NSSDC news

NASA's National Space Science Data Center

Vol. 8, No. 1, Spring 1992

IACG Defines Campaigns for Mid-1990s Mission Coordination

The most recent meeting of the Inter-Agency Consultative Group (IACG) for Space Science was held in Nara, Japan, in November of 1991. The heads of the delegation were Alex Galeev, Space Research Institute of the Academy of Sciences (IKI); Jun Nishimura, Institute of Space and Aeronautical Science (ISAS); Dr. Len Fisk, NASA; and Dr. Martin Huber, representing Dr. Roger Bonnet, European Space Agency (ESA). The IACG is composed of the administrative heads of the science organization in each of the four major international space agencies.

This IACG meeting focused primarily on the report of the Core Group, which the IACG put together last year. The group is a small science team with one scientist from each agency to represent that agency's missions; the Core Group works with their associated mission scientists to come up with the new IACG science objectives.

The main purpose behind the IACG's discussions was to determine a course of action for their agencies that would greatly enhance space science research from their space physics missions that will be launched over the next several years.

The key aspect of the expected enhanced science is to accomplish new mission goals through correlative and simultaneous measurements that extend far beyond each mission's original scientific objectives; of course these enhancements will have to be accomplished without compromising any of the original mission science objectives.

IACG meeting participants gather outdoors in Nara, Japan.

Dr. James Burch from SWRI was the NASA representative on the Core Group. The identified IACG campaigns build on the list of science objectives compiled at a workshop held in San Antonio, Texas, in February 1991 and hosted by Dr. Burch. Other members of the Core Group were Professor Atsuhiro Nishida, representing ISAS; Dr. Rudi Schmidt, ESA; and Dr. Lev Zelenyi, IKI. The Core Group Report has already been distributed to investigators on the IACG Prime Missions—GEOTAIL, WIND, POLAR, INTERBALL, Relict-2, Equator-S, CLUSTER, and SOHO. A copy of this report can be requested from Code SS NASA Headquarters.

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inside:

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

Director's Message:

New Data Centers Are Established for Earth Science

The NSSDC has been collecting, managing, archiving, and distributing data for more than 20 years. During this time it has amassed over 4,000 data sets in the broad science disciplines of Earth science, astrophysics, planetary physics, and space physics. With the upcoming new Earth-observing missions (such as SeaWIFS, TRMM, EOS, etc.), worldwide attention is being focused on the importance of understanding global climate changes.

New active archives for Earth science are currently under development in at least seven locations across the country. Each new Earth science archive is called a Distributed Active Archive Center, or DAAC. Each DAAC will specialize in a particular subdiscipline of Earth science. These initial DAACs are being set up where science experts reside. The experts plan to oversee the scientific aspects of data management, archiving, and the distribution functions of large amounts of Earth science data from past and upcoming missions.

The first seven DAACs are located at Marshall Space Flight Center, Langley Space Center, Jet Propulsion Laboratory, National Snow and Ice Data Center, EROS Data Center, the Alaskian SAR Data Center, and Goddard Space Flight Center. These new and developing DAACs are called the Version-0 DAACs, a name that distinguishes them from the massive DAACs that will be built to support the long-term EOS platforms, which are scheduled for launch in the late 1990s. Version-0 DAACs are responsible for managing the existing Earth science data as well as the data from the Earth science missions that will be launched before EOS.

In response to these new and exciting thrusts in Earth Science, Goddard Space Flight Center (GSFC) has established a new data center to manage its DAAC and some Earth science flight mission responsibilities. The Global Change Data Center (GCDC) was recently established to provide the Earth science discipline with data operations and archive management for key NASA Earth science flight missions. The GCDC, the NSSDC, and the NASA Center for Computational Sciences currently reside in the Space Data and Computing Division under Dr. Milton Halem, and for now, the entire Space Data and Computing Divison is in the Earth Science Directorate. It is anticipated that the NSSDC will be reorganized into the Space Science Directorate sometime this year.

