catalog is based on the information contained in that system.

NSSDC provides facilities for reproduction of data and for onsite data use. Resident and visiting researchers are invited to study the data while at the Data Center. The Data Center staff will assist users with additional data searches and with the use of equipment. In addition to spacecraft data, the Data Center maintains some supporting information and other supporting data that may be related to the needs of the researchers.

The Data Center's address for information (for U.S. researchers) follows:

National Space Science Data Center
Code 633.4
Goddard Space Flight Center
Greenbelt, Maryland 20771
Telephone: (301) 344-6695
Telex No.: 89675
TWX No.: 7108289716
SPAN Address: NSSDC::REQUEST

Researchers who reside outside the U.S. should direct requests for information to the following address:

World Data Center A for Rockets and Satellites
Code 630.2
Goddard Space Flight Center
Greenbelt, Maryland 20771 U.S.A.
Telephone: (301) 344-6695
Telex No.: 89675
TWX No.: 7108289716
1.4 DATA ACQUISITION

NSSDC invites members of the scientific community involved in spaceflight investigations to submit data to the Data Center or to provide information about the data sets that they prefer to handle directly. The Data Center assigns a discipline specialist to work with each investigator or science working team to determine the forms of data that are likely to be most useful to the community of users that obtain data from NSSDC. The pamphlet Guidelines for Submitting Data to the National Space Science Data Center can be provided on request.
Research and Development

Spacecraft and Investigation Descriptions
The objective of this experiment was to investigate the effects of spaceflight conditions on the growth of various species of streptomyces. These bacteria were selected for their ability to form spores, which are highly resistant to radiation and other environmental stresses. The experiment was conducted aboard the Apollo-Soyuz Test Project spacecraft. Streptomyces cultures were inoculated into nutrient media and placed in containers designed to simulate spaceflight conditions. These containers were then flown on board the spacecraft and subjected to nominal and extreme space conditions. Upon return to Earth, the cultures were recovered and analyzed for changes in growth rates, metabolism, and spore production.

The experiment involved the following key components:

1. **Astronauts**: The mission comprised a three-person crew, with two astronauts and one auxiliary scientist.
2. **Spacecraft**: The Apollo-Soyuz Test Project spacecraft was utilized for the experiment.
3. **Experiment Duration**: The experiment duration was approximately 20 minutes.
4. **Data Collection**: Real-time television transmissions were scheduled, with selected experiments also planned for later analysis.
5. **Radiation Detectors**: Physical radiation detectors, such as nuclear emulsions, were used to estimate the penetration of interstellar helium into the solar system.
6. **Biological Materials**: Bacterial spores, protozoa cysts, and insect eggs were flown to observe the effects of high energy-loss (HZE) heavy cosmic radiation on biological materials.

**Investigation Name**: Earth Observations and Photography

**Investigation Code**: E2

**Investigation Discipline**: Astronomy

**Personnel**:
- PI: C.S. BOWEY, U. OF CALIF., BERKELEY

**BRIEF DESCRIPTION**: This ASP experiment investigated the distribution of helioluminescent radiation in selected regions of the night sky. The measurements were made using a small, high-passband photometer and were focused on a specific target area.
The Apollo-Soyuz Test Project was an international collaborative effort between the United States and the Soviet Union to conduct scientific research in space. The project involved several experiments on-board the spacecrafts, including studies of crystal growth, stratospheric aerosol measurement, and geodynamics. The experiments were conducted to gain insights into various scientific phenomena and their applications.

For instance, the crystal growth experiment involved growing single crystals of insoluble substances by allowing two or more reactant solutions to diffuse through each other in a region of neutral gravity. This approach took advantage of the absence of gravity-driven convection. The crystals were then photographed to determine the process of diffusion and crystal growth. The reactant solutions were placed in the outer compartments of the spacecraft, and the camera was placed in the central compartment. The reactions were monitored, and the crystals were photographed at regular intervals. The results of this experiment were found in 'Crystal Growth Experiment MA-206.'

The stratospheric aerosol measurement experiment was conducted to study the distribution of stratospheric aerosols. The instrument consisted of a photometer and associated electronics. The data obtained were used to study the extinction distribution of stratospheric aerosols. The data were recorded by the camera and used for determining the vertical distribution of aerosols.

The geodynamics experiment involved the measurement of gravity anomalies. The experiment was conducted with the Apollo spacecraft connected with Madrid and the ATM 6. The measured variations of solar intensity were recorded by the photometer and solar diode. The results can be found in the report 'Geodynamics - Experiment MA-128.'

These experiments, among others, were executed as part of the Apollo-Soyuz Test Project (ASTP) to demonstrate various scientific and technological capabilities, including spacecraft docking, joint scientific experiments, and orbital operations.

**Investigation Name: Crystal Growth**

**NSSDC ID:** 75-066A-18

**INVESTIGATIVE PROGRAM:** SCHELD

**INVESTIGATION DISCIPLINE(S):** PHARMA, SCIENCE

**PERSONNEL:** T.J. Pepin

**U OF WYOMING**

**BRIEF DESCRIPTION:** The crystal growth experiment involved a novel process for growing single crystals of insoluble substances by allowing two or more reactant solutions to diffuse through each other in a region of neutral gravity. The reactant solutions were placed in the outer compartments of the spacecraft, and the camera was placed in the central compartment. The reactions were monitored, and the crystals were photographed at regular intervals. The results of this experiment were found in 'Crystal Growth Experiment MA-206.'

**Investigation Name: Stratospheric Aerosol Measurement**

**NSSDC ID:** 75-066A-19

**INVESTIGATIVE PROGRAM:** SCHELD

**INVESTIGATION DISCIPLINE(S):** METEOROLOGY

**METEOROLOGY**

**UPPER ATMOSPHERE RESEARCH**

**PERSONNEL:** T.J. Pepin

**U OF WYOMING**

**BRIEF DESCRIPTION:** The Stratospheric Aerosol Measurement (SAM) experiment was conducted to study the distribution of stratospheric aerosols. The instrument consisted of a photometer and associated electronics. The data obtained were used to study the extinction distribution of stratospheric aerosols.

**Investigation Name: Geodynamics**

**NSSDC ID:** 75-066A-17

**INVESTIGATIVE PROGRAM:** SCHELD

**INVESTIGATION DISCIPLINE(S):** METEOROLOGY

**METEOROLOGY**

**SPACE PROCESSING**

**PERSONNEL:** T.H. Scheid

**U OF HOUSTON**

**BRIEF DESCRIPTION:** The geodynamics experiment involved the measurement of gravity anomalies with the Apollo spacecraft connected with Madrid and the ATM 6. The measured variations of solar intensity were recorded by the photometer and solar diode. The results can be found in the report 'Geodynamics - Experiment MA-128.'
continued its separate mission.

-------- ASTP-TAYLOR IVANDY

INVESTIGATION NAME- USSR MULTIPLE MATERIAL MELTING

NSSDC ID- 75-065A-02 INVESTIGATIVE PROGRAM
CODE EN/CO-0P INVESTIGATIVE DISCIPLINE(S)
TECHNOLOGY SPACE PROCESSING

PERSONNEL
PI - L.A. IVANDY NASA-SAS

BRIEF DESCRIPTION
The objective of this experiment was to determine the degree of improvement of materials processed in zero gravity, Carbon fibers and superalloy products, form a fabrication process in which materials based on the earth, the onboard multipurpose furnace system was used. Three different material systems were used. In the hot and biaxial regions a sample of carbon and tungsten carbide was melted and subject to a vacuum. A germanium rod containing 2 atomic percent of silicon was partially melted and solidified in the gradient region. An additional biaxial region was created to test the ability to phase and to process an amorphous powder.

-------- ASTP-TAYLOR

INVESTIGATION NAME- MICROBIAL EXCHANGE TEST

NSSDC ID- 75-065A-01 INVESTIGATIVE PROGRAM
CODE EB/CO-0P INVESTIGATIVE DISCIPLINE(S)
SPACE BIOLOGY

PERSONNEL
PI - G.R. TAYLOR NASA-JSC

BRIEF DESCRIPTION
The objective of the microbial exchange experiment was to determine the components of the infectious disease process in space flight by measuring changes in three factors: (1) the composition of the microflora of the participants living in the spacecraft; (2) the ability of each crew member's immune system to resist infection; and (3) the ability of certain microorganisms to maintain normal flora. The experiment was designed to monitor quantitatively the microbial load of all crew members and of selected body sites of both the Apollo and Soyuz spacecraft. The normal autoimmunity and autoimmune processes in each of the spacecraft were measured before flight and repeated sampling after flight. Selected samples were collected from the 5 prime and 1 backup crew members and from 10 areas on the inner surfaces of each spacecraft at specific times before, during, and after the flight. For inflight samples, a specially developed sample collection device was used that was protected by a metal-tipped Teflon swab on a capillary tube containing preservation fluid to keep the microorganisms alive. All four sets of swabs were launched in the Soyuz spacecraft. Two kits to be used on the Apollo were transferred from the Soyuz at the end of the first joint activity and returned to the Soyuz near the end of the last joint activity. The analysis of all samples collected during flight were divided between U.S. and U.S.S.R. scientists. More extensive details and some flight results can be found in "Microbial Exchange Experiment A3-002" by G. R. Taylor et al., Apollo-Y Soyuz Test Project, Preliminary Science Report, NASA-JSC; TR-505135 pp. 161-186; EPA-1 1976.

------- ATS 3 -------

SPACER CRAFT COMMON NAME- ATS 3
ALTERNATE NAME(S)- ATS-C

NSSDC ID- 67-111A

LAUNCH DATE- 11/05/67 WEIGHT- 365.0 KG
LAUNCH SITE- KENNEDY SPACE CENTER, UNITED STATES
LAUNCH VEHICLE- ATS

SPONSORING COUNTRY/AGENCY- UNITED STATES NASA-055A

ORBIT PARAMETERS
ORBIT TYPE- GEOSTATIONARY EPOCH DATE- 01/05/68
ORBIT PERIOD- 143.8 MIN INCLINATION- 0.455 DEG
PERIAPSIS- 35176. KM ALAT- 4513. KM ALT

-------- ATS 3 --------

BRIEF DESCRIPTION
The ATS 3 (Applications Technology Satellite) was one of a series of spacecraft designed to demonstrate the utility and feasibility of a variety of technological and scientific activities that could be carried out by an earth-synchronous spacecraft. Of the 11 experiments on board, 8 were technological engineering experiments concerned with navigation, communication, and spacecraft operations and equipment. Two of the remaining experiments were photographic experiments leading to pictures that could be produced near real-time. The remaining experiment was an ionospheric beacon. The spin-stabilized spacecraft was cylindrically shaped and measured 102 cm in length and 142 cm in diameter. The primary structural members were a honeycomb sandwiched shell and thrust tube. Support was extended radially by means of 100-in panels that were affixed to solar panels which formed the outer walls of the spacecraft. Equipment components and instruments were mounted in the middle region of the spacecraft and were assembled in such a manner that the annular space between the thrust tube and solar panels, in addition to the location of the trim, was chosen to support meteorological operations. In general, the various experiments have been successful.

-------- ATS 3- BRANCHFLOWER-2 --------

INVESTIGATION NAME- IMAGE DISSECTOR CAMERA (IDC)

NSSDC ID- 67-111A-03 INVESTIGATIVE PROGRAM
CODE EC INVESTIGATIVE DISCIPLINE(S)
METEOROLOGY

PERSONNEL
PI - G.R. BRANCHFLOWER(SPA) SPAR AEROSPACE

BRIEF DESCRIPTION
The ATS 3 Image Dissector Camera (IDC) was a camera system designed to (1) test the feasibility of using electrical scanning techniques in an earth-orbiting camera and (2) provide real-time cloud cover data for research projects with Earth coverage. The camera was mounted with its optical axis perpendicular to the spacecraft spin axis and in such a manner that the camera produced a scan line with each revolution of the spacecraft. On the spacecraft was determined by ground command. The image dissector tube consisted of a visible wavelength electrically scanning photodetector and a 15-stage electron multiplier. The camera was focused on the cameras performed normally until May 1969, when the IDC system was upset by erratic spacecraft antenna performance and was turned off for about a year. After the camera was repositioned on May 30, 1969, the IDC system, although still capable of solving the problems, was left in operationally off mode since that time except for periodic testing. For a detailed and listing of the different forms of photographic data available from this experiment, see the "Meteorological Data Catalog for the Applications Technology Satellites" TRF Report 1002, available from NSSDC. Data can be obtained through SOOS.
PERSONNEL
PI - AJ. DANSO
STANFORD U

BRIEF DESCRIPTION
The ionospheric propagation experiment consisted of continuosly transmitting radio frequency (137.350 and 412.050 MHz) from the spacecraft. By study of spacecraft rotating angle measurements of lower frequency or differential Doppler frequency recordings of the two frequencies, the total electron content along the propagation path could be calculated. Ionospheric irregularities could also be observed. Performance was nominal.

------- ATS 3, SUOMI -------

INVESTIGATION NAME- MULTICOLOR SPIN-SCAN CLOUDCOVER CAMERA
(MSSC)
NSSDC ID- 67-1114-01
INVESTIGATIVE PROGRAM
CODE C2 APPLICATIONS
INVESTIGATION DISCIPLINE(S)
METEOROLOGY

PERSONNEL
PI - V.E. SUOMI
U OF WISCONSIN
OI - H.A. SARGENT
U OF WISCONSIN

BRIEF DESCRIPTION
The ATS 3 Multicolor Spin-Scan Cloud Cover Camera (MSSC) represented a significant advance over a similar but monochromatic spin-scan camera on ATS 1. The MSSC was mounted with its optical axis perpendicular to the spacecraft's spin axis viewed the earth through a special aperture in the spacecraft side. The camera consisted of a high-resolution television, three photomultiplier light detectors (color, blue, and green), and a precision latitude stepper. Light entering the system was focused alternately on a set of three 2038-mm aperture plates and then passed through various filters to image on the appropriate photodetector. The telescope multimultiplier assembly could be tilted in discrete steps to provide pole-to-pole coverage in 240 scan lines. Each scan was provided by the spin of the satellite itself. A total time of 24 min was required to scan one frame and less than 5 min to retrace with a normal satellite rotation of 100 rpm. From its geostationary equatorial orbit, the camera had a ground resolution of better than 1 km at nadir. The experiment was successful, with ATS 3 being the first spacecraft to transform three-color spin-scan cameras from scientific photography to operational cameras. Approximately 3 months after launch, however, the red and blue channels failed, and the system subsequently was limited to producing black-and-white pictures. Good quality black-and-white pictures were received daily until December 11, 1974, when operations were curtailed to three frames a week. For a listing and description of the different forms of photographic data, see the "Meteorological Data Catalog for the Applications Technology Satellites" (RF 0092641), available from NSSDC. Data can be obtained through NSSDC.

-------- BE-8 -------

SPACESTRACK COMMON NAME- BE-8
ALTERNATE NAMES- EXPLORER 22, S 660
01989
NSSDC ID- 64-066A
LAUNCH DATE- 10/13/64
LAUNCH SITE- VANDERBERG AFB, UNITED STATES
LAUNCH VEHICLE- SCOUT
SPONSORING COUNTRY/AGENCY
UNITED STATES NASA-GSFC

INITIAL ORBIT PARAMETERS
ORBIT TYPE- GEOCENTRIC
ORBIT PERIOD- 101.5 hr
EPOCH DATE- 10/13/64
PERIAPSIS- 850.174 KM ALT
APOAPSIS- 1320.830 KM ALT

PERSONNEL
PM - F.T. MARTIN
PS - L.W. BRACE
NASA-GSFC
PM - R.E. BOURDEAULIA
NASA-GSFC

BRIEF DESCRIPTION
BE-8 (Explorer 22) was a small ionospheric research satellite instrumented with an electromagnetic radio beacon at 20.455 MHz and 3.2 MHz radio beacon, a passive laser tracking reflector, and a Doppler navigation experiment. Its operation was to obtain worldwide observations of total electron content between the satellite and the earth. The satellite was initially spin-stabilized but was despun after solar paddle erection. Subsequent stabilization of the satellite was accomplished by using the sun sensors and their bi-orientation. There were no tape recorder aboard so that satellite performance data and electrostatic probe data could be observed only when the satellite was within range of a ground telemetry station. Continuous transmitters also operated at 102 and 324 MHz to permit precise tracking by "Transit" tracking stations for navigation and geodetic studies. In August 1969, data acquisition from the satellite telemetry channels was discontinued. In July 1969, tracking and worldwide observations were discontinued by GSFC, and worldwide observations were subsequently assumed by NSSOC. The satellite failed in February 1970 and BE-C (65-032A) was turned on in order to partially replace use made of this satellite.
navigation and geodetic studies. The satellite was turned off on July 26, 1973, due to frequency interference with higher priority spacecraft.

--- BEC+ BLUMLE---

INVESTIGATION NAME- RADIO BEACON

NSSDC ID- 65-0324A-01 INVESTIGATIVE PROGRAM
CCDC ENSC SCIENCE

INVESTIGATION DISCIPLINE(S)
IONOSPHERES AND RADIO PHYSICS

PERSONNEL
PI = L.J. BLUMLE(NASA)

BRIEF DESCRIPTION

At launch, a beacon radiated a plane-polarized signal at 28.005 MHz, 40.010 MHz, 41.010 MHz, and 360.092 MHz, all harmonics of 1,200 kHz. The plane of polarization of the three lower frequencies underwent an appreciable number of rotations due to electron concentration. The polarization plane of highest frequency did not rotate appreciably. Several methods were used to analyze these rotations and determine the total electron content between the satellite and a ground receiver. The beacons were turned on until the satellite operation terminated on May 6, 1968. On February 13, 1970, the beacons were again turned on to replace the 64-064A (EH) beacon which had completely failed by the end of January 1976.

--- BEC+ BRACE---

INVESTIGATION NAME- LANGMUIR PROBE

NSSDC ID- 65-0324A-02 INVESTIGATIVE PROGRAM
CCDC ENSC SCIENCE

INVESTIGATION DISCIPLINE(S)
MAGNETIC FIELD

PERSONNEL
PI = L.M. BRACE NASA-GSFC

BRIEF DESCRIPTION

Two cylindrical electrostatic probes of the Langmuir probe type were used. They consisted of a collector electrode extending from the central axis of a cylindrical guard ring. The guard ring extended 5 in. from the spacecraft and the probe extended 9 in. A 2-kV, saturated voltage of +5 to +5 V was swept to either of the probes, and the resulting current profile to the probe was telemetered. From this profile, the electron density, electron temperature, and mean ion mass were determined. This experiment performed nominally from launch until August 13, 1968, when solar cell degradation resulting from radiation prevented operation of all systems on the satellite. The probes were operated for about 40 s after that time, no archival data were produced since the experiment was a back-up for the DC-1 mission, which had been flown successfully.

---------- ECHO 2 JACCHIA----------

INVESTIGATION NAME- SATELLITE DRAG ATMOSPHERIC DENSITY

NSSDC ID- 64-0044A-03 INVESTIGATIVE PROGRAM
CCDC ENSC SCIENCE

INVESTIGATION DISCIPLINE(S)
PLANE Atmospheres

PERSONNEL
PI = L.G. JACCHIA NASA

BRIEF DESCRIPTION

Because of its symmetrical shape, Echo 2 was selected by the experimenters for use in determining upper atmospheric densities as a function of altitude, latitude, season, and solar activity. This experiment was not planned prior to launch. Density values near perigee were deduced from sequential observations of the spacecraft position, using optical (Baker-Brown camera network) and radio and/or radar tracking techniques. A good discussion of the general techniques used to deduce density values from satellite drag data can be found in "Geophysical Monograph Special Report No. 104" by L.G. Jacchia and J.R. Slowey. This echo experiment resulted in the successful determination of reasonable density values until the spacecraft re-entered the earth's atmosphere on June 7, 1973.

---------- ECHO 1---------

SPACECRAFT COMMON NAME- ECHO 1

ALTERNATE NAMES- C45A- 05435 COLE

NSSDC ID- 71-071A

LAUNCH DATE- 08/16/71
WEIGHT- 84.7 KG
LAUNCH SITE- WALLOPS FLIGHT CENTER- UNITED STATES
LAUNCH VEHICLE- SCOUT

SPONSORING COUNTRY/AGENCY
FRANCE
UNITED STATES

NSSDC

INVESTIGATION NAME- SATELLITE DRAG ATMOSPHERIC DENSITY

NSSDC ID- 71-071A-O1 INVESTIGATIVE PROGRAM
CCDC ENSC SCIENCE

INVESTIGATION DISCIPLINE(S)
PLANE Atmospheres

PERSONNEL
PI = W.R. BANOEEN NASA-GSFC

BRIEF DESCRIPTION

ECHO 1, the second French experimental meteorological satellite and the first launched by NASA under a cooperative agreement with the Centre National d'Etudes Spatiales (CNES), was designed to function primarily as a passive communications spacecraft to acquire and relay telemetered data on altitudes, pressures, temperatures, densities, and upper atmospheric wind velocities from instrumented earth-orbiting constant density meteorological balloons. The octagonally shaped satellite measured 0.71 m across opposite corners and was 2.55 m long. Electrical power (20 W average) was supplied by eight rectangular solar panels deployed 45 deg from the Echo 1 upper octagonal structure after orbital insertion, and by 15 rechargeable silver-vanadium batteries. Constant earth orientation was maintained by a deployable 10.68-m gravity gradient boom. Satellite spin was near zero rpm in orbits, and the attitude was programmed to remain stable within 9 deg of local vertical. The data were stored on board the spacecraft and unloaded on command when the spacecraft was within range of the ground station. The onboard telemetry consisted of (1) a 136.5 MHz downlink transmitter for relaying balloon telemetry to ground stations and also to serve as a tracking beacon; (2) a 148.25-MHz receiver for receiving spacecraft commands and telemetry programs for balloon operations; and (3) a spacecraft-to-balloon transmitter (464.84 MHz) and receiver (451.79 MHz). The spacecraft operation was successful with the exception of the inadvertent destruction of 71 balloons by an erroneous ground command. The last balloon ceased transmitting in January 1973. However, the spacecraft was subsequently used to track and receive data from ocean buoys, icebergs, and ships.

---------- ECHO 1 BANOEEN----------

INVESTIGATION NAME- UPPER ATMOSPHERE WINDS AND WEATHER DATA RELAY SYSTEM

NSSDC ID- 71-071A-O1 INVESTIGATIVE PROGRAM
CCDC ENSC OP- APPLICATIONS

INVESTIGATION DISCIPLINE(S)
PLANE Atmospheres
The radar altimeter was the highest priority experiment on GEOS 3. The objectives were (1) to determine the feasibility and utility of a spaceborne radar altimeter for mapping the topography of the ocean surface with an absolute accuracy of ±1 m and with a relative accuracy of ±0.2 m, (2) to determine the feasibility of measuring the deflection of the vertical information at sea, (3) to determine the feasibility of measuring wave heights, and (4) to contribute to the technology leading to a future operational altimeter-satellite system with a 1-cm measurement capability. To meet the experiment objectives, the altimeter had two distinct data-gathering modes: a long-pulse mode and a short-pulse mode. Performance capabilities and operating characteristics of the altimeter differed for the two modes.

Both modes operated at 532-nm frequency using a parabolic antenna. The long-pulse mode had a maximum range acquisition time of 6 s and had a range resolution of 1 m in latitude and longitude. The short-pulse mode was capable of measuring the topography of the ocean surface with an absolute accuracy of ±1 m and with a relative accuracy of ±0.2 m. Performance characteristics were as follows: (1) altitude data rate for the long-pulse mode was 50 Hz and for the short-pulse mode was 100 Hz. The long-pulse mode had several features in common with the altimeters used in the Skylab missions, but it had advantages over the Skylab altimeter because of improved accuracy and ability to operate over extended periods of time by providing the capability of measuring the range error over longer arcs and obtaining results from more ocean areas. The third in the series of satellite altimeters was flown on Seasat 1. The system provided good quality data and demonstrated capabilities never before originally anticipated. More details can be found in J. Geophys. Res. v. 84, n. 88 1979.
were detectors to 115 K. The orbit plane.

**PRO~RA~**

because the altitude of Accelerometer Calibration System Orbital Accelerometer Experiment, terminated on September 30, 1980. More detailed information can be found in "Heat Capacity Mapping Mission Users' Guide" (TRF B32822), available from NSSDC.

**PERSONNEL**

PI - W.L. BARNES NASA-GSFC

**BRIEF DESCRIPTION**

The objectives of the Heat Capacity Mapping Radiometer (HCMM) were (1) to produce thermal maps at the optimum times for making thermal-inertia studies for discrimination of rock types and mineral resources location, (2) to measure plant-canopy temperatures at frequent intervals to determine the transpiration of water and plant life, (3) to measure soil-moisture effects by observing the temperature cycle of soils, (4) to map thermal effluents, both natural and man-made, (5) to investigate the feasibility of geothermal source location by remote sensing, and (6) to provide frequent coverage of snow fields for water runoff prediction. The HCMM transformed data from each orbital pass to the ground so that selected areas were covered within the 12-hour period corresponding to the easting and minimum of temperature observed. The instrument operated in two channels, 15 to 15.5 micrometers (IR) and 0.55 to 1.1 micrometers (visible). The spatial resolution was approximately 600 m at nadir for the IR channel, and 500 m for the visible channel. The instrument utilized a radiation cooler to cool the two Hg-Cd-Te detectors to 115 K. The experiment included an analog multiplexer that accepted analog outputs of the detectors and multiplied their signal for suitable transmission by the spacecraft S-band transmitter. The instrument performed satisfactorily until the spacecraft operations terminated on September 30, 1980. More detailed information can be found in "Heat Capacity Mapping Mission Users' Guide" (TRF B32822), available from NSSDC. Data are available from NSSDC and Earthnet Users Services via Galileo Gallileo, C.P. 64, 00194 Frascati, Italy.

********** LOGACS 1, AGENA **********

**SPACECRAFT COMMON NAME- LOGACS 1, AGENA**

**ALTERNATE NAME-**

**DEB16**

**NSSDC ID-**

**78-041a-01**

**INVESTIGATIVE PROGRAM**

**CODE**

**EX**

**INVESTIGATION DISCIPLINE(S)**

**EARTH RESOURCES SURVEY**

**METEOROLOGY**

**PERSONNEL**

PI - W.L. BARNES NASA-GSFC

**BRIEF DESCRIPTION**

This experiment was a Miniature Electrostatic Accelerometer (MEAS). The instrument was a balanced proof mass, which could be electrostatically pulse released along the sensitive axis. Three pulses were observed and converted into digital values. For further details see G. Fotou "LOGACS experiments" in The Low Accelerometer Calibration System Orbital Accelerometer Experiments, v. 1 (TRF B19604). The experiment was intended for only a few days due to the low orbit perigee (which was the location of the most useful data).

********** LOGACS 1, AGENA CHU **********

**INVESTIGATION NAME-**

**WIND COMPONENT NORMAL TO ORBIT PLANE**

**RELNO**

**200 km**

**NSSDC ID-**

**67-0552b-02**

**INVESTIGATIVE PROGRAM**

**SPACE TEST PROGRAM**

**INVESTIGATION DISCIPLINE(S)**

**PLAETARY ATMOSPHERES**

**PERSONNEL**

PI - Y.T. CHIU AEROSPACE CORP

O1 - W.A. FEES AEROSPACE CORP

**BRIEF DESCRIPTION**

This experiment was not planned, but its possibilities were realized after the Agena spacecraft, which was extended for a flight of low altitude control, and stabilization and control orientation to be controlled to plus or minus 1 deg for about 1.5

in diameter at the base, and about 3 m across with solar paddles extended.

