NSSDC news

NASA's National Space Science Data Center

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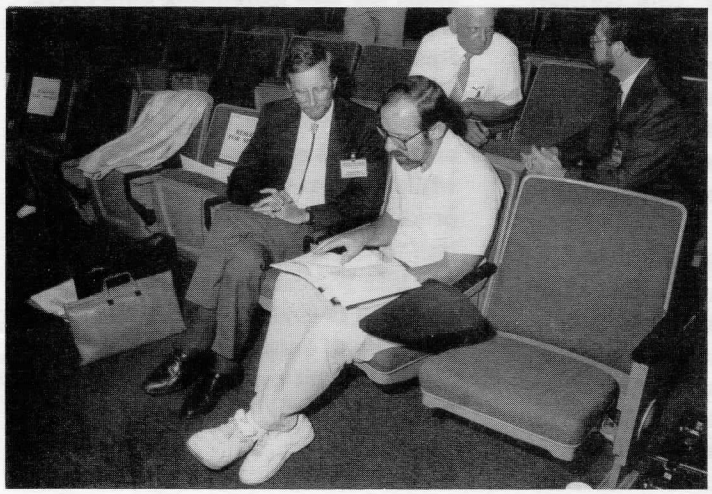
# Critical Role of Mass Storage Media and Techniques Explored at Three-Day NSSDC Conference



***Reagan Moore of San Diego Supercomputer Center and Dr. Barry Jacobs of NSSDC discuss mass storage issues.***

To stimulate industry interest in NASA's future mass storage requirements, the NSSDC recently hosted and sponsored a conference on Mass Storage Systems and Technologies for Space and Earth Science Applications. The central purpose of the event was to review the current status of mass storage capabilities and to assess NASA's upcoming requirements.

"We at Goddard have a vested interest in on-line mass data storage systems, and are anxious to learn from the experts gathered here what the field has to offer in solutions to some of the problems NASA faces in managing its large data systems," said Dr. Milton Halem, chief of NASA's Space Data and Computing Division, in introducing the conference. Halem went on to tell the approximately 200 attendees on the morning of July 23, 1991, that "the emerging role of mass storage media and their proper incorporation into the environments of NASA's computing centers and data centers is fundamental to the ultimate success of many of our scientific missions.

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*"To archive and deliver this volume of data to scientists with reasonable response times constitutes a major technological challenge."*

*—Dr. Milton Halem*

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"In particular, it is a critical element to the success of one of the most ambitious projects NASA has ever undertaken or, for that matter, the science community has ever undertaken, namely the Earth Observing System, planned for launch towards the end of this decade. To archive and deliver this volume [i.e., hundreds of terabytes] of data to scientists with reasonable response times constitutes a major technological challenge today. NASA will attempt to bring into being a massive distributed collection of

*see* Mass Data Storage, *p. 4*

## *inside:*



*Dedicated to providing multidisciplinary data and information for the worldwide science community*

*Director's Message:*

# A New Way of Doing Business— Rapid Access to Archived Data

Major changes are currently occurring in the way NASA is working with the scientific user community, changes that will result in more rapidly acquired and accessed data and that will necessitate operational modifications in data centers like the NSSDC. Shifting missions away from the typical Principal Investigator type, facility class instruments on NASA spacecraft are being managed by teams of scientists who create the algorithms that then process the data and provide products to a set community of scientists. Those data are then archived and distributed to the entire community faster than ever before. In many cases, the processing done by the science teams, the distribution, and the archival are almost immediate. Processing data to become available within a few days after they are generated is the mode of many new NASA missions, cutting across all the science disciplines, including space physics to the Earth Observing System (EOS). For example, Earth science will produce data products and distribute them within 24 to 48 hours in some cases.

One of the reasons NASA is moving toward providing data more quickly is that science is beyond the exploratory phase and a greater need for correlations among data exists. Although there are still many Principal Investigator type missions, scientists will need data from other missions and from other instruments on the same mission in order to achieve a high caliber of scientific work. This, coupled with a tremendous community concern about accessing data beyond the select few Principal Investigators, has pressured NASA to change the way it does business and has signaled data access as a major issue for the 1990s.

NASA is now funding a lot of researchers to perform scientific analysis from data in the archives, much like a mission to the archives themselves. In my opinion, however, the amount of science done will depend upon how easily these scientists can access archived data. Of course, the type of access depends on what data are needed. It is very important for the NSSDC to acclimate to this new environment and facilitate rapid access to the key archive data it holds.

The current and many of the future NASA missions produce massive volumes of data with the expected volume to increase exponentially over the next few years. Using the NSSDC as an example will put this into perspective. The data center has acquired approximately seven terabytes of data on approximately 100,000 data tapes, optical disks, etc., which have been accumulated over the past 25 years. By the year 2000, just a few of the Earth science missions will be generating six terabytes every few days. That is approximately a data center or two a week by the end of this century. This is not a step function; it gradually grows. Many missions are now generating data in the high kilobit range (50 kb-100 kb). Space Telescope itself generates a terabyte of data per year. In approximately six years, the raw data amount will equal a data center, while the process products that are produced will equal about three and a half terabytes per year. That mission will last 15 years. Based on this example, it is evident that massive amounts of data are coming and that all NASA data centers must be ready to handle them.

NASA is in the process of rewriting many of the NASA Management Instructions (NMIs) that deal with data management and archiving issues. Instead of all the future data going to the NSSDC, archiving will now become the responsibility of the science discipline for which that mission has been launched on behalf of that community. Each science discipline must determine how its data will be archived. For instance, in Earth science there are many Earth probes and the EOS, which will deposit the data from these missions in at least seven major archives. In astrophysics, access to much of its data is through the Space Telescope Science Institute or Infrared Processing and Analysis Center (IPAC) to access Infrared Astronomical Satellite (IRAS) data, and there will be many other similar organizations.

*see* Director's Message, *p. 3*

Director's Message, *from p. 2*

Since the NSSDC is not "the only archive in town," it will be working hard to provide important complementary services in addition to being the main archive for many missions. The NSSDC will have certain functions that cut across all disciplines. For example, NSSDC's newly created Interoperable Systems Office (ISO) will include primarily discipline-independent activities such as the Master Directory and Global Change Master Directory. In addition, the ISO will manage a variety of standards activities. All these functions will benefit each of the NASA science disciplines.

As we enter a new era, NSSDC's goal is not so different from the old one, that is, to maximize the scientific return. Re-examining the old documents from the establishment of the NSSDC reveals a constantly recurring phrase, "to maximize the scientific return from NASA space science missions through effective data services." Simply stated, this is what the NSSDC is about. The Grand Strategy is to clarify its roles within the next several years, with a number of discipline data systems (or services).

Early project interfaces will be extremely important. The center will provide scientific users with services that quickly identify what data are needed and the means to rapidly access those data. In the strategy and in the mission, NSSDC has a number of roles that cut across all the disciplines, so the Grand Strategy will not weed out one discipline over another. The NSSDC itself is still very much a part of this overall picture, whether Earth science, astrophysics, or space physics is involved.

James L. Green

# Data Census Yields Interesting Facts

In 1990 there was a major effort to determine the location and status of data from past NASA/Office of Space Science and Applications (OSSA) spaceflight investigations. This effort was intended to contribute to an information base, which will be as comprehensive relative to extant OSSA mission data as the NASA Master Directory is intended to be comprehensive relative to worldwide accessible/usable data of potential interest to OSSA researchers.

The 1990 data census was initially defined by Greg Hunolt, NASA Headquarters; Margaret Johnson, the Jet Propulsion Laboratory (JPL); and Joseph King, NSSDC. It was done in two phases. Results of the first phase—primarily oriented towards data held at Goddard Space Flight Center (GSFC), including NSSDC, and JPL—were given in a report written by Margaret Johnson in 1990.

The second phase involved surveying 213 former Principal Investigators. They were each given a list of the investigations with which they had been associated, were reminded what data from those investigations had already been archived, and were asked what additional data they might hold that might be archive-desirable. For any such data identified, questions were asked about the state of the data volumes and of the documentation.

Of these 213 surveyees, 171 had data from inactive investigations—that is, those that flew on spacecraft that are no longer active and for which no project-coordinated archiving activity is continuing. Responses were received from 73 of these 171 persons. Eighty-two percent of the investigations for which responses were received had no further data for archiving. Investigations for which no responses were received tended to be the oldest investigations, for which there is slim likelihood that desirable data for archiving still exist.

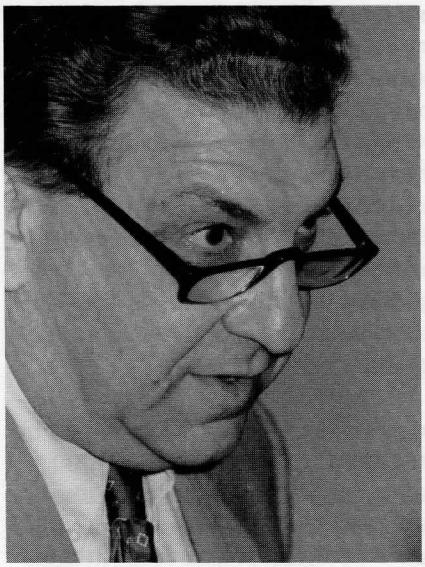
A new report has just been issued by NSSDC on the results of the 1990 data census. This report identifies the surveyees, their investigations, and their responses. It also recapitulates the results of the first phase of the census (by reproducing selected material from the 1990 Johnson report in an appendix). Copies of the report are available from Joseph King or from the NSSDC Coordinated Request and User Support Office (CRUSO).

As a next step in the process of building a definitive data base of information about extant data and of building effective archives of the right data, NSSDC expects to create discipline-subsetted reports from its data base holding the census results and holding knowledge from other sources. The data center plans to share these reports with OSSA Discipline Divisions and their advisory groups in a process of prioritizing past data for restoration and archiving. Here, "restoration" means migrating data bits from aging media, upgrading documentation, etc.

Joseph King

***The Astronomical Data Center CD-ROM set of "Selected Astronomical Catalogs, Volume 1" has arrived. The discs contain more than 100 popular astronomical catalogs. Copies may be requested from the CRUSO (NCF::REQUEST).***

Mass Data Storage, *from p. 1*



***Dr. Milton Halem, chief of NASA's Space Data and Computing Division, introduced the conference.***

discipline-specific data archives where all data are managed on line and with transparent access to the users, so that scientists and other interested groups can have near-instantaneous access—from seconds to minutes, at worst—for browsing, querying, visualizing, and downloading data to their local workstations. This presents very unique technical requirements to the developers of mass data storage systems that I believe have not yet been addressed in other applications."

Concluding his brief kickoff address for the three-day conference, Dr. Halem predicted, "The 1990s will be the decade for on-line interactive access to all the information knowledge that mankind has acquired. Such data systems will become the libraries of the future; and I hope that by the end of this conference we will begin to get a feel from the experts here whether this is indeed the direction of the 1990s."