The GCDC will be responsible for the development and operation of the Goddard DAAC Version 0. The Goddard DAAC Facility, or G-DAAC, is responsible for acquiring, processing, archiving, and disseminating scientific data from the SeaWIFS, TOMS/METEOR, NIMBUS-7, and other NASA missions. These missions primarily support the ocean biology and climate research disciplines that have been assigned to GSFC.

In addition to its responsibility for directing NASA's Earth science mission archive support, the G-DAAC also has begun operating several existing data systems that were developed and managed at the NSSDC. These systems include the NASA Climate Data System (NCDS), the Pilot Land Data System (PLDS), and the Crustal Dynamics Data and Information System (CDDIS). The NSSDC has already transferred to the GCDC key staff, both civil servants and contractors, who have been responsible for these systems.

Although I personally am sorry to see my good friends and colleagues move to another organization, I also have high hopes that the GCDC, which is dedicated to Earth Science, will provide greater scientific support in their designated Earth science disciplines than could have been accomplished at the NSSDC under the previous and existing circumstances.

It is important to note that the NSSDC will still be supporting all NASA science disciplines, but the level of support and the amount of data that we will actually hold will be significantly different among the individual science disciplines. Even though the NSSDC holds approximately 3.6 terrabytes of Earth science data, over the next couple of years the NSSDC

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will be migrating this data to the new DAACs as they become operational. By about 1994 the NSSDC is not expected to be managing any digital Earth science data but will be holding various amounts of information about Earth science data and missions and perhaps most of the Earth science film data. In the coming years, therefore, the NSSDC's data holdings will concentrate on astrophysics, space physics, and planetary data, perhaps with some life sciences data also.

During this transition period, when the NSSDC will manage an ever-smaller volume of digital Earth science data as the these DAACs come on-line, we will strive to continue to provide the best service we can and not confuse the science user as to which DAAC or data center holds what data. NSSDC plans to keep the Master Directory up to date with the latest information about the location of the older Earth science data as well as that of the new data.

Regretably, because of this reorganization much of the Earth science news that the NSSDC reported in this newsletter will no longer appear here. However, other Earth science newsletters, such as the EOS Observer (published out of the EOS project office here at GSFC), are starting to appear that should more than fill this gap.

Our sister data center, the GCDC, is just beginning, and NSSDC's staff will be working hard to provide whatever support it needs. I am sure I speak for the entire staff at the NSSDC when I say that we look forward to having all the DAACs come up to speed in providing the Earth science community with important data services and give them our best wishes and great success in the coming years.

James L. Green

Solar Images from Skylab Are Now Available for IBM PC and Apple Mac

Recently, NSSDC acquired digitized images of the Sun in soft X-rays which were produced from photographic film exposed aboard the Skylab space station (1973-74). In their original form, these images were used to make great advances in the understanding of the solar corona and flares, but the photographic medium was not suited to image analysis techniques that can be used today to analyze digital images. Approximately 10% of the 30,000 images were digitized by the instrument PI team, but the images never were distributed to other investigators.

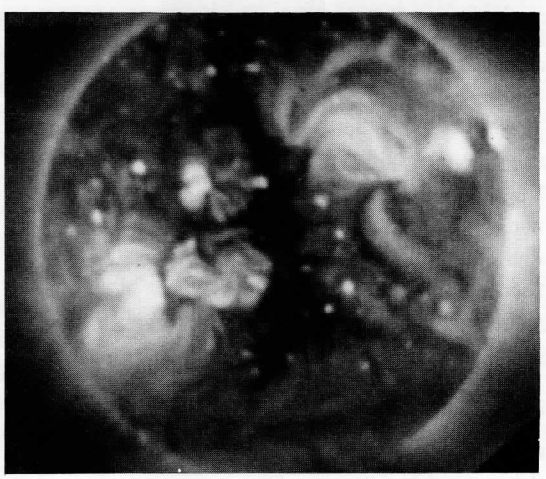
A software package has been developed at NSSDC that transforms the images from their native form into the data formats used by IBM-compatible PCs, and enables the user to display the images in false color on PCs with standard VGA 256-color graphics. This software package makes the images available to a far greater community of potential users than heretofore, from professional solar physicists to high school educators and journalists. A demo diskette and C-language source code for the programs are available.