The sensory ring, which formed the satellite bases, housed the electronics equipment and battery modules. The lower surface of the torus-shaped sensory ring provided mounting space for sensors and telemetry antennas. An infrared structure mounted within the center of the torus provided support for the larger experiments and tape recorders. Mounted on the control system housing, which was located on top of the spacecraft, were sun sensors, horizon cameras, gas nozzles for attitude control, and a command antenna. Use of a stabilization and control system allowed the spacecraft to be controlled to plus or minus 1 deg for all three axes (pitch, roll, and yaw). The spacecraft carried (1) a high-resolution visible system (HAS) for recording and storing remote cloudcover pictures, (2) an automatic picture transmission (APT) camera for processing and storing remote cloudcover pictures, and (3) a high-resolution infrared radiometer (HIR) to complement the daytime TV coverage and to measure nighttime radiative temperatures of cloud tops and surface terrain. A short second-stage burn resulted in an unplanned eccentric orbit. Otherwise, the spacecraft and its experiments operated

********** NIMBUS 1 **********

**SPACECRAFT COMMON NAME- NIMBUS 1**

**ALTERNATE NAMES-**

**EBF2, NIMBUS-A**

**NSSDC ID-**

**64-052a**

**LAUNCH DATE-**

**08/20/64**

**WEIGHT-**

**374.6 kg**

**LAUNCH SITE-**

**VANDENBERG AFB, UNITED STATES**

**LAUNCH VEHICLE-**

**THOR**

**SPONSORING COUNTRY/AGENCY**

**UNITED STATES**

**NASA-GSFC**

**INVESTIGATION NAME-**

**HEAT CAPACITY MAPPING RADIOMETER**

**SPONSORING COUNTRY/AGENCY**

**UNITED STATES**

**NASA-GSFC**

**INVESTIGATION DISCIPLINE(S)**

**ECOLOGY, APPLICATIONS**

**ATMOSPHERES**

**EARTH RESOURCES SURVEY**

**METEOROLOGY**

**PERSONNEL**

PI - M. PRESSKIN NASA-GSFC

O1 - W.P. NORDNESS(2 DECEASED) NASA-GSFC

**BRIEF DESCRIPTION**

Nimbus 1, the first in a series of second-generation meteorological research and development satellites, was designed to serve as a stabilized, earth-oriented platform for the testing of advanced meteorological sensor systems and for collecting meteorological data. The polar-orbiting spacecraft consisted of three major elements: (1) a sensory ring; (2) solar paddles; and (3) the control system housing. The solar paddles and the control system housing were connected to the sensory ring by a truss structure, giving the satellite the appearance of an ocean buoy. Nimbus 1 was nearly 3.7 m tall, 1.5 m in diameter at the base, and about 3 m across with solar paddles extended. The sensory ring, which formed the satellite bases, housed the electronics equipment and battery modules. The lower surface of the torus-shaped sensory ring provided mounting space for sensors and telemetry antennas. An infrared structure mounted within the center of the torus provided support for the larger experiments and tape recorders. Mounted on the control system housing, which was located on top of the spacecraft, were sun sensors, horizon cameras, gas nozzles for attitude control, and a command antenna. Use of a stabilization and control system allowed the spacecraft to be controlled to plus or minus 1 deg for all three axes (pitch, roll, and yaw). The spacecraft carried (1) a high-resolution visible system (HAS) for recording and storing remote cloudcover pictures, (2) an automatic picture transmission (APT) camera for processing and storing remote cloudcover pictures, and (3) a high-resolution infrared radiometer (HIR) to complement the daytime TV coverage and to measure nighttime radiative temperatures of cloud tops and surface terrain. A short second-stage burn resulted in an unplanned eccentric orbit. Otherwise, the spacecraft and its experiments operated

********** LOGACS 1, AGENA BRUCE **********

**INVESTIGATION NAME-**

**ATMOSPHERIC DENSITY SYSTEM**

**SPONSORING COUNTRY/AGENCY**

**UNITED STATES**

**NASA-GSFC**

**INVESTIGATION DISCIPLINE(S)**

**SPACE TEST PROGRAM**

**PLAETARY ATMOSPHERES**

**PERSONNEL**

PI - R.W. BRUCE AEROSPACE CORP

O1 - J.L. PEARSON AEROSPACE CORP

O1 - C.G. FOTOU AEROSPACE CORP

O1 - A.D. PRAV AEROSPACE CORP

O1 - W.A. YOUNG AEROSPACE CORP

**BRIEF DESCRIPTION**

This experiment was a Miniature Electrostatic Accelerometer (MEAS). The instrument was a balanced proof mass, which could be electrostatically pulse released along the sensitive axis. Three pulses were observed and converted into digital values. For further details see G. Fotou "LOGACS experiments" in The Low Accelerometer Calibration System Orbital Accelerometer Experiments, v. 1 (TRF B19604). The experiment was intended for only a few days due to the low orbit perigee (which was the location of the most useful data).
It equipped ground stations on a spacecraft, photographed images of the earth's surface. The camera used a 100-mm wide-angle f/3.5 objective lens with a focal length of 5.2 mm. The camera was mounted facing earthward on the spacecraft, the sensor ring, with its optical axis parallel to the spacecraft spin axis. The actual picturing required 8 s and the transmission 200 s. Earth-cloud images retained on the photosensitive surface of the 5.2-cm-diameter stationary were read out at four times per second to form a 400-line picture. A 4-5 TV transmitter (156.95 MHz) relayed the pictures to local AP stations within communication range. The faceplate of the vidicon had reflectance marks that appeared on the picture format in relating the picture to its geographical position on the earth's surface. At the nominal spacecraft altitude, a 3.5-deg field of view was covered approximately a 1660- by 1660-km square with a horizontal resolution of better than 1 km at nadir from an altitude of 800 km. At this altitude, the camera array could produce a composite picture covering an area of R = 2700 km. Up to 192 pictures (two full orbits of data) or 64 pictures per camera could be stored for subsequent transmission to an appropriate ground station. Using a transmission frequency of 1702.5 MHz, the two video picture signals were transmitted to ground at a data transmission rate of 4.25 MHz.

The AVCS experiment was highly successful. It provided the first near-global, high-resolution, cloudcover pictures ever obtained by a satellite. The data recorded by the AVCS experiment have been distributed to meteorologists as a basis for the first operational satellite system 105/115 (TIROS Operational System/Environmental Science Services Administration). Data from this experiment can be obtained through NSSDC. For an index of the data see "Nimbus 1 Users' Catalog: AVCS and APT" (Ref 804499), available from NSSDC.

**Nimbus 1** advanced**

**INVESTIGATION NAME—ADVANCED VIDICON CAMERA SYSTEM (AVCS)**

**NSSDC ID—64-052B-01**

**INVESTIGATIONAL PERSONNEL**

<table>
<thead>
<tr>
<th>PI</th>
<th>L. J. BURDETT</th>
</tr>
</thead>
</table>

**BRIEF DESCRIPTION**

The Nimbus 1 Advanced Vidicon Camera System (AVCS), which consisted of three cameras, 12 tape recorders, and an S-band transmitter, recorded and stored a series of remote daytime cloudcover pictures for subsequent playback to selected ground data acquisition stations. The AVCS cameras were mounted on the spacecraft's sensor ring, facing earthward and deployed in a fan-like array to produce a three-segment composite picture. Each camera covered a 23-deg field of view with the center camera pointing straight down. The optical axes of the three cameras were directed 35 deg to either side. Each of the cameras employed an f/4 lens with a focal length of 10,500 mm, a potentiometer attached to the solar array controlled the lens opening from the wide-angle to the telephoto position over an internal range to f/4 when it was near the scene. The 800-scene-line, 2.54-cm-diameter vidicon pickup tube yielded a picture format to aid in spacecraft orientation to the earth's surface. At the nominal spacecraft altitude, a 3.5-deg field of view was covered approximately a 1660- by 1660-km square with a horizontal resolution of better than 1 km at nadir from an altitude of 800 km. At this altitude, the camera array could produce a composite picture covering an area of R = 2700 km. Up to 192 pictures (two full orbits of data) or 64 pictures per camera could be stored for subsequent transmission to an appropriate ground station. Using a transmission frequency of 1702.5 MHz, the two video picture signals were transmitted to ground at a data transmission rate of 4.25 MHz.

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**SPACECRAFT COMMON**

**SPACECRAFT COMMON NAME—NIMBUS 1**

**NSSDC ID—64-052B**

**LAUNCH DATE—05/15/66**

**WEIGHT—414, KG**

**LAUNCH SITE—VANDENBERG AFB, UNITED STATES**

**LAUNCH VEHICLE—THOR**

**SPONSORSING COUNTRY/AGENCY—CONTINENTAL UNITED STATES**

**INVESTIGATION DISCIPLINES**

**CODE ECC**

**ADVA**

**METEOROLOGY**

**INVESTIGATION NAME—HIGH-RESOLUTION INFRARED RADIOMETER (HRIR)**

**NSSDC ID—64-052B-02**

**INVESTIGATIONAL PERSONNEL**

<table>
<thead>
<tr>
<th>PI</th>
<th>C. M. HUNTER</th>
</tr>
</thead>
</table>

**BRIEF DESCRIPTION**

The Nimbus 1 Automatic Picturing Transmission (APT) system was a camera and transmitter combination designed to transmit local daytime, slow-scanning television pictures of cloudcover conditions to properly equipped ground receiving stations on a real-time basis. The camera used a 100-mm wide-angle f/3.5 objective lens with a focal length of 5.2 mm. The camera was mounted facing earthward on the spacecraft, the sensor ring, with its optical axis parallel to the spacecraft spin axis. The actual picturing required 8 s and the transmission 200 s. Earth-cloud images retained on the photosensitive surface of the 5.2-cm-diameter stationary were read out at four times per second to form a 400-line picture. A 4-5 TV transmitter (156.95 MHz) relayed the pictures to local AP stations within communication range. The faceplate of the vidicon had reflectance marks that appeared on the picture format in relating the picture to its geographical position on the earth's surface. At the nominal spacecraft altitude, a 3.5-deg field of view was covered approximately a 1660- by 1660-km square with a horizontal resolution of better than 1 km at nadir from an altitude of 800 km. The experiment supplied over 1600 high-quality cloudcover pictures to participating AP stations during the spacecraft's 3.5-week lifetime. It proved the capability of weather forecasting by high-resolution, cloudcover pictures to operational meteorologists in an essentially real-time basis. It established the feasibility of such instrumentation in the TIROS Operational System (TOS). For more information and system specifications, see "APT Users' Guide" (Ref 804499), available from NSSDC. This investigation was primarily intended for operational use within the local AP acquisition station and are generally not available for distribution.

**Nimbus 1**

**INVESTIGATION NAME—AUTOMATIC PICTURE TRANSMISSION (APT) SYSTEM**

**NSSDC ID—64-052B-02**

**INVESTIGATIONAL PERSONNEL**

<table>
<thead>
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**BRIEF DESCRIPTION**

The Nimbus 1 Automatic Picturing Transmission (APT) system was a camera and transmitter combination designed to transmit local daytime, slow-scanning television pictures of cloudcover conditions to properly equipped ground receiving stations on a real-time basis. The camera used a 100-mm wide-angle f/3.5 objective lens with a focal length of 5.2 mm. The camera was mounted facing earthward on the spacecraft, the sensor ring, with its optical axis parallel to the spacecraft spin axis. The actual picturing required 8 s and the transmission 200 s. Earth-cloud images retained on the photosensitive surface of the 5.2-cm-diameter stationary were read out at four times per second to form a 400-line picture. A 4-5 TV transmitter (156.95 MHz) relayed the pictures to local AP stations within communication range. The faceplate of the vidicon had reflectance marks that appeared on the picture format in relating the picture to its geographical position on the earth's surface. At the nominal spacecraft altitude, a 3.5-deg field of view was covered approximately a 1660- by 1660-km square with a horizontal resolution of better than 1 km at nadir from an altitude of 800 km. The experiment supplied over 1600 high-quality cloudcover pictures to participating AP stations during the spacecraft's 3.5-week lifetime. It proved the capability of weather forecasting by high-resolution, cloudcover pictures to operational meteorologists in an essentially real-time basis. It established the feasibility of such instrumentation in the TIROS Operational System (TOS). For more information and system specifications, see "APT Users' Guide" (Ref 804499), available from NSSDC. This investigation was primarily intended for operational use within the local AP acquisition station and are generally not available for distribution.
The Nimbus 2 Advanced Vidicon Camera System (AVCS) was a combination of cameras, tape recorders, and transmitter that could record and store a series of real-time day/night cloud cover pictures for subsequent playback to a ground data acquisition station. The AVCS sensors consisted of three vidicon cameras mounted on the satellite sensory rings, facing earthward and deployed in a fan-like array to produce a three-dimensional picture of the earth's surface. The AVCS also included a transmission frequency of 1707.5 Hz, that was modulated and recorded on three tracks of a magnetic tape, one track for each camera. The magnetic tape was provided for recording five pictures (1/2 to 1/3 orbits of data). The AVCS data were multiplexed with the high-resolution infrared radiometer (HRIR) data. The AVCS was successful, and good data were obtained until August 21, 1966, when the tape recorder malfunctioned. Sporadic operation was continued until September 2, 1966, when the recorder failed completely. Data obtained during this period were successfully received, and a usable tape was recorded. For more detailed information of the experiment and the Index of data, see Section 2 of "Nimbus II Users' Guide" (TRF 806548), and "The Nimbus 2 Advanced Vidicon Camera System (AVCS)" (NSSDC ID: 66-0440-01).
**Nimbus 3** third in a series of second-generation meteorological and geophysical research spacecraft. The NIMBUS spacecraft consisted of three major elements: (1) a sensor, (2) power, and (3) control system housing. The sensor was a line-scanning beam scanned simultaneously with the satellite’s motion, with the sensor looking directly at the ground at all times. The NIMBUS sensor was a shutterless, computer controlled, scanned line image dissector camera (IDC) for collecting nadir-viewing infrared radiation. The NIMBUS IDC was powered by a radioisotope thermoelectric generator (RTG) and contained a computer controlled 250,000 pixel recorder. Data from this experiment were transmitted to ground stations for subsequent playback to APT stations, when operations were terminated due to spacecraft problems. Data from this experiment were available from NSSDC. The IDC and KHR systems were presented in the "Nimbus III Data Catalog" (TRF 806523), available from NSSDC.

---

**INVESTIGATION NAME**: Image Dissector Camera System (IDCS)

**INVESTIGATION COMMON NAME**: NIMBUS 3

**ALTERNATE NAMES**: "Nimbus 3", "Nimbus 82"

**NSSDC ID**: 69-0374

**LAUNCH DATE**: 04/14/69

**WEIGHT**: 576, KG

**LAUNCH SITE**: VANDENBERG AFB, UNITED STATES

**LAUNCH VEHICLE**: APT

**SPONSORING COUNTRY/AGENCY**: NASA-GSFC

**INITIAL ORBIT PARAMETERS**

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<th>SMALL NEGATIVE</th>
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**EPOCH DATE**: 04/25/69

**INCLINATION**: 99.91 DEG

**PERIAPSIS**: 1074 KM ALT

**APOAPSIS**: 1135 KM ALT

**PERSONNEL**

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**BRIEF DESCRIPTION**

The Nimbus 3 Image Dissector Camera System (IDCS) was designed to take daytime cloudcover photographs. The IDC was used to photograph the earth’s surface by measuring the earth’s radiation at low and medium resolution. The IDC transmitted irradiance in the wavelength range of 3.5 to 12.0 microns. The IDC was designed to provide data for the following purposes: to map the earth’s cloud cover, to map the earth’s surface radiation, to map the earth’s surface temperature, and to map the earth’s surface topography. The IDC was designed to provide data for the Nimbus III Users’ Guide (TRF 806523). The experiment was successful and provided good data until January 21, 1972, when operations were terminated due to spacecraft problems. Data from this experiment were available from NSSDC.

---

**INVESTIGATION NAME**: High-Resolution Infrared Radiometer (HRIR)

**INVESTIGATION COMMON NAME**: NIMBUS 3

**ALTERNATE NAMES**: "Nimbus 3", "Nimbus 82"

**NSSDC ID**: 69-0374-02

**LAUNCH DATE**: 04/14/69

**WEIGHT**: 576, KG

**LAUNCH SITE**: VANDENBERG AFB, UNITED STATES

**LAUNCH VEHICLE**: APT

**SPONSORING COUNTRY/AGENCY**: NASA-GSFC

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**BRIEF DESCRIPTION**

The Nimbus 3 High-Resolution Infrared Radiometer (HRIR) was designed to map the earth’s nighttime cloud cover and to measure radiative information on the earth’s cloud cover and to measure the radiative information on the earth’s cloud cover and to map the earth’s surface temperature. The Nimbus 3 HRIR was a non-mapping experiment that was part of the HRIR experiment. The experiment was successful and provided good data until January 21, 1972, when operations were terminated due to spacecraft problems. Data from this experiment were available from NSSDC.

---

**INVESTIGATION NAME**: High-Resolution Infrared Radiometer (HRIR)

**INVESTIGATION COMMON NAME**: NIMBUS 3

**ALTERNATE NAMES**: "Nimbus 3", "Nimbus 82"

**NSSDC ID**: 69-0374-03

**LAUNCH DATE**: 04/14/69

**WEIGHT**: 576, KG

**LAUNCH SITE**: VANDENBERG AFB, UNITED STATES

**LAUNCH VEHICLE**: APT

**SPONSORING COUNTRY/AGENCY**: NASA-GSFC

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**BRIEF DESCRIPTION**

The Nimbus 3 Infrared Interferometer Spectrometer (RIS) experiment was designed to provide data on the vertical structure of the atmosphere at low and medium resolution. The NIMBUS 3 RIS experiment was designed to provide data on the vertical structure of the atmosphere at low and medium resolution. The experiment was successful and provided good data until January 21, 1972, when operations were terminated due to spacecraft problems. Data from this experiment were available from NSSDC.
The reemitted beam was then focused on a bolometer detector. Interference effects resulted from the optical path difference because the disk as the mirror moved. The beam traveled about 2 m in 11 s to give an interferogram, which was recorded on magnetic tape. The interferograms were transformed to an acquisition station where a Fourier transform was performed to produce a thermal emission spectrum of the earth. From this, vertical profiles of temperatures, water vapor, and ozone as well as other parameters of meteorological importance could be obtained. The instrument had a field of view equivalent to a 144 x 144-degree circle on the surface of the earth when the spacecraft's rear window. The filter used for the experiment was an 8000-A, 1250 lines per inch, (5) a set of photodiodes, which were then amplified and recorded on magnetic tape for subsequent playback to a ground acquisition station. The field of view was 10 km. A horizontal resolution of 10 km was obtained. The experiment was successful in spite of a telemetry conflict which caused the experiment to be periodically turned off. During August and September 1970 (hurricane season), the NSDC was on essentially full time to cover the area from the equator to 70 deg N and from 10 deg S to 100 deg W. On September 25, 1970, the satellite's rear horizontal scanner failed, making it impossible to determine where the NSDC sensor was pointing. The experiment was operated periodically until January 22, 1972, when all spacecraft operations were terminated.

PERSONNEL

PI - D. F. HEATH NASA-GSFC

BRIEF DESCRIPTION

The Nimbus 3 Monitor of Ultraviolet Solar Radiation (MUSR) experiment was designed to: (1) to look for temporal variations in the earth or UV background in the infrared window at 3000 A (2) to correct for the solar flux at this wavelength and (3) to measure the atmospheric attenuation at these wavelengths as the spacecraft had crossed the terminator in the Northern Hemisphere. The sensors had their maximum response at 1216 A and 1540 A and their response at 2000 A and 2600 A. The MUSR instrumentation, which consisted of five vacuum photodiodes housed in an aluminum oxide package and a sensor package was mounted on the satellite's rear windows. The spacecraft had crossed the terminator in the Northern Hemisphere. The sensors had their maximum response at 1216 A and 2000 A and their response at 2600 A. A 1216 A sensor had 1050-A, 2000-A, and 2600-A sensors had MgF2 and CaF2 windows respectively. The five spectral regions were determined by the transmittance of the filter or window materials on the short wavelength side, while the long wavelength cutoffs were produced by the varying degrees of opacity of the different photocathode materials. The appropriate bands of UV flux entered the photodiodes and produced a current that was measured by an electrometer and digitized by the Nimbus pulse code modulation (PCM) system. Simultaneously, the solar radiation system measured the angular incidence of the solar rays and transmitted its digital data information to the PCM system. The PCM data were stored on magnetic tape and transmitted on playback to the data acquisition facility. The instrument had a basic 4444 cycle and a one sample per second data rate. The field of view of the instrument was about 9 deg. Solar acquisition began, therefore, at 45 deg prior to the earth's day/night terminator and ceased completely at the satellite's day/night transition. The instrument had an on-flying electrical calibration sequence because there were no known suitable UV sources that could produce the proper spectral distribution of light for this instrument. From the data, vertical profiles of temperature, water vapor, and ozone as well as other parameters of meteorological importance could be obtained. The instrument had a field of view equivalent to a 144 x 144-degree circle on the surface of the earth when the spacecraft's rear window. The filter used for the experiment was an 8000-A, 1250 lines per inch, (5) a set of photodiodes, which were then amplified and recorded on magnetic tape for subsequent playback to a ground acquisition station. The field of view was 10 km. A horizontal resolution of 10 km was obtained. The experiment was successful in spite of a telemetry conflict which caused the experiment to be periodically turned off. During August and September 1970 (hurricane season), the NSDC was on essentially full time to cover the area from the equator to 70 deg N and from 10 deg S to 100 deg W. On September 25, 1970, the satellite's rear horizontal scanner failed, making it impossible to determine where the NSDC sensor was pointing. The experiment was operated periodically until January 22, 1972, when all spacecraft operations were terminated.

PERSONNEL

PI - A. F. McCulloch NASA-GSFC

BRIEF DESCRIPTION

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PERSONNEL

PI - A. F. McCulloch NASA-GSFC

BRIEF DESCRIPTION

The Nimbus 3 Medium Resolution Infrared Radiometer (MRIR) experiment consisted of a rotating mirror at a horizontal resolution of 10 km. A horizontal resolution of 10 km was obtained. The experiment was successful in spite of a telemetry conflict which caused the experiment to be periodically turned off. During August and September 1970 (hurricane season), the NSDC was on essentially full time to cover the area from the equator to 70 deg N and from 10 deg S to 100 deg W. On September 25, 1970, the satellite's rear horizontal scanner failed, making it impossible to determine where the NSDC sensor was pointing. The experiment was operated periodically until January 22, 1972, when all spacecraft operations were terminated.

PERSONNEL

PI - C. W. Mackenzie NASA-GSFC

BRIEF DESCRIPTION

The Nimbus 3 Medium Resolution Infrared Radiometer (MRIR) experiment consisted of a rotating mirror at a horizontal resolution of 10 km. A horizontal resolution of 10 km was obtained. The experiment was successful in spite of a telemetry conflict which caused the experiment to be periodically turned off. During August and September 1970 (hurricane season), the NSDC was on essentially full time to cover the area from the equator to 70 deg N and from 10 deg S to 100 deg W. On September 25, 1970, the satellite's rear horizontal scanner failed, making it impossible to determine where the NSDC sensor was pointing. The experiment was operated periodically until January 22, 1972, when all spacecraft operations were terminated.

PERSONNEL

PI - C. W. Mackenzie NASA-GSFC

BRIEF DESCRIPTION

The Nimbus 3 Medium Resolution Infrared Radiometer (MRIR) experiment consisted of a rotating mirror at a horizontal resolution of 10 km. A horizontal resolution of 10 km was obtained. The experiment was successful in spite of a telemetry conflict which caused the experiment to be periodically turned off. During August and September 1970 (hurricane season), the NSDC was on essentially full time to cover the area from the equator to 70 deg N and from 10 deg S to 100 deg W. On September 25, 1970, the satellite's rear horizontal scanner failed, making it impossible to determine where the NSDC sensor was pointing. The experiment was operated periodically until January 22, 1972, when all spacecraft operations were terminated.

PERSONNEL

PI - C. W. Mackenzie NASA-GSFC

BRIEF DESCRIPTION

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PERSONNEL

PI - C. W. Mackenzie NASA-GSFC

BRIEF DESCRIPTION

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HAN: was successful in nominal modified in the of the torus ring provided the Real-Time Transmission System (RTTS) that
ex:eriment PROGRAM was on top of backwards in orbit, (inclUding sun sensors, the atmosphere, (S) a monitor of attitude
atmosphere from absorption fixed and turned off on January 25, 1972 to experiment-
Hz back mount; was three of the sensors responded (1216 which formed the control system housing_
gas nozzles for solar view layers the center of the torus provided and ATS 3. The camera was mounted on a photosensitive surface
interval). For a complete description, see Section 4 in lThe
 succeeds. The experiments operated on a limited time basis after that time until September 19, 1980.-----------------
-------- NIMBUS 4, BRANCHFLOWER

INVESTIGATION NAME- INFRARED INTERFEROMETER SPECTROMETER (IRIS)

NSDC ID- 70-0252A-01 INVESTIGATIVE PROGRAM CODE & APPLICATIONS

INVESTIGATION DISCIPLINE(S) METEOROLOGY

PERSONNEL PI - D.A. HEATH NASA-GSFC

BRIEF DESCRIPTION

The Nimbus 4 Monitor of Ultraviolet Solar Radiation (MUSE) experiment was designed to provide information on the vertical structure of the atmosphere and on the off-sun profiles of the earth's atmosphere by measuring the surface and atmospheric radiation in the 2.5- to 4-kilometer range using a modified Michelson Interferometer. Radiation from a cone of the atmosphere, whose base on the surface of the earth was a circle about 15 km in diameter for a normal satellite altitude of approximately 1100 km, was received and reflected by a mirror. The reflected radiation was split into two approximately equal beams by a beam splitter. After reflection on a fixed and moving mirrors respectively the two beams interfered with each other, and a phase difference, proportional to the optical path difference between both beams, the moving mirror traveled
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calibration sequences since there were no known suitable UV sources that could provide an infall optical calibration. No archival data have been procured due to lack of funding.

--- NIMBUS 4: METHE ---

INVESTIGATION NAME - BACKSCATTER ULTRAVIOLET (BUV) SPECTROMETER

NSSDC ID - 70-0254-05

INVESTIGATIVE PROGRAM CODE CC: APPLICATIONS

INVESTIGATION DISCIPLINE(S) METEOROLOGY

UPPER ATMOSPHERE RESEARCH

PERSONNEL

PI - O.F. HEATH
OI - J.W. DAVE
DI - I.S. MCGILL

BRIEF DESCRIPTION

The Nimbus 4 Backscatter Ultraviolet (BUV) spectrometer experiment was designed to monitor the vertical distribution and total amount of atmospheric ozone on a global scale by measuring the intensity of UV radiation backscattered by the Earth/atmosphere system. The instrument operated from 10 to 340 nm in the spectral band. The primary instrumentation consisted of a double monochromator containing all reflective optics and a photocathode phosphor. The detector was composed of two Ebert-Fastie-type monochromators in tandem. Each monochromator had a 12° x 12° field of view with a 2400 line/mm grating with 400 lines/mm. Light from a 0.05°-1 solid angle subtending approximately one degree of the Earth's surface from a satellite height of approximately 1100 km entered the monochromator instrument through a deflasher filter. A motor-driven scan step the gratings to monitor the intensity of UV at each wavelength at each total ozone absorption peak. The detector was a photo-multiplier tube. For background, a filter allowed the spectrometer to reflect the UV radiation into an ozone-free absorption area near 3800 A. Signals from both units were read by separate range-switching electrometers with seven ranges. A BUV experiment cycle required 450-500 seconds. Each cycle of 300 cycles required 1.5 hours of data. Calibration by on-board light sources was performed in 26 of the 192 frames. The other frames were used for onboard data calibration. Each of these data frames contained the monochromator measured the intensity of the UV radiation in each of the UV wavelength bands, while the monochromator measured the UV intensity in a single wavelength band. The dwell time at each wavelength was 3.8 s, and within this interval four analog UV intensity measurements were taken at 40 s intervals in addition to an integrated pulse count measurement of the UV intensity and energetic particle flux. Once each orbit, the field of view was changed to monitor the sun or moon directly. The measurement range of the signal was from 0.1 to 10 keV. The vertical distribution of ozone was obtained by mathematical inversion techniques. For a complete description of the BUV experiment, see Table 1 of the Nimbus 4 User's Guide (NSF 606861). For an index of the data, see User's Guide to the Nimbus Backscatter Ultraviolet Experiment Data Sets (NSF 635361).