### Numerous Speakers Address Crucial Data Storage and Access Topics

Having identified some general conference objectives, Dr. Halem's remarks established an enthusiastic tone for the rest of the meeting. A succession of about 30 speakers appeared during the next three days' sessions to discuss many critical data storage issues. The variety of speakers at the conference in the Building 3 auditorium at Goddard Space Flight Center represented a cross-section of data storage media, hardware, and software systems vendors; members of NSSDC management (both government and contractor); people from several government agencies outside NASA; and representatives from the academic community.

### Disk and Tape Media Technology Stressed on Day One

Following the keynote address by Fred Moore of Storage Technology Corporation on the data storage and management environment of the 1990s, the speakers at the first day's session dealt with the topics of optical disk and tape technology; magnetic disk media; magnetic tape; storage management and file systems; and file servers, networking, and supercomputers. In the afternoon, the problems and challenges of specific applications were described in talks relating to actual data storage experiences at the National Science Foundation (NSF), the National Center for Atmospheric Research (NCAR), the Scientific Computing Division, and the National Archives and Records Administration (NARA).

Among the major points made in Mr. Moore's morning keynote address were the following:

- Effective storage and storage management are the most pressing issues in the 1990s environment.
- Automated operations are quickly becoming a strategic goal of most large-scale data centers.
- Storage management and the ability to access all data objects from all computing platforms will become a requirement of the 1990s.

For his evening banquet address, Dr. John Mallinson, former Director of the Center for Magnetic Recording Research of the University of California, San Diego, described developments in optical magnetic recording that occurred during his 25-year tenure with the AMPEX Corporation. Mallinson explained that, for the most part, research at AMPEX was directed towards attaining the ultimate (and to date, not yet achieved) goal of recording enormous data bases, terabit data bases, and accessing them at gigabit-per-second rates.

### Mass Storage Systems, Physical Storage Media Panel Discussion Highlight Second Day

Presentations on Wednesday, July 24, the second conference day, began with an opening address by Patric Savage, a research consultant with the Shell Development Company, on the topic "Stewardship of Very Large Digital Data Archives." Savage pointed out that there is not really much widely known about operating digital

*see* Mass Data Storage, *p. 14*

***Dr. John Mallinson of Mallinson Magnetics describes his experiences with AMPEX Corporation.***

# *1991 NSSDC Data Listing* Is Available

The *1991 NSSDC Data Listing* is published by the National Space Science Data Center to permit its user community to identify, in a highly summarized way, the data center's data holdings available for distribution. Several data sets in the data listing have arrived at NSSDC, or have been added to, since the relevant data catalog was issued in the 1980s.

The *1991 NSSDC Data Listing* identifies more than 3700 data sets from 1070 experiments flown on 317 spacecraft. It begins with a brief description of each of NSSDC's special services and systems that offer data: the Astronomical Data Center (ADC), the Coordinated Data Analysis Workshops (CDAW), the NASA Climate Data System (NCDS), the Pilot Land Data System (PLDS), the Crustal Dynamics Data Information System (CDDIS), and NSSDC's no-password account on its NSI/DECnet-accessible VAX, through which the NASA Master Directory and selected on-line data bases are accessible and through which any data shown in the data listing may be ordered.

The "Satellite Data Listing," which immediately follows the descriptive material referred to above, is made up of off-line data sets (most on magnetic tape or as film/print products of various sizes or as disks) from individual instruments carried on spacecraft. Descriptive names, time spans, data form, and quantity of the data sets are identified in the listing, which is sorted alphabetically—first by spacecraft name and then by the Principal Investigator's or Team Leader's last name.

The "NSSDC Supplementary Data Listings" (one for astronomy data and the second for non-astronomy data), which follow the "Satellite Data Listing," identify data sets not associated with the individual spaceflight instruments. Included here are composite spacecraft data sets, rocket data, ground-based data, models, and computer routines.

The NASA Climate Data System section is next, followed in order by the Pilot Land Data System section and the Crustal Dynamics Data Distribution section. Two appendices complete the report. Appendix A is a fold-out listing of the data form codes, so that the user can readily identify the data medium while viewing the listing. Appendix B contains NSSDC Data Request Forms to order any data identified in the data listing.

Requests for copies of the *1991 NSSDC Data Listing* should be addressed as specified on the back page of this newsletter.

Richard Horowitz

# Planning Under Way for International Space Year Conference on Earth and Space Science Information Systems

The International Space Year (ISY) conference on Space and Earth Science Information Systems will convene February 10-13, 1992, at the Pasadena convention center in Pasadena, California. The purpose of the conference is to promote and enhance international scientific communication and cooperation on data and information systems for space and Earth science data acquisition, analysis, distribution, and archiving; to stimulate discussion among users and information system developers—especially with respect to user interface; to demonstrate and explore the use of information systems and the application of new information system technologies; and to provide outreach opportunities to education.

This is a one-time only conference focusing on advancement of knowledge with information systems, the role of information systems in international cooperation and partnership, information access and the use of information systems in education and outreach.

Several NSSDC staff members will address the conference. Dr. James Thieman's talk is entitled "Identifying, Accessing, and Interoperability Using Earth and Space Science Information Systems." Dr. Robert Cromp, William Campbell, and Nicholas Short, Jr., will present "An Intelligent Information Fusion System for Handling Archiving and Querying of TeraByte-sized Data Bases." "Lessons Learned from Extant NASA Discipline Data Systems" is the subject of a talk by Dr. Joseph King and Messrs. Roelofs, Preheim, and Hilberg.

Hopefully, this event will lead to the development of international understanding of common goals, needs, and capabilities and technological challenges as well as ways of exploring how information systems can become an integral part of education and research. It is also a goal to foster stronger international ties in the promotion of information system application and access and develop an understanding of how to acquire, organize, archive, distribute, and assimilate the large amount of data expected during the next few decades.

William J. Campbell

# NSSDC Expands Its Holding of Atmospheric Models

NSSDC maintains and archives software for more than 50 models representing different regions and parameters of the solar-terrestrial environment. Several of these made the 1990 NSSDC hit list of most frequently requested items in space science. All models and application software held at NSSDC are described in the NSSDC report 90-19 published in July 1990 (see Fall 1990 *NSSDC News*). In this article three new model entries are explained, which were recently added to the atmospheric section of NSSDC's collection of solar-terrestrial models.

The atmosphere is the solar-terrestrial region closest to Earth, consisting of the neutral gas volume that surrounds the planet from the ground to about 1000 km altitude. Below 90 km, in the so-called "homosphere," turbulence ("eddy diffusion") produces a homogeneously mixed gas with an average molecular mass number of about 29. The well-publicized ozone layer is, of course, an important exception. Ozone, however, remains a minor constituent throughout the homosphere. The region above 90 km is called the "thermosphere" and is characterized by, first, an increasing temperature up to about 300 km altitude, and then, an almost constant temperature, often called exospheric temperature.

Atmospheric densities, temperatures, and winds are important parameters for a wide spectrum of application in science, engineering, and education. Since the early 1950s, several national and international committees have been set up with the goal to establish a standard atmosphere model. Most notably, the Committee on Space Research (COSPAR) has issued several editions of its COSPAR International Reference Atmosphere (CIRA), the most recent in 1986. At Goddard Space Flight Center A. E. Hedin and his colleagues have used the large data base accumulated by the Atmosphere Explorer satellites as a starting point for their continued modeling activity. Combining satellite and ground-based measurements, they called their model the Mass Spectrometer and Incoherent Scatter (MSIS) thermosphere model. In 1986, recognizing the maturity and reliability of Hedin's model, the CIRA working group decided to accept the MSIS-86 model as the thermospheric part of their new CIRA-86.

NSSDC's collection of model software packages includes several atmospheric and thermospheric models. In the table below the most recent and most important models are listed. Three of those (the Marshall Engineering Thermosphere [MET], the Horizontal Wind Model [HWM]-90, and the Mass Spectrometer and Incoherent Scatter Extended [MSISE]-90) were acquired this year and are described below. NSSDC distributes these software items on tape, on 5 1/4- or 3 1/2-inch diskettes for use on personal computers and on line on computer networks. A requester should indicate the NSSDC-ID and the preferred media. In the case of the MSIS-86 model, the media specific NSSDC-ID is sufficient.

### Marshall Engineering Thermosphere Model

The MET model describes the thermospheric temperature and densities in

*see* Atmospheric Models, *p. 7*

## Table of Atmospheric Models

| Model Name | Short | Date | NSSDC-ID | Number of Requests* |
|---|---|---|---|---|
| COSPAR International Reference Atmosphere | CIRA | 1986 | MN-17A | 19 |
| Mass Spectrometer Incoherent Scatter Thermosphere Model | MSIS | 1986 | MN-61A, B, - 61C, D | 162 |
| Marshall Engineering Thermosphere Model | MET | 1988 | MN-61G | --- |
| Horizontal Wind Model (Thermosphere) | HWM | 1990 | MN-61E | 27 |
| Extended MSIS Model (Atmosphere) | MSISE | 1990 | MN-61F | 5 |

* ***Total number of requests since model was received at NSSDC.***

Atmospheric Models, *from p. 6*

the altitude range from 90 km to 2500 km. It is based on the modeling approach established by L. G. Jacchia in the early 1970s. Assuming diffusive equilibrium, the atmospheric profiles are defined by the exospheric temperature, and the exospheric temperature is adjusted such that the densities fit satellite drag measurements. A constant boundary value is assumed at 90 km for the temperature and densities. Satellite in situ observations, however, have shown considerable temperature and density variations at this altitude.

MET is essentially a modified Jacchia 1970 model that includes some spatial and temporal variation patterns of the Jacchia 1971 model. It is based primarily on satellite drag data obtained during solar cycle 19, which reached exceptionally high solar activity values. In addition to thermospheric densities and temperatures, the well-documented code provides also several often-used parameters like gravitational acceleration, specific heat, etc. MET was developed at NASA's Marshall Space Flight Center, primarily for engineering applications. The MSIS and CIRA models are generally considered superior to MET because of their larger data base and their more elaborate mathematical formalism. MET, however, is a good choice for satellite drag estimates and other applications where only the total density is needed. M. P. Hickey described the MET model in two NASA contractor reports (NASA CR-179359 and CR-179389, 1988), and he also provided NSSDC with the MET program on diskette.

