NSSDC
NATIONAL SPACE SCIENCE DATA CENTER

NEWS

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Data Center Establishes New Office of Science Data Systems Standards for NASA

With encouragement from NASA Headquarters, NSSDC has established the NASA Science Data Systems Standards Office (NSDSSO). The purpose of this office is to provide the space science and applications community with a focal point for standards leading to improved interoperability among its many data systems and improved long-term access to data.

Specifically, the NSDSSO will assist space science and applications community members in the development, adoption, recognition, and use of standards for their mutual benefit. It will both stimulate and support NASA-wide standards development by participating as an active member in the community of standards organizations and maintaining awareness of standards development and use.

The NSDSSO has three functional areas. The Standards Library focuses on the collection, updating, and dissemination of information about existing and emerging standards relevant to NASA and NASA-related data systems and standards organizations. The Standards Accreditation area is concerned with the establishment, maintenance, and use of policies and procedures to guide and support the development of new space science and applications standards. The Standards Conformance and Support function offers a broad range of support services to users of existing and emerging standards, in response to expressed needs and within the constraints of resource availability.

Photo by Jay Friedlander

Members of the new Standards Office staff (from left): Donald Sawyer, Cindy Posinski, Dolores Parker, and (seated) Alan Dwyer.

The Standards Library offers a walk-in browse service to patrons interested in general and specific information about

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Message from the Director

A New Era in Data Archiving

The more data a center must handle, the more resources it needs to maintain a given level of "scientific access" to them. This point is missed in most discussions of data archiving.

It is one thing to store numbered boxes of data tapes (or optical disks) in a big warehouse; it is quite a different situation to deliver those data on line, managing them scene by scene (or unit by unit) and maintaining network accessibility for scientists at all times. These scenarios are at opposite ends of the spectrum in terms of total elapsed access time for the scientist.

Between the time a scientist initiates a request and a data center satisfies it by identifying, copying, and sending a tape that was stored in a box, the scientist may forget why the data were wanted. Promptness is essential to provide useful scientific data. This fact cannot be ignored.

It is clear that not *all* the data in a data center can or should be held on line. However, finding the right mix of online and offline data has been a trial and error process. While putting data on higher and higher density media does reduce the storage space needed, the "scientific access" time for the data escalates because someone has to find the box containing the needed tape.

Danger of "Black Hole" Label

Therefore, if a data center with constantly increasing inventory does not employ a variety of data management techniques, it offers less and less timely access to the data it manages. Eventually, the data center becomes known as a "black hole," accepting data but allowing nothing to escape. Once that label has been stuck on a data center, scientists see no point in archiving their data there. Their own institutions begin to look just as good as places for data storage; in fact, in many cases the scientist's location would provide better short-term access.

Appropriate long-term archiving and data management involves a hierarchy of storage media. In the past, the hierarchy was simply magnetic disk and magnetic tape. Today, write once/read many (WORM) optical disks offer a potential for major cost savings because of the large amount of data that can be stored per unit space. However, this technology brings uncertainties in media life and media handling constraints (breakage of the glass disks if dropped, for instance). There are also several CD/ROMs (compact disk/read-only memory) of high-quality spacecraft data available now, and there is a promise of many more to come.

It is important to note that optical disks, or other types of mass storage, will become widely used for data storage and distribution only after they have been adopted by NASA spaceflight projects. The projects are the only elements within NASA that can afford to significantly upgrade the investigator facilities. Currently, NASA spaceflight projects are waiting for other organizations, like NSSDC, to prove that optical disks are reliable enough for them to use.

Other factors, such as data compression and data format standards, are also of considerable importance. If the new types of storage media are to be used, there must be an upgrading of the facilities at the institutions and discipline data centers doing business with NASA. Ongoing programs are needed to develop these methodologies into real solutions to the problems of properly handling and managing very large data bases.

Research in these areas is just beginning and should be accelerated. It is important to note that NASA spaceflight projects are not the organizations that should be doing the research in data compression and format standards but are the organizations that should use them.

A national archive needs to have operational plans for ensuring that a natural disaster, such as fire, does not permanently destroy irreplaceable data. For a data center whose archive is mostly in digital form, storing a copy of the data in another location would be the best solution. Over the last 20 years, NSSDC has received data for archiving from investigators at hundreds of institutions across the country. The procedure is for the remote investigator to retain the original data and send a copy to NSSDC.

Because of budget constraints and inadequate resources to provide a complete backup, NSSDC's disaster recovery plan has been to request a copy of the data from the original producer. This plan is inadequate, however, since many of the investigators would not be able to reproduce data more than four or five years old for reasons such as inadequate resources and low-density formats of the older tapes. In addition, NASA's missions are now moving toward facility instruments, where NSSDC must assume full backup responsibility for the data being archived.

New Disaster Plan Being Devised

Plans are now being devised at NSSDC that, once in place, will provide a complete, safe storage backup to the NSSDC digital archive. With such large volumes of data to back up, a cost-effective solution requires extremely dense media with a very small cost per megabyte of storage, a high data transfer rate, and adequate data compression schemes (preferably lossless) to further reduce the volume. Even though scientists are reluctant to provide NSSDC with compressed data for distribution, there is little argument against data compression techniques being applied to provide for a cost-effective backup of the entire digital archive.

Based on the above elements, to better serve scientists the world over, NSSDC is working hard to dramatically improve access to the data and information in its archive. It is working more closely with the NASA flight projects and data-producing scientists to get the right data in the right form (format and media) archived, and it is beginning to step up to the responsibility of being a real archive (a place for which records are preserved) for all its data.

Much progress has been made with the existing resources. Much more needs to be accomplished.

James L. Green

Online Master Directory Will Help Scientists Locate Data Sets

The first operational version of the NASA Master Directory (MD) will be released in early October. The directory will serve as a readily available online system for locating and browsing summary information about space and earth science data.

The MD is intended to be comprehensive in its coverage of the earth and space sciences, so it describes more than just the data sets available through NSSDC. In addition to data acquired through NASA-funded research, data sets from other federal agencies, international institutions, universities, state agencies, etc., are included if they are of potential interest to the NASA research community.

The directory also gives descriptive information about selected data centers and facilities, as well as some of the coordinated scientific campaigns. Another important and interesting feature is the capability, in many cases, for users to request an automatic link to participating data systems and immediately obtain the more detailed information those systems have to offer.

Data set information contained in the MD comes from scientific and data center personnel who are knowledgeable about the data. Data set descriptions are submitted to the MD in a simple text format known as the Directory Interchange Format (DIF). It is designed to facilitate the transfer of directory level information among data systems.