--- NIMBUS 4: METHE ---

INVESTIGATION NAME - SELECTIVE CHOPPER RADIOMETER (SCR)

NSSDC ID - 70-0254-10

INVESTIGATIVE PROGRAM CODE CC: APPLICATIONS

INVESTIGATION DISCIPLINE(S) METEOROLOGY

UPPER ATMOSPHERE RESEARCH

PERSONNEL

PI - I.L. GOLDBERG
OI - J.T. HUNTINGTON
DI - S.G. SMITH

BRIEF DESCRIPTION

The Nimbus 4 Selective Chopper Radiometer (SCR) observed the emitted infrared radiation in the 15-micrometer absorption band of carbon dioxide. From these measurements, the temperatures of six successive 15-km layers of the atmosphere were determined from earth or cloudtop level to 60-km heights. The spectral bands were selected using multi-layer filters and selective absorption of radiation using carbon dioxide. Each band was divided into two bands; the shorter wavelength band was used to define the viewing depth of the atmosphere. The longer wavelength band was used to define the viewing depth of the atmosphere. The carbon dioxide analysis was performed by a system of high-precision filters, and the thermometer was calibrated using a reference blackbody of known temperature prior to the observation. In addition, the temperature of the background was determined in each channel. The temperature of the background was determined in each channel. The telescope had a 3.6° field of view and was pointed at 31° above the horizon. The telescope was moved to the next channel on a 3.6° arc. The telescope was moved to the next channel on a 3.6° arc. The telescope was moved to the next channel on a 3.6° arc. The telescope was moved to the next channel on a 3.6° arc. The telescope was moved to the next channel on a 3.6° arc. The telescope was moved to the next channel on a 3.6° arc.
sensor transformed the received radiation into an electrical (voltage) output with an information bandwidth of 0.5 to 360 Hz for the 11.2- to 12.0-micrometer channels and 2.5 to 45 Hz for the water vapor channel. The ThIs sensor data were normally recorded on tape for later sensor calibration and atmospheric correction. However, direct readout infrared radiometer (SIR) data could be transmitted to APL ground stations on a day and night operation, and a command antenna. An advanced meteorological system permitted the spacecraft orientation to be controlled to within plus or minus 11.5 degrees in all three axes (pitch, roll, and yaw). Primary experiments included (1) a temperature-humidity infrared radiometer (THRIR) for measuring day and night surface and clouded temperatures as well as the water vapor content of the upper atmosphere, (2) an electrically scanning microwave radiometer (ESMR) for mapping the microwave radiation in the earth's atmosphere, (3) an infrared temperature-humidity infrared radiometer (THRIR) for measuring day and night surface and clouded temperatures as well as the water vapor content of the upper atmosphere, (4) a Nimbus 5 Microsatellite (SMB) for determining atmospheric water vapor abundances, and cloud liquid water contents, (5) a selective channel radiometer (SCR) for observing the global temperature structure of the atmosphere, and (6) a surface composition mapping radiometer (SCMR) for measuring the differences in the thermal emission characteristics of the earth's surface. A more detailed description can be found in "The Nimbus 5 User's Guide" (TRF B06861), available from NSSDC.

---------- NIMBUS 4, WARK

INVESTIGATION NAME- SATELLITE INFRARED SPECTROMETER (SIRS)

NSSDC ID- 70-025A-04

INVESTIGATIVE PROGRAM CODE EC, APPLICATIONS

INVESTIGATION DISCIPLINE(S) METEOROLOGY

PERSONNEL

PI - O.J. WARK
OI - T.L. MILLEARY
AOA-NESSDIS

BRIEF DESCRIPTION

The Nimbus 4 Satellite Infrared Spectrometer (SIRS) experiment was designed to determine the vertical temperature and water vapor profiles of the atmosphere by using a Fastie-Ebert etal. grating spectrometer. The instrument measured the infrared radiation (1 to 36 micrometers) emitted from the earth's atmospheric temperature and with the sunlit portion of the sunlit portion of the earth's surface. It used the spectrometer's infrared window to determine surface temperatures. The instrument was used to observe the global temperature structure of the atmosphere, and was designed to provide measurements at low latitudes.

---------- NIMBUS 5, HOUGHTON

INVESTIGATION NAME- SELECTIVE CHOPPER RADIOMETER (SCR)

NSSDC ID- 70-099A-02

INVESTIGATIVE PROGRAM CODE EE/CO-0A, APPLICATIONS

INVESTIGATION DISCIPLINE(S) METEOROLOGY

BRIEF DESCRIPTION

The Nimbus 5 Selective Chopper Radiometer (SCR) was designed to (1) observe the global temperature structure of the atmosphere up to 150 km in altitude (2) make supporting observations of water vapor distributions, and (3) determine the density of ice particles in the earth's atmosphere. The SCR was used to observe the temperature structure of the atmosphere, and was designed to provide measurements at low latitudes.

---------- NIMBUS 5, HOUSSO

INVESTIGATION NAME- SURFACE COMPOSITION MAPPING RADIOMETER (SCMR)

NSSDC ID- 70-099A-05

INVESTIGATIVE PROGRAM CODE EE, APPLICATIONS

INVESTIGATION DISCIPLINE(S) EARTH RESOURCES SURVEY

BRIEF DESCRIPTION

The Surface Composition Mapping Radiometer (SCMR) was designed to provide measurements at low latitudes. The SCMR was used to observe the temperature structure of the atmosphere, and was designed to provide measurements at low latitudes.
BRIEF DESCRIPTION

The Nimbus 6 research-and-development satellite served as a stabilized, earth-oriented platform for testing advanced systems for sensing and collecting meteorological data on a global scale. A multiparameter instrumentation package consisted of three major systems: (1) a hollow torus-shaped sensor mount, (2) a solar-powered data acquisition system, and (3) a balloon-mounted seismic instrument. The sensor mount was a torus-shaped structure supported by a tripod truss structure. Configured somewhat like an ocean buoy, Nimbus 6 was nearly 3.7 m tall, 1.5 m in diameter at the base, and about 4 m wide with solar panels extended. The sensor mount that formed the satellite base housed the electronics equipment and battery modules. The balloon's position was varied at altitudes between 45 and 70 km on a global scale.

The data acquisition system included the following sensors:

- A temperature sounder was designed to make in situ temperature measurements at various altitudes. The balloon's position was varied at altitudes between 45 and 70 km on a global scale.
- A limb radiometer was used to make global temperature measurements.
- A balloon-mounted seismic instrument was used to study the ground motion along the direction of the balloon.

The balloon experiment, many other experiments were conducted in earth-orbiting satellites. The Nimbus 6 experiment included the following objectives:

- Studying the tropospheric ozone band (0.2 to 0.7 micrometers), the stratospheric ozone band (13.6 to 15.5 micrometers), and the 15.5 to 120-micrometer band.
- Providing direct measurements of atmospheric temperature, ozone, and water vapor abundance, and cloud water content.
- Providing vertical profiles of temperature, ozone, and water vapor.
- Mitigating solar radiation from the sun using solar paddles and a stabilizing structure of the upper stratosphere and lower mesosphere.
- Determining the extension of selective chopping techniques to higher altitudes where the pressure sounder was used to make measurements in the stratosphere and lower mesosphere.
- Providing direct measurements of atmospheric temperature, ozone, and water vapor abundance, and cloud water content.
- Providing vertical profiles of temperature, ozone, and water vapor.
- Mitigating solar radiation from the sun using solar paddles and a stabilizing structure of the upper stratosphere and lower mesosphere.

The instrument performed satisfactorily.

INVESTIGATION NAME: TROPICAL WIND ENERGY CONVERSION AND REFERENCE LEVEL EXPERIMENT (TWERL)

NSSDC ID: 75-0524-01

INVESTIGATIVE DISCIPLINE(S): METEOROLOGY

PERSONNEL

- P. H. JULIAN
- W. R. SCHMIDT
- J. C. GROVER

INVESTIGATION NAME: PRESSURE MODULATOR RATIOMETER (PMR)

NSSDC ID: 75-0524-09

INVESTIGATIVE DISCIPLINE(S): METEOROLOGY

PERSONNEL

- J. T. HOUGHTON
- J. D. STEEN
- J. W. WILLIAMSON
- P. CURTIS

BRIEF DESCRIPTION

The Nimbus 6 Pressure Modulator Radiometer (PMR) experiment took radiometric measurements in the CO2 band at altitudes between 45 and 70 km on a global scale. The PMR used a multiparameter instrument package that was designed to make in situ temperature measurements at various altitudes. The balloon's position was varied at altitudes between 45 and 70 km on a global scale.

The data acquisition system included the following sensors:

- A temperature sounder was designed to make in situ temperature measurements at various altitudes. The balloon's position was varied at altitudes between 45 and 70 km on a global scale.
- A limb radiometer was used to make global temperature measurements.
- A balloon-mounted seismic instrument was used to study the ground motion along the direction of the balloon.

The balloon experiment, many other experiments were conducted in earth-orbiting satellites. The Nimbus 6 experiment included the following objectives:

- Studying the tropospheric ozone band (0.2 to 0.7 micrometers), the stratospheric ozone band (13.6 to 15.5 micrometers), and the 15.5 to 120-micrometer band.
- Providing direct measurements of atmospheric temperature, ozone, and water vapor abundance, and cloud water content.
- Providing vertical profiles of temperature, ozone, and water vapor.
- Mitigating solar radiation from the sun using solar paddles and a stabilizing structure of the upper stratosphere and lower mesosphere.
- Determining the extension of selective chopping techniques to higher altitudes where the pressure sounder was used to make measurements in the stratosphere and lower mesosphere.
- Providing direct measurements of atmospheric temperature, ozone, and water vapor abundance, and cloud water content.
- Providing vertical profiles of temperature, ozone, and water vapor.
- Mitigating solar radiation from the sun using solar paddles and a stabilizing structure of the upper stratosphere and lower mesosphere.

The instrument performed satisfactorily.

INVESTIGATION NAME: BLACK BODY RADIATION AND ATOMS (BBBA)

NSSDC ID: 75-0524-03

INVESTIGATIVE DISCIPLINE(S): ATMOSPHERIC PHYSICS

PERSONNEL

- P. H. JULIAN
- W. R. SCHMIDT
- J. C. GROVER

INVESTIGATION NAME: ATOMS IN THE TROPICAL WIND ENERGY CONVERSION AND REFERENCE LEVEL EXPERIMENT (TWERL)

NSSDC ID: 75-0524-01

INVESTIGATIVE DISCIPLINE(S): ATMOSPHERIC PHYSICS

PERSONNEL

- P. H. JULIAN
- W. R. SCHMIDT
- J. C. GROVER

INVESTIGATION NAME: PATTERN RECOGNITION (PR)

NSSDC ID: 75-0524-05

INVESTIGATIVE DISCIPLINE(S): COMPUTATIONAL SCIENCE

PERSONNEL

- J. T. HOUGHTON
- J. D. STEEN
- J. W. WILLIAMSON
- P. CURTIS

BRIEF DESCRIPTION

The NIMBUS 6 Pressure Modulator Radiometer (PMR) experiment took radiometric measurements in the CO2 band at altitudes between 45 and 70 km on a global scale. The PMR used a multiparameter instrument package that was designed to make in situ temperature measurements at various altitudes. The balloon's position was varied at altitudes between 45 and 70 km on a global scale.

The data acquisition system included the following sensors:

- A temperature sounder was designed to make in situ temperature measurements at various altitudes. The balloon's position was varied at altitudes between 45 and 70 km on a global scale.
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- A balloon-mounted seismic instrument was used to study the ground motion along the direction of the balloon.

The balloon experiment, many other experiments were conducted in earth-orbiting satellites. The Nimbus 6 experiment included the following objectives:

- Studying the tropospheric ozone band (0.2 to 0.7 micrometers), the stratospheric ozone band (13.6 to 15.5 micrometers), and the 15.5 to 120-micrometer band.
- Providing direct measurements of atmospheric temperature, ozone, and water vapor abundance, and cloud water content.
- Providing vertical profiles of temperature, ozone, and water vapor.
- Mitigating solar radiation from the sun using solar paddles and a stabilizing structure of the upper stratosphere and lower mesosphere.
- Determining the extension of selective chopping techniques to higher altitudes where the pressure sounder was used to make measurements in the stratosphere and lower mesosphere.
- Providing direct measurements of atmospheric temperature, ozone, and water vapor abundance, and cloud water content.
- Providing vertical profiles of temperature, ozone, and water vapor.
- Mitigating solar radiation from the sun using solar paddles and a stabilizing structure of the upper stratosphere and lower mesosphere.

The instrument performed satisfactorily.
BRIEF DESCRIPTION

The Nimbus 6 Earth Radiation Budget (ERB) experiment measured reflected and emitted terrestrial radiation fluxes in conjunction with solar radiation. The results were used (1) to determine the earth radiation budget, (2) to determine the angular distribution of terrestrial radiation for various meteorological and geographic regimes, and (3) to correlate measurement made using identical but independent channels calibrated to the same standard. An additional goal was to determine the angular distribution of terrestrial radiation as it would be seen by satellites placed at different intervals as the satellite orbited over the Earth. Just before it started its northward trip on the day side of the Earth, the experiment was left in the satellite's orbit for purposes of calibration to determine the absolute accuracy of the Earth radiation budget experiment. Calibration was performed continuously in the 0.2- to 4-micrometer, 4.7- to 3-micrometer, and 6.7- to 7-micrometer intervals. Measurements of calibration standards were taken twice daily in the 3.5- to 4-micrometer, 0.7- to 3-micrometer, and 4.7- to 6-micrometer bands. The calibration standards were obtained from a field of View (FOV) that included a 4-deg field of view in the 4-micrometer band.

The two sets of measurements were obtained from high-resolution narrow-angle scanning channels that measured the terrestrial radiation emanating from a relatively small area over a range of zenith and azimuth angles. The multi-channel radiometer employed a bispectral scanning mechanism with the ability to be used from the forward horizon to the aft horizon in a 4-sec interval. Each axis of the scan contained four short-wave channels (0.2 to 4.0 micrometers) and four long-wave channels (4.0 to 50 micrometers) with a 1.25 deg by 0.75 deg field of view. The channels were oriented in a direction that covered 20 deg to each side of the orbital plane. The scan was performed slowly during the day and faster during the night. The scanning channels developed mechanical scan problems in August 1975 and were effectively removed from service in March 1976. Data processing had been delayed due to lack of funding.

INVESTIGATION NAME- EARTH RADIATION BUDGET (ERB)

INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

INVESTIGATION DISCIPLINE(S)

METEOROLOGY

ATMOSPHERIC PHYSICS

PERSONNEL

PI - H. L. KLLE NASA-GSFC

PI - M. JACOBOWITZ NOAA-NESSOS

PI - A. J. DRUMMOND (DECEASED) EPPLEY LAB, INC

PI - J. HUFF NOAA-NESSOS

PI - J. R. RUFF NASA-NESSOS

PI - W. J. SCHLOES EPPLEY LAB, INC

PI - L. L. STOBBS NASA-NESSOS

INVESTIGATION NAME- TEMPERATURE/HUMIDITY INFRARED RADIOMETER (THIR)

INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

INVESTIGATION DISCIPLINE(S)

METEOROLOGY

INVESTIGATION NAME- SCANNING MICROWAVE SPECTROMETER (SCAMS)

INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

INVESTIGATION DISCIPLINE(S)

METEOROLOGY

INVESTIGATION NAME- HIGH RESOLUTION INFRARED RADIATION SOUNDER (HIRS)

INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

INVESTIGATION DISCIPLINE(S)

METEOROLOGY

INVESTIGATION NAME- ELECTRICALLY SCANNING MICROWAVE RADIOMETER (ESMR)

INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

INVESTIGATION DISCIPLINE(S)

METEOROLOGY

OCEANOGRAPHY
The Nimbus 7 study aimed to provide the first comprehensive survey of global aerosol content and its variations. The satellite carried two instruments: the Total Ozone Mapping Spectrometer (TOMS) and the Stratospheric Aerosol and Gas Experiment (SAGE). The TOMS was designed to map the Earth's atmosphere using a scanning radiometer operating in the visible and ultraviolet regions. The SAGE instrument measured the vertical distribution of aerosols and gases using a photometer technique.

The TOMS instrument scanned the Earth's surface, collecting data every 10 days. The SAGE instrument operated continuously, providing a more detailed view of the stratospheric aerosol layer. Both instruments were part of the Nimbus 7 mission, which launched on September 15, 1978, and operated until 1987.

The Nimbus 7 mission also contributed valuable data to the study of ocean dynamics and sea ice parameters. The satellite carried an Advanced Microwave Radiometer (AMR) that measured the Earth's microwave emissions, which were crucial for understanding ocean and sea ice conditions.

In summary, the Nimbus 7 mission provided a wealth of data that significantly advanced our understanding of aerosol distribution, stratospheric dynamics, and oceanic processes. The legacy of Nimbus 7 continues to inform research and model development in these critical fields.
BRIEF DESCRIPTION

The Nimbus 7 Color Scanner's primary purpose was to observe color caused by absorption due to chlorophyll, especially in the coastal regions. The instrument had a resolution of 0.18 rad and was mounted so that it viewed almost exactly parallel to the surface. The scanner mirror was tilted to sense color distribution caused by chlorophyll, especially in coastal regions.

The instrument was mounted so that it viewed almost exactly parallel to the surface, with the scanner mirror tilted to sense color caused by absorption due to chlorophyll. The scanner mirror was tilted to view the color distribution caused by chlorophyll, especially in coastal regions.

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profiles of emission by CO₂. These profiles were mathematically inverted to obtain temperature versus pressure in the lower stratosphere. The infrared temperature profiles, together with radiance profiles in the other spectral bands, were then used to infer the Vertical Distribution of Trace Constituents (VDTC). The precipitable water vapor in the lower stratosphere was determined to an accuracy of about 10 mm. K. The temperature at the top of the stratosphere was about 250 K, with the exception of N₂O which was determined to be about 310 K. The temperature field at the horizon was 2 K for the temperature, ozone, and nitric acid data combined for the two channels and the N₂O data for the channel. For a more detailed description see Section 4 in "The Nimbus 7 Users' Guide" (TRF 85045), available from NSSDC. The 50-channel instrument was turned off due to depletion of oxygen as planned in June 1979. 

--- NIMBUS 7 ---

INVESTIGATION NAME: TEMPERATURE/HUMIDITY INFRARED RADIOMETER (THIR)

NSSDC ID: 78-093A-10
INVESTIGATIVE PROGRAM CODE: CECP-06
INVESTIGATION DISCIPLINE(S): METEOROLOGY
METEOROLOGY
UPPER ATMOSPHERE RESEARCH

PERSONNEL

PI: L.L. STONE
OI: P. H. HUANG
OI: P. K. BHARTIA

BRIEF DESCRIPTION

The Nimbus 7 Temperature-Humidity Infrared Radiometer (THIR), which was launched on Nimbus 5 in 1979, was designed to detect emitted thermal radiation in the 10.5- to 12.5-um (micrometer) region (15 km) and the 6.3- to 7.3-um region (water vapor). The window channel, with a 2-um bandpass, provided an image of the cloud cover and temperatures of the cloud tops, land, and ocean surfaces. The channel provided information on the moisture and cirrus cloud content of the upper troposphere and stratosphere and the location of jet streams and frontal systems. The ground resolution at nadir was 6.7 km for the window channel and 20 km for the water vapor channels. Data from these two channels were used primarily to support other sophisticated meteorological experiments onboard Nimbus 7. The instrument is a non-imaging radiometer consisting of a 12.7-cm Cassegrain system and scanning mirror common to both channels, a beam splitter, filters, and two germanium-tempered thermistor bolometers. Incoming radiant energy was collected by a flat scanning mirror inclined at 45 deg to the optical axis. The mirror rotated through 360 deg at 48 rpm and scanned in a plane normal to the spacecraft velocity. The energy then was focused on a dichroic beam splitter, which divided the energy spatially and spectrally. The two channels of this sensor transformed the received radiation into electric outputs (voltages) which were digitized and recorded on magnetic tape for subsequent playback to a ground acquisition station. For a more complete description of instrumentation and data products see Section 9 in "The Nimbus 7 Users' Guide" (TRF 85045) and the Nimbus 7 Temperature-Humidity Infrared Radiometer (THIR) Data User's Guide (TRF 86045), both available from NSSDC. Except for data being digitized on boards the Nimbus 7 THIR was of the same design and operation as the MIT flown on Nimbus 6, 5, and 4.

--- NIMBUS 7 ---

INVESTIGATION NAME: STRATOSPHERIC AND MESOSPHERIC SOUNDER (SAMS)

NSSDC ID: 78-093A-02
INVESTIGATIVE PROGRAM CODE: CECP-06
APPLICATIONS
INVESTIGATION DISCIPLINE(S): METEOROLOGY
UPPER ATMOSPHERE RESEARCH

PERSONNEL

PI: R.W. TAYLOR
OI: G.E. PESKEET
OI: J.O. RODERICK
OI: J. J. WILLIAMSON
OI: J. J. BARNETT
OI: R.L. JONES
OI: J. M. VㄟER

BRIEF DESCRIPTION

The SAMS radiometer was a interferometer, the interferometer was insensitive to the gas, which was determined to be about 310 K. The temperature field at the horizon was 2 K for the temperature, ozone, and nitric acid data combined for the two channels and the N₂O data for the channel. For a more detailed description see Section 4 in "The Nimbus 7 Users' Guide" (TRF 85045), available from NSSDC. The 50-channel instrument was turned off due to depletion of oxygen as planned in June 1979. 

--- NIMBUS 7 ---

INVESTIGATION NAME: STRATOSPHERIC AND MESOSPHERIC SOUNDER (SAMS)

NSSDC ID: 78-093A-02
INVESTIGATIVE PROGRAM CODE: CECP-06
APPLICATIONS
INVESTIGATION DISCIPLINE(S): METEOROLOGY
UPPER ATMOSPHERE RESEARCH

PERSONNEL

PI: R.W. TAYLOR
OI: G.E. PESKEET
OI: J.O. RODERICK
OI: J. J. WILLIAMSON
OI: J. J. BARNETT
OI: R.L. JONES
OI: J. M. VㄟER

BRIEF DESCRIPTION

The SAMS radiometer was a interferometer, the interferometer was insensitive to the gas, which was determined to be about 310 K. The temperature field at the horizon was 2 K for the temperature, ozone, and nitric acid data combined for the two channels and the N₂O data for the channel. For a more detailed description see Section 4 in "The Nimbus 7 Users' Guide" (TRF 85045), available from NSSDC. The 50-channel instrument was turned off due to depletion of oxygen as planned in June 1979. 

--- SAGE ---

SPACECRAFT COMMON NAME: SAGE
ALTERNATE NAMES: AER-5, STRAT AERO AND GAS EXP
APPL. EXP. MISSION NO. 11270

NSSDC ID: 79-013A
LAUNCH DATE: 02/13/79
WEIGHT: 114.7 KG
LAUNCH SITE: WALLOPS FLIGHT CENTER, UNITED STATES
LAUNCH VEHICLE: SCOUT-F
SPONSORING COUNTRY/AGENCY: UNITED STATES
NASA-GSFC

INITIAL ORBIT PARAMETERS
ORBIT TYPE: GEOSTATIONARY
EPOCH DATE: 02/13/79
ORBIT PERIOD: 96.8 HR
INCLINATION: 50.5 DEG
APOGEE: 660.2 KM

PERSONNEL

PI: C.W. MACKENZIE
OI: R.S. FRASER

BRIEF DESCRIPTION

The Stratospheric Aerosol and Gas Experiment (SAGE) spacecraft was the second Atmospheric Aerosol and Gas Experiment (AEG) spacecraft to be launched. The SAGE spacecraft was launched on January 7, 1979, on a 3-year life in orbit. The spacecraft experienced power problems after May 13, 1979. Spacecraft operations continued until December 19, 1981. The signal for the spacecraft was last received on January 7, 1982. For more detailed information, see "Satellite studies of the stratospheric aerosol", by P.M. McCormick et al., Bull. Am. Meteorol. Soc., v. 65, pp. 1039-1046, 1979.

--- SAGE ---

INVESTIGATION NAME: STRATOSPHERIC AEROSOL AND GAS EXPERIMENT (SAGE)

NSSDC ID: 79-013A-01
INVESTIGATIVE PROGRAM CODE: EC06-01
APPLICATIONS
INVESTIGATION DISCIPLINE(S): UPPER ATMOSPHERE RESEARCH
METEOROLOGY

PERSONNEL

PI: M.P. MCCORMICK
OI: D.H. CUNNOLD
OI: D.G. GRAMS
OI: W. H. HENDERSON
OI: D.E. MILLER
OI: D.G. MURRAY
OI: W. H. PEPIN
OI: W. S. PLANET
OI: P.B. RUSSELL

BRIEF DESCRIPTION

The objectives of the Stratospheric Aerosol and Gas Experiment (SAGE) were to determine the spatial distribution of stratospheric aerosols and ozone on a global scale (1) to develop a satellite-based remote-sensing technique for stratospheric aerosols (SAGE) and ozone (2) to map aerosol and ozone concentrations on a time scale shorter than the stratospheric scale (3) to locate stratospheric aerosol and ozone sources and sinks (4) to determine circulation and transport phenomena (5) to examine hemispheric differences, and (6) to investigate the optical properties of aerosols and assess their effects on global radiation. The SAGE instrument was based on a Grigorian telescope and a detector subassembly which measured the field-splitted mirror in which directed radiation to six detectors. The remaining divisional operation was accomplished through dichroic beam splitters. There were seven pressure modulator cells (PMCs), two containing CO₂, the remaining divisional operation was accomplished through dichroic beam splitters. There were seven pressure modulator cells (PMCs), two containing CO₂, the remaining divisional operation was accomplished through dichroic beam splitters.
the attenuation of solar radiation at four wavelengths (0.356, 0.445, 0.66, and 1.25 micrometers) during solar occultation. As the spacecraft emerged from the earth's shadow, the instrument scanned the earth's atmosphere from the horizon up and returned to scan the earth's atmosphere by different atmospheric layers. This procedure was repeated during subsequent sunrises. Two vertical scans were obtained during each orbit, with each scan requiring approximately 1 min of time to cover the atmosphere above the troposphere. The instrument had a field of view of approximately 0.15 degrees, which resulted in a vertical resolution of about 1 km. Spatial coverage was extended from about 79 deg N to 79 deg S latitude and thus complimented the coverage (64 deg N to 80 deg N and 64 deg S to 80 deg S) of Seasat II. The instrument performed satisfactorily. Because of power problems, the data collection was limited to sunset events after June 1978, and was eventually terminated on November 13, 1981. Both NSSDC and World Ozone Data Center, Atmospheric Environmental Services, Downsview, Ontario, have data ready.

************ SEASAT 1 ************

**SPACECRAFT COMMON NAME** - SEASAT 1  **ALTERNATE NAMES** - DECAY DYNAMICS SAT-A, SEA SATELLITE-A

**NSSDC ID** - 78-064A

**LAUNCH DATE** - 06/27/78  **WEIGHT** - 1850 KG

**LAUNCH SITE** - VANDENBERG AFB, UNITED STATES  **LAUNCH VEHICLE** - Atlas-AEGR

**SPONSORING COUNTRY/AGENCY** - UNITED STATES NASA-OSSA

**INITIAL ORBIT PARAMETERS**

**ORBITAL GEODETIC EPOCH** - 1978.71 M  **INCLINATION** - 108.0 DEG  **PERIAPSIS** - 579.6 KM ALT  **APOAPSIS** - 2804.6 KM ALT

**PERSONNEL**

PM - W.A. DUREN  **NASA-JPL**

PS - J.L. DUREN  **NASA-JPL**

**BRIEF DESCRIPTION**

The Ocean Dynamics Satellite (Seasat 1) was designed to provide measurements of sea-surface temperatures, wave heights, internal waves, atmospheric liquid water, and sea ice, and to provide meaningful ocean features, ocean topography, and the marine geoid. Seasat 1 provided global coverage every 36 h. The instrument payload consisted of (1) an X-band compressed pulse radar altimeter (CALT II), (2) a coherent synthetic aperture radar (SAR), (3) a Seasat scatterometer system (SASS), (4) a scanning multichannel microwave radiometer (SMMR), and (5) a visible and infrared radiometer (VIIRR). The accuracies obtained were distance between spacecraft and ocean surface to 10 cm, wind speeds to 1 m/s, and surface temperature to 1 deg C. For more information about Seasat 1, see "Seasat mission overview," Science, v. 204, pp. 964-966, 1979; and a special issue on the Seasat 1 sensors, I.J. of Oceanic Engns. v. 03-05, 1979. On October 15, 1978, Seasat 1 failed due to a massive short circuit in its electrical system. During most of its 195 days in orbit, Seasat 1 returned a unique and extensive set of observations of the ocean's surface.