### Horizontal Wind Model 1990

The HWM model describes the global variation of the horizontal wind from 100km to the top of the thermosphere. A. E. Hedin, the principal author, represents the meridional and zonal wind components in a manner similar to the formalism used in his MSIS model. The model is based on thermospheric wind data obtained from the Atmosphere Explorer-E and Dynamics Explorer 2 satellites, on wind data for the lower and upper thermosphere from ground-based incoherent scatter radar, and on Fabry-Perot optical interferometers. Seasonal and diurnal variations are most distinct at mid-latitudes. They were modeled with the help of the ground-based data. HWM-90 includes solar activity variations, which are found to be small and most obvious at the higher latitudes. The model correctly reproduces the transition from predominantly diurnal variations in the upper thermosphere to semidiurnal variations in the lower thermosphere. It also describes a transition from summer to winter flow above 140 km to winter to summer flow below. Significant altitude gradients in the wind are found to extend to 300 km at some local times. Comparison of the various data sets with the aid of the model shows in general good agreement, particularly at mid- and low latitudes.

HWM-90 is described by A. E. Hedin et al. in the *Journal of Geophysical Research*, Vol. 96, No. A5, pages 7657-7688, 1991. It is a revision of the HWM-87 empirical model. Major changes are the extension of the model down to 100 km, the improvement of diurnal and seasonal variations using incoherent scatter and Fabry-Perot ground-based data, and the inclusion of solar activity effects. NSSDC received the HWM-90 program from A. E. Hedin.

### Mass Spectrometer and Incoherent Scatter Extended Model

The MSISE model describes atmospheric parameters from ground level to the top of the thermosphere. A. E. Hedin revised his MSIS-86 empirical thermosphere model (lower limit 80 km) in the lower thermosphere and extended it into the mesosphere and lower atmosphere. In the lower atmosphere the data base proposed for the CIRA-86 model (Barnett and Corney, *MAP Handbook 16*) was used as the primary guide. New data inputs at higher altitudes include rocket data from 1947 to 1972 (pitot tube, falling sphere, and grenade sounder; all partly used also in MSIS-86); densities derived from space shuttle flights from 1983 to 1986; and temperature and density data from the incoherent scatter radars in St. Santin, France, and Scandinavia (EISCAT). In merging the thermospheric part with the lower atmosphere, the minimization of departures from hydrostatic equilibrium was one of the constraints used in constructing the model.

As in MSIS-86 and HWM-90 low order spherical harmonics and Fourier series are applied to describe the major variations throughout the atmosphere. MSISE-90 has the advantage of being fully analytic and thus being more easily accessible (electronically) than the MAP/CIRA-86 tabulations. Zonal average temperatures of the MAP tabulation are fitted by MSISE-90 with an overall standard deviation of 3 K and pressure values with a standard deviation of two percent.

For someone interested only in the thermosphere above 120 km, A. E. Hedin recommends the MSIS-86 as the model of preference. There are some small differences between MSIS-86 and MSISE-90 above 120 km. He also suggests that MSISE-90 is not the preferable model for specialized tropospheric work. Rather, it should be considered for interdisciplinary studies reaching over several atmospheric boundaries (e.g., the Upper Atmosphere Research Satellite [UARS] and Coupling, Energetics, and Dynamics of Atmospheric Regions [CEDAR]). MSISE-90 is described by A. E. Hedin in the *Journal of Geophysical Research*, Vol. 96, No. A2, pages 1159-1172, February 1991. NSSDC received the MSISE-90 program from A. E. Hedin.

Dieter Bilitza

# Government Peers Honor Co-Workers

The Space Data and Computing Division at NASA/Goddard Space Flight Center, which includes the NSSDC, held its annual Peer Awards Luncheon on September 12, 1991. The eight Peer Award winners were selected by their co-workers in the division, on the basis of excellent performance in their respective tasks. Five of the eight winners were NSSDC staff members.

Jeanne Behnke was honored for design and development work on the Mission Information and Planning System for the Roentgen Satellite (ROSAT) mission.

Dr. Robert F. Cromp was honored for his leadership of the Intelligent Information Fusion System and the International Ultraviolet Explorer (IUE) Expert System.

Nathan L. James was cited for his work on the NSSDC On-Line Data and Information Service (NODIS) and the Personnel Information Management System (PIMS) data bases.

For her work on the Crustal Dynamics Data Information System, Carey E. Noll was honored.

Dr. James R. Thieman was cited for his design and implementation guidance of the NASA Master Directory and for organizing the Catalog Interoperability workshops.

Other non-NSSDC winners from the Space Data and Computing Division were Gary Wolford, Medora Fahnestock, and Harold Domchick.

The awards consist of framed citations of appreciation from NASA and cash bonuses.

David Batchelor


***Standing with their awards, from left to right, are government employees Dr. Robert F. Cromp,* Dr. James R. Thieman,* Gary Wolford, Medora Fahnestock, Harold Domchick, Jeanne Behnke,* and Nathan L. James.* Carey Noll* was unable to attend. (Asterisks indicate NSSDC staff members.)***

# NSSDC Hosts Minority University Space Interdisciplinary Network's First Users Working Group Conference

The Minority University Space Interdisciplinary Network (MU-SPIN) Program held its First Annual Users Working Group Conference on September 25-27, 1991, at GSFC in Greenbelt, Maryland. The NSSDC-hosted conference was jointly sponsored by NASA and the National Science Foundation (NSF).

The main goal of the MU-SPIN Program is focused on transferring wide area networking technology into a large community of Historically Black Colleges and Universities (HBCUs) and other Minority Universities (MUs) and on promoting the use of networks in support of collaborative interdisciplinary research among faculty and students and NASA scientists.

One component of the program is the Users Working Group (UWG), which has an annual September conference. This first UWG conference had 152 attendees representing NASA Headquarters (HQ) and field centers, 32 different universities, NSF, and a few telecommunications organizations.

The conference began with a welcome message by GSFC's deputy director, Mr. Peter Burr, followed by presentations on the High Performance Computing and Communications Initiative, an Overview of NASA's Science Programs, and Computing Challenges in Space and Earth Sciences by Dr. Stephen Wolff (NSF), Joseph Alexander (NASA HQ), and Dr. Milton Halem (NASA/GSFC), respectively.

The conference also included overview presentations on each of the MU-SPIN and the NSFnet programs as well as presentations highlighting various NASA and NSF University Research and Education Programs.

The conference offered the following two tracks of technical sessions:

1) The first track included two sessions on scientific networking resources and supercomputing, which was largely attended by faculty members and other users of wide area networks. These sessions included presentations on network applications and supercomputing activities.

2) The second track included two sessions on network management, operations and user support, which was offered mainly to staff members of university computer centers who have system or network management responsibilities. This track offered participants an in-depth look at the wide area networking technology starting with campus networking to regional and worldwide connectivity with emphasis on network operations and user support.

Both of the first two days concluded with birds-of-a-feather sessions that brought participants into discussions on issues related to topics presented during the technical sessions and other topics of interest, such as use of computer networks and their applications for curriculum enrichment, network security, user support, and network management and operations.

The conference also included a set of presentations on a number of GSFC projects (e.g., the Master Directory system, the NASA Climate Data System, Scientific Data Visualization, and the Electronic Library Concept) and a short session on successful proposal development. The speakers and session moderators were people from NASA, NSF, and various universities, who generously volunteered their time and skills to make this conference a success.

One of the highlights of the conference was a recognition dinner held at the Holiday Inn in Lanham, Maryland. Valerie Thomas, MU-SPIN program manager (NASA/GSFC), hosted the dinner, and Dr. Milton Halem was the guest speaker to about 100 attendees.

The MU-SPIN Program recognized Dr. Yvonne Freeman (NASA/Jet Propulsion Laboratory), Dr. Harry Hedges (NSF), and Lawrence Oliver (NSF) for their major contributions to promote wide area networking technology at minority institutions. Dr. Nagi Wakim, program coordinator, was surprised with a special citation. The conference concluded the morning of September 27 with a tour of GSFC.

The conference was very productive, and the participants expressed strong interests in being involved with the MU-SPIN Program and its on-going activities. For more information on the conference or the program, please contact Nagi Wakim, program coordinator, at (301) 286-3409 or NWAKIM@AMARNA..GSFC.NASA.GOV.

Nagi Wakim

## *NSSDC Gets Newest IGRF Coefficients*

The most recent update of the International Geomagnetic Reference Field (IGRF), from 1945-1995, was provided to NSSDC by R. Langel on behalf of the IGRF working group of the International Association of Geomagnetism and Aeronomy. IGRF describes the Earth's main (core) magnetic field without external sources. The new coefficients were implemented in the B-L calculation program BILCAL, which can be obtained from NSSDC on tape, diskette, or online, as well as remotely through the GEOPHYSICAL MODELS option of the NODIS account.

Dieter Bilitza

# Climate Data System's New Interface Enhances User Acceptance

Recently, the NASA Climate Data System (NCDS), in response to the wide range of needs and expertise of the user community, underwent a major enhancement to its interface design to provide simplicity of operation while providing an even higher level of functionality than was previously possible.

One goal was to develop an interface that could accommodate a user community that ranges from the university graduate student, possibly unfamiliar with on-line data systems, to the veteran NASA researcher with a need for specific data but little time for learning the idiosyncracies of an on-line data system. NCDS has accomplished this goal with the development of a new user interface using the JYACC Application Manager (JAM).

The new text-based windows interface allows NCDS to display more information on the screen and use less screen space than the previous Transportable Applications Executive (TAE) full-screen method. This enhancement has allowed NCDS to increase its functionality while reducing full page screens about 40 to 1. The ability to reduce the users' input to a single screen was accomplished through the use of scrolling arrays, check lists, and shrink-to-fit windows provided by JAM.

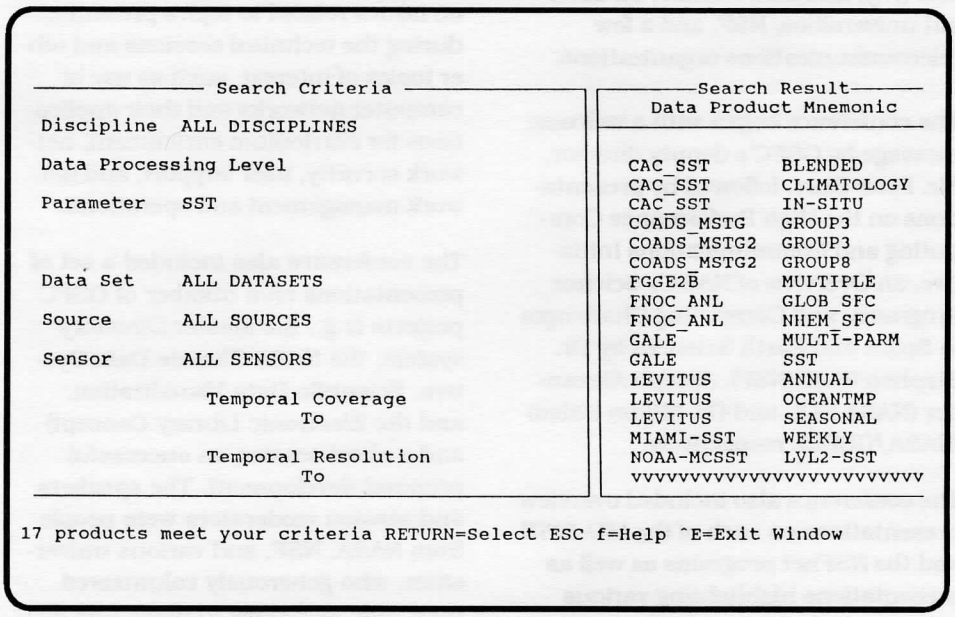
The screens are also portable: The VAX-based screens can be moved from VAX text-based windows to X-windows, motif windows, and back to VAX text-based windows. The new screen interface also allows users to pull the valid list information directly from the NCDS data base, using the JAM Data Base Interface (DBI). The JAM DBI allows the JAM interface to connect with the NCDS data base, which resides in Oracle, by generating SQL statements, thus allowing NCDS to keep the data base information in one place.