DIF directory level information includes:

- Data set identifiers and descriptive title
- Summary abstract
- Start and stop dates
- Sensor/source names
- Investigator
- Technical contact person
- Data center/archive contact person
- Storage media information
- Physical parameters measured
- Discipline keywords (ocean science, space science, etc.)
- Location and geographic coverage
- Selected bibliographic references

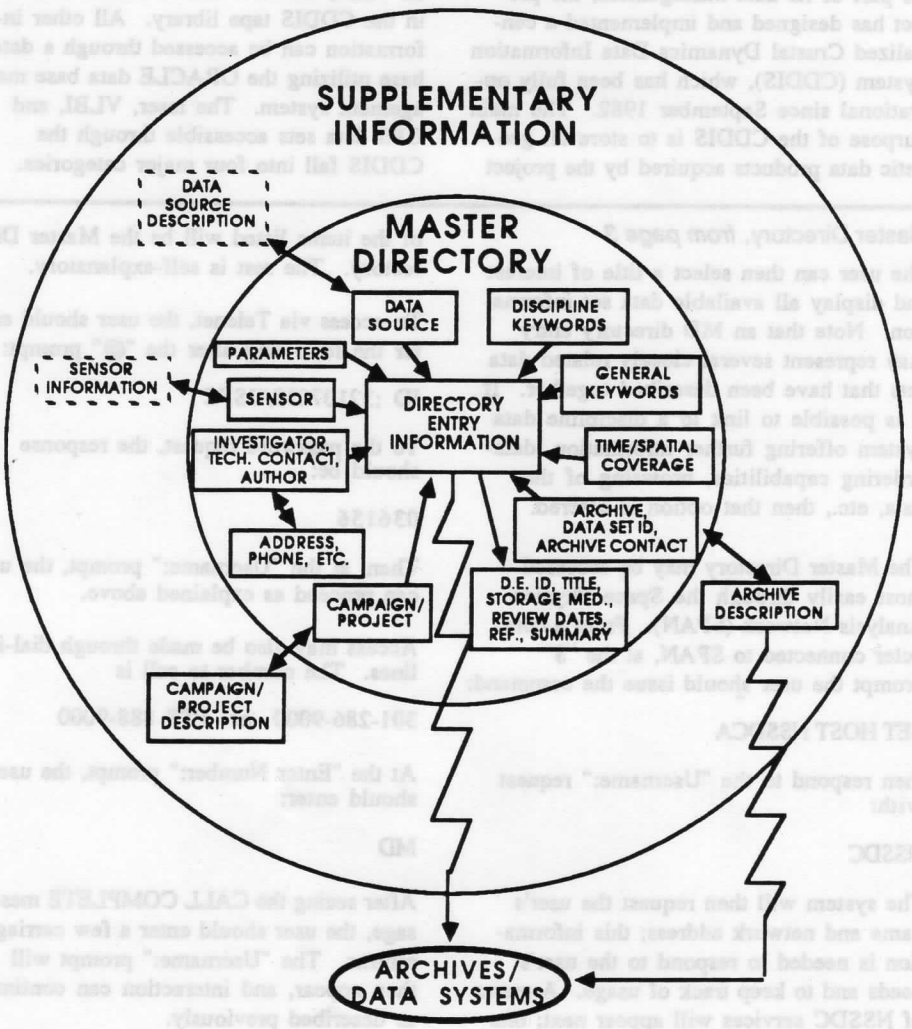
The MD may be accessed from a computer terminal or personal computer through network or dial-in lines. On entering, the user may choose to search for data set, data center (archive), or campaign information. If seeking data center information, the user may request a list of available data centers. After the researcher selects a data center, information about the archive is displayed, including a description of the types of data and services offered, contacts, and access and ordering information.

An option to link to the data system is offered when a connection to that system is available. Upon invoking the connection, the user is logged on automatically and can continue the search for further information. On leaving that system the user is returned to the MD at the place of departure. Searching for campaign information works in a similar way.

Most users will be interested primarily in data set information. The figure below indicates the types of keyword that may be used to search the data base and the displayable information and connection capabilities that result from the search. The dotted lines indicate supplementary information to be added in the future.

The user may search for data set information by selecting any combination of discipline, parameter, and location keywords; sensor (instrument) or source (spacecraft) name; time period of interest; geographic coverage (latitude, longitude); or investigator name. Users may also search with arbitrary words or phrases. The search results in a list of descriptive titles of directory entries meeting the specified criteria.

see Master Directory, *page 4*



Dedicated Computer Allows Rapid Access to Crustal Dynamics Data

Since 1981, NSSDC staff members have provided data management support for NASA's Crustal Dynamics Project. A dedicated computer was recently procured for this effort, and project investigators now can achieve rapid access to the facility at all times. This new system is based on a MicroVAX II computer with 16 megabytes of memory and 1.3 gigabytes of storage.

The Crustal Dynamics Project was formed by NASA to apply space technology to advance the scientific understanding of earth dynamics, tectonophysics, and earthquake mechanisms. The project uses three space-age techniques in this study: laser ranging to an artificial satellite or the moon, Very Long Baseline Interferometry (VLBI), and the Global Positioning System (GPS).

As part of its data management, the project has designed and implemented a centralized Crustal Dynamics Data Information System (CDDIS), which has been fully operational since September 1982. The main purpose of the CDDIS is to store all geodetic data products acquired by the project in a central data bank and to maintain information about the archival of all project-related data.

All authorized project investigators, staff, and cooperating institutions have access to the system via the Space Physics Analysis Network (SPAN), Internet, and the GTE Telenet facilities, as well as through dial-up telephone lines. Software for direct Telenet and BITnet connections will soon be procured and installed on the CDDIS MicroVAX, thus increasing the connectivity of the system to the worldwide user community. The menu-driven system provides the user with access to the different parts of the CDDIS, and user-friendly interfaces make data retrievals or queries possible.

The archive of preprocessed laser, correlated VLBI, and GPS data is retained off line in the CDDIS tape library. All other information can be accessed through a data base utilizing the ORACLE data base management system. The laser, VLBI, and GPS data sets accessible through the CDDIS fall into four major categories.

Preprocessed Data

This category includes catalogs of preprocessed Satellite Laser Ranging (SLR) data from 1976 to the present, VLBI data from 1976 to the present, and GPS data from 1985 to the present. Summaries of SLR data from LAGEOS, BE-C, Starlette, and EGS satellites are stored on line in a data base; the actual data are archived off line on magnetic tape. The VLBI data consist of online experiment listings in the data base and a magnetic tape archive of the actual experiment data. Listings of available GPS data are also contained in the online data base.

Analyzed Data

These data include SLR, Lunar Laser Ranging (LLR), VLBI, and combined analyzed results supplied by the project's science support groups and other analysis centers, and project investigators at Goddard Space Flight Center, the Jet Propulsion Laboratory, the National Geodetic Survey, the Massachusetts Institute of Technology, the University of Texas, and many other institutions worldwide. These analyzed results currently span different periods from 1976 through the present and are accessible

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Master Directory, *from page 3*

The user can then select a title of interest and display all available data set information. Note that an MD directory entry may represent several closely related data sets that have been described together. If it is possible to link to a discipline data system offering further information, data-ordering capabilities, browsing of the data, etc., then that option is offered.