Requesters are invited to contact NSSDC Request Office and ask for the Skylab S-054 Image Display Demo diskette (NSSDC dataset ID 73-027A-05G). It is available on low-density 5 1/4 inch or 3 1/2 inch diskettes. The diskette includes three sample data files of images reduced to 230 x 198 dimensions and display software for VGA 256-color 320 x 200 pixel graphics mode (mode 19). The user will need a PC compatible with this VGA mode or software which emulates it on another machine (such as a Macintosh) to view the images. The C-language source code of the display programs is also supplied on the diskette.

Requesters may also ask for sample files on tape, diskette, or via computer network file transfer. Additional software has been developed and is available to requesters so that they can process and display the images on IBM PC compatibles. Sample images are also available in TIFF format, which can be ported directly to other machines such as Macintoshes.

In a previous edition of *NSSDC News*, NSSDC announced the availablility of these images and that they were 512 x 512 pixels. It has since been learned that these dimensions were only an example used in the documentation that NSSDC received. Most of the full-Sun images were actually 1243 x 1244 or 1400 x 1401, and there are many scans of other assorted smaller sizes. The software for the PC described above enables a user to reduce the image dimensions as desired.

David Batchelor



This image of the Sun was recorded on Skylab with the Soft X-ray Spectrographic Telescope.

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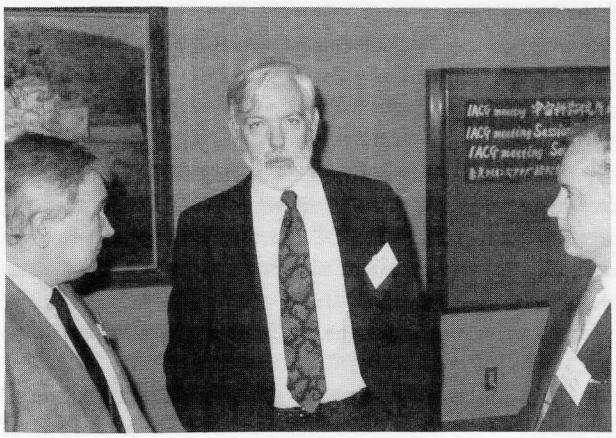
The main recommendation of the Core Group was that the primary mode of multi-space agency mission science coordination be the conduct of specific campaigns, each with a definite scientific focus and the ability to be accomplished over a period of several months when spacecraft positions are particularly favorable.



Serguei Khlemchov (IKI), Len Fisk (NASA), and Alex Galeev (IKI) converse during a break.

The Core Group went on to define 17 potential science campaigns. The first two such campaigns would be the study of "Magnetotail Energy Flow" and the "Role of Non-Linear Dynamics". These campaigns are envisioned to begin in late 1993. The Core Group Report also highly recommended starting two other campaigns: "Boundaries in Collisionless Plasmas" that would begin in late 1996 and "Solar Events and Their Manifestations in Geospace" beginning in 1996. It is hoped that space science investigators will be able to point identifiable scientific accomplishments achieved through a coordinated campaign mode at the end of this decade as the major result of the IACG efforts.

To help carry out the inter-agency coordinations, the IACG has created three working groups. The activities of these working groups over the last several years has been frequently discussed in various issues of *NSSDC News*. Working group status reports were also given at the Nara meeting.