************ SEASAT 1, MCCLAIN ************

**INVESTIGATION NAME** - VISIBLE AND INFRARED RADIOMETER (VIIRR)

**NSSDC ID** - 78-064A-04

**INVESTIGATIVE PROGRAM** - CODE E6, APPLICATIONS

**INVESTIGATION DISCIPLINE(S)** - OCEANOGRAPHY

**PERSONNEL**

TL - K.P. MCCLAIN  **NOAA-NESSOS**

TM - B. BEARNETZ  **SCRIPPS INST OCEANOGR**

TM - B. BARNES  **LOUISIANA STATE U**

TM - M.V. YUZKOVICH  **RESEARCH TRIANGLE INST**

TM - D. FELLERMAN  **NASA-GSFC**

**BRIEF DESCRIPTION**

The Visible and Infrared Radiometer (VIIRR) experiment provided detailed and clear air sea surface temperatures and cloud top brightness temperatures. This sensor was developed specifically to be compatible with the Seasat 1 Scatterometer (SASS) on the ICG/NOAA series spacecrafts, consisted of two scanning radars with a dual polarization (HH, VV). The scanner consisted of two SR processors and two SR recorders. The measured reflected radiation from the earth's atmosphere was obtained from 0.05 to 100 km during the day and through thermal IR radiation from the earth and its atmosphere in the 18.5- to 12.5-micrometer region during both daytime and nighttime. The measurements were used to aid in interpreting the measurements from the microwave instruments. The spatial resolution was 9 km for both channels. More detailed information can be found in P. Maloney, "Visible and Infrared (VIIRR) experiment," J. of Oceanic Engns., v. 03-05, pp. 144-145, 1979. The instrument performance was better than specified until August 27, 1978, when the scan drive ceased functioning. Data are available from SASS.

************ SEASAT 1, TAPLEY ************

**INVESTIGATION NAME** - RADAR ALTIMETER (ALT)

**NSSDC ID** - 78-064A-05

**INVESTIGATIVE PROGRAM** - CODE E6, APPLICATIONS

**INVESTIGATION DISCIPLINE(S)** - OCEANOGRAPHY

**PERSONNEL**

TL - W.J. TAPLEY  **NOAA-NESSOS**

TM - B. BEARNETZ  **SCRIPPS INST OCEANOGR**

TM - D. FELLERMAN  **NASA-GSFC**

TM - J.P. TAPLEY  **NOAA-NESSOS**

TM - J.W. SHERMAN  **NASA-JPL**

TM - J. WATERS  **NASA-JPL**

TM - J.B. HOLLING  **US NAVY RESEARCH LAB**

TM - T.J. VUKOVICH  **NASA-NESDIS**

TM - A. W. CAMPBELL  **US GEOLOGICAL SURVY**

TM - J. CARROLL  **NOAA-NESSOS**

**BRIEF DESCRIPTION**

The primary purpose of the Scanning Multichannel Microwave Radiometer (SMMR) experiment was to provide all-weather measurements of ocean surface temperature and wind speeds, and (2) to obtain integrated liquid water column content and atmospheric liquid water column content for path length and attenuation Corrections for the ALT and SASS. Measurement brightness temperatures were observed with a 1-channel (five-frequency dual polarized) scanning radiometer operating at 0.85, 1.45, 3.57, 8.9, and 18.70 micrometers. The same antenna reflector offset from nadir by 6.73 rad. Motion of the antenna reflector provided observations from within a conical volume along the ground track of the spacecraft. The SMMR had a swath width of about 650 km and the spatial resolution ranged from about 2.5 km at 37.5 GHz to about 100 km at 6.6 GHz. The absolute accuracy of the sea surface temperatures was 0.5 deg C. The accuracy of the wind speed measurements was 1 m/s. The same experiment was flown on Nimbus 7. More detailed information can be found in P. Maloney, "Seasat Scanning Multichannel Microwave Radiometer (SMMR) Instrument description and performance," IEEE J. Oceanic Engns., v. 03-05, pp. 138-150, 1979. The instrument performed continuously in orbit from July 6, 1978, for a period of 95 days until the spacecraft failed on October 15, 1978. Data are available from SASS.
SSOC ID: 78-0644-01
INVESTIGATIVE PROGRAM CODE CE, APPLICATIONS
INVESTIGATION DISCIPLINE(S) OCEANOGRAPHY, METEOROLOGY

PERSONNEL

TL - R.D. TAPLEY
TM - SMITH, III
TM - W.F. YOUNG
TM - W.L. MCCOSKIN
TM - H.M. BYRNE
TM - P.S. GARDINER
TM - YAPLE
TM - COHEN

US DEPARTMENT OF THE NAVY, NAVO-DO

US NAVAL RESEARCH LAB

US NAVAL RESEARCH LAB

US NAVY LABORATORY

SSOC ID: 73-0274
INVESTIGATIVE PROGRAM CODE CE, APPLICATIONS
INVESTIGATION DISCIPLINE(S) OCEANOGRAPHY

PERSONNEL

TM - D.L. SMITH

US NAVAL LABORATORY

BRIEF DESCRIPTION

The Skylab mission was a manned, orbiting spacecraft composed of five parts: the Apollo telescope mount (ATM), the airlock module (AM), the instrument unit (IU), and the orbital workshop (OWS). The ATM was in the form of a cylinder, the AM being posited at right angles to the ATM from the longitudinal axis after insertion into orbit. The ATM was a solar observatory with a large field of view and a capability of several hours of experiment pointing for the rest of the cluster. It was attached to the IU and AM at one end and to the OWS, the reception and installation of functions in the ATM was accomplished by astronauts during extravehicular activity (EVA). The OWS served as a dock for the command and service modules, which served as personnel tasks to the Skylab. The AM provided an anchorage between the IU and the OWS, as well as containing controls and instrumentation. The IU which was used only during launch and the initial phases of operations, provided guidance and sequencing functions for the initial deployment of the ATM, solar arrays, etc. The OWS was a modified Saturn 4B stage suitable for long duration manned habitation in orbit. It contained provisions and crew quarters nearest to support three-man crews for periods of up to 90 days each. All parts were also capable of uninhabited in-orbit storage, reactivation and reuse. The Skylab itself was launched on May 14, 1973. It was first manned during the period May 25-June 22, 1973 by the crew of the SL-2 mission (73-0274). Next, it was manned during the period July 25-September 25, 1973, by the crew of the SL-3 mission (13-050A). The final manned period was February 8 to February 15, 1974, when it was manned by the crew of the SL-4 mission (13-0094).

INVESTIGATION NAME: SYNTHETIC APERTURE RADAR (SAR)
NSSOC ID: 78-0644-01
INVESTIGATIVE PROGRAM CODE CE, APPLICATIONS
INVESTIGATION DISCIPLINE(S) OCEANOGRAPHY, METEOROLOGY

PERSONNEL

TL - R.D. TAPLEY
TM - D.L. SMITH
TM - W.F. YOUNG
TM - W.L. MCCOSKIN
TM - H.M. BYRNE
TM - P.S. GARDINER
TM - YAPLE
TM - COHEN

US NAVAL RESEARCH LAB

US NAVAL RESEARCH LAB

US NAVY LABORATORY

US NAVY LABORATORY

INVESTIGATION NAME: INFRARED SPECTROSCOPIC
NSSOC ID: 73-0274-18
INVESTIGATIVE PROGRAM CODE CE, APPLICATIONS
INVESTIGATION DISCIPLINE(S) OCEANOGRAPHY, METEOROLOGY, EARTH RESOURCES SURVEY

PERSONNEL

PI - T.L. BARNETT

US NAVAL RESEARCH LAB

BRIEF DESCRIPTION

The Skylab mission was a manned, orbiting spacecraft composed of five parts: the Apollo telescope mount (ATM), the airlock module (AM), the instrument unit (IU), and the orbital workshop (OWS). The ATM was in the form of a cylinder, the AM being posited at right angles to the ATM from the longitudinal axis after insertion into orbit. The ATM was a solar observatory with a large field of view and a capability of several hours of experiment pointing for the rest of the cluster. It was attached to the IU and AM at one end and to the OWS, the reception and installation of functions in the ATM was accomplished by astronauts during extravehicular activity (EVA). The OWS served as a dock for the command and service modules, which served as personnel tasks to the Skylab. The AM provided an anchorage between the IU and the OWS, as well as containing controls and instrumentation. The IU which was used only during launch and the initial phases of operations, provided guidance and sequencing functions for the initial deployment of the ATM, solar arrays, etc. The OWS was a modified Saturn 4B stage suitable for long duration manned habitation in orbit. It contained provisions and crew quarters nearest to support three-man crews for periods of up to 90 days each. All parts were also capable of uninhabited in-orbit storage, reactivation and reuse. The Skylab itself was launched on May 14, 1973. It was first manned during the period May 25-June 22, 1973 by the crew of the SL-2 mission (73-0274). Next, it was manned during the period July 25-September 25, 1973, by the crew of the SL-3 mission (13-050A). The final manned period was February 8 to February 15, 1974, when it was manned by the crew of the SL-4 mission (13-0094).
The Skylab experiment was designed to photograph regions of the earth’s surface including ocean areas in a range of wavelengths from near infrared through the visible. For remote sensing of earth resources from space, specific attempts were made at spectral signature identification and mapping of ground truth targets in the atmosphere, forestry, geology, hydrology, and oceanography. The 5190 experiment was a passive, non-scanning microwave sensor that utilized a fixed planar array antenna. Brightness temperature of the earth was recorded from 1.4 to 1.437 GHz with a digital output giving an absolute antenna temperature to an accuracy of 1 deg K. The system utilized a built-in calibration scheme that sampled known sources.

The spatial characteristics were a half-power beam width of 1 deg at 0.8 to 0.9 deg, a circular footprint of approximately 124 km diameter, and a 12.8 km diameter. All data were recorded on magnetic tape. The data output was at 200 bps. For information of data availability, contact the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

-------- SKYLAB EVANS --------

INVESTIGATION NAME- MULTISPECTRAL SCANNER

NSSDC ID- 73-027A-17 INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

OCEANOGRAPHY

INVESTIGATION DISCIPLINE(S) METEOROLOGY

EARTH RESOURCES SURVEY

PERSONNEL PI = D.E. EVANS NASA-JSC

BRIEF DESCRIPTION The 5190 Skylab experiment was designed to supplement experiment 5193 (73-027A-20) in measuring brightness temperature of the earth’s surface along the spacecraft track which would provide ocean surface features varying with ocean areas and earth surface features information. The 5190 experiment was a passive non-scanning microwave sensor that utilized a fixed planar array antenna. Brightness temperature of the earth was recorded from 1.4 to 1.437 GHz with a digital output giving an absolute antenna temperature to an accuracy of 1 deg K. The system utilized a built-in calibration scheme that sampled known sources. The spatial characteristics were a half-power beam width of 1 deg at 0.8 to 0.9 deg, a circular footprint of approximately 124 km diameter, and a 12.8 km diameter. All data were recorded on magnetic tape. The data output was at 200 bps. For information of data availability, contact the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

-------- SKYLAB EVANS --------

INVESTIGATION NAME- MULTISPECTRAL SCANNER

NSSDC ID- 73-027A-19 INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

OCEANOGRAPHY

INVESTIGATION DISCIPLINE(S) METEOROLOGY

EARTH RESOURCES SURVEY

PERSONNEL PI = D.E. EVANS NASA-JSC

BRIEF DESCRIPTION The primary goal of the Skylab experiment 5192 was to assess the feasibility of multispectral techniques for a wide variety of ocean and land applications, for remote sensing of earth resources from space. Specifically, attempts were made at spectral signature identification and mapping of ground truth targets in the atmosphere, forestry, geology, hydrology, and oceanography. The 5192 instrument had 16 spectral bands with wavelengths ranging from 0.4 to 2.43 micrometers in the visible and near IR regions and 1 band in the 12.2-12.5 micrometer thermal IR region. The system gathered quantitative high-spatial-resolution Linie-scan imagery data on radiation reflected and emitted by selected ground sites in the U.S. and other parts of the world. The motion of the sensor was a circular scan with a radius of 4.18 km. Data of ground scenes were recorded in recording track 7 km wide in front of the spacecraft, yielding a 79 cm ground resolution. The 5192 optical mechanical scanner utilized a 30°-reflecting telescope with a rotating mirror. The telescope and mirror were mounted outside the multiple docking adapter. Information on area of operation and area of coverage of experiment can be obtained from the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

-------- SKYLAB EVANS --------

INVESTIGATION NAME- L-BAND MICROWAVE RADIOMETER

NSSDC ID- 73-027A-20 INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

OCEANOGRAPHY

INVESTIGATION DISCIPLINE(S) METEOROLOGY

EARTH RESOURCES SURVEY

PERSONNEL PI = D.E. EVANS NASA-JSC

BRIEF DESCRIPTION The objectives of the 5193 Skylab experiment were to provide the near-simultaneous measurement of the radar backscatter from ocean areas, and the passive microwave thermal emission of the land and ocean on a global scale. The 5193 experiment was designed to provide engineering data for use in designing space radar altimeters. The 5193 instrument had a 30°-reflecting telescope with a rotating mirror. It measured the backscattering cross section and differential backscattering cross section and spatial characteristics were a half-power beam width of 1 deg at 0.8 to 0.9 deg, a circular footprint of approximately 124 km diameter, and a 12.8 km diameter. All data were recorded on magnetic tape. The data output was at 200 bps. For information of data availability, contact the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

-------- SKYLAB EVANS --------

INVESTIGATION NAME- L-BAND MICROWAVE RADIOMETER

NSSDC ID- 73-027A-21 INVESTIGATIVE PROGRAM CODE EC APPLICATIONS

OCEANOGRAPHY

INVESTIGATION DISCIPLINE(S) METEOROLOGY

EARTH RESOURCES SURVEY

PERSONNEL PI = D.E. EVANS NASA-JSC

BRIEF DESCRIPTION The second flight of the Space Shuttle STS-2 carried the first scientific payload OSTA-1 (Orbiting Solar Terrestrial Application 1). The instruments from the OSTA-1 payload were designed to perform remote sensing of the earth’s atmosphere, oceans, and land resources. During its eight day mission, the Shuttle assumed an earth-observing orientation, thus accommodating the experiments of the OSTA-1 payload. In this experiment, called 2-ars (close vertical), the Shuttle’s payload bay faces the earth on a line perpendicular to the earth’s surface. The OSTA-1 payload consisted of (1) a shuttle
imaging radar (SMIRR), (2) a shuttle multispectral infrared radiometer (SMIRR), (3) a feature identification and location experiment (FILE), (4) a measurement of air pollution from satellites (MAPS), (5) an ocean color experiment (OCE), (6) a nighttime orbital survey of lightning (NSDC 10-111A-02), and (7) a heliophysics imaging test (HBT). The first five instruments were located in the payload bay. A pallet, supplied by the European Space Agency, node the interface between the payload bay and these five experiments. The NSDC and OCE instruments were located in the crew compartment. Due to the loss of one of the three fuel cells, the SIRS-2 mission was shortened from the planned 124 h to a 58 h mininm mission. The OSTA-1 payload was activated approximately 4.5 h after launch. The earth-viewing time was reduced from the planned 58 h to 36 h. The SIRS-2 mission successfully demonstrated the capability of the space shuttle to conduct scientific research. For more detailed descriptions of the OSTA-1 payloads, see "OSTA-1 Experiments," JSC 17059, NASA-JSC, and Science, v. 212, n. 4476, pp. 993-1033, 1982.

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INVESTIGATION NAME: HELIOPHYSICS BIDIRECTIONAL CHEMISTRY TEST (HBT)
NSDC 10-111A-07 INVESTIGATIVE PROGRAM CODE EE, APPLICATIONS
INVESTIGATION DISCIPLINES: SPACE BIOLOGY
PERSONNEL
PI - A.W.izards
U OF PENNSYLVANIA
BRIEF DESCRIPTION
The objective of the Heliophysics Bidirectional Chemistry Test (HBT) was to determine the effect of near weightlessness and g salt content on Helianthus annuus (sunflower) growth. The HBT was a precursor to the Heliophysics Investigation of the Solar-Terrestrial System planned on Spacelab 1. The HBT experiment was a suitcase-like container carrying 80 scaled plant modules. A paper culture substrate was used to achieve low moisture content from 50% by weight to 77%. This plant experiment was stored in a locker in the crew compartment of the Space Shuttle. There was insufficient time for the plants to grow because of the shortened mission. Germination percentage was 99%, but the data relating to growth required to support the Spacelab 1 experiment were not obtained.

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INVESTIGATION NAME: SHUTTLE IMAGING RADAR-A (SIR-A)
NSDC 10-111A-01 INVESTIGATIVE PROGRAM CODE EE, APPLICATIONS
INVESTIGATION DISCIPLINES: EARTH RESOURCES SURVEY
PERSONNEL
PI - C. Elachi
NASA-JPL
01 - W.L. STAHL NASA-JPL
01 - R.S. ZWICK NASA-JPL
01 - R.K. PETERS U OF KANSAS
01 - L.R. BLAINE NASA-JPL
01 - G. SCHABER US GEOLOGICAL SURVEY
BRIEF DESCRIPTION
The prime objective of Shuttle Imaging Radar-A (SIR-A) was to obtain images of the earth's surface for geological exploration. The SIR-A experiment used a side-looking, synthetic aperture radar system. The long wavelength (10.7 cm) and a viewing angle of 47° to create two-dimensional images of the earth's surface. The imaging radar was independent of sunlight and was able to penetrate cloud cover. A swath width of 50 km and a resolution of 40 m both across and along the track of the beam was obtained by this system. The sensor was in operation for 8 h during the 2-1/2 day flights, acquiring images of about 10 billion sq km between 36 deg N and 36 deg S latitude. Radar imagery recorded differences in surface roughness and terrain and was used to delineate such geological features as faults, anticlines, folds and drainage patterns, and stratification. Landmap multispectral imagery was used to provide supplementary information necessary to identify rock types and types of vegetation. For more detailed descriptions, see "Shuttle Imaging Radar-A (SIR-A) Experiment," JPL 82-77, NASA-JPL, and C. Elachi, et al., "Shuttle Imaging Radar Experiment," Science, v. 212, n. 4476, pp. 996-1003, 1982.

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INVESTIGATION NAME: SHUTTLE MULTISPECTRAL INFRARED RADIOMETER (SMIRR)
NSDC 10-111A-02 INVESTIGATIVE PROGRAM CODE EE, APPLICATIONS
INVESTIGATION DISCIPLINES: EARTH RESOURCES SURVEY
PERSONNEL
PI - A.W. english
NASA-JPL
01 - L.G. Rovnak
US GEOLOGICAL SURVEY
BRIEF DESCRIPTION
The purpose of the Shuttle Multispectral Infrared Radiometer (SMIRR) experiment was to determine the spectral bands to be included in the future high-resolution imaging system for mapping rocks associated with mineral deposits from space. The SMIRR system consisted of a Cassegrain telescope, a filter wheel, two MPd-10 detectors, two file cameras, and supporting electronics. The telescope was a modified version of the Maxi-80 telescope that gathered images of Venus and Mercury in 1973. Since SMIRR was not an imaging device, photographs were not necessary to locate objects. The two 100-meter wavelength absorptivity bands were located in the cameras' ground view (20 by 25 km). The two cameras, one color and one black-and-white, were aligned with the telescope. Analyses showed that the cameras remained aligned after launch stresses. The filter wheel allowed 10 filters to sample the following spectral bands: filters 1 and 2 at 0.5 and 0.6 micron for correlation with Landsat filters 3 and 4 at 1.05 and 1.25 micrometers for field measurement; filter 3 at 1.22-micrometer NO2 hydrosulfur absorption band; filters 5, 6, and 7 at the 2.1-2.5 micrometer NO2 hydrosulfur absorption band; and filters 8 and 9 at the 2.35-micrometer carbonate absorption band. The SMIRR sampled 66,000 km of the earth's surface for 3 h and 6 min. Over 1 h of prime data was obtained over cloud-free land areas.
radiometer operating at the 4.67-micrometer CO band. The instantaneous field of view was approximately 20 by 22 km. The equipment was coupled to a cold plate and mounted on the experiment pallet shelf. The aerial camera was mounted alongside the MAPS electro-optical head to provide information on cloud cover and the terrain over which the data were gathered.

Investigation Name: Feature Identification and Location Experiment (FILE)

NSSOC ID: 81-I11A-03

InVESTIGATIVE PROGRAM
CODE C: APPLICATIONS
INVESTIGATION DISCIPLINE(S)
Earth Resources Survey

PERSONNEL
PI - W.E. SCHAPPELL
PI - W.G. SIVERTSON Jr.
PI - R.G. TIETZ
PI - R.G. WILSON

SCHAPPELL
SIVERTSON, JR.
TIETZ
WILSON

MARTIN-MARIETTA AEROSP
MARTIN-MARIETTA AEROSP
NASA-LARC
NASA-LARC

BRIEF DESCRIPTION
The objective of the Feature Identification and Location Experiment (FILE) was to test a technique for autonomously classifying earth's features into four categories: water, vegetation, bare land, and clouds/snow/ice. The FILE system consisted of a sunrise sensor, two TV cameras, a decision-making electronics unit, a buffer memory, a tape recorder, and a 70-mm Hasselblad camera. This equipment was mounted on the experiment pallet shelf. The sunrise sensor would activate the experiment when the sun was 60 deg from the Space Shuttle's zenith. The two TV cameras were equipped with optical filters for visual red (0.65 micrometer) and near-infrared (0.85 micrometer) to determine the ground track. The FILE was a data management technique. Using the ratio between visual red reflectance and near-IR reflectance, it categorized scenes as vegetation, bare ground, water, or snow and clouds. And it would suppress further data acquisition in a certain category after it had acquired a given number of scenes. The FILE experiment operated successfully for several orbits. But only 5 s of classified data were recorded due to a tape recorder malfunction. More description can be found in "Feature Identification and Location Experiment," Science, v. 218, n. 4576, pp. 1031-1033, 1982. The data are available from investigators Eugene Sivertson, Jr. and Gale Wilson, NASA-LARC.

Investigation Name: Night/Day Optical Survey of Lightning (NOSL)

NSSOC ID: 81-I11A-06

INVESTIGATIVE PROGRAM
CODE C: APPLICATIONS
INVESTIGATION DISCIPLINE(S)
Meteorology
Atmospheric Physics

PERSONNEL
PI - B. VONNEGUT
PI - M. BROOK
PI - O.H. VAUGHAN Jr.

VONNEGUT
BROOK
VAUGHAN, JR.

STATE U OF NEW YORK
NH INST OF MINE + TECH
NASA-MSFC

BRIEF DESCRIPTION
The objective of the Night/Day Optical Survey of Lightning (NOSL) was to obtain motion picture films and correlated photcell sensor signals of lightning storms. The NOSL equipment consisted of the camera, the attached photcell sensor, and the connected tape recorder. During launch, boost, and reentry, this equipment was secured in storage lockers in the crew compartment. In orbit, the equipment was retrieved and assembled for use in the crew cabin. The motion picture camera was a 16-mm data acquisition camera, a model which has been flight tested on Apollo and Skylab missions. Despite the curtailed duration of the flight and the greatly increased demands on the crew, the crew obtained photographs of lightning at night and excellent motion picture sequences of six large thunderstorm systems during the day. This experiment was reflown twice on later Shuttle missions (STS-4 and STS-6). Data are available from the principal investigator, Dr. Bernard Vonnegut, SUNY at Albany, NY.
Operational Spacecraft
and Investigation Descriptions
### Brief Description

**DMSP** (Defense Meteorological Satellite Program) series meteorological satellites were developed and operated by the Air Force. This program, previously known as Data Acquisition and Processing Program (DAPP), was classified until March 1973. The objective of this program was to provide global visual and infrared cloudcover data and specialized environmental data to support Department of Defense requirements for operational weather analysis and forecasting. The program consisted of two satellites in 830-km sun-synchronous polar orbits, with the ascending node of one satellite early in the morning and the other near local noon. The spacecraft, shaped like the frustum of a polyhedron, consisted of four subassemblies: (1) a solar array hat, (2) a base-plate assembly, (3) a sensor AVE (aerospace vehicle electronics) package (SAP), and (4) a data processing system. The primary sensor (SAP) was a four-channel scanning radiometer. Secondary sensors included a vertical temperature profile radiometer (supplementary sensor E - SSE) and an electron spectrograph (supplementary sensor J or J/2 - SSJ or SSJ/2), which were mounted, along with the primary sensor, on the base-plate assembly. Spacecraft stabilization was controlled by a combination flywheel and magnetic control coil system so that the sensors were maintained in the desired earth-looking mode. The data processing system included three tape recorders capable of storing a total of 440 min of data. Either recorded or real-time data were transmitted to ground receiving sites via an S-band transmitter. Recorded data were read out to tracking sites located at Fairchild AFB, Wash., and Loring AFB, Maine, and relayed to Air Force Global Weather Central, Offutt AFB, Nebraska. Real-time data were read out at mobile tactical sites located around the world. For more detailed information, see "Defense Meteorological Satellite Program (DMSP) User's Guide." For information of meteorological data, users may contact SDSD. For the availability of unclassified environmental data, users may direct inquiries to the National Geophysical and Solar-Terrestrial Data Center, NOAA/National Environmental Satellite, Data, and Information Service (NESDIS), Boulder, Colorado 80303.

### Table: Launch Inclination, Perigee, and Apogee

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PM - Space Division Staff

USAF Space Division
Investigation Name - Lightning Detector (SSL)
Flown on - DMSP 5B/F5
NSSDC ID - 74-015A-04
PI - AFGWC Staff

Brief Description
The lightning detector (Special Sensor L-SSL) was designed to count lightning flashes at night to aid in severe weather detection. The sensor consisted of 12 silicon photodiodes that detected radiation emitted by lightning flashes in the 0.4- to 1.1-micrometer range. The peak response was near 0.8 micrometer. Each photodiode had a nominal field of view of 740 by 740 km on the earth's surface from an altitude of 830 km. The photodiodes were aligned in a 3 by 4 array so that the sensor's field of view was approximately 2200 by 3000 km. The SSL stored the total number of counts and the value of the largest pulse observed by each photodiode during a 1-s sampling interval. Some useful data were collected, but they were never archived for public use.

Investigation Name - Scanning Radiometer (SR)
Flown on - DMSP 5B/F2-F5, 5C/F1,F2
PI - AFGWC Staff

Brief Description
The four-channel scanning radiometer, designated the sensor AVE (aerospace vehicle electronics) package (SAP), was the primary experiment on the DMSP 5B/5C series. The purpose of this experiment was to provide global, day/night cloud cover and cloud temperature measurements to support Department of Defense requirements for operational weather analysis and forecasting. The radiometer operated in two spectral intervals: (1) visible and near infrared (0.4 to 1.1 micrometers) and (2) infrared (8 to 13 micrometers). The four-channel radiometer was essentially two scanning radiometers driven by a common motor. One radiometer produced high resolution (HR) visual and infrared (IR) data with nadir resolutions of 3.7 and 4.4 km, respectively. The other radiometer produced very high resolution (VHR) visual and infrared (WHR) data with nadir resolutions of 0.63 and 0.67 km, respectively. Onboard recorders had a storage capacity of 210
min of both HR and IR data and a total of 20 min of VHR and WHR data. For direct readout to tactical sites, the experiment was programmed so that VHR and IR data were obtained during the daytime and HR and WHR data were obtained at night. The infrared channels (WHR and IR) covered a temperature range of 210 to 310 deg K with an accuracy of 1 deg K. Electronic circuitry in the sensor converted the sensed infrared energy directly into equivalent black body temperature (as opposed to radiance) prior to transmission to ground sites. The HR channel included a zero resolution sensor which measured solar input and was used to control channel gain, thereby producing an output signal that represents scene albedo. This feature also made it possible to obtain useful visual data at night. The sensor incorporated sunshades and glare suppression devices in conjunction with a long-scan automatic gain control which allowed the HR channel to provide usable data through the day/night terminator. Besides the earth surface/cloud cover imagery at the National Snow and Ice Data Center, Univ. of Colorado, Campus Box 449, Boulder, Colorado 80309, the auroral imagery data are available from the National Geophysical and Solar-Terrestrial Data Center, NOAA/National Environmental Satellite, Data, and Information Service (NESDIS), Boulder, Colorado 80303.