A global data dictionary and a local data block (LDB) accompany the new interface product. The data dictionary is a list of screen fields and their attributes, used to create the LDB when the system starts up. The LDB consists of global storage set aside for field data that is used by the entire application and consists of entries indexed by name. These entries are directly correlated with any fields of the same name that exist on the screens in the application. This storage for LDB entry values is not allocated until it is actually used.

The use of the LDB is advantageous in that it allows NCDS to control the scope of the variables without having to initialize them. The LDB consists of fields from the data dictionary, resembling global variables in a third generation programming language (3gl) that are associated by name with screen fields. The LDB is dynamically created from the description of the field elements in the data dictionary file. All of the characteristics that can be associated with screen fields can also be designed for data dictionary entries. Field data are automatically preserved as the user moves from screen to screen, provided that the fields in question are linked to entries in the LDB, thus sparing the user from having to remember information entered previously. Application source codes, such as C, use the same library routines to access fields and LDB entries on the active screen by name.

NCDS uses what it calls Dynamic Query Building to build a custom query. The SQL query generated by the DBI from entries in the search criteria will only join the tables nec-

*see* Enhancements, *p. 11*




***NCDS's new interface features portable screens, like the one pictured, that allow users to use the JAM Data Base Interface to pull information directly from the NCDS data base.***

Enhancements, *from p. 10*

essary to satisfy the search. As an added level of functionality, each criterion entered will also narrow the valid lists for successive criteria appropriately. These enhancements to the new NCDS interface allow users to search for data within NCDS regardless of their level of knowledge about the data and ensure that a query returns at least one data product. The user does not have to enter information for all the criteria options in order to perform a valid search.

For example, if searching for data from the Nimbus 7 platform, one need only select "NIMBUS-7" from the platform valid list and execute the query. If a user were only interested in ozone data from the Nimbus 7 platform, the search could be narrowed further by selecting "OZONE" from the parameter valid list, along with "NIMBUS-7" from the platform valid list. Currently, there are several fields in the search criteria screen from which to perform a query, including discipline, parameter, processing level, source (platform), sensor (instrument), temporal resolution, temporal coverage, and data set. Additionally, queries based on spatial resolution will soon be available within the NCDS.

The NCDS data base system is built on a normalized relational data base model. In this data base schema most of the tables in the data base are linked with a unique two-field key consisting of data set and data type, which relates the information in the tables. NCDS breaks down its data sets into smaller logical groups called data types. Data types are created when a data set has multiple temporal or spatial resolutions, multiple disciplines, multiple processing levels, or multiple producer-defined subgroups. It is these fields that provide NCDS with the logical data set breakdown needed to help users retrieve only the type of data in which they have interest. This data base design allows NCDS to provide a considerably more powerful data base search capability than was previously possible.

The JAM Data Base Interface (DBI) allows NCDS (or any other system) to interface with any of the following 14 data bases: ORACLE, INGRES, Sybase, Informix, xdb, SQLBase, SQLServer, Share Base, Rdb, Ultrix/SQL, VAX SQL/Services, Nucleus, and Progress. This interface not only provides the concurrent heterogeneous interoperability required for NCDS to access all data bases listed from one executable but also provides NCDS with data base independence. As a result NCDS is not dependent on any specific data base vendor and is free to change the foundational data base without having to rewrite source code.

The enhancements made to NCDS will help prepare for an expanding role in the Earth Observing System era. NCDS, considered the kernel system of the Goddard Distributed Active Archive Center (DAAC), is anticipating the integration of the six other DAACs. The seven DAACs are located at the Goddard Space Flight Center (GFSC), the Jet Propulsion Laboratory (JPL), the Langley Research Center (LaRC), the Marshall Space Flight Center (MSFC), the Alaska SAR Facility (ASF) of the University of Alaska, the U.S. Geological Survey (USGS) EROS Data Center (EDC), and the National Snow and Ice Data Center.

The exchange of data and metadata among the seven major "distributed" centers will be centered around an Information Management System (IMS) as part of the EOS Data Information System (EOSDIS). Each DAAC will be able to choose its own data base and interface of preference. Further enhancements to NCDS to meet the needs of the EOS era include the development of a user activity and request tracking system and data base.

Although the NCDS is now using a relational data base, the staff members are interested in utilizing object-oriented data bases and distributed computing to enhance the current system. This enhancement would make data types transparent to developers and allow data to be networked to remote sites effectively. NCDS staff members are collaborating with members of the Intelligent Data Management (IDM) staff in investigating advanced techniques for functioning in a distributed environment.

User response to the new NCDS user interface has been overwhelmingly favorable. Users have found the system to be more intuitive, quicker, and highly functional. With the on-going addition of new data sets and the experiences of its users, NCDS is gaining a greater acceptance among a growing range of users within the research community. The growing popularity of NCDS has also resulted in more researchers requesting use of the system. The NCDS staff has also benefited from the enhancements made; although the system supports a greater number of users, the problems users encounter have decreased, and users are more often walking away with the data they want.

Frank Corprew
Hank Griffioen

***An interesting fact:***
In 1991, NSSDC distributed almost two terrabytes of data to requesters on CD-ROM.

# Pilot Land Data System Holds Workshop

The Pilot Land Data System (PLDS), a component of the Goddard Space Flight Center (GSFC) Distributed Active Archive Center (DAAC), held a workshop at the University of New Hampshire in Durham on September 18–20, 1991. The purpose of the workshop was to evaluate and discuss PLDS services in terms of PLDS's incorporation into the GSFC DAAC and Earth Observing System Data Information System (EOSDIS). Twenty-seven individuals from NASA's Earth Science Program attended the meeting.

This group represented the entire NASA land science research program and included EOS and non-EOS related investigators, including members of the PLDS Science Working Group and associates in their respective disciplines within the land sciences (e.g., ecology, hydrology, geology, etc.), representatives from the land processes and biogeochemical cycling EOSDIS Distributed Active Archive Centers (i.e., the EROS Data Center and GSFC), NASA Headquarters representatives from the above scientific disciplines, and the PLDS project staff.

As representatives from the EOS era science community, the entire group provided valuable science user input. The specific objectives of the workshop were as follows:

- To review PLDS services, including the June 1991 operational release of the on-line system and the suite of off-line services.
- To discuss the transition process of the PLDS into the EOSDIS Version 0.
- To collect a list of this community's data system needs within the EOSDIS time frame.

The results of the workshop are contained in a workshop report available since December 1991. This report, written by the members of the PLDS Science Working Group, will address the evaluation of the various services provided by PLDS, the evolution of PLDS into the EOSDIS era in the context of the entire land science program, perspectives on the scientists' experiences with PLDS, and any other significant findings.

Blanche Meeson

# Crustal Dynamics DIS Undergoes Transition, as CD Project Closes at Year End and Dynamics of Solid Earth Begins

The Crustal Dynamics Data Information System (CDDIS) has recently begun the operational support of the precise orbit determination (POD) team for the European Space Agency's (ESA) first European Remote Sensing Satellite (ERS 1). On July 17, 1991, at 1:46 UTC, ERS 1 was successfully launched from Kourou, French Guiana.

This satellite uses advanced microwave techniques to measure various ocean parameters, such as sea state, sea surface winds, ocean circulation, and sea/ice levels as well as all-weather imaging of the ocean, ice, and land surfaces.

ERS 1 was placed in the Venice commissioning orbit on July 26, 1991, at 19:26 UTC. The satellite will remain in this orbit through mid-December of 1991. The ERS 1 spacecraft is equipped with laser retro-reflectors and will be tracked by laser ranging systems.

The Crustal Dynamics satellite laser ranging (CDSLR) stations have joined the SLR stations located worldwide in support of the ERS 1 satellite by providing tracking on a daily basis. The CDDIS has begun its support of the ERS 1 project by providing a repository for both quick-look and full-rate SLR data for analysis by the ERS 1 POD team located at the German Processing and Archiving Facility (D-PAF) in Oberpfaffenhofen, Germany.

The CDSLR headquarters data processing center deposits the SLR quick-look data into the CDDIS on a daily basis (Monday through Friday). D-PAF can then access CDDIS via electronic networks to retrieve these data sets and in turn deposit data from foreign sites as well as orbit predictions and station time bias information.

By using this procedure, D-PAF will typically receive quick-look data from the global set of stations within a maximum of three days after the observation day. All ERS 1 quick-look data for a period of several weeks will be archived on line on the CDDIS MicroVAX. CDDIS staff summarizes each data file transferred on a daily basis. These summaries are then loaded into the CDDIS data base for generation of weekly and monthly tracking status reports.

The CDDIS is also archiving full-rate SLR data from ERS 1 and will supply this data to interested parties approximately 60 days after the observation. The CDSLR network and the CDDIS

*see* CDDIS Transition, *p. 13*

CDDIS Transition, *from p. 12*

will also support The Ocean Topography Experiment (TOPEX)/POSEIDON (launch date June 1992) mission and its POD analysis in a similar fashion to ERS 1.

The CDDIS received additional funds in FY 1991 from NASA Headquarters to upgrade the computer facility. Procurements have been issued to purchase a VAX 4000 Model 200 upgrade kit and associated software licenses. Dedicated UPS systems have also been ordered to provide power conditioning for the facility. This upgrade should increase CPU performance by a factor of five.