The Master Directory may be accessed most easily through the Space Physics Analysis Network (SPAN). From a computer connected to SPAN, at the "$" prompt the user should issue the command:

SET HOST NSSDCA

then respond to the "Username:" request with:

NSSDC

The system will then request the user's name and network address; this information is needed to respond to the user's needs and to keep track of usage. A menu of NSSDC services will appear next; one of the items listed will be the Master Directory. The rest is self-explanatory.

To access via Telenet, the user should enter the following after the "@" prompt:

ID ;32107035/GSFC

To the password request, the response should be:

036156

Then, at the "Username:" prompt, the user can proceed as explained above.

Access may also be made through dial-in lines. The number to call is

301-286-9000 or FTS 888-9000

At the "Enter Number:" prompt, the user should enter:

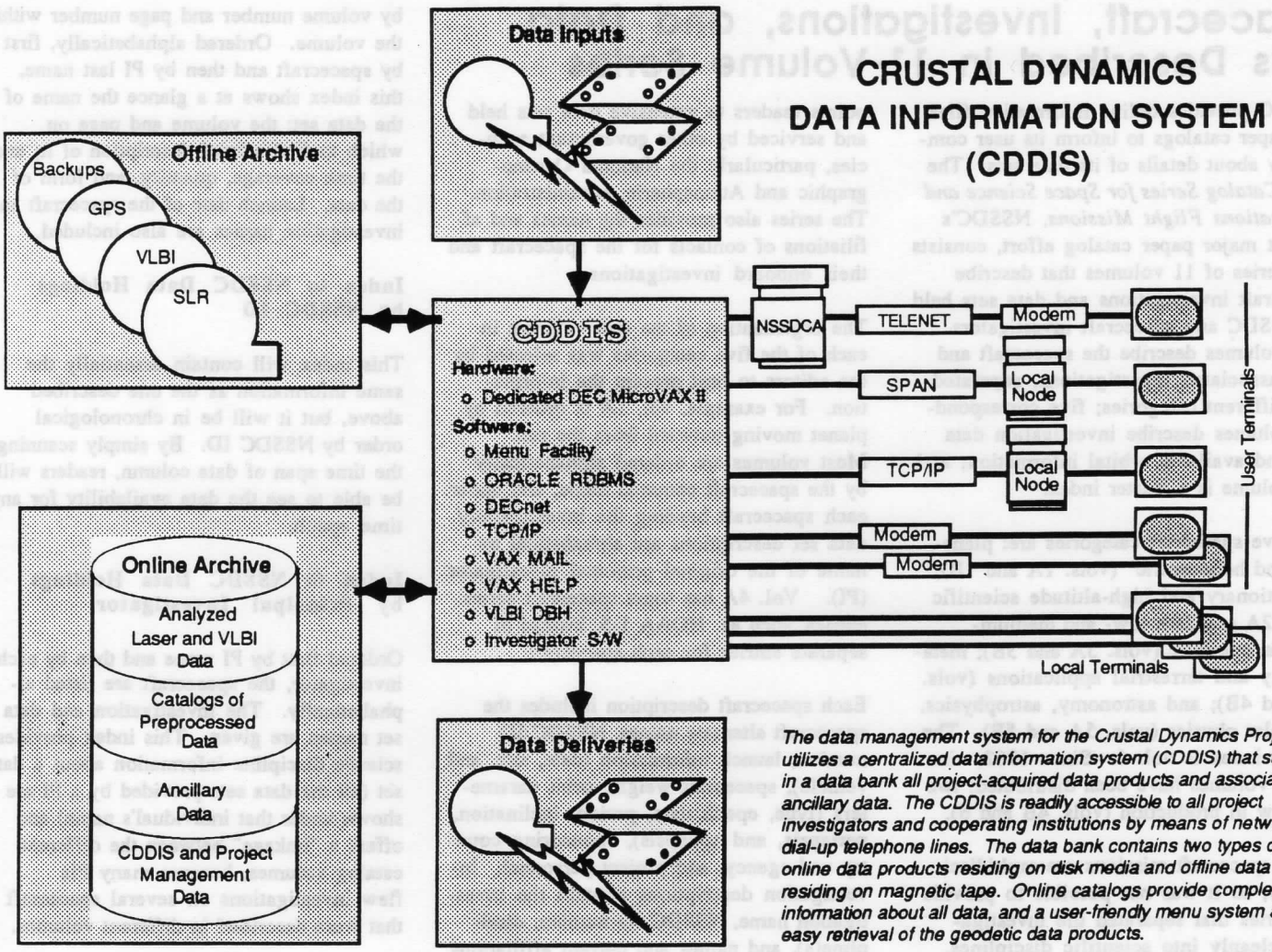
MD

After seeing the CALL COMPLETE message, the user should enter a few carriage returns. The "Username:" prompt will then appear, and interaction can continue as described previously.

The MD has been made possible in part through the work of the Catalog Interoperability working group. This group includes representatives of several major NASA data systems, including NASA's Climate Data System (NCDS), the Pilot Land Data System (PLDS), the NASA Ocean Data System (NODS), and the Planetary Data System (PDS), as well as representatives from NOAA and USGS. A six-month usage and evaluation period begins in October.

The Master Directory is intended to be usable without training. Researchers who would like to obtain a user's guide or have questions or problems should contact James Thieman at (301) 286-9790 or Mary James at (301) 794-5316. Those who hold useful data sets and are interested in submitting information about them, or who wish to have more information on the DIF, should request the *Directory Interchange Format Manual*, NSSDC publication 88-19. General comments from the science community are welcome.

James Thieman and Mary James



The data management system for the Crustal Dynamics Project utilizes a centralized data information system (CDDIS) that stores in a data bank all project-acquired data products and associated ancillary data. The CDDIS is readily accessible to all project investigators and cooperating institutions by means of network or dial-up telephone lines. The data bank contains two types of data: online data products residing on disk media and offline data residing on magnetic tape. Online catalogs provide complete information about all data, and a user-friendly menu system allows easy retrieval of the geodetic data products.

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through the data base management system. They include precision baseline distances, earth rotation and polar motion determinations, length-of-day values, and calculated station positions.

Ancillary Data

This information includes descriptions of Crustal Dynamics Project site locations, a priori monument coordinates and calibration data, and a priori star coordinates. These data sets are contained in the online data base.

Project Management Information

This category is accessible through the CDDIS data base to authorized project personnel only and includes mobile system schedules, occupation information, and configuration control information. In addition, CDDIS operational information is kept in the data base and is accessible to CDDIS staff only. These data include logs of all laser, VLBI, and GPS tapes received from the many international sources, as well as logs of all tapes created by the CDDIS for outside users and listings of CDDIS backup tapes.

In addition to providing the online, menu-driven user view, the CDDIS assists investigators in meeting their data requirements. Services consist primarily of receiving and archiving Crustal Dynamics-related data on magnetic tape and cataloging the data in the CDDIS data base. All data received by the CDDIS from the contributing sites must be verified, and often reformatted, before distribution. The CDDIS then disseminates these data to authorized investigators of the Crustal Dynamics Project, located both inside and outside the United States. Efforts are made by the staff to send the data in the format most convenient for the investigators. Data can be made available as printout listings, magnetic tape, floppy disk, or network files.