--------------DMSP 5B/F2-F5, 5C/F1,F2, AFGWC Staff--------------

Investigation Name - Vertical Temperature Profile Radiometer (SSE)

Flown on - DMSP 5B/F2,F3,F5, 5C/F1,F2

NSSDC ID - 72-018A-02, 72-089A-02, 74-015A-02, 74-063A-02, 75-043A-02

PI - AFGWC Staff

Brief Description

The Special Sensor E (SSE) was a vertical temperature profile radiometer. The objective of this experiment was to obtain vertical temperature and water vapor profiles of the atmosphere to support Department of Defense requirements in operational weather analysis and forecasting. The SSE was an eight-channel sensor with six channels (668.5, 677, 695, 708, 725, and 747 cm⁻¹) in the carbon dioxide 15-micrometer absorption band, one channel (535 cm⁻¹) in a water vapor absorption band, and one channel (835 cm⁻¹) in the 11-micrometer atmospheric window. The experiment consisted of an optical system, a detector and associated electronics, and a scanning mirror. The scanning mirror stepped across the satellite subtrack, allowing the SSE to view 25 separate columns of the atmosphere every 32 s over a cross-track ground swath of 185 km. While the scanning mirror stopped at a scene station, the channel filters were sequenced through the field of view.
The surface resolution of the SSE was approximately 37 km at nadir. The carbon dioxide band radiation data were transformed to a temperature profile by a mathematical inversion technique. By a similar technique, this information could be combined with water vapor band data to obtain a water vapor profile. No archival data were produced, due to lack of funds and storage facilities in the operational environment.

Investigation Name - Electron Spectrograph (SSJ)

Brief Description
The Special Sensor J (SSJ) was an electron spectrograph with one fixed channel and one stepping channel. The channels detected energetic electrons over ranges of energies associated with visible aurora. The fixed channel was 6 keV and the stepping channel cycled through eight energy thresholds: 54, 98, 219, 600, 1400, 3540, 8200, and 19700 eV. The data sample was taken approximately every second. The field of view was 3 deg by 12 deg.

Investigation Name - Electron Spectrograph (SSJ/2)

Brief Description
The Special Sensor J/2 (SSJ/2) was an improved version of the SSJ. It consisted of an electron spectrograph using a single stepping channel with six energy ranges. Nominal energy steps were 0.3, 0.68, 1.6, 3.5, 7.9, and 18 keV. The sampling rate was 0.0922 second per energy step, and the field of view was a 30-degree anti-earth cone.

Investigation Name - Gamma Ray Detector (SSB)

Brief Description
It consisted of an electron spectrograph using a single stepping channel with six energy ranges. Nominal energy steps were 0.3, 0.68, 1.6, 3.5, 7.9, and 18 keV. The sampling rate was 0.0922 second per energy step, and the field of view was a 30-degree anti-earth cone.
Brief Description

The instrument consisted of a four-detector array of cesium iodide scintillators and photomultiplier tubes each surrounded by a tantalum ring shield to provide a directional system. Each detector was positioned so that its most sensitive direction faced 30 deg from the vertical. Pulse-height discriminators were used to provide gamma-ray energy loss thresholds of 0.06, 0.15, and 0.375 MeV. Gamma rays produced in the atmosphere by cosmic rays, precipitating electrons, and other means could be monitored with this instrument.

************************DMSP 5D-1/F1-F4************************

Spacecraft Name - DMSP 5D/F1-F4

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DMSP 5D-1/F1,F2 PM - J.J. McGlinchey USAF Space Division
DMSP 5D-1/F3,F4 MG - J. Rivers USAF Space Division

Brief Description

DMSP 5D-1 series was one of a meteorological satellite series developed and operated by the Air Force. This program, previously known as DAPP (Data Acquisition and Processing Program), was classified until March 1973. The objectives of this program were to provide global visual and infrared cloud cover and specialized environmental data to support Department of Defense requirements for operational weather analysis and forecasting. The program consisted of two satellites in planned 830-km sun-synchronous polar orbits, with the ascending node of one satellite in early morning and the other at local noon. The 5.4-m-long spacecraft was separated into four sections: (1) a precision mounting platform (PMP) for sensors and equipment requiring precise alignment; (2) an equipment support module (ESM) containing the electronics, reaction wheels, and some meteorological sensors; (3) a reaction control equipment (RCE) support structure containing the spent third-stage rocket motor, and supporting the ascent phase reaction control equipment; and (4) a 9.29-sq-m solar cell panel. The Block 5D spacecraft stabilization was controlled by a combination flywheel and magnetic control coil system so sensors could be maintained in the desired "earth-looking" mode. One feature of Block 5D was the precision-pointing accuracy of the primary imager to 0.01 deg provided by a star sensor and an updated ephemeris navigation system. This allowed automatic geographical mapping of the digital imagery to the nearest picture element. The operational linescan
system (OLS) was the primary data acquisition system that provided real-time or stored, multi-orbit, day-and-night visual and infrared imagery at 0.6-km resolution for all major land masses, and 2.8-km resolution for complete global coverage. This series also had special meteorological sensors (SSC, SSD, SSH and SSM/T) and other sensors to measure electrons, gamma rays, ionospheric plasma, and X rays. The data processing system, included three high-density tape recorders, each of which could store 400 min of data. Either recorded or real-time data were transmitted to ground-receiving sites via two redundant S-band transmitters. Recorded data were read out to tracking sites located at Fairchild AFB, Wash., and Loring AFB, Maine, and relayed via Satcom to Air Force Global Weather Central, Offutt AFB, Nebraska. Real-time data were read out at mobile tactical sites located around the world. A more complete description of the Block 5D spacecraft can be found in the report, D. A. Nichols, "The Defense meteorological satellite program," Optical Engineering, v. 14, n. 4, July-August 1975. For information on meteorological data, users may contact SDS. For the availability of unclassified environmental data, users may direct inquiries to the National Geophysical and Solar-Terrestrial Data Center, NOAA/National Environmental Satellite, Data, and Information Service (NESDIS), Boulder, Colorado 80303.

-----------------------DMSP 5D-1/F1-F4, AFGWC Staff-----------------------

Investigation Name - Operational Linescan System (OLS)

Flown on - DMSP 5D-1/F1-F4

NSSDC ID - 76-091A-01, 77-044A-01, 78-042A-01, 79-050A-01

PI - AFGWC Staff AFGWC

Brief Description

The Operational Linescan System (OLS) was the primary experiment on the DMSP Block 5D spacecraft. The purpose of this experiment was to provide global, day/night observations of cloud cover and cloud temperature measurements to support Department of Defense requirements for operational weather analysis and forecasting. The OLS employed a scanning optical telescope driven in an oscillating motion, with optical compensation for image motion, which resulted in near-constant resolution throughout the sensor field of view. The radiometer operated in two ("light" and "thermal infrared") spectral intervals: (1) visible and near infrared (0.4 to 1.1 micrometers) and (2) infrared (8 to 13 micrometers). With DMSP 5D-1/F4, the OLS IR spectral band was changed from 8-13 micrometers to 0.5-12.6 micrometers to improve the sea surface temperature resolution. With onboard processing, the radiometer produced data in four modes: LF (light fine) and TF (thermal fine) data with a resolution of 0.56 km, and LS (light
smoothed) and TS (thermal smoothed) data with a resolution of 2.8 km. There were three onboard recorders, and each had a storage capability of 400 min of both LS and TS data or 20 min of LF and TF data. For direct readout to tactical sites, the experiment was programmed so that LF and TS data were obtained at night. The infrared data (TF and TS) covered a temperature range of 210 to 310 deg K with an accuracy of 1 deg K. The LS data mode provided visual data through a dynamic range from full sunlight down to a quarter moon. This mode also automatically adjusted the gain along scan to allow useful data to be obtained across the terminator. Additional information on this experiment is contained in the report, D. A. Nichols, "Primary optical subsystems for DMSP Block 5D," Optical Engineering, v. 14, n. 4, July-August 1975. Besides the earth surface/cloud cover imagery at the National Snow & Ice Data Center, Campus Box 449, Univ. of Colorado, Boulder, Colorado 80309, the auroral imagery is available from the National Geophysical and Solar-Terrestrial Data Center, NOAA/National Environmental Satellite, Data, and Information Service (NESDIS), Boulder, Colorado 80303.

------------------DMSP 5D-1/F1-F4, AFGWC Staff------------------

Investigation Name - Multispectral Filter Radiometer (SSH)

Flown on - DMSP 5D-1/F1-F4

NSSDC ID - 76-091A-02, 77-044A-02, 78-042A-02, 79-050A-02

PI - AFGWC Staff

Brief Description
Special Sensor H (SSH), also known as a Vertical Temperature Profile Radiometer (VTPR), was a cross-tracking scanning, multi-channel filter radiometer similar to the HIRS/2 on TIROS-N series. The objective of this experiment was to obtain vertical temperature, water vapor, and ozone profiles of the atmosphere to support Department of Defense requirements in operational weather analysis and forecasting. The SSH was a 16-channel sensor with one channel (1022 cm-1) in the 9.6-micrometer ozone absorption band, one channel (835 cm-1) in the 12-micrometer atmospheric window, six channels (747, 725, 708, 695, 676, 668.5 cm-1) in the 15-micrometer CO2 absorption band, and eight channels (535, 408.5, 441.5, 420, 374, 397.5, 355.4, 353.5 cm-1) in the 18- to 30-micrometer rotational water vapor absorption band. The experiment consisted of an optical system, detector and associated electronics, and a scanning mirror. The scanning mirror was stepped across the satellite subtrack, allowing the SSH to view 25 separate columns of the atmosphere every 32 s over a cross-track ground swath of 2000 km. While the scanning mirror stopped at a scene station, the channel filters were sequenced through the field of view. The surface resolution was approximately 39 km at nadir. Radiance
data were transformed into temperature, water vapor, and ozone profiles by a mathematical inversion technique. A more complete description of the experiment can be found in the report, D. A. Nichols, "DMSP Block 5D special meteorological sensor H, optical subsystem," Optical Engineering, v. 14, n. 4, pp. 284-288, July-August 1975. SDSD has the archival data and NSSDC has some ozone data.

------------------DMSP 5D-1/F1-F4, AFGWC Staff------------------

Investigation Name - Microwave Temperature Sounder (SSM/T)

Flown on - DMSP 5D-1/F4

NSSDC ID - 79-050A-06

PI - AFGWC Staff

Brief Description

The special sensor microwave/temperature sounder was a seven-channel scanning radiometer which measured radiation in the absorption band of molecular oxygen (50.5, 53.2, 54.35, 54.9, 58.4, 58.825, and 59.4 GHz) to provide data for vertical temperatures from the earth's surface to above 30 km. It was designed to scan in synchronization with the special sensor H package, and it provided temperature soundings at higher altitudes and cloudy regions inaccessible to SSH. By choosing frequencies with different absorption coefficients on the wing of the oxygen absorption band, a series of weighting functions peaking at preselected altitudes was obtained. The radiometer scanned across the nadir track on seven scan positions and two calibration positions (cold sky and 300 deg K). The dwell time for the crosstrack and calibration positions was 2.7 s each. The total scan period was 32 s. The instrument had an instantaneous field of view of 12 deg and scanned plus or minus 36 deg from the nadir. Data are available from SDSD.

------------------DMSP 5D-1/F1-F4, AFGWC Staff------------------

Investigation Name - Snow/Cloud Discriminator (SSC)

Flown on - DMSP 5D-1/F4

NSSDC ID - 79-050A-08

PI - AFGWC Staff

Brief Description

The Snow/Cloud Sensor was an experimental unit used in conjunction with the OLS sensor on spacecraft F4. The experiment being performed by the simultaneous in-orbit use of these two sensors is primarily that of proving the proposition that snow/cloud scene discrimination can be obtained through
the combination of near IR sensor data and OLS 1-channel
(visual) information. The snow/cloud detector was a
"push-broom" scan radiometer that depended upon orbital
velocity of the spacecraft to provide the along-track scan and
a linear array of 48 detector elements at the image plane of a
wide lens to provide a 40.2 deg cross-track scan. The sensor
measured the reflected solar energy in the 1.51- to 1.63-
micrometer spectral band.

------------------DMSP 5D-1/F1-F4, Blake-----------------

Investigation Name - GFE-3R Dosimeter (SSJ*)

Flown on - DMSP 5D-1/F1

NSSDC ID - 76-091A-03

PI - J.B. Blake
OI - S.J. Imamoto
OI - N. Katz
OI - W.A. Kolasinski

Aerospace Corp.
Aerospace Corp.
Aerospace Corp.
Aerospace Corp.

Brief Description

The purpose of the GFE-3R dosimeter was to measure the
radiation dose in silicon under aluminum shielding of four
thicknesses representative of Block 5D DMSP spacecraft. The
dosimeter consisted of four separate, single-detector units.
These omnidirectional sensors were small, cubical,
lithium-drifted, silicon detectors centered under hemispherical
shells, and heavily shielded (relative to the hemispherical
shell) over the rear 2 pi solid angle. The shielding domes for
the four sensors were 35, 75, 125, and 200 mils of aluminum,
respectively. The dosimeter directly measured the ionization
in the silicon cube caused by natural radiation and served as
an electron-proton spectrometer, thus yielding fluxes of
energetic electrons and protons encountered in the DMSP orbit,
as a function of time. Four integral discriminators, with
thresholds corresponding to deposited energy of 25, 75, 300,
and 5000 keV, were used to analyze the pulse-height spectrum of
signals produced by protons, electrons, and gamma rays entering
the detector. Individual pulses from the 25, 300, and 5000 keV
channels were counted in scaling registers, which were read out
and reset by the telemetry system every 3 s. Pulses, whose
amplitudes exceed the gating thresholds of 25 keV and 75 keV,
were integrated into 1 MeV equivalent energy pulses
(corresponding to a dose of 8.0E-6 rad), which were counted by
a cumulative storage register. These registers were read out
every 3 s but not reset by the telemetry so that the number of
counts read out at any time represented the total energy in MeV
deposited in the silicon active volume during the mission life.
Maximum accumulated dose storage corresponded to 5.5E5 rad.
Additional information can be obtained from Aerospace
Corporation publication number TOR-0077(2630)-1, June 1977.
Investigation Name - Remote X-Ray Sensor (SSB/O)

Flown on - DMSP 5D-1/F2

NSSDC ID - 77-044A-06

PI - P.F. Mizera Aerospace Corp.

Brief Description

The investigation was primarily concerned with X rays produced in the atmosphere by precipitating electrons. The instrument consisted of a large-area proportional counter and four circular cadmium-telluride (CdTe) semiconductors embedded in a hemispherical plastic scintillator that was viewed by a photomultiplier tube. The sealed proportional counter had a collimator and was sensitive to X rays from 1.5 to 20.0 keV. The CdTe detectors had discriminators that provided threshold values of 15, 30, 60, and 90 keV.

Investigation Name - Atmospheric Densit¥ Sensor (SSD)

Flown on - DMSP 5D-1/F4

NSSDC ID - 79-050A-07

PI - F.A. Morse Aerospace Corp.
OI - D. R. Hickman Aerospace Corp.
OI - A.B. Christensen Aerospace Corp.
OI - J.B. Pranke Aerospace Corp.

Brief Description

The SSD was a limb-scanning ultraviolet spectrometer which measured dayglow emissions from O and N2. The wavelengths of primary interest were at 1356 and 3371 A. Energetic photoelectrons were produced by photoionization of neutral molecules by solar EUV radiation. As these fast photoelectrons lost energy through collisions with neutrals, those with energy near 16 eV excited O and N2 to electronic states of energy higher than the ground states. The subsequent decay to the ground state produced emissions monitored by the SSD. The SSD measured light emitted by molecular nitrogen excitation in the LBH and 2d positive bands, and atomic oxygen in the 1356 and 1304 lines. The instrument also had the capability of providing spectral scans from 850 to 1200, from 1100 to 1600, and from 2900 to 3950 A at 4-, 6-, and 12-A resolution, respectively. Light was monitored with narrow collimators that provided a field of view of 0.1 deg x 4 deg. The SSD was mechanically driven to scan vertically through the earth's limb from 80 to 480 km. It provided approximately 50 sets of density profiles on the daylight portion of each orbit.
Investigation Name - Precipitating Electron Spectrometer (SSJ/3)
Flown on - DMSP 5D-1/F2-F4
NSSDC ID - 77-044A-03, 78-042A-03, 79-050A-03
PI - P.L. Rothwell

Brief Description
The spectrometer consisted of two different-sized cylindrical electrostatic analyzers (ESA) using channeltron electron multipliers. The ESAs pointed toward the zenith in order to measure precipitating electrons. The large ESA had a field of view (FOV) of 1.6 by 8.0 deg with a \((\Delta E)/E\) of 0.04, while the small one had an FOV of 3.7 by 4.8 deg with a \((\Delta E)/E\) of 0.072. The large ESA covered the range from 1 to 20 keV and the other one from 50 to 1000 eV. A complete eight-point spectrum from each unit was obtained in 1 s.

Investigation Name - Ionospheric Plasma Monitor (SSI/E)
Flown on - DMSP 5D-1/F2,F4
NSSDC ID - 77-044A-05, 79-050A-05
PI - R.C. Sagalyn

Brief Description
The instrument consisted of one spherical (SEA) and one planar (PEA) electrostatic analyzer. The SEA provided measurements of electron densities from 10 to 1 \(\times\) 10^6/cc in the temperature range from 200 to 15,000 deg K. The PEA measured ion temperatures in the same range as well as the average ion mass over the range 1 to 35 u. The PEA was oriented in the direction of the positive spacecraft velocity vector, while the SEA was oriented at right angles to this direction and away from the sun to minimize the effect of photoelectrons. The device also provided a measurement of the spacecraft potential.

Investigation Name - Gamma Ray Detector (SSB)
Flown on - DMSP 5D-1/F1,F3
NSSDC ID - 76-091A-04, 78-042A-04
PI - J. Shrum

AFTAC
Brief Description
The instrument consisted of a four-detector array of cesium iodide scintillators and photomultiplier tubes each surrounded by a tantalum ring shield to provide a directional system. Each detector was positioned so that its most sensitive direction faced 30 deg from the vertical. Pulse-height discriminators were used to provide gamma-ray energy loss thresholds of 0.06, 0.15, and 0.375 MeV. Gamma rays produced in the atmosphere by cosmic rays, precipitating electrons, and other means could be monitored with this instrument.

-------------------------------DMSP 5D-1/F1-F4, Snyder-------------------------------

Investigation Name - Passive Ionospheric Monitor (SSI/P)
Flown on - DMSP 5D-1/F2,F4
NSSDC ID - 77-044A-04, 79-050A-04
PI - A.L. Snyder AFGL

Brief Description
The instrument consisted of a high-frequency radio receiver connected to a short antenna that swept from 1.3 to 13.9 MHz in 100-kHz steps. The device was used to monitor the ionospheric breakthrough frequency of noise generated by manmade or natural sources below the F2 layer to obtain the critical frequency of this layer (foF2). The foF2 parameter was used in constructing electron-density profiles used in forecasting the state of the ionosphere. The instrument could detect electric fields down to 10 microvolt/m.

***********************DMSP 5D-2/F6-F7***********************

Spacecraft Name - DMSP 5D-2/F6-F7

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DMSP 5D-2/F6-F7 MG - S. McElroy USAF Space Division

Brief Description
DMSP 5D-2 series was one of a meteorological satellite series developed and operated by the Air Force. This program, previously known as DAPP (Data Acquisition and Processing Program), was classified until March 1973. The objective of this program was to provide global visual and infrared cloudcover data and specialized environmental data to support Department of Defense requirements for operational weather analysis and forecasting. Operationally, the program consisted
of two satellites in planned 830-km, sun-synchronous polar orbits, with the ascending node of one satellite in early morning and the other at local noon. The 6.4-m-long spacecraft was divided into four sections: (1) a precision mounting platform for sensors and equipment requiring precise alignment; (2) an equipment support module containing the electronics, reaction wheels, and some meteorological sensors; (3) a reaction control equipment to support structure containing the spent third-stage rocket motor, and supporting the ascent phase reaction control equipment; and (4) a 9.29-sq-m solar cell panel. The spacecraft stabilization was controlled by a combination flywheel and magnetic control coil system so sensors were maintained in the desired "earth-looking" mode. One feature was the precision-pointing accuracy of the primary imager to 0.01 deg, provided by a star sensor and an updated ephemeris navigation system. This allowed automatic geographical mapping of the digital imagery to the nearest picture element. The operational linescan system was the primary data acquisition system that provided real-time or stored, multi-orbit, day-and-night, visual and infrared imagery. This series also had special meteorological sensors such as the SSH-2 and the SSM/T and other sensors to measure electrons, gamma rays, ionospheric plasma, and X rays. Either recorded or real-time data were transmitted to ground-receiving sites by two redundant S-band transmitters. Recorded data were read out to tracking sites located at Fairchild AFB, Washington, and at Loring AFB, Maine, and relayed by SATCOM to Air Force Global Weather Central, Offutt AFB, Nebraska. Real-time data were read out at mobile tactical sites located around the world. A more complete description of the satellite can be found in the report by D. A. Nichols, "The Defense Meteorological Satellite Program," Optical Engineering, v. 14, n. 4, July-August 1975. For information on meteorological data, users may contact the National Snow and Ice Data Center, CIRES, Campus Box 449, University of Colorado at Boulder, Boulder, CO 80309. For the availability of unclassified environmental data, users may direct inquiries to the National Geophysical and Solar-Terrestrial Data Center, NOAA/National Environmental Satellite, Data and Information Service (NESDIS), Boulder, CO 80303.

Investigation Name - Operational Linescan System (OLS)

Flown on - DMSP 5D-2/F6-F7

NSSDC ID - 82-118A-01, 83-113A-01

PI - AFGWC Staff
Brief Description

The Operational Linescan System (OLS) was the primary experiment on the DMSP Block 5D spacecraft. The purpose of this experiment was to provide global day and night cloudcover observations and cloud temperature measurements. The OLS employed a scanning optical telescope driven in an oscillating motion, with optical compensation for image motion, which resulted in near-constant resolution throughout the sensor field of view. The radiometer operated in two ("light" and "thermal") spectral intervals: (1) visible and near infrared (0.4 to 1.1 micrometers) and (2) infrared (10.2 to 12.8 micrometers). The radiometer produced, with onboard processing, data in four modes: LF (light fine) and TF (thermal fine) data with a resolution of 0.56 km, and LS (light smoothed) and TS (thermal smoothed) data with a resolution of 2.8 km. There were four onboard recorders, each had a storage capability of 400 min of both LS and TS data or 20 min of LF and TF data. For direct readout to tactical sites, the experiment was programmed so that LF and TS data were obtained at night. The infrared data (TF and TS) covered a temperature range of 190 to 310 deg K with an accuracy of at best 2 deg K. The LS data mode provided visual data through a dynamic range from full sunlight down to a quarter moon. This mode also automatically adjusted the gain along the scan to allow useful data to be obtained across the terminator. Additional information on this experiment is contained in the report by D. A. Nichols, "Primary optical subsystems for DMSP Block 5D," Optical Engineering, v. 14, n. 4, July-August 1975. Data can be obtained through the National Snow & Ice Data Center, Campus Box 449, Univ. of Colorado, Boulder, Colorado 80309.

-----------------DMSP 5D-2/F6-F7, AFGWC Staff------------------

Investigation Name - Infrared Temperature Profile Sounder (SSH-2)
Flown on - DMSP 5D-2/F6
NSSDC ID - 82-118A-02
PI - AFGWC Staff

Brief Description

The objective of this experiment was to obtain vertical temperature and water vapor profiles of the atmosphere at altitudes from 0 to 30 km. The infrared temperature and moisture sounder, SSH-2, was a 16-channel sensor with one channel (3.7 micrometers) in the 3.7-micrometer window, one channel (11.1 micrometers) in the 12-micrometer window, six channels (13.4, 13.7, 14.1, 14.4, 14.8, 15.0 micrometers) in the 15-micrometer CO2 absorption band, and eight channels (12.5, 18.7, 20.1, 22.7, 23.9, 24.5, 25.2, 28.3 micrometers) in the 22- to 30-micrometer rotational water vapor absorption
band. The experiment consisted of an optical system, detector and associated electronics, and a scanning mirror. The scanning mirror was stepped across the satellite groundtrack, allowing the sounder to view 25 separate columns of the atmosphere every 32 s over a crosstrack ground swath of 2204 km. While the scanning mirror was stopped at each of the 25 positions, the channel filters were sequenced through the field of view. The crosstrack surface resolution was approximately 60 km at nadir. The radiance data were transformed into temperature and water vapor profiles by a mathematical inversion technique. The rms error of the temperature was 2.5 to 3 deg K. Archival data are available from SDSD at the National Climatic Data Center (NCDC), Room 100, World Weather Building, Washington, D. C. 20233.

------------------DMSP 5D-2/F6-F7, AFGWC Staff------------------

Investigation Name - Microwave Temperature Sounder (SSM/T)

Flown on - DMSP 5D-2/F7

NSSDC ID - 83-113A-03

PI - AFGWC Staff

Brief Description

The microwave temperature sounder, SSM/T, was a seven-channel scanning radiometer which measured radiation in the 5- to 6-mm wavelength (50- to 60-GHz) region, (specifically 50.5, 53.2, 54.35, 57.9, 58.4, 58.825, and 59.4 GHz) to provide data on the vertical temperature profile from the earth's surface to above 30 km. The SSM/T provided temperature soundings at higher altitudes and over cloudy regions inaccessible to an infrared temperature and moisture sounder. By choosing frequencies with different absorption coefficients on the wing of the oxygen absorption band, a series of weighting functions peaking at preselected altitudes was obtained. The radiometer scanned across the nadir track on seven scan positions and two calibration positions (cold sky and 300 deg K). The dwell time for the crosstrack and calibration positions was 2.7 s each. The total scan period was 32 s. The instrument had an instantaneous field of view of 12 deg and scanned plus or minus 36 deg from the nadir. Archival data are available from SDSD at the National Climatic Data Center (NCDC), Room 100, World Weather Building, Washington, D. C. 20233.
Investigation Name - Magnetometer (SSM)

Flown on - DMSP 5D-2/F7
NSSDC ID - 83-113A-06

PI - AFGWC Staff

Brief Description

The primary purpose of the magnetometer experiment was to obtain the components of magnetic field transverse to the main geomagnetic field at high latitudes which are associated with auroral field-aligned currents. The instrument consisted of (1) a triaxial fluxgate magnetometer with a fixed Z-axis sensor and adjustable X- and Y-axis sensors and (2) a signal processor to provide data at a 15-nT resolution over the range of 0 to 60,000 nT. Inquiries about data can be directed to Dr. Fred Rich, AFGL, Office PHG, Hanscom AFB, MA 01731.