Dr. Elden Whipple, Chief of the Magnetospheric Physics Branch in NASA's Space Physics Division, was approved as the new chairman of Working Group-1 (WG-1, Science), to fill the vacancy left by the death of Dr. Stanley Shawhan in 1990. Dr. James Green of NSSDC became chairman of Working Group-2 (WG-2, Data Exchange), and Dr. Uesugi of ISAS remains chair of Working Group-3 (WG-3, Mission Design and Planning). Professor Atsuhiro Nishida of ISAS was approved as executive secretary, replacing Dr. Rudegar Reinhard from ESA, who had done an excellent job serving the IACG for many years.

WG-1 has planned an international workshop for June 1-3,1992 near Washington, D.C. which will further define and prioritize specific, achievable science objectives for the first two campaigns and prepare an implementation plan. This plan would include recommendations on spacecraft configurations and requirements for ground data and modeling activities and systems. WG-2 will facilitate the campaigns by promoting the appropriate data exchange mechanisms and provide other science support activities as required in the implementation plan.

A new report entitled *Handbook of Solar-Terrestrial Data Systems* was issued by WG-2. (A copy is available free of charge from the NSSDC/WDC-A-R&S at NSSDCA::REQUEST.) The handbook is a "cookbook" on how to gain access to more than 20 on-line data systems currently supported by the IACG member agencies for accessing key solar-terrestrial data and other relevant data systems.

A major thrust of WG-2 over the past several years has been to provide or enhance computer-to-computer network communications to all the member agencies. This effort has recently been completed. In addition, members of WG-2 have been instrumental in providing standard data format information to the agencies' science teams such that a common format could be used in the exchange of all key parameter data generated from the core IACG missions. It is hoped that within the next year or so the data formats for IACG campaign data will be decided.

James L. Green

A deer grazes in Nara Park near the IACG conference site.

SSC Supports International Programs

Satellite Situation Center (SSC), a small unit of the NSSDC/WDC-R&S, was established in the mid 1970s to support and coordinate the multi-mission program, International Magnetospheric Study (IMS).

The software and hardware resources that were developed during the IMS era continued to be used in assisting planning efforts, notably of DE 1, ISEE 1/2, and IMP 8. With very few changes to the software and hardware, the SSC then played a major planning and coordinating role during the multi-mission Polar Region and Outer Magnetospheric International Studies (PROMIS) program in 1986, and the NASA-IKI-ISAS joint program (1989/90) that centrally involved the IKI spacecraft Active, under the aegis of the Inter-Agency Consultative Group (IACG).

Among the international programs now supported by SSC is the Solar Terrestrial Energy Program (STEP; 1990-97). STEP is a comprehensive program that embraces many Solar, interplanetary, magnetospheric, ionospheric, and atmospheric investigations underway around the globe, using ground-based and space-based instruments. (See *NSSDC News*, Vol. 7, No. 2, 1991). It encompasses several autonomous working groups that address broad global scale topics, with each working group coordinating a variety of more focussed, autonomous projects.

Each project involves numerous, independent but interlocking investigations and campaigns. The other major program of current SSC involvement is the IACG, whose chartered concern is science data from spacecraft borne experiments alone; organizationally, IACG is composed of official representatives from NASA, IKI, ESA, and ISAS.

The SSC's resources that may be germane to the needs of STEP, and IACG, and their derivative groups, projects, and investigations are its armory of software and hardware related to spacecraft orbits. It maintains a library of orbital elements for all current and planned science spacecraft.

Predictions can be made, at desired time resolutions, of the location of any spacecraft in a variety of coordinate systems. Time intervals of a spacecraft in one or more of the several domains such as magnetotail and interplanetary medium can be predicted and sorted out; these intervals can also be charted. The time intervals when one or more spacecraft will simultaneously pass through the same (modeled) magnetic tube of force, or when any of them will pass through a given tube of force egressing from a ground station of interest can be listed out. Also available is a code that can list out the magnetic field footprint of a spacecraft at desired time intervals. A variety of magnetic field and plasma regime models can be invoked for these and other computations.

These capabilities, essentially dating back to the IMS era, have been updated. A recent modification of the SSC codes, in tune with increasing use of electronic networking, is that the output list will contain only those parameters that are requested by a space physicist; this helps save disk space at the NSSDC as well as on the requester's account.