A user's guide, *Quick-Look Guide to the Crustal Dynamics Project's Data Information System,* gives brief descriptions of the DIS and its menu items, as well as detailed instructions on how to access the system and whom to contact when problems occur. A regular bimonthly publication, the *DIS Bulletin,* is available to project investigators and affiliates. The principal purpose of this publication is to familiarize the Crustal Dynamics Project investigator community with the data held by the CDDIS and to report any peculiarities in previously acquired data.

For additional information contact Carey E. Noll at (301) 286-9283 or FTS 888-9283; or via SPAN (CDDIS::NOLL), Internet (NOLL@CDDIS.GSFC.NASA.GOV), or Telemail ([CNOLL/GSFCMAIL]GSFC/USA).

Carey E. Noll

Spacecraft, Investigations, and Data Sets Described in 11-Volume Series

NSSDC provides online information files and paper catalogs to inform its user community about details of its data sets. The *Data Catalog Series for Space Science and Applications Flight Missions*, NSSDC's current major paper catalog effort, consists of a series of 11 volumes that describe spacecraft investigations and data sets held by NSSDC and spacecraft investigators. Five volumes describe the spacecraft and their associated investigations, separated into different categories; five corresponding volumes describe investigation data sets and available orbital information; and one volume is a master index.

The five spacecraft categories are: planetary and heliocentric (vols. 1A and 1B); geostationary and high-altitude scientific (vols. 2A and 2B); low- and medium-altitude scientific (vols. 3A and 3B); meteorology and terrestrial applications (vols. 4A and 4B); and astronomy, astrophysics, and solar physics (vols. 5A and 5B). The master index is vol. 6. Since 1982, nine of the volumes have been distributed; two are now in production (vols. 4B and 6).

Many spacecraft missions are multidisciplinary, so it was not possible to provide categories that separated the investigations cleanly into scientific disciplines. With the category breakdown used, which is part discipline-oriented and part orbit-oriented, almost all spacecraft belong clearly to only one category. The few exceptions result in some data sets appearing in more than one data set volume.

More than 270 spacecraft, 1,100 investigations, and 2,300 data sets are described in this series. The one major exclusion is 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 data are described in the *Catalog of Lunar Mission Data* (NSSDC 77-02).

The series describes the holdings from all spacecraft flight investigations for which NSSDC possesses data or can direct people to the data source, some of the data sets held and serviced by NASA-funded investigators, and some of the data sets held and serviced by foreign investigators. It also points readers to extensive data sets held and serviced by other government agencies, particularly the National Oceanographic and Atmospheric Administration. The series also provides the names and affiliations of contacts for the spacecraft and their onboard investigations.

The organization of the two volumes in each of the five categories was selected by the editors to best present the information. For example, vol. 1A is ordered by planet moving outward from the sun. Most volumes are ordered alphabetically by the spacecraft common name, and under each spacecraft heading the investigation/data set descriptions are alphabetical by name of the original principal investigator (PI). Vol. 4A has some spacecraft series entries, such as NOAA 1-5, instead of separate entries for each spacecraft.

Each spacecraft description includes the spacecraft alternate names, NSSDC ID number, launch information (date, site, and vehicle), spacecraft weight, orbit parameters (type, epoch date, period, inclination, periapsis, and apoapsis), sponsoring country and agency, and project personnel. Investigation descriptions contain the investigation name, NSSDC ID number, discipline(s), and names and current affiliations of the PI and other associated investigators. In the data set volumes, under each investigation heading, the data set descriptions are arranged according the NSSDC ID. The data set entries furnish the data set short and long names, the time period covered, the quantity of the data, and the medium on which the data are stored.

The master index volume is being written now. It will contain several indexes, generated to maximize the scientist's use of this data catalog series. At present, the following indexes (not a complete list) are scheduled for inclusion:

Index to NSSDC Data Holdings by Spacecraft Name/Principal Investigator Last Name

Each catalog volume has a section that is an index to its contents. This master volume index is a composite of the individual catalog indexes, and the entries are listed by volume number and page number within the volume. Ordered alphabetically, first by spacecraft and then by PI last name, this index shows at a glance the name of the data set; the volume and page on which to find a brief description of it; and the time coverage, quantity, and form of the data. Launch date of the spacecraft and investigation names are also included.

Index to NSSDC Data Holdings by NSSDC ID

This index will contain essentially the same information as the one described above, but it will be in chronological order by NSSDC ID. By simply scanning the time span of data column, readers will be able to see the data availability for any time epoch.

Index to NSSDC Data Holdings by Principal Investigator

Ordered first by PI name and then by each investigator, the spacecraft are listed alphabetically. The investigation and data set names are given. This index provides science discipline information about a data set (all the data sets provided by a PI are shown under that individual's name) and offers a "linkage" between the different catalog volumes, because many PIs flew investigations on several spacecraft that were described in different volumes.

Index of Ephemeris Data Ordered by COSPAR ID

This chronological index shows the launch date, epoch date, orbit type, apoapsis, periapsis, inclination, and period. For example, a user can easily pick the spacecraft of interest for a particular time period and location, and then use the first or second index mentioned above to check time span of data for data availability.

The indexes are generated by NSSDC's information management system. Fixed field information contained in this data catalog series is being entered into an Acius, Inc., "4th Dimension" data base, for use with an Apple Macintosh. Suggestions for including a particular type of index are welcome and should be addressed to Richard Horowitz at (301) 286-6314 or NCF::HOROWITZ via SPAN.

Richard Horowitz

Publications Recently Available from NSSDC

Announcements of Data, Systems, and Services

Astronomical Data Center Bulletin, vol. 1, no. 4, July 1987, NSSDC 87-16.

Skymap Catalog of 248516 Stars, Version 3.3—Documentation for the Machine-Readable Version, Y.W. Kang and W. Warren Jr., August 1987, NSSDC 87-15.

Graphical Manipulation, Management, and Display of Hierarchical Data Structures, L.A. Treinish and W.T. Campbell, October 1987.

The Crustal Dynamics Intelligent User Interface Anthology, N.M. Short, Jr., W.J. Campbell, L.H. Roelofs, and S.L. Wattawa, December 1987, NASA Technical Memorandum 100693.

A Finding List for Observers of Interacting Binary Stars—5th Edition, Y.W. Kang, December 1987, NSSDC 87-17.

NSSDC Data Listing, R. Horowitz and J.H. King, January 1988, NSSDC 88-01.

A Flexible, Template-Based Software Package for Generating Maps, K.-P. Ni, M. Gough, and L.A. Treinish, February 1988.

Crustal Dynamics Project: Catalogue of Site Information, C.E. Noll (ed.), March 1988, NASA/GSFC RP1198.

Space Physics Analysis Network Node Directory (The Yellow Pages), revised third edition, T. Ha, P. Sisson, V. Thomas, and J.L. Green, March 1988, NSSDC 88-04.