Investigation Name - Space Radiation Dosimeter (SSJ*)

Flown on - DMSP 5D-2/F7
NSSDC ID - 83-113A-07

PI - AFGWC Staff

Brief Description

The primary purpose of the space radiation dosimeter was to measure the radiation dose above desired thresholds in silicon under aluminum shielding of four thicknesses representative of the Block 5D DMSP spacecraft. The instrument consisted of four detectors mounted beneath hemispherical domes of different thicknesses. Each detector was a pin-diffused junction silicon diode. The dosimeter directly measured the ionization in the silicon cube caused by natural radiation and served as an electron-proton spectrometer, thus yielding the fluxes of energetic electrons and protons encountered in the orbit as a function of time. The energy thresholds for measured electrons by different dome sensors were 1.0, 2.5, 5.0 and 10.0 MeV, and those for protons were 20, 35, 51, and 75 MeV. The radiation dose and the energetic electron flux obtained in this experiment may result in an optimization of space radiation-shielding design to protect sensitive electronics components. Inquiries about data can be directed to Ms. S. Gussenhoven at AFGL, Office PHG, Hanscom AFB, MA 01731.
Investigation Name - Scanning X-ray Spectrometer (SSB/A)

Flown on - DMSP 5D-2/F6

NSSDC ID - 82-118A-03

PI - A. Kolasinski

Brief Description

The primary objective of the scanning X-ray spectrometer, SSB/A, was to carry out studies in X rays, Lyman-alpha, and locally mirroring electrons. The instrument was composed of a high-energy and a low-energy scanning X-ray sensor, a Lyman-alpha sensor, and Geiger counters for monitoring electron background. The high-energy X-ray sensor consisted of three CdTe crystal detectors to measure X rays in the energy ranges 15 to 30 keV, 30 to 60 keV, 60 to 100 keV, and >100 keV. Each detector had an area of 1 sq cm and a 14-deg field of view. The low-energy X-ray sensor was a 3-atm single-wire proportional counter containing equal amounts of argon and xenon. It measured the flux of X rays in 24 logarithmically spaced energy bands between 1.8 and 78 keV. This sensor had an effective area of 3.7 sq cm and a 5-deg (in track) by 10-deg (crosstrack) field of view. The high- and low-energy X-ray sensors were mounted on separate scanning heads which scanned across the ground track through a 110-deg arc. A complete limb-to-limb scan took 10 s. The Lyman-alpha sensor detected prominent proton events. The two Geiger counters measured electron fluxes above 40 keV and 100 keV. Archival data can be obtained through Dr. David Gorney at the Aerospace Corporation, Space Science Lab, M2/262, P. O. Box 92957, Los Angeles, CA 90009.

Investigation Name - Precipitating Electron/Ion Spectrometer (SSJ/4)

Flown on - DMSP 5D-2/F6-7

NSSDC ID - 82-118A-05, 83-113A-05

PI - P. L. Rothwell

Brief Description

The primary purpose of the precipitating electron/ion spectrometer was to measure fluxes and energies of electrons and ions precipitated into the upper atmosphere. Particles were separated by an electrostatic analyzer into 20 energy bands from 30 eV to 30 keV: (1) 10 high-energy levels, at
0.948, 1.39, 2.04, 3.00, 4.40, 6.46, 9.48, 13.92, 20.44 and 30.00 keV; and (2) 10 low-energy levels, at 30.0, 44.0, 64.6, 94.9, 139.2, 204.4, 300, 440, 646, and 948 eV. Channeltrons were used to count the impinging electrons and ions in each energy band with particle flux accuracies of 1% and energy flux accuracies of 3.5%. Inquiries about data can be directed to Ms. S. Gussenhoven at the AFGL, Office PHG, Hanscom AFB, MA 01731.

------------------DMSP 5D-2/F6-F7, Sagalyn------------------

Investigation Name - Ionospheric Plasma Monitor (SSI/E)
Flown on - DMSP 5D-2/F6-F7
NSSDC ID - 82-118A-04, 83-113A-04
PI - R. C. Sagalyn USAF Geophys Lab

Brief Description
The instrument consisted of one spherical (SEA) and one planar (PEA) electrostatic analyzer. The SEA provided measurements of electron densities from 10 to 1E6 electrons/cc in the temperature range from 200 to 15,000 deg K. The PEA measured ion temperatures in the same range as well as the average ion mass over the range 1 to 35 u. The PEA was oriented in the direction of the positive spacecraft velocity. Inquiries about data can be directed to Dr. Fred Rich at AFGL, Office PHG, Hanscom AFB, MA 01731.

------------------DMSP 5D-2/F6-F7, Shrum------------------

Investigation Name - X-Ray Detector (SSB/S)
Flown on - DMSP 5D-2/F7
NSSDC ID - 83-113A-08
PI - J. Shrum USAF Tech Appl Ctr

Brief Description
The primary purpose of the X-ray detector, SSB/S, was to detect nuclear debris from nuclear detonations. The instrument consisted of three sensors. Two of the sensors were arrays of four 1-cm-diameter CdTe detectors which sensed X rays in the four energy bands >45 keV, >75 keV, >115 keV, and >165 keV. The third sensor was a NaI detector which sensed scintillation. Rotating the sensor assembly caused all three sensors to scan across the ground track.
**ESSA 1-9**

Spacecraft Name - ESSA 1-9

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Brief Description

ESSA 1-9 (Environmental Science Services Administration) were spin-stabilized operational meteorological spacecraft designed to take daytime cloudcover pictures and solar and terrestrial radiation on a global basis. They were also known as Operational TIROS (OT) and TIROS Operational Satellites (TOS). ESSA 1 had a redundant vidicon camera system. Later odd-number ESSA satellites were equipped with two advanced vidicon camera system (AVCS) cameras. Even-numbered ESSA satellites had two automatic picture transmission (APT) cameras. The AVCS satellites also carried a flat plate radiometer (FPR) system. The satellites had essentially the same configuration as that of the TIROS series, i.e., an 18-sided right prism, 107 cm across opposite corners and 56 cm high, with a reinforced baseplate carrying most of the subsystems and a cover assembly (HAT). Electrical power was provided by approximately 10,000 1- by 2-cm solar cells that were mounted on the cover assembly and by 21 nickel-cadmium batteries. A pair of crossed-dipole command and receiving antennas projected out and down from the baseplate. A monopole telemetry and tracking antenna extended up from the top of the cover assembly. Each satellite was placed in a cartwheel orbital mode, with its spin axis maintained normal to the orbital plane. The satellite spin rate and attitude were determined primarily by a magnetic attitude spin coil (MASC). The MASC was a current-carrying coil mounted in the cover assembly. The magnetic field induced by the current interacted with the earth's magnetic field to provide the necessary torque maintaining a desired spin rate of 9.225 rpm for odd-numbered ESSAs and 10.9 rpm for even-numbered ESSAs. Five small solid-fuel thrusters mounted around the baseplate provided a secondary means of controlling the spacecraft spin rate.
Investigation Name - Automatic Picture Transmission (APT)
Flown on - ESSA 2, 4, 6, 8
PI - NESDIS Staff

Brief Description
This system was a camera, tape recorder, and transmitter combination that could record and store a series of remote daytime cloudcover pictures for subsequent playback to a ground data acquisition facility. The cameras and tape recorder system were essentially the same as those on Nimbus 1 and 2. The ESSA AVCS system consisted of two redundant wide-angle cameras with 2.54-cm vidicons. The cameras were mounted 180 deg apart on the side of the spacecraft, with their optical axes perpendicular to the spin axis. The camera optical system employed a 108-deg lens with a focal length of 6.0 mm. Each camera was independently triggered into action only when it came into view of the earth. A video frame consisted of 0.25 s of blanked video followed by 6.25 s of vidicon scan (833 lines) and a final 0.25-s period of blanked video. Concurrent with shutter actuation, a 16-increment gray scale was included at the edge of each picture frame as a contrast check. A four-track tape recorder could store up to 36 pictures. The data could be read out between picture-taking cycles without losing a picture or interrupting a sequence. Six or 12 AVCS pictures per orbit could be programmed. At nominal attitude and altitude (approximately 1450 km), a picture covered a 3100- by 3100-km square with a horizontal resolution of about 3 km at nadir. There was a 50% overlap along the track between successive pictures to ensure complete coverage. The experiment was a success. Data from this experiment are available through SDSD. For an index of available data, see the "Catalog of Meteorological Satellite Data - ESSA 3 Television Cloud Photography," "Catalog of Meteorological Satellite Data - ESSA 3 and ESSA 5 Television Cloud Photography," etc., for sale from the U.S. Superintendent of Documents.
Brief Description

This experiment was a camera and transmitter combination designed to transmit real-time, daylight, slow-scan television pictures of cloud cover to any properly equipped ground receiving station. The camera system consisted of two redundant APT cameras with 2.54-cm-diameter vidicons. Each camera had a 108-deg wide-angle f/1.8 objective lens with a focal length of 5.7 mm. The cameras were mounted 180 deg apart on the side of the spacecraft, with their optical axes perpendicular to the spacecraft spin axis. The cameras were programmed to take four or eight APT pictures per orbit. The actual photography required 8 s and the transmission 200 s. Earth-cloud images retained on the photosensitive surface of the vidicon were read out at four lines per second to produce an 800-line picture. Two 5-W TV transmitters (137.5 MHz) relayed the pictures to local APT stations within communication range. The faceplate of the vidicon had reticle marks that appeared on the picture format to aid in relating the picture to its geographical position on the earth's surface. At nominal satellite attitude and altitude (approximately 1450 km), a picture covered a 3100- by 3100-km square with a horizontal resolution of about 4 km at nadir. There was a 30% overlap between pictures along the track to ensure complete coverage. APT data were primarily intended for operational use within the local APT acquisition station.

----------------------ESSA 1-9, NESDIS Staff----------------------

Investigation Name - Vidicon Camera System

Flown on - ESSA 1

NSSDC ID - 66-008A-01

PI - NESDIS Staff

NOAA-NESDIS

Brief Description

This system was a camera, tape recorder, and transmitter combination that could record and store a series of remote daytime cloudcover pictures for subsequent playback to a ground data acquisition facility. The system was similar to those flown on previous TIROS missions, consisting of two redundant 500-scan-line TV cameras with 1.27-cm vidicons. The cameras were mounted 180 deg apart on the side of the spacecraft and were canted 75 deg from the spacecraft spin axis. The cameras were triggered into action only when they came into view of the earth. Each tape recorder had two separate channels, one for storing video signals and one for sun-angle data, which served as a time reference. Up to 32 pictures consisting of five levels of gray could be stored for subsequent playback. At nominal attitude and altitude (approximately 1450 km), the cameras covered a 1200- by 1200-km square with a spatial...
resolution of about 3 km at nadir. The experiment was a success. Data from this experiment are available through SDSD. For a complete index of data, see parts 1 and 2 of the "Catalog of Meteorological Satellite Data - ESSA 1 Television Cloud Photography," for sale from the U.S. Superintendent of Documents.

---------------ESSA 1-9, Suomi---------------

Investigation Name - Flat Plate Radiometer (FPR)

Flown on - ESSA 3, 5, 7, 9


PI - V.E. Suomi
OI - R.S. Parent

U of Wisconsin
U of Wisconsin

Brief Description

This experiment was designed to provide a measurement of the global distribution of reflected solar and long-wave radiation leaving the earth. The FPR system was comprised of four infrared sensors, an analog-to-digital converter, a commutator, and a tape recorder. Two pairs of radiometers were mounted on opposite sides of the spacecraft, with their axes perpendicular to the spin axis. A cone shield was employed on two of the radiometers to isolate or reduce any response due to direct solar radiation. The field of view on the other two instruments was unrestricted. Both types of radiometers used a coated (either black or white) aluminum disk as the sensing element. The disk temperature was measured by two thermistors mounted on the back surface of the disk. The black-coated disk responded to the sum of the reflected solar, direct solar, and emitted long-wave radiation. The white disk reflected in the visual range but absorbed in the infrared (7 to 30 micrometers) range. Data from this experiment are available through SDSD.

**************************Gemini 3-12**************************

Spacecraft Name - Gemini 3-12

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60
Brief Description

The specific objectives of the Gemini missions were (1) to determine how man performs in the space environment on flights of as much as 2 weeks; (2) to develop the capability to rendezvous with another craft and dock with it; (3) to maneuver the combined vehicles; (4) to provide a platform for scientific, engineering and medical experiments; (5) to develop methods of controlling reentry flight paths to selected landing areas; and (6) to develop astronaut space-flight experience, including extravehicular activity. The experiments conducted during manned flights derived from a variety of disciplines including aeronomy, astronomy, biology, physiology, geography, geology, meteorology, and space physics. The Gemini missions were highly successful and produced some significant experimental results.

-----------------------Gemini 3-12, Lowman-----------------------

Investigation Name - Synoptic Terrain Photography

Flown on - Gemini 3-12


PI - P.D. Lowman, Jr. NASA-GSFC

Brief Description

This experiment was designed to take high-quality color photographs of selected land and near-shore areas of the earth by hand-held cameras for geologic, geographic, and oceanographic studies. For the Gemini 3-9, a 70-mm Hasselblad 500C camera with a Zeiss Planar 80-mm f/2.8 lens was used to obtain the photographs. The Gemini 7 had another Zeiss Sonnar 250-mm f/4.5 lens. For the Gemini 9-12, two cameras were used. (Thus, with these two cameras plus the Hasselblad camera mentioned above, Gemini 9 had three cameras.) One camera was a super wide-angle Hasselblad 70-mm with a Zeiss Biogon 38-mm f/4.5 lens, and the other one was a specially designed Maurer camera with a Xenotar 80-mm f/2.8 lens. Haze filters were used on all cameras to reduce the intensity of blue light scattering from the atmosphere. This experiment was not formally scheduled on Gemini 3, but useful pictures were taken by the astronauts. Data from this experiment are available from the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota. The index of photographs can be found in "Earth Photographs from Gemini III, IV, and V" (NASA SP-129) and "Earth Photographs from Gemini 6 through 12" (NASA SP-171).
Investigation Name - Synoptic Weather Photography

Flown on - Gemini 4-12


PI - K. Nagler
OI - S. Soules

Brief Description
The synoptic weather photographs were taken by the same cameras used for the synoptic terrain photography experiment. Photographs were taken when the spacecraft were in a nearly vertical position. The photographs are archived at the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota. The index of photographs can be found in "Earth Photographs from Gemini III, IV, and V" (NASA SP-129) and "Earth Photographs from Gemini 6 through 12" (NASA SP-171).

***********************ITOS 1, NOAA 1-5***********************

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Brief Description
The primary objective of the ITOS 1/NOAAs 1-5 three-axis stabilized, sun-synchronous meteorological satellites was to provide improved operational infrared and visual observations of earth cloud cover, surface/cloud top temperatures, and global atmospheric temperature soundings for weather analysis and forecasting. The secondary objective was to provide solar...
proton flux data on a regular daily basis. ITOS 1 and NOAA 1 each had five experiments: (1) advanced vidicon camera system (AVCS), (2) automatic picture transmission (APT), (3) scanning radiometer (SR), (4) flat plate radiometer (FPR), and (5) solar proton monitor (SPM). NOAA 2-5 were redesigned to incorporate two instruments and to eliminate the APT and AVCS cameras as well as the FPR. With the addition of the very high resolution radiometer (VHRR) and the vertical temperature profile radiometer (VTPR), NOAA 2-5 entirely relied on scanning radiometers for images and carried an operational instrument capable of obtaining vertical temperature profiles of the atmosphere. The nearly cubical spacecraft measured 1 by 1 by 1.2 m. The spacecraft was equipped with three curved solar panels that were folded during launch and deployed after orbit was achieved. Each panel measured over 4.2 m in length when unfolded and was covered with 3420 solar cells, each measuring 2 by 2 cm. The attitude control system maintained desired spacecraft orientation through gyroscopic principles incorporated into the satellite design. Earth orientation of the satellite body was maintained by taking advantage of the precession induced from a momentum flywheel so that the satellite body precession rate of one revolution per orbit provided the desired "earth looking" attitude. Minor adjustments in attitude and orientation were made by means of magnetic coils and by varying the speed of the momentum flywheel.

------------ITOS 1, NOAA 1-5, NESDIS Staff-------------

Investigation Name - Advanced Vidicon Camera System (AVCS)

Flown on - ITOS 1, NOAA 1

NSSDC ID - 70-008A-04, 70-106A-04

PI - NESDIS Staff

Brief Description

The Advanced Vidicon Camera System (AVCS) was a redundant camera and tape recorder combination designed to record a series of wide-angle, high-resolution television pictures of the earth and its cloud cover during daylight. The AVCS operated in three modes: record, playback, and direct readout. The AVCS system was essentially the same as that used on all TOS/ESSA spacecraft (ESSAs 3, 5, 7, and 9). The two major elements of the system were (1) the camera sensor assembly, which contained lens, shutter, grayscale calibrator, vidicon, deflection yoke, camera electronics module, and power circuits, and (2) a preamplifier for converting optical images into electrical signals. The earth-oriented camera used a 108-deg wide-angle lens (5.7-mm focal length) with an f/1.8 aperture and a 2.54-cm-diameter vidicon with 833 scan lines. A video frame consisted of 0.25 s of blanked video, followed by 6.25 s
of vidicon scan video (833 lines), and a final 0.25-s period of
blanked video. Eleven pictures were taken at 260-s intervals
to cover the sunlit portion of the earth (sun elevation greater
than 15 deg). The tape recorder could be read out between
photographic cycles without losing a picture or interrupting a
sequence. At nominal satellite altitude (1450 km), the AVCS
pictures covered a 3000- by 3000-km square with a ground
resolution of about 3 km at nadir. There was a 50% picture
overlap along the track to ensure complete coverage. The
recorder could store up to 38 pictures (three orbits of data)
in a single start-stop operation. Data are available through
SDSD.

Investigation Name - Automatic Picture Transmission (APT)
Flown on - ITOS 1, NOAA 1
NSSDC ID - 70-008A-05, 70-106A-05
PI - NESDIS Staff
NOAA-NESDIS

Brief Description
The Automatic Picture Transmission (APT) experiment was
designed to automatically take wide-angle, slow scan television
pictures of the earth and its cloud cover during daylight.
This experiment consisted of two APT subsystems. The
photographic operations of APT were controlled by program
commands transmitted to the satellite by the command and data
acquisition (CDA) stations. A complete APT picture sequence
lasted approximately 46 min, during which 11 pictures were
taken at 260-s intervals. These pictures were transmitted by
137.62-MHz real-time transmitters to APT-equipped ground
stations within communication range of the satellites. The APT
subsystem was essentially the same as that used on the TOS/ESSA
spacecraft (ESSAs 2, 4, 6, and 8). The major elements of the
subsystem were the camera sensor assembly, video amplifier,
camera electronics module, and power circuits. The
earth-oriented camera used a 108-deg (5.7-mm focal length)
wide-angle lens with a maximum aperture of f/1.8 and a
2.54-cm-diameter vidicon with 600 scan lines. At the nominal
satellite altitude of 1450 km, each picture covered
approximately 3140 km across the track and 2400 km along the
track with a ground resolution of about 3 km at nadir. There
was an approximate 20% overlap between pictures along the track
to ensure complete coverage. APT data were intended primarily
for local operational use within an APT acquisition station and
generally are not available for distribution.
Investigation Name - Scanning Radiometer (SR)

Flown on - ITOS 1, NOAA 1-5

NSSDC ID - 70-008A-03, 70-106A-03, 72-082A-02, 73-086A-02, 74-089A-02, 76-077A-03

PI - NESDIS Staff

Brief Description
The Scanning Radiometer (SR) experiment consisted of two scanning radiometers, a dual processor, and two recorders. This subsystem permitted the determination of surface temperatures of the ground, the sea, or cloud tops viewed by the radiometers. The radiometer measured reflected radiation from the earth-atmosphere system in the 0.52- to 0.73-micrometer band during the day and emitted radiation from the earth and its atmosphere in the 10.5- to 12.5-micrometer band day and night. The SR on NOAA's 2 and 5 had an additional channel in the 0.50- to 0.94-micrometer region. Unlike a camera, the SR did not take a picture but instead formed an image using a continuously rotating mirror. The mirror scanned the earth's surface perpendicular to the satellite's orbital path at a rate of 48 rpm. As the satellite progressed along its orbital path, each rotation of the mirror provided one scan line of picture. Radiation collected by the mirror was passed through a beam splitter and spectral filter to produce the desired spectral separation. Up to two full orbits of data (145 min) could be stored on magnetic tape for subsequent transmission (1697.5 MHz) to one of the two acquisition stations. The data could also be transmitted in real time to local automatic picture transmission (APT) stations. Once the signal was received by the ground station, a continuous picture was formed by using a facsimile recorder whose scan was in phase with the satellite's forward motion. At nominal spacecraft altitude (approximately 1450 km), the radiometer had a ground resolution of better than 4 km at nadir. The radiometer was capable of yielding radiance temperatures between 185 and 330 deg K to an accuracy of 4 and 1 deg K, respectively. Data from this experiment are available through SDSD.

Investigation Name - Very High-Resolution Radiometer (VHRR)

Flown on - NOAA 2-5

NSSDC ID - 72-082A-03, 74-089A-03, 76-077A-01, 73-086A-03

PI - NESDIS Staff
Brief Description

The Very High-Resolution Radiometer (VHRR) experiment was designed to continuously measure surface temperatures of the earth, sea, and cloud tops day and night. The data were transmitted in real time to high-resolution picture transmission (HRPT) receiving stations throughout the world for local weather forecasting. In addition, 8 min of data per orbit were programmed for storage in the satellites for later playback to command and data acquisition (CDA) stations. The experiment included two scanning radiometers, a magnetic tape recorder, and associated electronics. The two-channel VHRR operation was similar to that of the scanning radiometer (SR) but with much greater resolution (0.9 km compared to 4 km for the SR at nadir). One VHRR channel measured reflected visual radiation from cloud tops in the spectral range of 0.6 to 0.7 micrometer. This provided more contrast between the earth and clouds than the SR by reducing the effect of haze. The second channel measured infrared radiation emitted from the earth, sea, and cloud tops in the 10.5- to 12.5-micrometer region. This spectral region permitted both daytime and nighttime radiance measurements. The VHRR formed an image by using a scanning mirror technique similar to the SR except that both radiometers operated simultaneously. As the satellite proceeded in its orbit, the 400-rpm revolving mirrors scanned the earth's surface 180 deg out of phase (one mirror at a time) and perpendicular to the orbit path. The visible and infrared data were time-multiplexed so that the scan of the infrared channel transmitted first, followed by the earth scan portion of the visible channel. This process was repeated 400 times per minute (equivalent to the scan rate). If one radiometer failed, the system was still capable of measuring both visible and infrared radiation using only the remaining radiometer. Data from this experiment are presently maintained at SDSD.

-------------------ITOS 1, NOAA 1-5, NESDIS Staff-------------------

Investigation Name - Vertical Temperature Profile Radiometer (VTPR)

Flown on - NOAA 2-5


PI - NESDIS Staff NOAA-NESDIS

Brief Description

This experiment consisted of two Vertical Temperature Profile Radiometer (VTPR) subsystems. The VTPR sensed the radiance energy from atmospheric carbon dioxide in six narrow spectral regions centered at 15.0, 14.8, 14.4, 14.1, 13.8, and 13.4 micrometers. The atmospheric gross water vapor content was determined from measurements centered at 18.7 micrometers. Measurements were also taken in the 12.0-micrometer spectral
region to determine surface/cloud top temperatures. The VTPR consisted of an optical system, a detector and associated electronics, and a scanning mirror. The scanning mirror looked at the earth's surface perpendicular to the satellite orbital path. As each area was scanned, the optical system collected, filtered, and detected the radiation from the earth into the eight spectral intervals. The field of view contributing to one profile was approximately 50 sq km at the ground. The radiometer operated continuously, taking measurements over every part of the earth's surface twice a day. The data were recorded throughout the orbit and played back on command when the satellite was within communication range of a command and acquisition station. Ground personnel used the data to compute temperature-pressure profiles to altitudes as high as 30 km. Data from this experiment are presently maintained at SDSD.

---------------------ITOS 1, NOAA 1-5, Suomi---------------------

Investigation Name - Flat Plate Radiometer (FPR)

Flown on - ITOS 1, NOAA 1

NSSDC ID - 70-008A-02, 70-106A-02

PI - V.E. Suomi U of Wisconsin

Brief Description

The Flat Plate Radiometer (FPR) system was designed to provide a measurement of the global distribution of reflected solar and longwave radiation leaving the earth. The FPR system consisted of four detectors, an analog-to-digital converter, and a tape recorder. The detectors had a hemispheric field of view of 2 pi sr and were mounted on the satellite baseplate facing earth. The detectors used coated aluminum disks as a sensing element. Two of the disks were white and responded only to infrared energy (7 to 30 micrometers) radiated from the earth and its atmosphere. The other two disks were painted black and had a broader band sensitivity (0.3 to 30 micrometers). Two disks (one of each type) had a thermistor bolometer mounted on the back surface to measure the disk temperature. The other two disks used thermopiles. A similar experiment was flown on ESSA 3, 5, 7, and 9. For a full description of the FPR system, see "Studies in Atmospheric Energetics based on Aerospace Probings, Annual Report -1967," pp. 179-189, Dept. Meteorology, University of Wisconsin, March 1968.
Investigation Name - Solar Proton Monitor

S/C          NSSDC ID  PI            OI
ITOS 1,      70-008A-01  D.J. Williams
NOAA 1,2     70-106A-01  APL
         72-082A-01
NOAA 3-5     73-086A-01  D.J. Williams  H.H. Sauer
         74-089A-01  APL  NOAA-ERL
         76-077A-04

Brief Description
Three solid-state detectors monitored the omnidirectional fluxes of solar protons with energies above 10, 30, and 60 MeV, respectively. Two telescopes, consisting of solid state detectors, each measured directional fluxes of protons in three energy intervals (0.27 - 3.2 MeV, 3.2 - 60 MeV, and above 60 MeV) and of alpha particles between 12.5 and 32 MeV. In the polar cap region, which was of the greatest interest, the telescopes looked parallel to and perpendicular to the local magnetic field direction. An additional solid state detector measured directional fluxes of electrons of energy >140 keV. This detector looked in a direction perpendicular to the orbit plane. Data are available from the National Geophysical and Solar-Terrestrial Data Center, NOAA/National Environmental Satellite, Data, and Information Service (NESDIS), Boulder, Colorado.

********************************************Landsat 1-3********************************************

Spacecraft Name - Landsat 1-3

Name          ID         Date     (deg)  (km)   (km)   (min)
Landsat 1     ERTS-A    72-058A  07/23/72 99.1 897 917 103.1
Landsat 2     ERTS-B    75-004A  01/22/75 99.1 907 918 103.3
Landsat 3     Landsat-C 78-026A  03/05/78 99.1 897 914 103.1

S/C          PM          PS
Landsat 1,2  C.M. MacKenzie  S.C. Freden
             NASA-GSFC     NASA-GSFC
R.K. Browning  W.P. Nordberg (Deceased)
             NASA-GSFC     NASA-GSFC
J. Sargent (Retired)
             NASA-GSFC
S. Weiland (Retired)
             NASA-GSFC
Landsat 3    C.M. MacKenzie  S.C. Freden
             NASA-GSFC     NASA-GSFC
R.K. Browning
             NASA-GSFC
Brief Description

Landsats 1-3 were modified versions of the Nimbus series of meteorological satellites. The near-polar orbiting spacecraft served as a stabilized, earth-oriented platform for obtaining near-global coverage of data on agricultural and forestry resources, geology and mineral resources, hydrology and water resources, geography, cartography, environmental pollution, oceanography and marine resources, and meteorological phenomena. To accomplish these objectives, each spacecraft was equipped with (1) a three- or two-camera return beam vidicon (RBV) to obtain visible and near IR photographic images of the earth, (2) a four- or five-channel multispectral scanner (MSS) to obtain radiometric images of the earth, and (3) a data collection system (DCS) to collect information from remote, individually equipped ground stations and to relay the data to central acquisition stations. Landsat 1-3 carried two wide-band video tape recorders (WBVTR) capable of storing up to 30 min of scanner or camera data. An advanced attitude control system consisting of horizon scanners, sun sensors, and a command antenna combined with a freon gas propulsion system permitted the spacecraft's orientation to be maintained within plus or minus 0.7 deg in all three axes. Spacecraft communications included a command subsystem operating at 154.2 and 2106.4 MHz, and a PCM narrow-band telemetry subsystem. operating at 2287.5 and 137.86 MHz, for spacecraft house-keeping, attitude, and sensor performance data. Video data from the RBV system were transmitted in both real-time and tape-recorder modes at 2265.5 MHz, while information from the MSS was constrained to a 20-MHz bandwidth at 2229.5 MHz. More information can be found in "Landsat Data Users Handbook," available from U.S. Geological Survey, Arlington, Va.