Currently, a SUN workstation is the main hardware that contains the primary data base and all the application codes. The primary data base uses the Cartesian coordinates in geocentric inertial coordinate system of numerous science spacecraft, predicted ahead of time, or retroactively, typically as one vector per minute. A limited parallel capability is also available on VAX. It has become an increasingly prevalent practice at the SSC to load on-line orbit related data of wide interest for access through FTP.

For example, the most recent 2-line orbital elements for all low altitude science spacecraft can be accessed through COPY NSSDC::ANON_DIR:[ACTIVE] NEW2LINE.ELEM, which are periodically moved to the file OLD2LINE.ELEM. These chronologically-listed composite element sets for about a dozen science spacecraft are sorted and grouped in separate files for each spacecraft in the subdirectory [ACTIVE.NORAD]; for example, the file named AKEBONO.EL contains element sets of Akebono only.

The elements for the planned and current higher-altittude spacecraft are in the subdirectory [ACTIVE.IACG], with files named GEOTAIL.EL, WIND.EL, etc. This subdirectory will soon be enhanced to incorporate files of predicted GSE coordinates of the major missions at moderate time resolution; other files, such as those providing the solar-wind times of the spacecraft, (IMP 8 and WIND) will also be placed in that subdirectory, with periodic revisions, as needed, to all of them. SSC has frequent contact with the many project offices responsible for future missions to keep abreast of changes to the planned orbits, launch dates, etc.

There is an extensive list of precomputed, on-line files of interest to the heliospheric groups such as STEP/SOLTIP, and IHS in the subdirectory [ACTIVE.HELIO]. These files were produced through specially written codes to meet the needs of the heliospheric community. The list also contains two executable codes. An annotated list of files is available by accessing the master file named JHK.RP.

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SSC, *from p. 5*

There is an ongoing effort at the SSC to modernize its graphics capabilities and user interfaces of all the codes. Meanwhile, functionally satisfactory graphics can be produced to meet requesters' bulk needs; on special instances, publication quality graphics can be produced by inputting computed list files into available commercial packages that run in a Macintosh environment.

The software resources available at SSC can be executed by the staff to meet specific requests from the community. (Some of these codes may soon be executed by outsiders through linkup with SSC's SUN or VAX.) Many requests for specific list outputs or graphics from an investigator, as well as the precomputed list files in the Anonymous account, concurrently fall within the chartered concerns of more than one of the several coordinating bodies (such as STEP, IACG, ISTP/GGS or their Working Groups, and Projects).