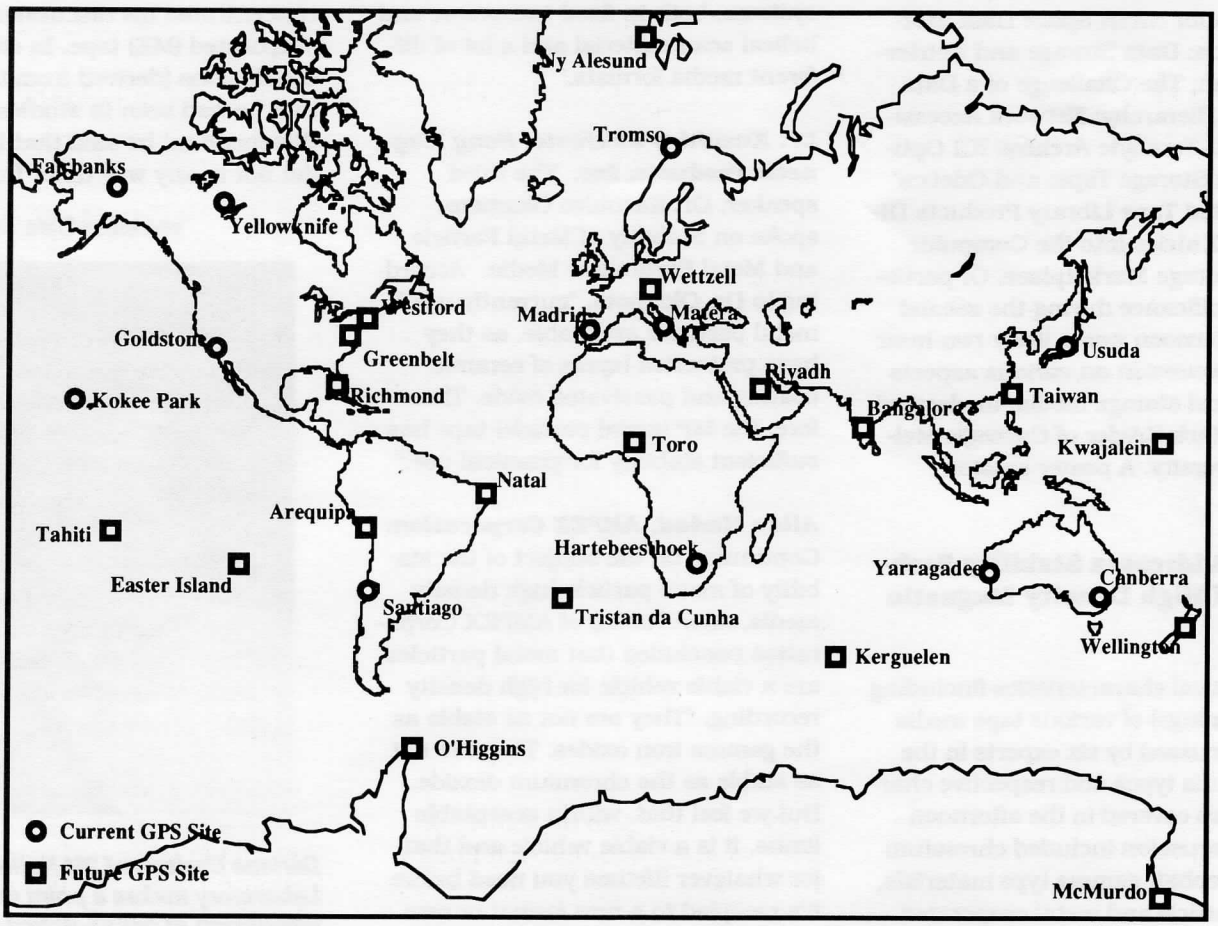
### Plans for the Future of CDDIS

On December 31, 1991, the era of the Crustal Dynamics Project came to a close. The project has been in existence since 1979 and has provided the geodynamics community with a rich history of data, much of which is currently archived in the CDDIS. A follow-on program, called the Dynamics of the Solid Earth (DOSE), began on January 1, 1992. This program is managed jointly by Goddard Space Flight Center (GSFC) and the Jet Propulsion Laboratory (JPL). The CDDIS has been selected as an archive to continue to support the geodynamics community through DOSE. In addition, the CDDIS has been tasked to create an archive of Global Positioning System (GPS) data received from the core network of sites supporting the DOSE.

During the next year, this network will consist of 31 global sites (see the figure below) that will daily generate about three to five megabytes of GPS data. These data will be daily transmitted electronically to JPL for validation and verification. The final product, in the Receiver Independent Exchange (RINEX) format, will be generated at JPL and transmitted to CDDIS within several days.

Discussions with JPL have begun on the data volumes, transfer method, etc. Various methods of data transmission will be tested; these include exchange of rewriteable optical disk media and automated electronic methods. CDDIS will provide the science community with on-line access to these data; details on the amount of data available on line and time period of on-line availability still need to be determined.

Carey Noll




***Flinn Core Network of 31 global sites transmits Global Positioning System data to the Jet Propulsion Lab.***

Mass Data Storage, *from p. 4*

data archives, let alone very large ones. Even the oil companies have been in a sense overwhelmed by this somewhat unplanned-for hugeness. Stewardship entails a great deal more than storing and protecting the archive," he continued. "The complete steward will

- Provide against loss caused by physical phenomena.
- Assure that data are not 'lost' because of storage technology obsolescence.
- Maintain data in a current formatting methodology. Also, it may be a requirement to be able to reconstitute data to original as-received format."

Remaining topics for the day included High Performance Storage Systems; The I/O Computer, A Mass Storage Subsystem; EMASS: An Expandable Solution for NASA Space Data Storage Needs; Data Storage and Retrieval System; The Challenge of a Data Storage Hierarchy; Network Accessible Multi-Terabyte Archive; ICI Optical Data Storage Tape; and Odetics' Automated Tape Library Products Division's Entries into the Computer Mass Storage Marketplace. Of particular significance during the second day's afternoon was a lively two-hour panel discussion on various aspects of physical storage media, moderated by Dr. Mark Kryder of Carnegie Mellon University. A poster session followed.

## Panel Addresses Stability Problems of High Density Magnetic Tape

The archival characteristics (including shortcomings) of various tape media were discussed by six experts in the field. Media types and respective characteristics covered in the afternoon panel discussion included chromium dioxide, cobalt gamma type materials, metal particle and metal evaporated type materials, and barium ferrite.

***Dr. Barbara Reagor, Bellcore Corporation.*** Initiating the panel discussion, Dr. Barbara Reagor briefly described the storage constraints under which her company, Bellcore, must operate. "Bellcore must address the issues of tape reliability, environmental robustness, or potentially toxic characteristics. The tape would need to withstand the impacts of indoor air pollutants, heat, and humidity, and should not pose a toxic removal problem," she said.

***Darlene Carlson, 3M National Media Laboratory:*** Following Ms. Reagor's presentation, Ms. Darlene Carlson of 3M National Media Laboratory continued the discussion with a talk on the stability of cobalt-doped gammaferric oxide tape. Emphasizing the versatility of cobalt-doped magnetic recording tape, Ms. Carlson indicated that "it is used in a wide variety of systems, both in fixed transverse and helical scan material and a lot of different media formats."

***Dr. Kazuhiro Okamoto, Sony Magnetic Products, Inc.*** The third speaker, Dr. Kazuhiro Okamoto, spoke on Stability of Metal Particle and Metal Particulate Media. According to Dr. Okamoto, "currently used metal particles are stable, as they have protection layers of ceramic coating and passivated oxide. Therefore, the MP (metal particle) tape has sufficient stability for practical use."

***Allan Hadad, AMPEX Corporation:*** Continuing on the subject of the stability of metal particle high density media, Allan Hadad of AMPEX Corporation concluded that metal particles are a viable vehicle for high density recording. "They are not as stable as the gamma iron oxides. They are not as stable as the chromium dioxide. But we feel that, within acceptable limits, it is a viable vehicle and that, for whatever lifetime you need before it's recopied to a new format or rerecorded, we think that the metal particles themselves do provide a good means—an excellent means of recording at high densities."

***John Corcoran, AMPEX Corporation:*** Another representative of AMPEX Corporation, Mr. John Corcoran, mentioned in his talk (regarding archival stability of metal particle tape) that a specially formed committee, SMPTE, comprised of 31 companies representing broadcasters, tape manufacturers, and equipment manufacturers started five years ago to compose what is now known as the D-2 standard. He said that the group concluded that metal particle tape would be satisfactory "under rigorous broadcast conditions, and the use of barium ferrite would not be beneficial before at least 1990."

***Dr. Dennis Speliotis, Advanced Development Corporation:*** The final panel speaker, Dr. Dennis Speliotis, concentrated his discussion on metal evaporated (ME) tape. In stating his conclusions (derived from test results that he had seen in studies involving this medium) he said that his results did not in any way differ from the

*see* Mass Data Storage, *p. 16*

***Darlene Carlson of 3M National Media Laboratory makes a point during her discussion of cobalt-doped magnetic recording tape.***

# NSSDC Seeks To Integrate Its Information Systems

In the past few years, NSSDC has been widely recognized for its role in the development and operations of the NASA Master Directory (NMD). At present NMD is identical to the Global Change Master Directory (GCMD), used by many U.S. agencies and international groups involved in Earth science data.

The purpose of this article is to identify additional information systems at NSSDC, to discuss the relative roles of the multiple systems, to identify additional NSSDC information management requirements, and finally to discuss the steps being taken to provide a more integrated information system at NSSDC.

The goal of the NASA Master Directory is to identify, briefly describe, and when possible E-link to all worldwide data accessible and of potential research interest to researchers supported by NASA's Office of Space Science and Applications (OSSA) across the broad OSSA discipline domain. The GCMD has as its intended customer community the U.S. Earth science research community. The NMD/GCMD is a widely advertised, on-line system accessible to and accessed by a much broader community than its intended customer communities.

### The System for Information Retrieval and Storage

Over the years, the principal NSSDC information system has been the System for Information Retrieval and Storage (SIRS). This system has consisted of a series of "files" capturing information about various object types. The Automated Internal Management (AIM) file holds information about (mostly NSSDC-held) data from individual instruments flown on individual spacecraft as well as information about instruments and spacecraft themselves (discussed further below). The NSSDC Supplementary Data File (NSDF) captures information about other categories of "data sets" that do not fit into the AIM spacecraft/instrument/data set hierarchy.

The Technical Reference File (TRF) is a bibliographic file in which published papers are linked to the investigations whose data were used in the papers. The file is also used to track papers using NSSDC-supplied data or services. The Interactive Request and Name Directory (IRAND) file, which underlies the personnel information option from the NSSDC On-Line Data and Information Service (NODIS), is used to track people and data requests. Additional inventory files are also used to track the individual computer-sensible and other data volumes held by NSSDC.

In the past these information files have resided on NSSDC's two MODCOMP computers where they were accessible only to NSSDC staff. Over the past year, however, these files have been migrated to a relational data base management system in NSSDC's VAX environment, although they are still primarily intended for internal staff use. In this relational environment, SIRS has been renamed RSIRS.