MK Classification of OB Stars (Rountree Lesh 1968)—Documentation for the Machine-Readable Version, W. Warren Jr., March 1988, NSSDC 88-09.

Descriptions of Data Sets From Geostationary and High-Altitude Scientific Spacecraft and Investigations, N. Schofield, H.K. Hills, and R. Parthasarathy, Data Catalog Series, vol. 2B, May 1988, NSSDC 88-11.

Descriptions of Astronomy, Astrophysics, and Solar Physics Spacecraft, Investigations, and Data Sets, S.J. Kim, Data Catalog Series, vols. 5A and 5B, June 1988, NSSDC 88-12.

Spectra of Late-Type Standard Stars in the Region 2.0-2.5 Microns—Documentation for the Machine-Readable Version, Y.W. Kang and W. Warren Jr., February 1988, NSSDC 88-02.

Refereed Publications

"Evaluation of the International Reference Ionosphere With the Large AE-C and DE-2 Data Bases," D. Bilitza, W.R. Hoegy, L.H. Brace, and R.F. Theis, *Advances in Space Research*, vol. 8, no. 4, pp. 209-212, 1988.

"National Space Science Data Center and World Data Center A for Rockets and Satellites: Ionospheric Data Holdings and Services," D. Bilitza and J. King, *Advances in Space Research*, vol. 8, no. 4, pp. 99-102, 1988.

"Study of Ionospheric Models for Satellite Orbit Determination," D. Bilitza, K. Rawer, and S. Pallaschke, *Radio Science*, vol. 23, no. 3, pp. 223-232, 1988.

"The Space Physics Analysis Network," J.L. Green, *Computer Physics Communications*, vol. 49, pp. 205-213, 1988.

Proceedings of Conferences

"PCDS Concepts Applicable to Archiving Antarctic Meteorological Data," L.M. Olsen, *Proceedings of the Workshop on the U.S. Antarctic Meteorological Data Delivery System*, Washington, DC, September 1987.

"Using ORACLE to Manage a Very Large Database," M.G. Reph, B.W. Meeson, and R.V. Sylto, *Proceedings of the International ORACLE Conference*, September 1987.

"NASA Climate Data System," P.H. Smith, *Proceedings of the 21st International Symposium on Remote Sensing of Environment*, October 1987.

"The Intelligent User Interface for NASA's Advanced Information Management Systems," W.J. Campbell, *Proceedings of the 3rd Annual Conference on Artificial Intelligence*, Huntsville, Alabama, November 1987.

"Advances in Data Exchange Methodology," M.G. Reph, L.M. Olsen, and W.B. Rossow, *Proceedings of the International Workshop on Remote Sensing Retrieval Methods*, Williamsburg, Virginia, December 1987.

"An Interactive, Discipline-Independent Data Visualization System," L.A. Treinish, *Proceedings of the International Workshop on Remote Sensing Retrieval Methods*, Williamsburg, Virginia, December 1987.

"Generic Scientific Visualizations," L.A. Treinish, *Proceedings of NASA/JPL/NSF/SDSC Scientific Visualization Technology Workshop*, Pasadena, California, January 1988.

"User Interfaces to Scientific Databases," M.G. Reph, B.W. Meeson, and L.M. Olsen, *Proceedings of the R.I.A.O. Conference*, Cambridge, Massachusetts, March 1988.

"Data Availability Through NASA's Climate Data System," L.M. Olsen, *Proceedings of the Third International Symposium on Okhotsk Sea and Sea Ice*, Hokkaido, Japan, February 1988.

"An Interactive, Discipline-Independent Data Visualization System," L.A. Treinish, *Proceedings of the Template User Network Conference*, San Diego, California, March 1988.

"NASA's Climate Data System Supports Satellite Data Sets," L.M. Olsen, *Proceedings of Application of Data from Spaceborne Radar Altimeters to the Problems of the Polar Sea Ice and Ice Sheets Conference*, Washington, DC, April 1988.

"Discipline-Independent Scientific Visualization and Its Application to Coordinated Data Analysis," L.A. Treinish and R.E. McGuire, *Proceedings of the TAE User's Conference*, Greenbelt, Maryland, May 1988.

"The Second Generation Intelligent User Interface for the Crustal Dynamics Data Information System," N. Short, Jr., and S.L. Wattawa, *Proceedings of the 1988 Goddard Conference on Space Applications of Artificial Intelligence*, May 24, 1988.

The Advice Taker/Inquirer, a System for High Level Acquisition of Expert Knowledge," R.F. Cromp, *Proceedings of the 1988 Goddard Conference on Space Applications of Artificial Intelligence*, May 24, 1988.

Automatic Cataloging and Characterization of Space Derived Data," W.J. Campbell, L.H. Roelofs, M. Goldberg, *Proceedings of the 1988 Goddard Conference on Space Applications of Artificial Intelligence*, May 24, 1988.

Miscellaneous Publications

"A Software Package for the Data-Independent Management of Multidimensional Data," L.A. Treinish and M.L. Gough, *Eos*, vol. 68, no. 28, pp. 633-635, July 14, 1987.

"NSSDC Releases Version 1.0 of the NSSDC Graphics System (NGS)," L.A. Treinish, *Eos*, vol. 68, no. 47, pp. 1609-1610, November 24, 1987.

User's Note for Alouette and ISIS Ionograms, J. Jackson, February 1988, NSSDC 88-06.

Compendium of Meteorological Space Programs, Satellites, and Experiments, L. Dubach and C. Ng, March 1988, NSSDC 88-03.

Data Center's Photo Lab Prides Itself on Talent and Versatility

Versatility is the rubric of the NSSDC photo lab, which is run by NYMA, Inc. One week the staff is given a videotape of a press conference on the Chaos Computer Club of Hamburg (criminal hackers) and promptly furnishes an in-house translation from German, with dubbing in English. Another week the personnel prepare a series of photographs of potential landing sites for an unmanned spacecraft on Mars and on Phobos, one of Mars' two small satellites. The terrain is dusty, and the generation of sharp pictures with the right density scale demands very tight control and individual attention. The unusual thing is that the unmanned spacecraft will be a Soviet one and the project is part of a cooperative program.

These varied requests are overseen by Rudy Pauley, photo lab supervisor and unofficial translator. Pauley was born and educated in Germany. He received his associate degree from Augsburg Technical Photographic College and is skilled as a lithographer, photographer, and phototechnician. He has been at Goddard Space Flight Center for 14 years—11 of them with NSSDC.

Pauley has a keen interest in education. Aside from training photo lab personnel in the art of phototechnology, Pauley also volunteers as a a mentor for the Summer High School Apprenticeship Research Program (SHARP) and the Community-Based Education Program. SHARP is a federal program designed to encourage students to enter the fields of science and engineering, while the Community-Based Education Program offers youngsters who have been unsuccessful in the school setting an opportunity for success through creative and nontraditional approaches to education.