---------------Landsat 1-3, Arluskas, Freden---------------

Investigation Name - Multispectral Scanner System (MSS)

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Brief Description

The Multispectral Scanner (MSS) was designed to provide repetitive daytime acquisition of high-resolution, multispectral data of the earth's surface on a global basis and to demonstrate that remote sensing from space is a feasible and practical approach to efficient management of the earth's resources. In addition to obtaining data for use in earth resource type studies, the MSS system was used to conduct oceanographic and meteorological studies, i.e., to map sea-ice fields, locate and track major ocean currents, monitor both air and water pollution, determine snow cover, investigate severe storm environments, etc. The MSS consisted of a 22.86-cm
double reflector-type telescope, scanning mirror, filters, detectors, and associated electronics. The scanner on Landsats 1 and 2 operated in the following spectral intervals: (1) 0.5 to 0.6 micrometer, (2) 0.6 to 0.7 micrometer, (3) 0.7 to 0.8 micrometer, and (4) 0.8 to 1.1 micrometers (these bands were designated as bands 4, 5, 6, and 7, respectively). The Landsat 3 MSS had an additional band in the 10.4- to 12.6-micrometer thermal region (band 8). This thermal band failed on July 11, 1978, and produced little useful data. Incoming radiation was collected by the scanning mirror, which oscillated 2.89 deg to either side of nadir and scanned cross-track swaths 185-km wide. The along-track scan was produced by the orbital motion of the spacecraft. The primary image produced at the image plane of the telescope was relayed by fiber optic bundles to detectors where conversion to an electronic signal was accomplished. Optical filters were used to produce the desired spectral separation. Six detectors were employed in each of the four spectral bands: bands 4 through 6 used photomultiplier tubes as detectors, band 7 used silicon photodiodes. Band 8 on Landsat 3 had two Hg-Cd-Te detectors. A multiplexer included in the MSS system processed the scanner's 24 (26 for Landsat 3) channels of data. The data were time-multiplexed and then converted to a pulse-code modulated signal by an A/D converter. The data were then transmitted (at 2229.5 MHz) directly to an acquisition station or, in the case of remote areas, stored on magnetic tape for subsequent playback the next time the spacecraft came within the communication range of an acquisition station. The ground resolutions were 80 m for bands 4 to 7 and 240 m for band 8. Data from this experiment were handled by the NASA Image Processing Facility, GSFC, Greenbelt, Md. Archival data can be obtained through the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

------------------Landsat 1-3, Weinstein, Freden------------------

Investigation Name - Return Beam Vidicon Camera System

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Brief Description

The Landsat 1 and 2 Return Beam Vidicon (RBV) camera system contained three independent cameras taking pictures of earth scenes simultaneously during the daytime in three different spectral bands from blue-green (0.47 to 0.575 micrometer) through yellow-red (0.58 to 0.68 micrometer) to near IR (0.69 to 0.83 micrometer). While designed primarily to obtain information for earth resource type studies, the RBV camera system also conducted meteorological studies, i.e., to investigate atmospheric attenuation and to observe mesoscale phenomena, winter monsoon clouds (Japan), snow cover, etc. The
three earth-oriented cameras were mounted to a common base, which was structurally isolated from the spacecraft to maintain accurate alignment. Each camera contained an optical lens, a 5.08-cm RBV, a thermoelectric cooler, deflection and focus coils, a mechanical shutter, erase lamps, and sensor electronics. The cameras were similar except for the spectral filters contained in the lens assemblies that provided separate spectral viewing regions. The viewed ground scene, 185 by 185 km in area, was stored on the photosensitive surface of the camera tube, and, after shuttering, the image was scanned by an electron beam to produce a video signal output. Each camera was read out sequentially, requiring about 3.5 s for each of the spectral images. The cameras were operated every 25 s to produce overlapping images along the direction of spacecraft motion. Video data from the RBV were transmitted (at 2265.5 MHz) in both real-time and tape recorder modes. From a nominal spacecraft altitude of 900 km, the RBV had a ground resolution of about 80 m. The Landsat 3 RBV system, consisting of two panchromatic cameras, produced two side-by-side images rather than three overlapping images of the same scene. Each camera had the same spectral band of 0.505 to 0.750 micrometer. The two cameras were aligned to view adjacent 98-km square ground scenes which overlapped slightly so that the total width of the swath was 185 km. The cameras were operated every 12.5 s to produce overlapping images along the direction of spacecraft motion. After shuttering, the image was scanned by an electron beam to produce a video output signal. A 3.5-s offset was introduced between the readouts of the two cameras, permitting sequential readout, and allowing the same tape recorder and communications channel to be used. The Landsat 3 RBV had a better ground resolution of 40 m. Data from this experiment can be obtained through the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

***************Landsat 4, 5***************

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MG - B.B. Schardt
PM - L. Gonzales
PS - V.V. Salomonson

Brief Description
The Landsat 4 was an earth resources monitoring system with the new powerful remote-sensing capabilities of the thematic mapper (TM), and provided a transition for both
foreign and domestic users from the multispectral scanner (MSS) data to the higher resolution and data rate of the TM. It had a complete end-to-end highly automated data system, which was designed to be a new generation system, and was a major step forward in global remote-sensing applications. The Landsat 4 mission consisted of an orbiting satellite (flight segment) with the necessary wideband data links and support systems, and a ground segment. The Landsat 4 flight segment consisted of two major systems: (1) the instrument module, containing the two sensing instruments together with the mission unique subsystems, such as the solar array and drive, the TDRS (Tracking and Data Relay Satellite) antenna, the wide-band module (WBM), and the global positioning system (GPS); and (2) the multimission modular spacecraft (MMS) that contained the modularized and standardized power, propulsion, attitude control, and communications and data handling subsystems. The flight segment was designed with 3 years nominal life time in orbit and could be extended through in-orbit replacement capability when the shuttle becomes operational. The spacecraft was placed into an orbit having a descending node with equatorial crossing between 9:30 and 10:00 a.m. local time. The spacecraft and attendant sensors were operated through the GSTDN stations before the Tracking And Data Relay Satellite System (TDRSS) became available. Landsat 4 experienced failures of X-band transmission, primary command and data handling computer, and two of its four solar array panels after launch. Landsat 5 was forced to be launched earlier. Landsat 5 was identical to Landsat 4 in all aspects, but with those anomalies repaired.

--------------Landsat 4,5, Salomonson-------------------

Investigation Name - Multispectral Scanner System (MSS)

NSSDC ID - 82-072A-02, 84-021A-02

PI - V.V. Salomonson NASA-GSFC

Brief Description

The Multispectral Scanner (MSS) was designed to provide repetitive daytime acquisition of high-resolution, multispectral data of the earth's surface on a global basis and to demonstrate that remote sensing from space is a feasible and practical approach to efficient management of the earth's resources. In addition to earth resource type studies, the MSS system was used to conduct oceanographic and meteorological studies, i.e., to map sea-ice fields, locate and track major ocean currents, monitor both air and water pollution, determine snow cover, investigate severe storm environments, etc. The MSS consisted of a 22.86-cm double reflector-type telescope, scanning mirror, filters, detectors, and associated electronics. The scanner operated in the following spectral intervals: band 1, 0.5 to 0.6 micrometer; band 2, 0.6 to 0.7
micrometer; band 3, 0.7 to 0.8 micrometer; and band 4, 0.8 to 1.1 micrometers (the band numbering was different from Landsats 1-3). The Landsat 4 MSS was similar to the Landsat 1-3 MSS except for changes necessary to accommodate the lower orbital altitude. The swath width of 185 km remained the same by increasing the FOV of the sensors from 11.56 to 14.92 deg. The ground resolution was approximately 83 m for all four bands. The primary image produced at the image plane of the telescope was relayed by use of fiber optic bundles to detectors where conversion to an electronic signal was accomplished. Optical filters were used to produce the desired spectral separation. Six detectors were employed in each of the four spectral channels: bands 1 through 3 used photomultiplier tubes as detectors, band 4 used silicon photodiodes. A multiplexer included in the MSS system processed the scanner's video data. The data were time-multiplexed and then converted to a pulse-code modulated signal by an A/D converter. The data were then transmitted via the Tracking And Data Relay Satellites (TDRS) and/or direct readout to local receiving stations. Data can be obtained through the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

---------------------Landsat 4,5, Barker---------------------

Investigation Name - Thematic Mapper (TM)

NSSDC ID - 82-072A-01, 84-021A-01

PI - J. Barker NASA-GSFC

Brief Description

The Thematic Mapper (TM) was a seven-band, earth-looking, scanning radiometer with a 30-m ground element resolution covering a 185-km ground swath from a 705-km altitude. The instrument consisted of primary imaging optics, scanning mechanism, spectral band discrimination optics, detector arrays, radiative cooler, inflight calibrator, and required operating and processing electronics. The scanning mechanism provided the cross-track scan, while the progress of the spacecraft provided the scan along the track. The optical system imaged the earth's surface on a field stop or a detector sized to define an area on the earth's surface 30-m square. Several lines were scanned simultaneously to permit suitable dwell time for each resolution element. The variation in radiant flux passing through the field stop onto the photo and thermal detectors creates an electrical output that represents the radiant history of the line. Seven spectral bands were used to provide the spectral signature capability of the instrument: band 1, 0.45-0.52 micrometer; band 2, 0.52-0.60 micrometer; band 3, 0.63-0.69 micrometer; band 4, 0.76-0.90 micrometer; band 5, 1.55-1.75 micrometers; band 6, 10.40-12.50 micrometers; and band 7, 2.08-2.35 micrometers. The information outputs from the detector channels were processed
in the TM multiplexer for transmission via the Tracking And Data Relay Satellites (TDRS) and/or direct readout to local receiving stations. Data from this experiment can be obtained through the EROS Data Center, U.S. Geological Survey, Sioux Falls, South Dakota.

***********************SMS 1,2, GOES 1-6***********************

Spacecraft Name - SMS 1,2, GOES 1-6

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Brief Description

The Synchronous Meteorological Satellite (SMS) and the Geostationary Operational Environmental System (GOES) satellites were geostationary and spaced in longitude over the equator to provide near-continuous, timely, high-quality observations of the earth and its environment. SMS 1 and 2 were developed by NASA, and follow-on spacecraft GOES 1-6 were funded by NOAA. Each spin-stabilized, earth-synchronous spacecraft carried three experiments: (1) a visible infrared spin-scan radiometer (VISSR), or a VISSR atmospheric sounder (VAS), (2) a meteorological data collection system (DCS), and (3) a space environment monitor (SEM) system containing an energetic charged particle monitor, a magnetometer, and a solar X-ray monitor. The cylindrically shaped spacecraft measured
190.5 cm in diameter and 230 cm in length, exclusive of a magnetometer that extended an additional 83 cm beyond the cylinder shell. The primary structural members were a honeycombed equipment shelf and thrust tube. The VISSR telescope was mounted on the equipment shelf and viewed the earth through a special aperture in the spacecraft's side. A support structure extended radially from the thrust tube and was affixed to the solar panels, which formed the outer walls of the spacecraft and provided the primary source of electrical power. Located in the annulus-shaped space between the thrust tube and the solar panels were stationkeeping and dynamics control equipment, batteries, and most of the SEM equipment. The spacecraft spun at approximately 100 rpm with a spin axis nearly perpendicular to the equatorial plane. The spacecraft used both UHF-band and S-band frequencies in its telemetry and command subsystem. A low-power VHF transponder provided telemetry and command during launch and then served as a backup for the primary subsystem once the spacecraft had attained synchronous orbit. The satellites were relocated from time to time to support specific programs or to replace one that was failing. SMS 1 was initially located at 45 deg W to support the Global Atmospheric Research Program (GARP) Atlantic Tropical Experiment (GATE). After completion of the GATE in September of 1974, it was moved to 75 deg W. The follow-on spacecraft joined the SMS 1 to operate at 75 deg W and 135 deg W, which were known as GOES-East and GOES-West, respectively. During the FGGE (First GARP Global Experiment) Operational Year, December 1978 - November 1979, the GOES-East coverage was provided by GOES 2, SMS 1, and SMS 2. The GOES-West coverage was provided by GOES 3. GOES 1 served as the GOES-Indian at 58 deg E during May-August 1979. Beginning 1979, a WEFAX (Weather Facsimile) experimental service was provided by a satellite located at 107 deg W, which was known as GOES-CENTRAL. This service used earlier GOES spacecraft that were no longer suitable for imaging to retransmit GOES image sectors to ground receivers.

---------------SMS 1,2, GOES 1-6, Leinbach, Williams---------------

Investigation Name - Magnetic Field Monitor

Flown on - SMS 1, 2, GOES 1-6


PI - H. Leinbach
PI - D.J. Williams
OI - H.H. Sauer
OI - R.N. Grubb (NLA)
OI - J.C. Joselyn

NOAA-ERL
APL
NOAA-ERL
NOAA-ERL
NOAA-ERL
Brief Description

The biaxial, closed-loop, fluxgate magnetometer had a range of plus or minus 400 nT (without saturation) and a resolution of 0.1 nT over a range of plus or minus 50 nT.

-------------SMS 1,2, GOES 1-6, Leinbach, Williams-------------

Investigation Name - Energetic Particle Monitor

Flown on - SMS 1, 2, GOES 1-6


PI - H. Leinbach
PI - D.J. Williams
OI - H.H. Sauer
OI - R.N. Grubb(NLA)

---------------SMS 1,2, GOES 1-6, Leinbach, Williams---------------

Investigation Name - Solar X-Ray Monitor

Flown on - SMS 1, 2, GOES 1-6

NSSDC ID - 74-033A-03, 75-011A-02, 75-100A-03, 77-048A-03, 78-062A-03, 80-074A-03, 81-049A-03, 83-041A-03

PI - H. Leinbach
PI - D.J. Williams
OI - H.H. Sauer
OI - R.N. Grubb
OI - R.F. Donnelly

Brief Description

The energetic particle monitor on SMS 1 and 2, and GOES 1-4 consisted of two detector assemblies, each covering limited regions of the overall energy spectrum. The two detector assemblies monitored protons in seven energy ranges from 0.8 to 500 MeV and alpha particles in six ranges between 4 and 400 MeV. There was also one channel for the measurement of electrons in the energy range >500 keV. The SEM on GOES 5 and 6 had a third detector assembly. The high energy proton and alpha detector (HEPAD) measured protons in four energy ranges above 370 MeV, and alpha particles in two energy ranges above 640 MeV/nucleon.

---------------SMS 1,2, GOES 1-6, Leinbach, Williams---------------

Investigation Name - Solar X-Ray Monitor

Flown on - SMS 1, 2, GOES 1-6

NSSDC ID - 74-033A-03, 75-011A-02, 75-100A-03, 77-048A-03, 78-062A-03, 80-074A-03, 81-049A-03, 83-041A-03

PI - H. Leinbach
PI - D.J. Williams
OI - H.H. Sauer
OI - R.N. Grubb
OI - R.F. Donnelly

Brief Description

The X-ray monitor consisted of ion chamber detectors. The wavelength ranges and useful threshold energy flux sensitivities were 0.5 to 3 Å, 1.0E-13 J per sq cm per s; and 1 to 8 Å, 1.0E-12 J per sq cm per s; with a dynamic range of 1.0E4.
Investigation Name - Visual Infrared Spin-Scan Radiometer (VISSR)

Flown on - SMS 1,2, GOES 1-3

NSSDC ID - 74-033A-01, 75-011A-04, 75-100A-01, 77-048A-01, 78-062A-01

PI - NESDIS Staff
OI - W.E. Shenk

Brief Description

The Visible Infrared Spin-Scan Radiometer (VISSR) provided day/night observations of cloud cover and earth/cloud radiance temperatures for use in operational weather analysis and forecasting. The two-channel instrument was able to take both full and partial pictures of the earth's disk. The infrared channel (10.5 to 12.6 micrometers) and the visible channel (0.55 to 0.70 micrometer) used a common optics system. Incoming radiation was received by an elliptically shaped scan mirror and collected by a Ritchey-Chretien optical system. The scan mirror was set at a nominal angle of 45 deg to the VISSR optical axis, which was aligned parallel to the spin axis of the spacecraft. The spinning motion of the spacecraft (approximately 100 rpm) provided a west-to-east scan motion when the spin axis of the spacecraft was oriented parallel with the earth's axis. The latitudinal scan was accomplished by sequentially tilting the scanning mirror north to south at the completion of each spin. A full picture took 18.2 min to complete and about 2 min to retrace. During each scan, the field of view on the earth was swept by a linear array of eight visible-spectrum detectors, each with a ground resolution of 0.9 km at nadir. Two Hg-Cd-Te detectors (redundant) sensed the infrared portion of the spectrum with a horizontal resolution of approximately 9 km at nadir. The infrared detectors measured radiance temperatures between 180 and 315 deg K, with a sensitivity of 1.2 deg K at 200 deg K. The VISSR output was digitized and transmitted to the National Oceanic and Atmospheric Administration (NOAA) Command Data Acquisition (CDA) Station, Wallops Island, Va. There the signal was fed into a "line stretcher" where it was stored and time-stretched for transmission back to the satellite at reduced bandwidth for re-broadcast to data utilization stations (DUS). The VISSR data, as with all operational type data, were handled by NOAA, and the majority of data were archived by SDSD. NSSDC also has the data processed by the Image Processing Facility, NASA-GSFC. A more detailed description can be found in "The GOES/SMS User's Guide," available from NSSDC and SDSD.
Investigation Name - VISSR Atmospheric Sounder (VAS)

Flown on - GOES 4-6

NSSDC ID - 80-074A-01, 81-049A-01, 83-041A-01

PI - NESDIS Staff
OI - W.E. Shenk

Brief Description

The Visible-Infrared Spin-Scan Radiometer Atmospheric Sounder (VAS) operated in three distinct modes to provide parameter flexibility, spectral band selection, geographic location, and signal-to-noise (S/N) ratio. The VAS had the original VISSR imaging capability plus additional thermal bands in H2O and CO2 absorption regions for the determination of water vapor and temperature profiles. The VISSR mode was the same as the VISSR system on board GOES 1-3 except that the FOV for the VAS infrared imaging was 6.9 km. The dwell-sounding mode used up to 12 spectral filters in a wheel covering the range 678.7 per cm (14.74 micrometers) through 2535 per cm (3.94 micrometers) positioned into the optical train while the scanner was dwelling on a single N-to-S scan line. The filter wheel could be programmed so that each spectral band filter could dwell on a single scan line for from 0 to 255 spacecraft spins. Either the 6.9-km or 13.8-km resolution detectors could be selected for the seven filter positions operating in the spectral region 701.6 per cm (14.25 micrometers) through 1487 per cm (6.725 micrometers). For the remaining five spectral bands the 13.8-km resolution detectors were used. Selectable frame size, position and scan direction were also programmable via ground command. For the VAS demonstration, 10-bit reduced resolution (3.5-km) visible data were provided for imaging. In some of the spectral regions, multiple-line data were required to enhance the S/N ratio. Typically, 167 satellite spins at the same N-to-S scan line position were required to obtain the desired sounding data with a 30- x 30-km resolution. The multispectral imaging (MSI) mode could provide either (1) four spectral channel observation (the visible at 0.9-km resolution, the 11-micrometer window at 6.9-km resolution, and any two selected spectral bands at 13.8-km resolution) or (2) five spectral channel observation (the visible at 0.9-km resolution and any four infrared spectral channels at 13.8-km resolution). Unlimited N-to-S frame size and position selection, within the maximum N-to-S FOV scan direction, could be selected. The VAS output was digitized and transmitted to the NOAA Command Data Acquisition (CDA) Station, Wallops Island, Va. There the VISSR data were fed into a "line stretcher," where the data were stored and time-stretched for transmission back to the satellite at reduced bandwidth for rebroadcast to APT user stations. Data can be obtained through SDSD.
Spacecraft Name - TIROS 1-10

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NASA-GSFC | NASA-GSFC
TIROS 2 | R.A. Stampf (NLA) | Aero. and Meteo. Div.
NASA-GSFC | NASA-GSFC
TIROS 3-10 | R.M. Rados (Retired) | Aero. and Meteo. Div.
NASA-GSFC | NASA-GSFC

Brief Description

TIROS 1-10 (Television and Infrared Observation Satellite) were spin-stabilized meteorological spacecraft designed to test experimental television techniques and infrared equipments. The satellites were in the form of an 18-sided right prism, 48 or 56 cm high and 107 cm in diameter. The top and sides of the spacecraft were covered with approximately 9200 1- by 2-cm silicon solar cells. The TIROS satellites were equipped with a television camera system and an automatic picture transmission system for taking cloudcover pictures, three radiometers (two-channel widefield, omnidirectional, and five-channel scanning) for measuring radiation from the earth and its atmosphere, and an electron temperature probe. The satellite spin rate was maintained between 8 and 12 rpm by the use of five diametrically opposed pairs of small solid-fuel thrusters. TIROS 2-10 were equipped with a magnetic attitude-control device. The first four TIROS were launched into near-circular orbits with an orbit inclination of 48 deg to provide TV coverage of the sunlit portion of the earth between 55 deg N and 55 deg S lat. The orbit inclination on TIROS 5 through 8 was increased to provide TV coverage between 65 deg N to 65 deg S lat. The orbits of TIROS 9 and 10 were intended to be near-polar and sun-synchronous to extend the sensor coverage to the entire sunlit portion of the earth, but only TIROS 10 achieved this desired orbit. A failure in the guidance system placed TIROS 9 in a non-synchronous elliptical orbit. TIROS 1-8 and 10 were designed for a fixed attitude relative to space. TIROS 9 was

Investigation Name - Scanning Radiometer (SR)

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Brief Description

This radiometer measured the emitted and reflected radiation of the earth and its atmosphere. The five-channel radiometer scanned the earth and space as the satellite spun about its axis. The radiometer's bi-directional optical axes were inclined to the satellite spin axis at angles of 45 and 135 deg. The sensor used bolometer detectors and filters to limit the spectral response and to provide comprehensive data by measuring radiation intensities in selected portions of the infrared spectrum. The spectral bands of five channels were: (1) 6.0 to 6.5 micrometers (water vapor absorption), (2) 8.0 to 12.0 micrometers (atmospheric window), (3) 0.2 to 6.0 micrometers, (4) 8 to 13 micrometers (TIROS 4 used this channel to transmit a redundant time reference signal), and (5) 0.5 to 0.75 micrometer for reference and comparison with the TV systems. The water vapor absorption band was replaced by a 14- to 16-micrometer carbon dioxide band on TIROS 3. The major limitation of the experiment was the uncertainty in the absolute value of the measurements, resulting from the degradation of the sensors. A more detailed description of the instrument was given in Astheimer, R. W., et al., "Infrared radiometric instruments on TIROS II," J. of Opt. Soc., v. 51, pp. 1386-1393, 1961.
Investigation Name - Electron Temperature Probe

Flown on - TIROS 7

NSSDC ID - 63-024A-03

PI - L.H. Brace

OI - N.W. Spencer

Brief Description

A Langmuir probe was used to measure electron density and temperature. The cylindrical probe consisted of two concentric electrodes. The inner electrode, which was 0.056 cm in diameter and 23 cm long, was used as a collector. The outer electrode served as a guard electrode, and was 0.168 cm in diameter and 10 cm long. The probe was swept through the voltage range from 0 to 1.5 V in 2 s. The current at the collector was measured as the voltage was varied, and the signal was stored on a tape recorder and played back upon interrogation by a ground station. This experiment and the infrared experiment time shared a subcarrier oscillator, and the telemetry format sequence consisted of 18 s of probe data and 12 s of IR data. Although the experiment was designed to allow for computer determination of electron temperature values, this was impractical because of the marginal resolution of the data and the low information rate of the subcarrier; i.e., there were not enough data points per second.

Investigation Name - Television Camera System

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Brief Description

The TV system was developed to obtain cloudcover pictures for operational meteorological use. The experiment consisted of one or two independent camera chains, each containing a television camera, a magnetic-tape recorder and a television transmitter. The two sensor units were capable of concurrent or independent operation. Three different lens systems were
used on the TIROS spacecraft. On TIROS 1 and 2, the TV system had one narrow-angle (12-deg) lens and one wide-angle (104-deg) lens. TIROS 3, 7, 9, and 10 had two wide-angle lens systems. TIROS 4, 5 and 6 had one medium-angle (78-deg) lens system and one wide-angle system. TIROS 8 had only one wide-angle lens. Except on TIROS 9, the cameras were mounted on the baseplate of the spacecraft with their optical axes parallel to the spacecraft spin axis. Since the spin axis lay in the orbital plane, the cameras were directed earthward for only approximately one-fourth of each orbit. The two cameras on TIROS 9 were mounted 180 deg apart on the side of the spacecraft and canted 64 deg from the spacecraft spin axis. The cameras were automatically triggered into action only when they came in view of the earth. The TV pictures were transmitted directly to either of two ground receiving stations or stored on magnetic tape for later playback, depending on whether the satellite was within or beyond the communication range of the station. The TV cameras used 500-scan-line, 1.27-cm vidicons. Each recorder could store up to 32 (48 for TIROS 9) frames of pictures. Transmission of the 32-frame sequence was accomplished in 100 s by a 3-W FM transmitter operating at a nominal frequency of 235 MHz. At nominal attitude and altitude (approximately 700 km), a picture taken by the wide-angle camera covered a 1200- by 1200-km square with a spatial resolution of 2.5 to 3.0 km at nadir. The medium-angle camera covered a 725- by 725-km square and had a resolution of 2 km. Data from this experiment are available through SDSD. For a complete index of these data, see "Catalog of Meteorological Satellite Data - TIROS 1 Television Cloud Photography," "Catalog of Meteorological Satellite Data - TIROS 2 Television Cloud Photography," etc.

------------------------TIROS 1-10, Hanel------------------------

Investigation Name - Widefield Radiometer

Flown on - TIROS 2, 3, 4

NSSDC ID - 60-016A-01, 61-017A-02, 62-002A-02

PI - R.A. Hanel NASA-GSFC

Brief Description

The low-resolution, non-scanning, two-channel radiometer measured the thermal and reflected solar radiation from the earth-atmosphere system. The radiometer consisted of two detectors: one black and one white thermistor bolometer. Each of the detectors was mounted in the apex of a highly reflective mylar cone. The black detector responded equally to reflected solar radiation and long-wave terrestrial radiation (0.2 to 50 micrometers). The white detector reflected solar and visible radiation and measured only long-wave thermal radiation (5 to 50 micrometers). The optical axis of each detector was
parallel to the satellite spin axis. The field of view (50 deg) of the detectors when viewing the earth directly below the satellite was a circle of 832 km diameter. This area was within the field observed by the wide-angle television camera, and thus a direct measure of the heat balance of the earth-atmosphere system viewed in any of the pictures was provided. The radiation data were recorded on a continuously running endless loop magnetic tape that completed its cycle in about 100 min. Data older than 100 min were erased as newer data were recorded. The experiment performed normally, but the quality of the data was very poor because of decreased sensitivity of the detectors, detector-spacecraft thermal coupling, and less than nominal radiative characteristics. Thus, the collected data were too ambiguous for reduction or analysis. The experiment was described in "The TIROS Low Resolution Radiometer," NASA TN-D-614, 1964.

------------------------TIROS 1-10, Hunter------------------------

Investigation Name - Automatic Picture Transmission (APT)

Flown on - TIROS 8

NSSDC ID - 63-054A-02

PI - C.M. Hunter NASA-GSFC

Brief Description

This system was a camera and transmitter combination designed to test the feasibility of transmitting local daytime pictures of cloud cover to properly equipped ground receiving stations on a real-time basis. The system consisted of a single camera with a 2.54-cm-diameter vidicon. The camera used a 108-deg wide-angle f/1.8 objective lens with a focal length of 5.7 mm, and was mounted on the satellite baseplate with its optical axis parallel to the spacecraft spin axis. The actual picture taking required 8 s and the transmission 200 s. Earth-cloud images retained on the photosensitive surface of the vidicon were read out at four lines per second to produce an 800-line picture. A 5-W TV transmitter (136.95 MHz) relayed the pictures to local APT stations within communication range. The faceplate of the vidicon had reticle marks that appeared on the picture format to aid in relating the picture to its geographical position on the earth's surface. At nominal satellite attitude and altitude (approximately 700 km), a picture covered a 1200- by 1200-km square with a horizontal resolution of 7.5 km at nadir. The experiment performed normally, and good quality pictures were obtained until the experiment was terminated owing to degradation of the APT camera. The APT experiment successfully demonstrated the feasibility of using weather satellites to provide meteorologists with local cloudcover data on a near real-time basis, requiring only the use of a photofacsimile machine and a
relatively inexpensive antenna and receiver. APT data were primarily intended for operational use within the local APT acquisition stations and generally are not available for distribution.