In its role as World Data Center-A for Rockets and Satellites, NSSDC has a responsibility for the knowledge and announcement of launches of all satellites in all nations. This information is captured into the AIM file, which therefore is truly comprehensive relative to past satellites. In addition, as a service to the science community, NSSDC makes every effort to learn of future scientific spacecraft, entering information about them into the AIM file. The center also makes every effort to learn of all the instruments that have been or will be carried into space on scientific spacecraft, describing these also in the AIM file. Thus, this file identifies/describes

- All spacecraft launched in the past.
- Most NASA and many other spacecraft to be launched in the future.
- All past NASA/OSSA investigations.
- Many non-NASA past investigations.
- Most OSSA-selected future investigations and many future non-OSSA investigations.
- All NSSDC-held spacecraft data.
- A limited amount of data held at sites other than the NSSDC.

NSSDC's goal is to identify/describe in the AIM file all future NASA/OSSA spacecraft (with reasonable likelihoods of flight) and their scientific payloads when selected as well as all non-OSSA spacecraft of potential interest to the OSSA research community.

A relatively new requirement for NSSDC is to capture information about all extant OSSA mission data. This is primarily to provide an OSSA management tool rather than a data-seeking scientist's tool. Information would be ingested about data at various processing levels, held at spaceflight project facilities, Principal Investigator (PI) sites (or equivalent), and discipline-specific or generic OSSA archives. Information items about these data sets, not now in AIM or NMD, are being introduced, including projects' archiving plans, documentation adequacy, the state of the media, and results of discipline review groups' assessments of the value of continued retention of archived data.

*see* Information System, *p. 24*

Mass Data Storage, *from p. 14*

***Dr. Bharat Bhushan of Ohio State University discusses magnetic media tribology at start of third day.***

results reported on by the previous speakers.

### Emphasis on Networks, Hardware, and Application Experiences on Final Day

Leading off with an address by Dr. Bharat Bhushan of Ohio State University entitled Magnetic Media Tribology: State of the Art and Future Challenges, the final day of the conference featured the following presentations: Network Issues for Large Mass Storage Requirements, The Role of HIPPI Switches in Mass Storage Systems: A Five-Year Prospective, NASA's National Space Science Data Center (NSSDC), NASA's Earth Observing System Data Information System (EOSDIS), the United States Geological Survey, and the Earth Resource Observation System (EROS).

Afternoon sessions consisted of talks delivered by representatives of non-NASA government agencies including the Department of Commerce, the National Institute of Standards and Technology (NIST), the Department of Commerce, the National Oceanic and Atmospheric Administration (NOAA), the Laurence Livermore National Labs (Department of Energy), and Sandia National Laboratory.

### Opening Talk Stresses Importance of Magnetic Media Tribology

In his discussion of magnetic media tribology, the study of the phenomena and mechanisms of friction, lubrication, and wear of surfaces in relative motion, Dr. Bharat Bhushan pointed out that physical contact between the medium and the head occurs during starts and stops. Friction and wear issues are resolved by selecting appropriate interface materials and lubricants, by controlling the dynamics of the head and medium, and by compensating for any possible adverse effects of the environment.

### Blitstein Presents Operational Perspective of NSSDC

With NSSDC's management of more than 110,000 data tapes containing over 4000 data sets, the size of the digital archive is now approximately 6000 GB and is expected to grow to more than 28,000 GB by 1995, according to Ronald Blitstein, Hughes STX manager of NSSDC operations.

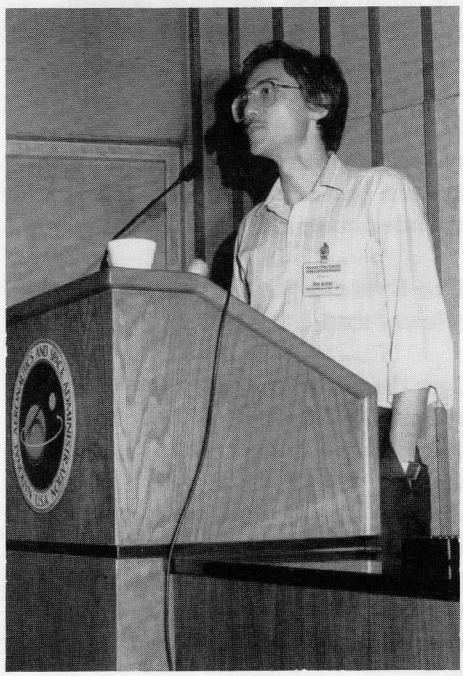
For most of its history, NSSDC has operated as a batch-oriented library providing custom support for the ingest and distribution of data. The data center annually responds to about 3000 requests for data, some of which are supported through on-line or near-line capabilities, but many of which are filled through the replication and distribution of data tapes or images. The NSSDC is involved in several initiatives to better serve the scientific community and improve the management of current and future data holdings. To that end, current focus is in the areas of mass storage, networks, media management, tool development, and standards advocacy.

### NSSDC's Ben Kobler Concludes Three Days of Sessions

The conference was concluded with closing remarks delivered by Ben Kobler of the NSSDC. Addressing attendees Thursday afternoon, July 25, Kobler indicated that understanding the underlying chemistry and physics of media is important, and it should not be forgotten as archive managers select the media that they will be putting into their deep archives.

Kobler added that "as we put this data into the archive, we want to be sure that we will be able to get to the data later; and as the data volumes increase, we want to be intelligent about how we manage that data, so the concept of building intelligent front ends is going to be important in the future."

Leonard Blasso



***Ben Kobler of NSSDC offers closing remarks at end of conference.***

# Visual Representation of Remotely Sensed Data Helps Public Understand Science

*Jay Friedlander of NSSDC photo lab (center) shows positive images of Mojave desert to Sarah Tweedie of Corcoran School of Art as Tim Nohe (right) looks on.*

For many years, the sciences that depend on satellite-gathered data have been perceived by the general public as abstract and mysterious. One reason for this veil of mystery is biological in origin and is a result of the human eye's being sensitive to a very small region of the electromagnetic spectrum, visible light, while a vast majority of the data is taken from nonvisible bands of the spectrum. Dr. Milton Halem, chief of the Space Data and Computing Division, in collaboration with Ms. Sara Tweedie of the Corcoran School of Art, has embarked on a research project that is designed to evaluate and report on methodologies that are needed to communicate a visual understanding of remote sensing data to the public at large. An improved understanding of this data and their related sciences will enable people to better appreciate the universe around them.

Scientists have realized for a long time that representing non-visible phenomena in a visible way helps them to interpret such data by providing a conventional frame of reference. Since one goal of the art world is to see and interpret our environment, Halem and Tweedie believe that artists can bring their experience to the representation of data.

According to Tweedie, two primary areas of research are involved. One approach is to experiment with new methods of using digitized data in combination with the serigraphic process, a screen printing process, similar to silkscreening. NSSDC's Photographic Laboratory is instrumental in the production of the negative plates that are used in this process, which provides a very high pixel resolution on the order of 1024 x 8000. She says that "the artist, working with a computer, generates a spectral color representation. Then, he or she develops algorithms and software that histogram the data and determine the color scales to be digitized. Finally, these data are converted into black and white positive film images," which NSSDC's Photographic Laboratory also processes.

Tweedie says that scientists also plan to explore visualization limitations of the photographic process. "Currently, the highest quality digital information is obtained with a film recorder. The chemical structure of the color film emulsion causes the light that passes through it to refract. Prints made from this film begin to loose clarity when they are enlarged to three times their original size. This limitation can be overcome by producing data on black and white film, which, when used in combination with the serigraphic process, also allows the artist a greater choice of colors," she says.

Tweedie further explains that "work has begun on this process, and our science-art group has found it possible to utilize software that organizes the data over a specified region of the non-visible spectrum. Three representative frequencies from this region are assigned the visible colors yellow, cyan, and magenta. In this way, nonvisible images can be mapped into the visible spectrum for study and appreciation."

By providing a frame of reference that is more in line with our human experiences, scientists will not only have an excellent quantitative understanding of their data but will also be able to have a more intuitive understanding of their data as well. This improved empirical-conceptual understanding will lead to more insightful research.

Kenneth Silberman

# newsbriefs newsbriefs

## STELAR Planning Committee Has First Meeting

NSSDC hosted the Third On-Line Astronomy Documentation and Literature Workshop in Columbia, Maryland, on October 24 and 25. This was the first meeting of the Study of Electronic Literature for Astronomical Research (STELAR) planning committee.

NSSDC staff members presented various aspects of the draft STELAR project plan and timelines and addressed remaining questions. The current plan calls for the testing of electronic access to the published literature by placing on line a sample of the astronomical literature. Thus, the STELAR project is working towards creating bitmaps of five years' worth of journals.

The STELAR project attempts to answer as many questions about electronic journals as possible. Fortunately, most (if not all) of the technical problems are soived or are easily solvable. The remaining difficult problems deal with administrative issues, such as funding, subscriptions, and copyrights.

The current membership list includes the American Astronomical Society (AAS) Publications Board members, AAS, ASP, editors and publishers, library representatives, interested information system collaborators, NSSDC staff, and representatives from NASA and the National Science Foundation (NSF).

Michael Van Steenberg

## CD-ROM of 114 Astronomical Catalogs Now Available

The Astronomical Data Center (ADC) has produced a Compact Disc Read-Only-Memory (CD-ROM) set containing 114 astronomical catalogs of astrometry, photometry, spectroscopy, and other miscellaneous data for stellar and extragalactic sources. The CD-ROM set comes on two discs: Disc 1 has all of the catalogs in flat text-file format, and Disc 2 has the same catalogs in Flexible Image Transport System (FITS) table format. Both discs have machine-readable documentation for every catalog describing the content and format of the data files.

The catalogs were selected in cooperation with the international astronomical data centers in Beijing, Moscow, Potsdam, Strasbourg, and Tokyo (descriptions of the data centers are included in the booklet that accompanies the CD-ROM). The International Astronomical Union (IAU) is supporting the project with a grant to help defray the costs of distributing the CD-ROMs to researchers in developing countries.

Members of the ADC who contributed to the preparation of the CD-ROM include Lee Brotzman, Susan Gessner, Nancy Roman, and Wayne Warren, all of Hughes STX; Michael Van Steenberg (Code 933); and Jaylee Mead.

Requests for the discs may be sent to the NSSDC Coordinated Request and User Support Office (CRUSO), as specified on the back page of this newsletter.

Jaylee Mead

## Proceedings of 1991 Space and Earth Science Data Compression Workshop Now Available

The Space and Earth Science Data Compression Workshop, held on April 11 at the Snowbird Conference Center in Snowbird, Utah, explored opportunities for data compression to enhance the collection and analysis of space and Earth science data. In seeking to identify the most appropriate data compression approaches for particular applications, six invited papers focused on the scientists' data requirements, as well as the constraints imposed by the data collection, transmission, distribution, and archival systems. Five of these invited papers are included in the proceedings.