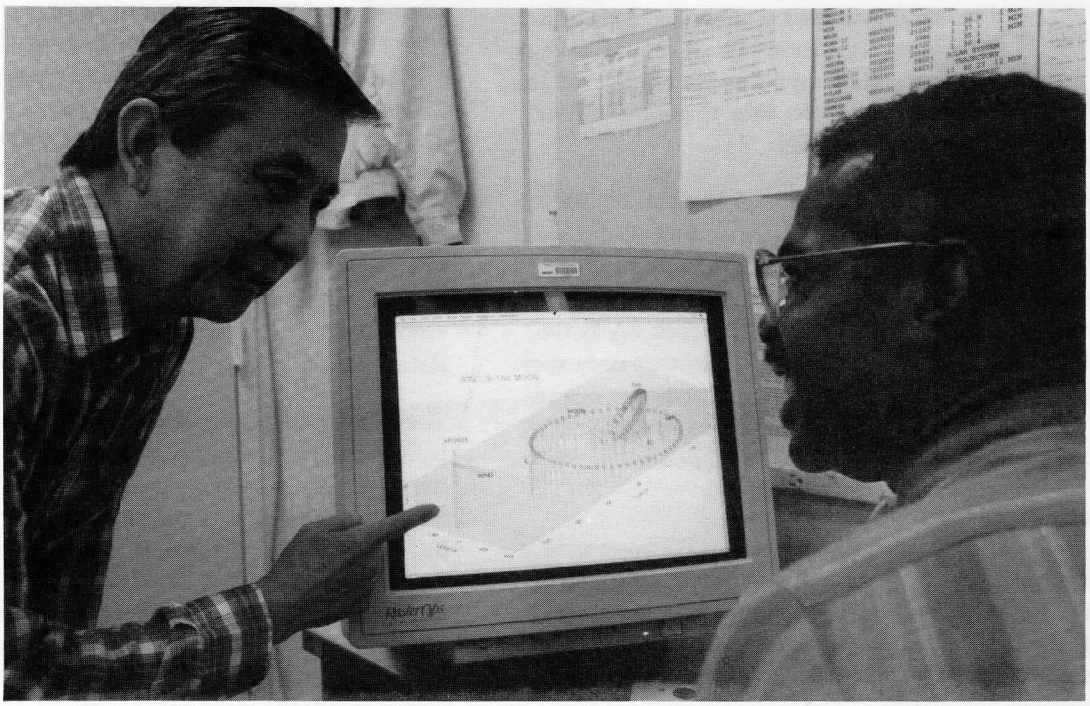
The NSSDC/SSC has been declared as the official Satellite Situation Center for the IACG, although there are such centers that are recently emerging in several countries. An example of a newly emerging center is SPIN at ISAS (Japan) that facilitates the operation of the IACG WG-3, which is home-based there. The SSC is providing SPIN with precomputed state vectors for future missions such as Wind, one vector per day written in the exact formats and time resolutions that SPIN's graphic code demands. Both SPIN and the center that is emerging at Rutherford-Appleton Laboratory, UK (mainly for CLUSTER and SOHO missions) have sought the collaboration of the SSC, which has agreed to extend all feasible help—either by loading precomputed files in the Anonymous account or by networking special computations directly to these centers, as needed.

The ISTP/GGS now has a dedicated Science Planning and Operations Facility (SPOF). The SSC has supplied to this SPOF copies of all its codes and has provided access to its voluminous ephemeris data base on the SUN computer.

SSC personnel wrote four articles for the STEP Newsletter at the request of the U.S. STEP coordinator. The articles address the essential orbital parameters of 44 magnetospheric spacecraft that are likely to be operational at least during any limited interval in 1990-97. SSC anticipates additional similar contributions. The NSSDC/WDC-A-R&S is well represented at the Working Groups leadership in both STEP and IACG. Additionally, the U.S. STEP coordinating office is physically located in the same building as the NSSDC and shares close organizational linkups. The volume and promptness of support that SSC can extend depends upon budgetary constraints.

The SSC is also (concurrently) the designated Spacewarn Office; as such it carries out WDC-A-R&S's commitments to COSPAR and IUWDS.

R. "Sardi" Parthasarathy



Satellite Situation Center scientists Chee-Ming Wong (left) and Frank Ferrier examine their three-dimensional plot of WIND data.

Dynamics Explorer Archiving Efforts Continue: Update as of February 1992

In the winter 1990 issue of NSSDC News, *an article entitled "Dynamics Explorer Archive Grows at NSSDC" (page 13) discussed the idea that, based on the exchange of metadata files between the Science Team members and the NSSDC at that time, it was possible to define DE 1 and DE 2 data files to be archived. This update describes the current status of the actual archiving process.*

On August 3, 1981, the DE 1 and DE 2 spacecraft were launched together into coplanar polar orbits to study the coupling between the magnetosphere, ionosphere, and the atmosphere. Initial apogee and perigee values were (in km) 23,290 and 570 for DE 1; and 1015 and 310 for DE 2. DE 2 re-entered Earth's atmosphere on February 19,1983, and DE 1 operations were terminated on February 28,1991.