In connection with the recent visit of Halley's comet, Pauley prepared enlargements from the ancient glass plates of its 1910 appearance. One of his most significant responsibilities in recent years was the Naval Research Laboratories' Spacelab II Spectrograph Project.

The single largest item in the workload (probably 50 percent)—the enlarging of Apollo, Viking, and Voyager images—is usually done by Jay Friedlander. Friedlander studied at Northeastern Illinois University, then received a bachelor of fine arts degree in painting and art history from the University of Illinois and a master of fine arts from the Maryland Institute College of Art.

Microfilm and fiche are handled by Hilda Burger, who has been working at the lab since 1973. Negatives are produced from hard copy and are printed out in 16 mm, 35 mm, or sheet microfiche by either the silver or the diazo process. Before coming to NSSDC, Burger became handicapped as a result of occupational exposure. After medical treatment and rehabilitation, she was named 1972 Handicapped Person of the Year by the mayor of Washington, DC, Walter Washington.

Photo lab staffers (from left): Robert Cornett, Rudy Pauley, Robert Tice, Hilda Burger, and Jay Friedlander.

Duplicating analog data for requesters is generally Robert Cornett's thing. Jobs include roll film from Apollo, Viking, and Nimbus. He also provides photographic support for the Naval Research Laboratories' S-019 far-ultraviolet and S-020 ultraviolet/X-ray photo experiments from Skylab II. The precision demanded is such that the equipment, particularly the UV point source, must be aligned by laser.

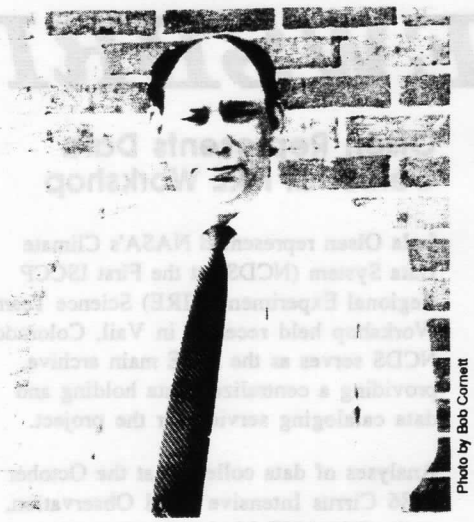
Cornett studied photography at Utah State, the Maine Photographic Workshop, and The School of Visual Arts in Manhattan, where he obtained a bachelor of fine arts degree. In the lab he may be a skillful technician, but in private life he is a serious still photographer. He visited Afghanistan and recently published *Postponed Jihad,* a photo essay on medical assistance programs there.

Robert Tice studied data processing, photography, and video. His job as quality control monitor means he must approve each print from lunar and planetary photography as meeting the exacting and critical requirements of the scientist requesters. He also puts all data onto the VAX computer, controls all in-house jobs, and videotapes events such as the Coordinated Data Analysis Workshops.

Although each member of the team—and it really is a team—has special areas of expertise and responsibility, cross-training is general so that absences do not affect work flow.

The photo lab houses a wide variety of machines for many different processes. One of the most elegant and advanced machines is the COM unit, which reads reels of magnetic tape and plots the data in graphic form with linear or logarithmic scales and units. It can append English text titles as needed. It then prints the re-

see Photo Lab, *page 9*



Stephen Peregoy

Photo Lab, *from page 8*

sult on a roll of 35 mm film. The investigator can rapidly scan this immense amount of data and request 8 x10 prints of the most interesting frames.

In contrast to the COM unit is the ITEK 303 silver duplicator, which would almost pass for an antique. It comes in a black box, '50s style, with chrome spools and idlers sticking out all over. Its function is high-volume, high-quality copying of 16 and 35 mm stock by the silver process. Its open architecture means that it can be adjusted (e.g., by adding filters) to cope with special cases and to maintain quality, even for nonstandard jobs.

Videotaping currently is about 5 percent of the workload. Tapes are available in either VHS or Beta format.

Most of the photographic chemistry is very safe, but the microfilm lab does use large quantities of ammonia in the gas phase for diazo developing. It comes in big cylinders of anhydrous liquid. To protect the staff, there is very effective ventilation. The freshest air in Goddard's Building 26 is probably in the basement, where the photo lab is located.

The lab has an excellent safety record. In March it received the Goddard Space Flight Center Contractor Safety Award. Each employee received a plaque from the center's director, Dr. John W. Townsend, Jr. The photo lab also recently received an award for support to the Coordinated Data Analysis Workshops, most notably for the rapid turnaround it provided.

Robert Richards

Peregoy Oversees NSSDC Photo Lab and Computer Operations

Stephen Peregoy is an enthusiast—he oversees the NSSDC photo lab and computer facility with a passion for perfection and overflowing energy. He is the onsite project manager for NYMA, a company based in Greenbelt, Maryland, that holds the contract to operate these two units.

Peregoy began to learn his business in the U.S. Army, where he was trained in aerial photography and photo interpretation. He came to the photo lab in 1968 as a senior photographic technician and has been here since, except for a stint with the U.S. Geological Survey (USGS) as a map editor and lithographer. He studied geography, cartography, and photography at Fort Belvoir, USGS, the University of Hawaii, and George Washington University.

It is a demanding job involving high-volume production of routine copies and special, difficult assignments like recovering useful data from accidentally "fried" negatives produced by the Apollo heliograph experiment.

Peregoy has managed computer operations since 1986, when NYMA took over the contract. By then the computer facility had grown to include its VAX 11/780 and 8650 computers, now a clustered system, along with the original MODCOMP and printer. On a tour of his domain, his pride and enthusiasm are obvious as he describes in complete detail the history, advantages, and problems of every machine.

Machines are only part of it. Peregoy believes in his people. He emphasizes teamwork and cross-training. He is responsible for 14 employees—5 in the photo lab and 9 in computer operations—and is particularly proud that many are university graduates or are taking college courses.

Robert Richards

Time Convention and Flow Latitude Changes Being Made on OMNItape

Two conventions denoting day of year have been used in space physics. In one, called "decimal day," Jan. 1 is considered day 0, while in the other, called "calendar day," Jan. 1 is regarded as day 1. Use of the decimal day convention has been steadily waning for several years. Today its use is relatively infrequent.

Over the years, NSSDC has created, maintained, and periodically extended a multi-spacecraft compilation of hourly averaged, near-earth solar wind magnetic field and plasma parameters. This compilation exists on magnetic tape (the "OMNItape"), in a series of data books, and as an electronically accessible online file.

When the OMNItape was first created in the mid-1970s, most of its source data sets used the decimal day convention. Accordingly, this convention was used for the OMNItape. By the time the online OMNIfile was created in the mid-1980s, use of the decimal day convention had diminished significantly, so the OMNIfile was created with the calendar day convention.

The use of different time conventions for the OMNItape and OMNIfile is a source of confusion and potential error, and should be eliminated. As the calendar day convention is overwhelmingly the dominant convention, NSSDC intends, effective Jan. 1, 1989, to maintain, update, and disseminate only calendar day versions of the OMNItape.