The workshop also included discussion groups on the following three topics:

- Data compression for browse/quick look and for data archival.
- Data compression for near Earth to Earth transmission and for deep space to Earth transmission.
- Techniques for containing error propagation in compression/decompression schemes.

Each group outlined the issues and the data compression technologies that could solve the problems singled out by the issues and then made recommendations on how NASA and the data compression community could work together to solve NASA's data compression needs. A report from each discussion group is included in the proceedings.

This workshop was organized and sponsored by NASA and co-sponsored by the Institute of Electrical and Electronic Engineering (IEEE) Computer Society Technical Committee on Computer Communications (TCCC). It was held in conjunction with the 1991 Data Compression Conference, which was sponsored by the IEEE TCCC in cooperation with NASA and the Center of Excellence in Space Data and Information Sciences at Goddard Space Flight Center (GSFC).

James Tilton

# newsbriefs newsbriefs

## Recent Meetings Affect Future of Master Directory

James Thieman attended two recent meetings affecting future plans for the Master Directory.

First, a meeting at the University of Michigan on September 4–6, 1991, was held by the Consortium for International Earth Science Information Networks (CIESIN) concerning a proposed CIESIN Health and Atmosphere Information Network. This would be a pilot project to create a directory and underlying information system network involving global change effects on the atmosphere and related effects on human health. The U.S. Federal Agency Global Change Master Directory (GCMD), located at NSSDC, currently does not contain data set information related to the health sciences. CIESIN proposed the creation of a directory that would be compatible to the GCMD but would also be specifically oriented to the health and atmospheric sciences. They intend to expand this directory to include socio-economic science data. (To some extent, it is intended that the GCMD contain data of this sort as well.) CIESIN will be working more closely with the GCMD staff to maintain compatibility and information sharing capabilities for the future.

Second, a meeting at NASA Headquarters on September 12, 1991, brought together NASA groups supporting the GCMD and the NASA Master Directory (NMD), which are presently synonymous. In the future it may be necessary to split these two directory functions so that each may be optimized for its user community. The NMD is intended to serve NASA and NASA-funded researchers in all Office of Space Science and Applications disciplines. The GCMD is oriented toward the world's global change research community. To facilitate the changes that might be necessary to provide for each community, it was agreed that the NMD and GCMD be maintained on separate computer platforms. Presently, however, they will serve as backups to each other to assure reliable access for the user community.

James Thieman

## IMS Development Team Finalizes Interoperability Prototype Design

The Earth Observing System Data Information System (EOSDIS) Information Management System (IMS) Version 0 Development Team held a meeting at the Coolfont Conference Center in Berkeley Springs, West Virginia, July 16–18, 1991. Attending were the IMS System Level Task personnel from Goddard Space Flight Center (GSFC) and the IMS team members from the seven Distributed Active Archive Centers (DAACs). Representatives from the EOSDIS Data Panel and the EOSDIS Program and Project Offices were also in attendance.

The primary purpose of the meeting was to finalize the design of the FY 1991 interoperability prototype, which will provide uniform access to the data inventories on four of the systems running at DAAC sites (the Global Land Information System at the Earth Resources Observation System Data Center; the Pilot Land Data System at GSFC; the NASA Ocean Data Systems/Interactive Access System at the Jet Propulsion Laboratory; and the Cryospheric Information Management System at the National Snow and Ice Data Center. The prototype will consist of software that allows the user to construct a data search message and pass it to the DAAC sites, map the messages into queries that can be executed on the local inventories, construct standard results messages, and pass the results back to the originating system where they will be displayed to the user.

In addition to soliciting their comments on the design, the EOSDIS Data Panel representatives were requested to provide additional science scenarios that could be used to test the interoperable inventory prototype. The current set of scenarios requires both functions and data sets found outside the four systems to be uniformly accessed via the prototype. During the meeting, the representatives constructed and presented three scenarios that demonstrated valid science queries but were limited by the existing systems' capabilities.

The remainder of the meeting was devoted to reporting on the progress that had been made by the system level team and at the DAAC sites. Presentations were made on the alphanumeric user interface, the search message builder and mapping software, the message passing software, results message format, and the graphical user interface screens (to be incorporated into the system in FY 1992). The respective development responsibilities of the IMS System Level Task and the DAACs were finalized, and a milestone schedule was constructed. The schedule calls for an internal demonstration and review of the interoperable inventory by the development team in November, followed by a demonstration to the Program and Project in January.

Kenneth McDonald

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## Data Systems Standards Effort Makes Progress

The Consultative Committee for Space Data Systems (CCSDS) Panel 2 held its semi-annual workshop in Orlando, Florida, from September 23–27, 1991. This was one of the most productive workshops in recent years as the NSSDC-led NASA members achieved all of their major objectives, with highlights listed as follows:

- Preliminary review comments from the agencies on the SFDU Structures and PVL Red Books, which are undergoing formal agency reviews, were discussed, and it appears likely that agency concerns can be accommodated without major perturbations to the books. A NASA implementation and evaluation report is planned for March 1992, with the possibility of final agency approvals for Blue Book status of these two books at the May workshop.

- Intense editing sessions on the *Control Authority Procedures Red Book* also achieved wide consensus, and a second issue, for formal agency review, is expected by January 1992.

- Panel 2 decided not to propose to the agencies that the Master Directory (MD) Directory Interchange Format become a CCSDS standard at this time. Rather, it was felt that this should be addressed as part of a future work item on data location standards and not as a stand-alone proposal. In anticipation of such work and to promote current work, a resolution strengthening the liaison efforts with Catalog Interoperability/MD and the Committee on Earth Observing Satellites Working Group D was adopted.

Donald Sawyer

## Anonymous Accounts in VAX Provide Spacecraft Data

A number of anonymous accounts have been created in NSSDC's VAX system to provide orbital and science data for a number of spacecraft. These accounts enable a large section of the user community around the world to browse or access data without interfacing with the science/operations staff and also help to reduce follow-up paperwork. Though not as well-structured as the data in the NSSDC On-Line Data and Information Service (NODIS), the anonymous accounts do the same job reasonably well, with probably greater flexibility.

Among such accounts are ANON_DIR:[ACTIVE] and its several subdirectories; also, within the [ACTIVE] directory is one file with an ongoing collection of orbital elements of the relatively low altitude science spacecraft that are tracked by the USSPACECOM radars about three times a week. Access to these elements has encouraged several institutions to predict the trajectories, using their own preferred codes. Orbital elements and other precomputed data for a number of current and future, high-altitude missions that are under the aegis of the international Inter-Agency Consultative Group (IACG) can be accessed in the subdirectory called [ACTIVE.IACG]; a master file, within the subdirectory, named STEP.RP provides an annotated list of files.

By far, the largest subdirectory is the [ACTIVE.HELIO], which contains over 70 precomputed files of the trajectories of all heliospheric spacecraft for the period 1989 to 2000, in various coordinate systems. Also contained in this subdirectory is an executable code to obtain trajectory data of any of these spacecraft at time resolutions of the user's choice. A master file named JHK.RP provides an annotated list of all files and codes in the subdirectory. Another subdirectory [ACTIVE.SPX] contains an on-going collection of the monthly publication *SPACEWARN Bulletin*, published by the WDC-A-R&S. This bulletin provides announcements of new launches of spacecraft during each month, a list of orbiting objects that re-entered Earth during the month as well as lists of basic data for spacecraft that can be categorized in a functional way; a new category is the list of all Global Positioning System (GPS) spacecraft that are useful for accurate navigation, crustal dynamics, etc.

Typically, there have been about 200 accesses made each month to the files in [ACTIVE] and its subdirectories. If these accesses had occurred through traditional contact with the NSSDC staff, just the task of paper work in entering such requests and closing them would take at least 200 x 0.25 = 50 people-hours. Fold in the time needed to understand, advise, argue, locate, compute, and then supply the data, and one can see how these anonymous, unsung, and happy network users have helped save tax payers substantial amounts this year.

Sardi Parthasarathy

## Nimbus 7 TOMS Is Animated

An old friend of the NSSDC, Lloyd Treinish, has recently submitted two Nimbus 7 Total Ozone Mapping Spectrometer (TOMS) animation sequences to the Graphics group. The sequences were originally visualized on an IBM POWER Visualization Data Explorer at T. J. Watson Research Center. The images making up one animation sequence were output to a file in 24-bit

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interleaved format at a resolution of 720 x 468. Each sequence contains 91 frames of full-color images covering the same time period from 9/1/87 through 11/30/87. The two sequences highlight different but related visualization techniques. One sequence uses a polar orthographic projection with a deformed surface using height and pseudo-color to represent the ozone data. The second sequence uses a spherical projection, with the ozone data being represented by height, color, and opacity. The Graphics group has written a program to render these images on the Silicon Graphics Personal IRIS workstation in the Data Analysis Lab in Building 26. Anyone wishing to view these animations should contact Lara Aist-Sagara (NCF::AIST) for more information.

Lara Aist-Sagara

## Staff Work on Documentation for CDF Version 2.1

Common Data Format staff members have been working around the clock to improve the CDF library and toolkit. The main concern right now is to finish the documentation for CDF V2.1 so that the User Support Office is no longer overwhelmed with questions from users already using CDF V2.1 in its undocumented form. The new CDF documentation is being written in LaTeX so it will be more complete and look better than in the past. A port of CDF to the IBM PC has also been under way. The library has already been ported and partially tested with much success. Toolkit programs are now being ported. Also completed is a port of CDF to the IBM RS/6000 series of computers running the AIX operation system. After the documentation and IBM PC port are completed, ports of CDF to the Macintosh and Cray are planned.

Jeffrey Love

## Artificial Intelligence at the Eighth CI Workshop

A technical session at the Eighth Catalog Interoperability Workshop, Artificial Intelligence and Catalog Interoperability, was chaired by Dr. Robert Cromp of the Intelligent Data Management project at NSSDC. Dr. Cromp gave a talk on IDM's development of a natural-language user interface to the International Ultraviolet Explorer (IUE) data base, after which two other NSSDC researchers presented their work. Samir Chettri (Hughes STX) spoke on the utilization of neural networks in image classification to provide additional search keys for catalogs, and Erik Dorfman (Hughes STX) gave an overview of IDM's Intelligent Information Fusion System (IIFS) prototype, and how AI techniques are applied to the problems of automated data set ingest, data characterization, and catalog query processing.

Also presenting was Francois Major of the National Library of Medicine's National Center for Biotechnology Information, who talked about his application of constraint satisfaction toward searching a large scientific data base of molecules. After the break, Dr. Cromp directed an informal discussion during which audience members were welcomed to present their own transparencies and voice their questions, concerns, or experiences regarding the integration of AI in planned or existing catalogs. The session has so far received a good deal of positive feedback and many audience members approached the lecturers at the break requesting additional information on their research.