------------------------TIROS 1-10, Suomi------------------------

Investigation Name - Omnidirectional Radiometer

Flown on - TIROS 3, 4, 7

NSSDC ID - 61-017A-01, 62-002A-01, 63-024A-01

PI - V.E. Suomi

U of Wisconsin

Brief Description

This experiment was designed to measure the amount of solar energy absorbed, reflected, and emitted by the earth and its atmosphere. The experiment consisted primarily of two sets of bolometers in the form of hollow aluminum hemispheres, mounted on opposite sides of the spacecraft, whose optical axes were parallel to the spin axis. The bolometers were mounted on mirror surfaces so that the hemispheres behaved very much like isolated spheres in space. One bolometer in each set was painted black, and one was painted white. The black bolometer absorbed most of the incident radiation while the white bolometer was sensitive mainly to radiation with wavelengths longer than approximately 4 micrometers. The reflected and emitted radiation could thus be separated. The sensor temperatures were measured by thermistors fastened to the inside of the hollow hemispheres. The sensor temperatures, taken every 29 s, were an average of the two temperatures from the matched thermistors. A similar experiment was carried on Explorer 7.

************************* TIROS-N, NOAA 6-9*************************

Spacecraft Name - TIROS-N, NOAA 6-9

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S/C PM PS

TIROS-N, NOAA 6 G.W. Longanecker A. Arking

NASA-GSFC NASA-GSFC

J. Muller, Jr.

NASA-GSFC

G.A. Branchflower (NLA)

NASA-GSFC

84
Brief Description
The TIROS-N/NOAA series was the third generation of operational polar-orbiting meteorological satellites for use in the National Operational Environmental Satellite System (NOESS), which supported the Global Atmospheric Research Program (GARP) during 1978-84. The spacecraft design provided an economical and stable sun-synchronous platform for advanced operational instruments to be used in making measurements of the earth's atmosphere, its surface and cloud cover, and the near-space environment. Primary sensors included an advanced very high resolution radiometer (AVHRR) and a TIROS operational vertical sounder (TOVS). Secondary experiments consisted of a space environment monitor (SEM) and a data collection system (DCS). The NOAA 7 had an additional contamination monitor to obtain contamination sources, levels, and effects for consideration on future spacecraft. The NOAA 9 carried two other instruments: the earth radiation budget experiment (ERBE), and the solar backscatter ultraviolet radiometer (SBUV/2). Both NOAA 8 and 9 were also equipped with a search and rescue (SAR) system to receive, process, and relay distress signals which were transmitted by beacons carried on civil aircraft and some classes of marine vessels. The spacecraft was based upon the DMSP Block 5D spacecraft bus developed for the U.S. Air Force, and was capable of maintaining an earth-pointing accuracy of better than plus or minus 0.1 deg with a motion rate of less than 0.035 deg/s. For a more detailed description, see Schwalb, A., "The TIROS-N/NOAA A-G satellite series," NOAA Tech. Mem. NESS 95, 1978.

-------------------------TIROS-N, NOAA 6-9, Broome-------------------------

Investigation Name - Earth Radiation Budget Experiment (ERBE)
Flown on - NOAA 9
NSSDC ID - 84-123A-05
PI - G.C. Broome NASA-LaRC

Brief Description
The Earth Radiation Budget Experiment (ERBE) was designed to measure the energy exchange between the earth-atmosphere system and space. The measurements of global, zonal, and regional radiation budgets on monthly time scales helped in climate prediction and in the development of statistical relationships between regional weather and radiation budget anomalies. The ERBE consisted of two instrument packages: the non-scanner (ERBE-NS) instrument and the scanner (ERBS-S)
instrument. The ERBE-NS instrument had five sensors, each using cavity radiometer detectors. Four of them were primarily earth-viewing: two wide field-of-view (FOV) sensors viewed the entire disc of the earth from limb to limb, approximately 135 deg; two medium FOV sensors viewed a 10-deg region. The fifth sensor was a solar monitor that measured the total radiation from the sun. Of the four earth-viewing sensors, one wide and one medium FOV sensors made total radiation measurements; the other two measured reflected solar radiation in the shortwave spectral band between 0.2 and 5 micrometers by using Suprasil-W filters. The earth-emitted longwave radiation component was determined by subtracting the shortwave measurement from the total measurement. The ERBE-S instrument was a scanning radiometer which contained three narrow FOV channels. One channel measured reflected solar radiation in the shortwave spectral interval between 0.2 and 5 micrometers. Another channel measured earth-emitted radiation in the longwave spectral region from 5 to 50 micrometers. The third channel measured total radiation with wavelength between 0.2 and 50 micrometers. All three channels were located within a continuously rotating scan drum which scanned the FOV across track sequentially from horizon to horizon. Each channel made 74 radiometric measurements during each scan, and the FOV of each channel was 3 by 4.5 deg that covered about 40 km at the earth's surface. The ERBE-S also viewed the sun for calibration. Additional information can be obtained from "Earth Radiation Budget Experiment (ERBE): An Overview," J. Energy, v. 6, pp. 141-146 (1982), by B. R. Barkstrom and J. B. Hall, Jr.

--------------TIROS-N, NOAA 6-9, Cunningham--------------

Investigation Name - Solar Backscattered Ultraviolet Radiometer (SBUV/2)

Flown on - NOAA 9

NSSDC ID - 84-123A-07

PI - F.G. Cunningham

NASA-GSFC

Brief Description

The Solar Backscatter Ultraviolet Radiometer (SBUV/2) was designed to map total ozone concentrations on a global scale, and to provide the vertical distribution of ozone in the earth's atmosphere. The instrument design was based upon the technology developed for the SBUV/TOMS flown on Nimbus 7. The SBUV/2 instrument measured backscattered solar radiation in an 11.3-deg field of view in the nadir direction at 12 discrete, 1.1-mm wide, wavelength bands between 252.0 and 339.8 nm. The solar irradiance was determined at the same 12 wavelength bands by deploying a diffuser which reflected sunlight into the instrument's field of view. The SBUV/2 also measured the solar
irradiance or the atmospheric radiance with a continuous spectral
scan from 160 to 400 nm in increments of 0.148 nm. The SBUV/2
had another narrowband filter photometer channel, called the
cloud cover radiometer (CCR), which continuously measured the
earth's surface brightness at 380 nm. The CCR field of view was
11.3 deg.

---------TIROS-N, NOAA 6-9, Leinbach----------

Investigation Name - Space Environmental Monitor (SEM)

Flown on - TIROS-N, NOAA 6-9

84-123A-04

PI - H. Leinbach
PI - D.J. Williams
OI - H.H. Sauer
OI - R.N. Grubb (NLA)
OI - D.S. Evans
OI - R. Seale
OI - C.O. Bostrom

PIA - NOAA-ERL
PIA - APL
PIA - NOAA-ERL
PIA - NOAA-ERL
PIA - NOAA-ERL
PIA - APL

Brief Description

This experiment was an extension of the solar proton
monitoring experiment flown on the ITOS series spacecraft. The
experiment package consisted of three detector systems and a
data processing unit. The total energy detector (TED) measured
the energetic particle energy from 0.3 keV to 20 keV in 11
bands. The medium energy proton and electron detector (MEPED)
measured proton flux above 16, 30 and 80 keV; electron flux
above 30, 100 and 300 keV; and the intensity of protons and
electrons (inseparable) above 6 MeV. The high-energy proton
and alpha telescope (HEPAT) had a 48-deg viewing cone, viewed
in the anti-earth direction, and measured energy of protons
above 370 MeV and alpha particles above 640 and 850 MeV/n.

---------TIROS-N, NOAA 6-9, NESDIS Staff----------

Investigation Name - Advanced Very High Resolution Radiometer
(AVHRR)

Flown on - TIROS-N, NOAA 6-9

NSSDC ID - 78-096A-01, 79-057A-01, 81-059A-01, 83-022A-01,
84-123A-01

PI - NESDIS Staff
OI - W.E. Shenk

PIA - NOAA-NESDIS
PIA - NASA-GSFC

Brief Description

The Advanced Very High Resolution Radiometer (AVHRR) was a
four- or five-channel scanning radiometer capable of providing
global daytime and nighttime sea-surface temperature and
information about ice, snow, and clouds. These data were obtained on a daily basis for use in weather analysis and forecasting. On TIROS-N and NOAA's 6 and 8, the radiometer measured emitted and reflected radiation in the following spectral intervals: channel 1, 0.55 to 0.9 micrometer (visible); channel 2, 0.725 to 1.1 micrometers (near IR); channel 3, 3.55 to 3.93 micrometers (IR window); and channel 4, 10.5 to 11.5 micrometers (IR window). The AVHRR on NOAA 7 and 9 had a fifth channel in the 11.5- to 12.5-micrometer (IR window) region. All channels had a spatial resolution of 1.1 km at nadir, and the IR-window channels had a thermal resolution of 0.12 deg K at 300 deg K. The AVHRR was capable of operating in both real-time or recorded modes. Direct readout data were transmitted to ground stations of the automatic picture transmission (APT) class at low resolution (4-km) and to ground stations of the high-resolution picture transmission (HRPT) class at high resolution (1-km). Data recorded on board were available for processing in the NOAA Central Computer Facility. They included global area coverage (GAC) data, with a resolution of 4 km, and local area coverage (LAC) data which were from selected portions of each orbit with a 1-km resolution. Archival data are available from SDSD.

---------TIROS-N, NOAA 6-9, NESDIS Staff---------

Investigation Name - TIROS Operational Vertical Sounder (TOVS)

Flown on - TIROS-N, NOAA 6-9

NSSDC ID - 78-096A-02, 79-057A-02, 81-059A-02, 83-022A-02, 84-123A-02

PI - NESDIS Staff

NOAA-NESDIS

Brief Description

The TIROS Operational Vertical Sounder (TOVS) consisted of three instruments designed to provide temperature and humidity profiles of the atmosphere from the surface to the stratosphere (approximately 1 mb). The first instrument was the second version of the high-resolution infrared spectrometer (HIRS/2). The HIRS was originally tested onboard the Nimbus 6. The HIRS/2 had 20 channels in the following spectral intervals: channels 1 through 5, the 15-micrometer CO2 bands (15.0, 14.7, 14.5, 14.2, and 14.0 micrometers); channels 6 and 7, the 13.7- and 13.4-micrometer CO2/H2O bands; channel 8, the 11.1-micrometer window region; channel 9, the 9.7-micrometer ozone band; channels 10, 11, and 12, the 6-micrometer water vapor bands (8.3, 7.3, and 6.7 micrometers); channels 13 and 14, the 4.57- and 4.52-micrometer N2O bands; channels 15 and 16, the 4.46- and 4.40-micrometer CO2/N2O bands; channel 17, the 4.24-micrometer CO2 band; channels 18 and 19, the 4.0- and 3.7-micrometer window bands; and channel 20, the 0.7-micrometer window region. The HIRS/2 provided data for calculations of...
temperature profiles from the surface to 10 mb, water vapor content at three levels of the atmosphere, and total ozone content. The second instrument, the stratospheric sounding unit (SSU), was provided by the British Meteorological Office and was similar to the pressure-modulated radiometer (PMR) flown on Nimbus 6. The SSU operated at three 15.0-micrometer channels using selective absorption, passing the incoming radiation through three pressure-modulated cells containing CO2. The SSU provided temperature information in the stratosphere. The third instrument, the microwave sounding unit (MSU), was similar to the scanning microwave spectrometer (SCAMS) flown on Nimbus 6. The MSU had one channel in the 50.31-GHz window region and three channels in the 55-GHz oxygen band (53.73, 54.96, 57.95 GHz) to obtain temperature profiles which were free of cloud interference. The instruments were cross-course scanning devices utilizing a step scan to provide a traverse scan, while the orbital motion of the satellite provided scanning in the orthogonal direction. The HIRS/2 had a field of view (FOV) 30 km in diameter at nadir, whereas the MSU had an FOV of 110 km in diameter. The HIRS/2 sampled 56 FOVs in each scan line about 2250 km wide, and the MSU sampled 11 FOVs along the swath with the same width. Each SSU scan line had 8 FOVs with a width of 1500 km. For a more detailed description, see Smith, W. L., "The TIROS-N operational vertical sounder," Bull. Am. Meteorol. Soc., v. 60, pp. 1177-1187, 1979. Archival data are available from SDSD.

Investigation Name - Data Collection System (DCS)

Flown on - TIROS-N, NOAA 6-9

NSSDC ID - 78-096A-03, 79-057A-03, 81-059A-03, 83-022A-03, 84-123A-03

PI - NESDIS Staff NOAA-NESDIS CNES

Brief Description

The Data Collection System (DCS), also known as the Data Collection and Platform Location System (DCPLS) and ARGOS, was designed to receive low-duty-cycle transmissions of meteorological observations from free-floating balloons, ocean buoys, other satellites, and fixed ground-based sensor platforms distributed around the globe. These observations were organized on board the spacecraft and retransmitted when the spacecraft came within range of a command and data acquisition (CDA) station. For free-moving balloons, the Doppler frequency shift of the transmitted signal was observed to calculate the location of the balloons. The DCS was expected, for a moving sensor platform, to have a location accuracy of 5 to 8 km rms, and a velocity accuracy of 1 to 1.6 m/s. This system had the
capability of acquiring data from as many as 2000 platforms per day. Identical experiments were flown on other spacecraft in the TIROS-N/NOAA series. Processing and dissemination of data were handled by CNES of Toulouse, France.

-------------------TIROS-N, NOAA 6-9, NESDIS Staff-------------------

Investigation Name - Search and Rescue (SAR)

Flown on - NOAA 8, NOAA 9

NSSDC ID - 83-022A-05, 84-123A-06

PI - NESDIS Staff

Brief Description

The search and rescue (SAR) instruments, also known as the Search and Rescue Satellite Aided Tracking (SARSAT) instruments, had the capability of detecting and locating existing emergency transmitters in a manner independent of the environmental data. Data from the 121.5-MHz emergency locator transmitters (ELT), the 243-MHz emergency position indicating radio beacons (EPIRB), and the experimental 406-MHz ELTs/EPIRBs were received by the search and rescue repeater (SARR) and broadcasted in real time on an L-band frequency (1544.5 MHz). Real-time data were monitored by local user terminals operated in the United States, Canada, and France. The 406-MHz data were also processed by a search and rescue processor (SARP) and stored on the spacecraft for later transmittal to the CDA stations in Alaska and Virginia, thus providing full global coverage. The distress signals were forwarded to Mission Control Centers located in each country for subsequent relay to the appropriate Rescue Coordination Center.
Geodetic Tracking Spacecraft
The geodetic tracking data sets are part of a data exchange in which approved individuals or organizations submit tracking data and can then request the data submitted by other organizations. The approved list of requesters is controlled by the Geodynamics Program, Code EEG, at NASA Headquarters. Experiments involved are the optical camera tracking, the optical beacon system, the laser reflectors, the Doppler system, the Mini-track beacon, the radio range system, the S-band transponder, and the C-band transponder on the following satellites:

BE-B
BE-C
Diademe 1
Diademe 2
Echo 1
Echo 2
GEOS 1
GEOS 2
GEOS 3
LAGEOS
PAGEOS
Seasat 1
Starlette

For further information about these restricted satellite data sets, please contact:

Henry G. Linder
Code 634
Data Manager, Crustal Dynamics Project
NASA/Goddard Space Flight Center
Greenbelt, MD 20771

Telephone: (301) 344-9537
Telex No.: 89675
TWX No.: 7108289716
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Appendixes
APPENDIX A - DEFINITIONS

Investigation Discipline - The subject to which an investigation pertains. The possible entries are limited, and the NSSDC information files can be searched using this field.

Investigation Program - Code of the cognizant NASA Headquarters office, or name of other sponsoring agency program. "CO-OP" added to a code indicates a cooperative effort with another agency or a foreign country. Investigation program categories include the following:

- CODE EB (Life Sciences)
- CODE EC (Communications)
- CODE EE (Earth & Science Applications)
- CODE EL (Solar System Exploration)
- CODE EN (Materials Processing)
- CODE EZ (Astrophysics)
- CODE RS (Space Systems)

MG - Program Manager. For NASA missions, "program" usually refers to the NASA Headquarters level.

NLA - No longer affiliated. Used in the spacecraft personnel section to indicate that the person had the specified affiliation at the time of his participation in the project, but is no longer there. Used in the investigation personnel section to indicate that the affiliation shown is the last known scientific affiliation and that the given person is no longer there.

NSSDC ID - An identification code used in the NSSDC information system. In this system, each successfully launched spacecraft and experiment is assigned a code based on the launch sequence of the spacecraft. Subsequent to 1962, this code (e.g., 66-008A for the spacecraft ESSA 1) corresponds to the COSPAR international designation. The experiment codes are based on the spacecraft code. For example, the experiments carried aboard the spacecraft 66-008A are numbered 66-008A-01, 66-008A-02, etc. Each prelaunch spacecraft and experiment are also assigned an NSSDC ID code based on the name of the spacecraft. Prior to launch, for example, the approved NASA launch, Earth Radiation Budget Satellite, was coded ERBS. The experiments carried aboard this spacecraft were coded ERBS -01 and ERBS -02. Once it was launched, its prelaunch designation was changed to a postlaunch one: 84-108B.
Other Investigator.

Principal Investigator.

Project Manager. If a spacecraft has had several project managers, the initial and latest project managers are both indicated in the spacecraft personnel section. For NASA missions, "project" usually refers to the NASA field center (e.g., GSFC) level. For international programs, there is usually a project manager in each of the two or more participating nations. The current or more recent PM is listed first.

Project Scientist. The above comments for project managers also apply to project scientists.

Program Scientist. For NASA missions, "program" usually refers to the NASA Headquarters level.

Team Leader.

Team Member.
APPENDIX B - ABBREVIATIONS AND ACRONYMS

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<td>A</td>
<td>angstrom; ampere</td>
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<tr>
<td>ac</td>
<td>alternating current</td>
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<td>A/D</td>
<td>analog to digital</td>
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<td>Applications Explorer Missions (NASA)</td>
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<td>AFGL</td>
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<td>AFTAC</td>
<td>Air Force Technical Application Center</td>
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<tr>
<td>ALT</td>
<td>altitude; radar altimeter</td>
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<tr>
<td>AM</td>
<td>amplitude modulation</td>
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<td>a.m.</td>
<td>ante meridiem</td>
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<td>APL</td>
<td>Applied Physics Laboratory of Johns Hopkins University</td>
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<td>apog</td>
<td>apogee</td>
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<td>APT</td>
<td>automatic picture transmission</td>
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<td>ARC</td>
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<td>atm</td>
<td>atmosphere</td>
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<td>ATS</td>
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<td>C</td>
<td>degree Celsius; coulomb</td>
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<td>CaF2</td>
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<tr>
<td>cc</td>
<td>cubic centimeter</td>
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<td>CCD</td>
<td>charge-coupled device</td>
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<td>CH4</td>
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<tr>
<td>cm</td>
<td>centimeter</td>
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<td>CNES</td>
<td>Centre National d'Etudes Spatiales (French space agency)</td>
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<td>CNRS</td>
<td>Centre National de la Recherche Scientifique (France)</td>
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<td>CO2</td>
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<tr>
<td>COSPAR</td>
<td>Committee on Space Research</td>
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<td>d</td>
<td>day</td>
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<td>DAPP</td>
<td>Defense Acquisition and Processing Program (DOD; now called DMSP)</td>
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<td>dB</td>
<td>decibel</td>
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<tr>
<td>deg</td>
<td>degree</td>
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<td>DFVLR</td>
<td>Deutsche Forschungs- und Versuchsanstalt fur Luft- und Raumfahrt (Research Laboratory for Aeronautics and Astronautics, Federal Republic of Germany)</td>
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<td>DMSP</td>
<td>Defense Meteorological Satellite Program (USAF)</td>
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<td>DOD</td>
<td>Department of Defense</td>
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ERBE  earth radiation budget experiment
ERBS  Earth Radiation Budget Satellite (NASA)
ERL   Environmental Research Laboratory (NOAA)
EROS  Earth Resources Observation System (Dept. of the Interior)
ESA   European Space Agency
ESRO  European Space Research Organization (now ESA)
ESSA  Environmental Science Services Administration (now NOAA; also satellite series, ESSA-NASA)
eV    electron volt

FM    frequency modulation
FOV   field of view
ft     foot or feet

g     gram
GARP  Global Atmospheric Research Program
GATE  GARP Atlantic Tropical Experiment
GEOS  Geodynamics Experimental Ocean Satellite
GHz   gigahertz
GOES  Geostationary Operational Environmental Satellite (NASA-NOAA)
GSFC  Goddard Space Flight Center (NASA)
GSTDN ground spaceflight tracking and data network (GSFC)
GVHRR geosynchronous very high resolution radiometer

h       hour
H2O    H2O
HCMM   Heat Capacity Mapping Mission (satellite, NASA)
Hz     hertz (cycles per second)
in.     inch
incl   inclination
IR     infrared
ITOS   Improved TIROS Operational Satellite (NOAA)

J      joule
JPL    Jet Propulsion Laboratory (NASA)
JSC    Johnson Space Center (NASA)

K      Kelvin
kbs    kilobits per second
keV    kiloelectron volt
kg     kilogram
kHz    kilohertz
km     kilometer
KSC    Kennedy Space Center (NASA)
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<td>Laser Geodetic Earth-Orbiting Satellite (NASA)</td>
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<td>LeRC</td>
<td>Lewis Research Center (NASA)</td>
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<tr>
<td>lat.</td>
<td>latitude</td>
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<tr>
<td>LOGACS</td>
<td>Low-G Accelerometer Calibration System (USAF)</td>
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<tr>
<td>m</td>
<td>meter; milli- (prefix)</td>
</tr>
<tr>
<td>mb</td>
<td>millibar</td>
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<tr>
<td>MeV</td>
<td>megaelectron volts</td>
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<td>MgF2</td>
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<td>MHz</td>
<td>megahertz</td>
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<tr>
<td>min</td>
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<td>MIT</td>
<td>Massachusetts Institute of Technology</td>
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<td>mm</td>
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<td>MPI</td>
<td>Max Planck Institute (Federal Republic of Germany)</td>
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<td>mrad</td>
<td>milliradian</td>
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<td>mW</td>
<td>milliwatt</td>
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<td>N</td>
<td>north; newton; nucleon</td>
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<td>N2O</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<td>NCAR</td>
<td>National Center for Atmospheric Research (NSF)</td>
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<td>National Climatic Data Center (NOAA; formerly NCC)</td>
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<td>NESDIS</td>
<td>National Environmental Satellite, Data, and Information Service (NOAA)</td>
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<td>NESS</td>
<td>National Environmental Satellite Service (NOAA; now NESDIS)</td>
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<td>nm</td>
<td>nanometer</td>
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<td>NOAA</td>
<td>National Oceanic and Atmospheric Administration</td>
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<td>North American Air Defense Command</td>
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<td>NOS</td>
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<td>National Research Council (National Academy of Sciences)</td>
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<td>NSF</td>
<td>National Science Foundation</td>
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<td>NSSDC</td>
<td>National Space Science Data Center</td>
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<td>nT</td>
<td>nanotesla</td>
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<td>NWS</td>
<td>National Weather Service</td>
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<tr>
<td>O2</td>
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<tr>
<td>OMSF</td>
<td>Office of Manned Space Flight (NASA; now part of the Office of Space Flight)</td>
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<td>Office of Space Science and Applications (NASA)</td>
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<tr>
<td>OSTA</td>
<td>Office of Space and Terrestrial Applications (NASA; now part of OSSA)</td>
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Pa | pascal
--|---
PAGEOS | Passive Geodetic Earth-Orbiting Satellite (NASA)
PCM | pulse-coded modulation
per | orbit period
perig | perigee
p.m. | post meridiem
PMEL | Pacific Marine Environmental Laboratory (NOAA)

rad | radian
rms | root mean square
rpm | revolutions per minute

s | second
S | south
SAGE | Stratospheric Aerosol and Gas Experiment (NASA; S/C or Experiment)
SAM | Stratospheric Aerosol Measurement
SAO | Smithsonian Astrophysical Observatory (Smithsonian Institution)
SAR | synthetic aperture radar; search and rescue
SARSAT | Search and Rescue Satellite Aided Tracking
SAS | Soviet Academy of Science
SASS | SEASAT-A satellite scatterometer
S/C | spacecraft
SDSD | Satellite Data Services Division (NOAA)
SEASAT | Ocean Dynamics Satellite (NASA)
SMS | Synchronous Meteorological Satellite (NASA)
S/N | signal to noise
sq | square
sr | steradian
STS | Space Transportation System (NASA)
STDN | Spaceflight Tracking and Data Network (NASA)

TDRS | Tracking and Data Relay Satellite (NASA)
TDRSS | Tracking and Data Relay Satellite System (NASA)
TIROS | Television and Infrared Observations Satellite (NASA)
TOS | TIROS Operational Satellite or System (NASA)
TRF | technical reference file (NSSDC)

u | atomic mass unit
U | University
UHF | ultra-high frequency
U.K. | United Kingdom
U.S. | United States
USA | United States of America
USAF | United States Air Force
USSR | Union of Soviet Socialist Republics
UT | universal time
UV | ultraviolet
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<td>V</td>
<td>volt</td>
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<tr>
<td>VHF</td>
<td>very high frequency</td>
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<tr>
<td>VIS</td>
<td>visual imaging spectrometer; visible</td>
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<tr>
<td>W</td>
<td>watt; west</td>
</tr>
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<td>WDC</td>
<td>World Data Center</td>
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<td>WDC-A-R&amp;S</td>
<td>World Data Center A for Rockets and Satellites</td>
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<tr>
<td>WEFAA</td>
<td>weather facsimile</td>
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<td>WFC</td>
<td>Wallops Flight Center (NASA)</td>
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<td>WFF</td>
<td>Wallops Flight Facility (NASA)</td>
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<tr>
<td>WMO</td>
<td>World Meteorological Organization</td>
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<td>WWW</td>
<td>World Weather Watch (WMO)</td>
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<td>yr</td>
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CODE 633.4
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771

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ROCKETS AND SATELLITES
CODE 630.2
GODDARD SPACE FLIGHT CENTER
GREENBELT, MARYLAND 20771 U.S.A.

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NAME  TITLE

ORGANIZATION

ADDRESS

CITY  STATE

ZIP CODE OR COUNTRY

TELEPHONE (Area Code) (Number) (Ext.)

DATE OF REQUEST  DATE DESIRED

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☐ Reference material
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Documents Describing the Availability of Satellite Experiment Data

☐ NSSDC Data Listing  ☐ Particles and Fields
☐ Astronomy  ☐ Planetary Atmospheres
☐ Geodesy and Gravimetry  ☐ Planetology
☐ Ionospheric Physics  ☐ Solar Physics
☐ Meteorology  ☐ Earth Resources Survey

☐ Report on Active and Planned Spacecraft and Experiments

☐ Spacecraft Program Bibliographies

☐ Reports on Models of the Near-Earth Environment

☐ World Data Center A for Rockets and Satellites Launch Summaries

☐ SPACEWARN Bulletins

☐ Satellite Situation Center (SSC) Reports

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NSSDC/WDC-A-R&S DOCUMENT REQUEST FORM

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- Reference material
- Use in publication
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  __________________________________
  __________________________________
  __________________________________

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**DATE OF REQUEST**

**DATE DATA DESIRED**

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- ☐ Other: _____________________________________________________________________
  - exhibit or display
  - reference material
  - use in publication

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Additional Specifications (Negatives, Positives, Paper Prints, etc.)

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