This transition period will unavoidably place special demands on users, requiring that they take special care to determine which OMNItape they have. NSSDC plans to refer to these versions as OMNItape-0 (decimal days; Jan. 1 = day 0) and OMNItape-1 (calendar days; Jan. 1 = day 1). NSSDC also expects to maintain and update the OMNItape well into (and beyond) the ISTP/WIND era, thereby making transition problems worth the effort.

A separate problem also being "fixed" relates to the solar wind flow latitudes from IMP 8. It was discovered some time ago (but only after several years of IMP 8 data had been added to the OMNItapes) that there had been a drift away from the expected long-term average value of zero. This effect is now understood in terms of differing gain shifts of the two Faraday

see OMNI, *page 12*

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NSSDC Archives Data From SME Spacecraft

NSSDC has archived ozone and solar data from the Solar Mesosphere Explorer (SME) spacecraft. Daily averaged ozone volume mixing ratio profiles, measured by both the ultraviolet (UV) and near infrared (IR) spectrometers, are available for December 1981 to September 1985.

The ozone data from the UV spectrometer are given on pressure surfaces from about 50 to 90 km, while those from the near IR spectrometer are given in pressure levels from 1.0 to 0.1 mbar (about 48 to 65 km). They cover from 85 deg S. to 85 deg N., in 5-deg latitude intervals.

Even though the data are averaged over several longitudes, there are not enough samples to consider them a zonal average. These ozone data are good for studies of short-term changes in the middle atmosphere; however, they are not suitable for analyses of long-term ozone behavior.

Besides the ozone data, which are put on one tape per year (5 MB), there are also daily solar flux data measured by the solar ultraviolet spectrometer between 115 and 302 nm at 1-nm resolution. Absolute accuracy is estimated to be +/- 15 percent, and the data are complementary to sounding rocket measurements for studies of intermediate-term solar variability, but extraction of long-term solar variability is not recommended. There is one tape of solar data (7 MB) covering January 1982 to December 1987.

Carolyn Ng

Reph Participates in ISCCP Working Group Meeting

Mary Reph recently took part in the Seventh Session of the Working Group on Data Management for the International Satellite Cloud Climatology Project (ISCCP) as representative for NASA's Climate Data System (NCDS), which manages ISCCP data sets. The meeting was held in Banff, Canada, at the invitation of the Canadian Atmospheric Environment Service.

ISCCP produces global cloud climatology data sets derived from data collected by various geostationary satellites (such as GOES-East, GOES-West, Meteosat, and GMS) and polar orbiters (such as NOAA 7-10). The primary objectives of the meeting were to review the data management procedures and operations to resolve any programmatic issues, to review the status of data processing, and to promote coordination of validation efforts.

NCDS serves as the primary NASA archive for ISCCP B3 (image) and C (gridded non-image) data. Reph presented the capabilities developed in NCDS for providing NASA researchers with access to these data, as well as a summary of the user requests for the ISCCP data. The NCDS already stores, on 257 tapes, ISCCP Stage B3 data from the above-mentioned satellites, covering various periods from 1983-85. A preliminary version of the Stage C data is currently available, as are correlative snow/ice data. Additional data are now being processed and should be available to researchers soon.

The NCDS has already responded to requests for these data from 12 researchers and has distributed more than 300 tapes. Researchers interested in these data should contact the NCDS User Support Office at (301) 286-9760 for additional or more up-to-date information.

Mary Reph

NSSDC and COBE Approve Data Management Plan

The Cosmic Background Explorer (COBE) Project Data Management Plan (PDMP) has been approved by both NSSDC and the COBE project management. The PDMP, which is a mechanism for formally reaching agreement on the transfer of project data into the NSSDC archives, specifically defines the data products to be archived at NSSDC three years after the COBE launch. It also sets out guidelines for software and hardware supporting systems.

Joseph H. King

Olsen Represents Data Center at FIRE Workshop

Lola Olsen represented NASA's Climate Data System (NCDS) at the First ISCCP Regional Experiment (FIRE) Science Team Workshop held recently in Vail, Colorado. NCDS serves as the FIRE main archive, providing a centralized data holding and data cataloging service for the project.

Analyses of data collected at the October 1986 Cirrus Intensive Field Observation, at the July 1987 Marine Stratocumulus Field Observation, and during the Extended Time and Area Observations were presented in several workshop sessions. Olsen presented the status of NCDS support of FIRE in one of the workshops and also participated in the poster sessions showing graphic illustrations of FIRE data created through NASA's Climate Data System.

NCDS holds all reduced analysis products submitted by individual principal investigators in the Standard Data Format (SDF). Software written by NCDS staff allows these data to be translated to the Common Data Format (CDF). In CDF, the data can be previewed, accessed, or browsed using the tools provided by the NCDS Data Manipulation and Graphics Subsystems.

Extensive holdings of AVHRR, GAC, LAC, and HRPT; TOVS, HIRS, MSU, and SSU; and GOES VISSR data have been archived for the project. In addition, ISCCP products and other related data sets of interest to FIRE principal investigators are available through NCDS.

Lola Olsen

King Is Delegate to U.S. and U.S.S.R. Joint Working Group

Dr. Joseph H. King of NSSDC was an official delegate to the first meeting of the U.S./U.S.S.R. Joint Working Group (JWG) in solar-terrestrial physics held recently in Bethesda, Maryland. This JWG was one of five established by an agreement signed in April 1987 between U.S. Secretary of State George Shultz and Soviet Foreign Minister

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E. Shevardnadze. The first astronomy and astrophysics JWG was held in parallel with the solar-terrestrial meeting.

The solar-terrestrial JWG is cochaired by Dr. Stanley Shawhan for the United States and Dr. A. Galeev for the Soviet Union. The U.S. delegation consists primarily of the program scientists from Dr. Shawhan's division at NASA Headquarters, in addition to Goddard Space Flight Center representatives Dr. Robert Farquhar for Solar Probe and Dr. King for solar wind data. About a dozen U.S. discipline experts attended.

At a solar wind splinter group meeting chaired by Dr. King, it was agreed that the United States would continue to make IMP 8 (Interplanetary Monitoring Platform) and ICE (International Cometary Explorer) solar wind data accessible to Soviet scientists for various studies and for support of the Phobos spacecraft, which was launched in July toward Mars and its satellite, Phobos. In return, solar wind field and plasma data from the Prognoz spacecraft series would continue to be made available to U.S. scientists through NSSDC, and Phobos solar wind data would also become available.

Further data exchange involving the U.S. IMP and ICE spacecraft and the U.S.S.R. Interball mission scheduled for the 1990s was also discussed. The group agreed to discuss coordination of solar wind data for the International Solar Terrestrial Program at a subsequent meeting.