Erik Dorfman

## CDAW 9 Data Base Will Be Available on CD-ROM

To provide more convenient access to the Coordinated Data Analysis Workshop (CDAW) 9 data, NSSDC is working to generate a CDAW 9 CD-ROM. Susan Kayser is leading this effort, aimed at having the initial disc ready around February. The CD-ROM will contain the CDAW 9 data base in CDF form, the CDAW 9 Data Catalog, other documentation, and appropriate CDF software tools to enable users to extract data into their own system as desired. The software tools will initially operate on VAX and UNIX platforms but are expected to eventually include PC/DOS and Mac systems as well. NSSDC has a CD-ROM premastering system and has generated several CD-ROMs only to the CDAW 9 participants; an improved version(s) of the disc will be generated later, as necessary, and the later version will eventually be available for distribution to any requester. The date for this public release is about September 1992, subject to the decision of the CDAW 9 Steering Committee. The CDAW 8 data and declaration of its public availability will be handled separately.

H. Kent Hills

## CD-ROM Is a Popular Media

As of early February, 1992, NSSDC had 45 Magellan CD-ROMs available in the archives for distribution to the user community. The CDs contain radar mosaic images taken of the planet Venus. In addition to the Magellan CDs, NSSDC has a 12-volume set of CDs containing over 10,000 Voyager images, two Nimbus 7 TOMS CDs, a nine-volume set of GRSFE (Geologic Remote Sensing Field Experiment), one GRIPS (Government Raster Image

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Processing Software) CD and an Astronomical Data Center (ADC) CD-ROM. These media/data sets have created a great deal of interest in the user community and as a result NSSDC has witnessed a very high level of request activity for these CD-ROMs.

Ralph Post

## NOST Library Offers a Variety of Publications

The NOST Library keeps current editions of the *OPEN/OSI Product and Equipment News*, which features articles on new products such as X.400, X.500, and X/Open, to name a few. These standards and documents are available through the Standards and Technology Information System (STIS) or by contacting the library directly via E-Mail to NOST or at 286-3575. The library is located in Building 26, Room G10A, GSFC. Hours are from 8:00 a.m. to 5:00 p.m., but requests can be sent to NOST via E-Mail any time.

Nicki Fritz

## SSC Software Engineering Effort Is in Full Swing

The Satellite Situation Center's (SSC) science software is composed of five main components, each useful for obtaining information for a variety of terrestrial and heliocentric satellites. The components are Earth magnetospheric region determination, position determination in a number of different coordinate systems, Earth magnetic field line conjunction determination, heliocentric position determination, and coordinate system and satellite element set conversion utilities. These capabilities are available through a set of 15 separate programs, each written in Fortran-66. Information can be obtained in either plot or report formats by selection of the appropriate program.

Efforts are now under way to both rewrite the code into a C and Fortran-77 hybrid and to create a new streamlined user interface for both character terminals and windowing terminal/worksations. This effort includes full life-cycle development phases: analysis, design, coding, testing, and documentation. The user interface streamlining involves eliminating the current "program name" based selection menu with a "functionality" based selection menu comprised of the five main components listed above. This will provide users with a more natural and concise method for obtaining information. The new interface will be created using JYACC's Application Manager (JAM) on a Sun UNIX workstation.

Additional functionality will be added to the SSC system as the software engineering effort proceeds. This will involve converting existing graphics applications to use PHIGS graphics routines. PHIGS stands for the Programmer's Hierarchical Interactive Graphics Standard and, as such, provides the types of interactive graphics functions the SSC requires. PHIGS routines also provide many advanced graphical features, including the capability to render and manipulate 3D graphical objects.

Kevin Limperos

## NSSDC Data Archives Grow

NSSDC routinely receives data from many sources. These data may arrive in the form of magnetic tape, optical disk, floppy disk, CD-ROM, electronically, on film, hard copy, or in photographic form. Over the last several years, NSSDC has received an average of 3,000 - 5,000 tapes per year. The archive now consists of approximately 110,000 tapes, over 200 optical disks, about 65 floppy disks, and about 70 CD-ROMs. Keeping track of the data is handled by the IDA (Interactive Data Archive) file and various other inventory files. In the future the more traditional forms of media will be replaced with the higher storage capacity forms such as CD-ROM and optical disks. Currently, however, the standard open-reel magnetic tape is still NSSDC's most common form of archival media.

Ralph Post

## Color Images of Ozone Are Available on CD-ROM

Gene Major, the NSSDC acquisition scientist for Earth Science data, has recently archived several hundred copies of CD-ROM containing the Nimbus 7 TOMS (Total Ozone Mapping Spectrometer) color ozone images. The disc was produced by Dr. Richard McPeters, and Ms. Patricia Guimaraes, Code 916. There is also a color booklet to describe the data as well as the systems requirements for the disc. NSSDC/Hughes STX staff members as well as the general public may order the CD-ROM through CRUSO (Coordinated Request and User Support Office). Requesters who are not eligible for a waiver of charges have to pay a nominal price of $20 for the first CD-ROM and $6 per additional in the same data set and same order.

For the convenience of requesters, orders for NSSDC data and services may now be charged to a MasterCard, VISA, or American Express card. Checks or money order, in U.S. dollars only and made payable to ST Sys-

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tems Corporation (the Accounting Office in Vienna is working on the name change), will continue to be accepted as payment. CRUSO has prepared a flyer to advertise this new TOMS ozone image disc and the first disc which contains gridded ozone data in ASCII. Please direct inquires to the CRUSO, 286-6695.

Carolyn Ng

## NSSDC Transition of Earth Science Data

Dr. Len Fisk, Associate Administrator, Office of Space Science and Applications, has issued a new policy for data management and archiving. Under this new policy, Earth science data will be managed and archived by the EOS Distributed Data Archive Centers (DAACs). NSSDC, which currently manages and archives both space and Earth science data, has been requested by the Information Systems Management Board (ISMB) which is headed by Joseph Alexander (assistant associate administrator) to develop a plan for moving Earth science digital data and the associated management and archive responsibilities for these data out of NSSDC by 1994. In response to this request, NSSDC has developed a draft NSSDC Earth Science Transition Plan and is reviewing it with the EOS Project, Goddard management, the user community, and with NASA Headquarters before formal submission.

Valerie Thomas

## Campbell Becomes New Member of NSF Committee

William J. Campbell, head of the Information Science and Technology Office within the Space Data and Computing Division was nominated and accepted as a new member of the National Science Foundation's (NSF) Advisory Committee for the Division of Information, Robotics, and Intelligent Systems (IRIS). The committee consists of 16 experts from universities and private industry whose purpose is to advise IRIS management on current research thrusts, academic interests, and industrial needs in computer and information science. Based upon this advice, IRIS then determines what areas of research will be funded for the next fiscal year. Programs currently being funded are

- Information Technology and Organizations.
- Data Base and Knowledge Engineering.
- Knowledge Models and Cognitive Systems.
- Interactive Systems.
- Robotics and Machine Intelligence.

As a committee member, Campbell will share his expertise specific to the scientific data and knowledge engineering program. This program accepts proposals and provides funding for data and knowledge bases, design and implementation, query processing, storage access methods, and distributed systems.

IRIS is one of six divisions and offices which make up the NSF's Directorate for Computer and Information Science and Engineering (CISE). The IRIS Division is concerned with scientific and engineering research in pursuit of the following goals:

- To increase scientific understanding of information processes in machines, organisms, organizations, and other systems.
- To stimulate innovation and enhance U.S. competitiveness in the design of information-based products and the manufacture of information processing machines.
- To strengthen the national infrastructure for research, design, and manufacturing in this field.

Wendy Ames

## DAAC Science Data Plan Shows Current Holdings Exceed Three Terabytes

The Goddard Version 0 Distributed Active Archive Center (DAAC) staff of the EOS Data and Information System (EOSDIS) has completed an inventory of all Earth science data currently held at GSFC and available for distribution. The total volume exceeds three terabytes of science data. More than 200 data sets are contained within this volume. These data are available through operational GSFC data systems including the Coastal Zone Color Scanner (CZCS) Data System, NASA's Climate Data System (NCDS), the Pilot Land Data System (PLDS), the Crustal Dynamics Information System (CDDIS), and the NSSDC. Data are actively being requested in both on-line and off-line modes by researchers.

One goal of the Goddard DAAC is to integrate by 1994 the Goddard Earth science data systems into a single functional data management system. This system will archive and distribute all Earth science data available at the Goddard DAAC. With the addition of Pathfinder, Upper Atmosphere Research Satellite (UARS), SeaWiFS, and growing volumes of currently-held data, the volume is estimated to grow to approximately 13 terabytes by 1994.

Roger Dilling

Information System, *from p. 15*

**The NSSDC Information Management System**

There is an effort now under way at NSSDC to define a new information environment called the NSSDC Information Management System (NIMS). NIMS will be created through some optimal integration of the NMD and RSIRS functionalities, with a functionality growth capable of accommodating the "all extant OSSA data" requirements. Part of this effort involves the definition of all the "object types" that NSSDC needs to track (data sets, data set granules, spacecraft and instruments, people, requests, publications, software, other data facilities, campaigns, etc.). NIMS is intended to handle all this.

In order to make progress, the NIMS definition effort has been focused twice. An early effort excluded consideration of data granule (i.e., inventory) requirements. By way of terminology, HI-NIMS was defined to be NIMS, less inventory considerations. Then a further delimitation was necessitated by resource constraints to data set, spacecraft, and investigation considerations. It is believed that this aspect of HI-NIMS will provide virtually all the functionality needed by OSSA management officials. It will also furnish a very useful tool for the research community in supplying information not only about existing and available data worldwide (Master Directory [MD] functionality) but also about past and future programs providing data of interest.

NSSDC recognizes that definition and development of the NIMS information system will be easier than its comprehensive population. Any evolution of NMD into NIMS will be transparent to present MD users and to persons giving data descriptions in the Directory Interchange Format (DIF) structure.

Joseph King

## CALENDAR

**February 10-13, 1992**
***International Space Year Conference***
***Pasadena, California***

**March 17-19, 1992**
***Geographic Information Systems Workshops and Conference***
***Towson State University***
***Baltimore, Maryland***

**May 11-15, 1992**
***American Geophysical Union Spring Conference***
***Montreal***
***Quebec, Canada***


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# NSSDC Services

Researchers can obtain information about NSSDC's data archive—how to contribute to it or how to request data from it (including cost and availability concerns)—by addressing their questions as follows:

## INSIDE UNITED STATES

### *Data Submissions*

Dr. H. Kent Hills
NSSDC/Code 933.9
Goddard Space Flight Center
Greenbelt, MD 20771
Telephone: (301) 513-1670
FAX: (301) 513-1608
NSI-DECnet: NCF::HILLS

### *Data Requests*

NSSDC/Code 933.8
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Greenbelt, MD 20771
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NSI-DECnet: NCF::REQUEST

## OUTSIDE UNITED STATES

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