Dr. M. Verigin gave a presentation of a data book containing plots and listings of Prognoz 9 solar wind flow parameters for July 1983 to February 1984. The book also contained scatter plots of Prognoz 9 and simultaneously measured IMP 8 parameters gleaned from the NSSDC *Interplanetary Medium Data Book*. The Soviet data book was patterned on the NSSDC data book and even had Prognoz data gaps filled with IMP 8 data when available. New Prognoz data will be added to the "definitive" NSSDC compilation, filling many important data gaps that occurred when ISEE 3 was in the deep magnetotail.

During its stay, the Soviet delegation spent an afternoon touring Goddard. The space physics group spent an hour at NSSDC visiting the data archive, photo lab, and computer facilities, and was briefed on Data Center activities.

Karen Satin

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Solar-Terrestrial Models Available Via SPAN

The NSSDC archives contain a variety of software products that are of general interest to the science community. Models for the different regions of the solar-terrestrial environment constitute an important part of this collection. As a new service, NSSDC has developed an interface for online access to these models.

The online system presently includes the most recent editions of the COSPAR ionospheric/atmospheric models, the IAGA International Geomagnetic Reference Fields from 1945-85, and NSSDC's models for trapped particle fluxes in the inner and outer radiation belts. All are empirical models based on the combined data resources for the specific subregion. They are the internationally accepted standards and have been steadily improved over the last decades.

Although the current system contains only a small part of NSSDC's model collection, it does include the most recent and most frequently requested models. In the future, online access will be extended to include information about all of the models distributed by NSSDC.

The online system is implemented on the NCF::NSSDC account and can be accessed via the Space Physics Analysis Network (SPAN). The user first selects the area of interest (e.g., ionosphere, atmosphere, magnetospheric magnetic field, or radiation belt). Menu options then allow the user to read the documentation and transfer or run a model. The documentation file contains a brief description and references. In transfer mode, a note is sent to the user's account listing the model files and explaining how to copy them. In the run options, tables of model parameters tailored to the special needs of the individual can be generated.

NSSDC also distributes solar-terrestrial software products on tape and disk. In 1987, more than 300 requests for model software were processed.

Dieter Bilitza and Nathan James

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Paul Smith Transfers to NASA Headquarters

Dr. Paul Smith, formerly head of NSSDC's Data Management Systems Facility, recently transferred to NASA Headquarters, Code RC, where he directs the computer science program in the Information Sciences and Human Factors Division of the Office of Aeronautics and Space Technology. Smith was at Goddard Space Flight Center as a space scientist, data systems expert, and manager for close to 20 years. His former role is currently being filled, on an acting basis, by Dr. James L. Green, NSSDC head.

Joseph H. King

CALENDAR

October 24-26	Data Systems Users Working Group Anaheim, California
November 16-18	Catalog Interoperability Workshop Goddard Space Flight Center
November 29-December 1	PLDS Team and Science Advisory Meeting Goddard Space Flight Center

Standards Office, *from page 1*

existing and emerging standards in areas such as data interchange, media, data base, communications, languages, and operating systems. Now available in the fledgling library are standards specifications from such organizations as ANSI, CCITT, ISO, NBS (now NIST), and GSA, and related articles from a limited number of journals and periodicals. Articles and specifications are being added continuously. Copies are available, copyright permitting, and may be requested from the NSSDC Request Processing facility by sending electronic mail to NCF::REQUEST.

The Standards Information System (SIS), currently under development, will provide online access to information about standards including, but not limited to:

- abstracts of standards specifications
- a bibliography of standards organizations and their contacts
- topical articles from selected journals and periodicals

SIS will support not only the NSDSSO Standards Library but also the other functions of the NSDSSO.

The Standards Accreditation arm of the NSDSSO develops and administers the process by which the space science and applications community produces new standards for its more sophisticated data systems. A close relationship is maintained with NASA Headquarters to assure that the evolution of NSDSSO policies and procedures retains NASA-wide applicability. As the push for computer-based information exchange increasingly demands the implementation of universally accepted standards, the NSDSSO acts to facilitate their production by:

- forming the appropriate technical groups to develop particular standards
- providing the necessary logistical support during the development process
- maintaining an active interface with other standards organizations

Tools that may become NSDSSO-adopted standards and can help meet the need to efficiently transport, archive, manage, manipulate, display, and analyze data include CDF, SFDU, FITS, ESADS Lexicon, and DIF.

Falling within the purview of Standards Conformance and Support are a broad range of services that can be identified with the general tags of education, conformance testing, and user support. Educationally, the NSDSSO fosters forums, workshops, and studies that promote understanding of issues related to standards. It analyzes and evaluates particular standards, comparing and contrasting related or competing ones with respect to their direct benefit to the space science and applications community. The office gathers and makes available objective experiential information associated with the use of particular standards, which is particularly useful when a standard must be selected for a developing system. As need dictates and resources permit, it also provides support to users in testing and validating products for conformance to a particular standard. Full standards support offices may be established within the NSDSSO for selected non-vendor-supported standards.

Drafts of the NSDSSO's policies and procedures manual and its information management plan have been completed, and plans to sponsor the first Data Interchange Workshop are being developed. The office is responsive to the requirements of its user community and welcomes comments and suggestions concerning the kinds of information and services most needed. Direct these ideas to NCF::REQUEST, identifying the subject as NSDSSO.

Donald M. Sawyer, Alan Dwyer, and Dolores Parker

OMNI, *from page 9*

cup plates; the difference between their two outputs yielded the flow latitude value. The time series of annual averages of apparent IMP 8 flow latitudes for 1973 through 1986 is: 0.5 1.6 1.7 1.9 2.4 4.4 5.4 5.8 5.7 3.8 5.5 5.3 4.7 4.9. The standard deviations of these averages are near 3 through 1977 and closer to 4 thereafter. Although this effect was announced in a widely distributed erratum notice, to minimize the chance of misuse NSSDC will begin distributing (with OMNItape-1) modified values of this parameter wherein 2.0 will be subtracted from the OMNItape-0 values for periods before Jan. 1, 1978, and 5.0 will be subtracted for periods after that date. This change will also be made to the online OMNIfile.

Joseph H. King

Data Inquiries

For information on submitting data to the Data Center or inquiries regarding availability, cost, and ordering procedures, researchers *within the United States* should contact:

Submissions:

Dr. H. K. Hills
National Space Science Data Center
Code 633.8
Goddard Space Flight Center
Greenbelt, Maryland 20771
Telephone: (301) 286-4106
SPAN: NSSDCA::HILLS

Requests:

National Space Science Data Center
Code 633.4
Goddard Space Flight Center
Greenbelt, Maryland 20771
Telephone: (301) 286-6695
Telex: 89675 NASCOM GBLT
TWX: 7108289716
SPAN: NSSDC::REQUEST

Individuals residing *outside the United States* should contact Dr. James I. Vette for information on submissions. Inquiries to Dr. Vette and requests from outside the United States must be directed to:

World Data Center A for Rockets and Satellites
Code 630.2
Goddard Space Flight Center
Greenbelt, Maryland 20771 USA
Telephone: (301) 286-6695
Telex: 89675 NASCOM GBLT
TWX: 7108289716
SPAN: NSSDC::REQUEST

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