Over a period of years, the NSSDC has worked with the DE Project and the DE Science Team in preparation for the archiving of DE data. Specifications for the metadata files were developed jointly, Standard Formatted Data Unit (SFDU) Labels were agreed to, and metadata files (and in some cases, software) were generated by Principal Investigator (PI) teams, reviewed by the NSSDC, and finalized by PI teams.

The six DE 1 instruments are:

- Energetic Ion Mass Spectrometer (EICS)
- High Altitude Plasma Instrument (HAPI)
- Three Axis Fluxgate Magnetometer (MAG-A)
- Plasma Wave Instrument (PWI)
- Retarding Ion Mass Spectrometer (RIMS)
- Spin Scan Auroral Imager (SAI)

The nine DE 2 instruments are:

- Fabry-Perot Interferometer (FPI)
- Langmuir Probe (LANG)
- Low Altitude Plasma Instrument (LAPI)
- Three Axis Fluxgate Magnetometer (MAG-B)
- Neutral Atmosphere Composition Spectrometer (NACS)
- Retarding Potential Analyzer (RPA)
- Ion Drift Meter (IDM)
- Vector Electric Field Instrument (VEFI)
- Wind and Temperature Spectrometer (WATS)

At most PI sites, Write Once, Read Many (WORM) optical disks are being written with both the metadata files and the data files. Data from three investigations have either been submitted (NACS, LANG) or will be submitted (WATS) on magnetic tape.

All metadata files for the DE archive are written so that advanced graduate students, familiar with the science discipline but not familiar with the DE instrument, could use the archived data for their research. Furthermore, since a long term data archive is envisioned, all data sets are being submitted as "stand-alone" units. This means that the data should be correctly usable, in principle at least, using the documentation provided without recourse to the PI.

The archiving status is indicated below. The instruments are grouped first by spacecraft and then alphabetically by instrument acronym. The Estimated Time of Completion (ETC) for the data set is shown, following the Principal Investigator identification and the the data set parameter description. All time designations (month or season) are in 1992.

For the DE 1 instruments shown below, it should be noted that the MAG-A PI will provide "custom" files; the other DE 1 investigators are providing organized telemetry data transformable, via PI-provided software, to the parameters identified below.

EICS

PI: E. Shelly and W. Peterson, Lockheed

The EICS data consist of organized telemetry data transformable, via PI-supplied software, to flux, velocity space density, total counts, and counts per sample; for major mass constituents. Time resolution is 32 samples per second. Some data have arrived in the archive. The ETC is May.

HAPI

PI: J. Burch, SWRI, and R. Hoffman, NASA/GSFC

The one-second resolution data from HAPI contain differential number flux, distribution function, differential energy flux, and flux vs. direction. Electrons and positive ions over the energy/charge range from 5 eV to 32 keV are measured. The ETC is late winter.

MAG-A

PI: M. Sugiura, Tokai Univ., and J. Slavin, NASA/GSFC

The data files contain time, and B_X, B_Y, and B_Z measurements in spacecraft coordinates at 62.5 millisecond resolution. The data delivery schedule is still to be determined; a good guess is late winter.

PWI

PI: D. Gurnett, Univ. of Iowa

Data files contain 31 millisecond resolution data for AC measurements and 62 millisecond data for DC components. The parameters measured are AC electric and magnetic fields, narrow band spectra, DC electric field, and phase angle. AC electric field measurements are made from 1 Hz to 2 MHz, and the AC magnetic

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field measurements are made over the range from 1 Hz to 400 kHz. The narrow band measurements range in frequency from 100 Hz to 400 kHz. Some data have arrived in the archive. The ETC is the end of September.

RIMS

PI: C. Chappell and P. Craven, NASA/MSFC

Provided at 16-millisecond resolution, the data from the RIMS include detector count rate (DCR) vs. spin phase angle (SPA), DCR vs. energy, DCR vs. universal time (UT), DCR vs. SPA vs. time; DCR vs. mass step vs. UT, and DCR vs. energy vs. time. These measurements are over a mass range of 1 to 32 amu, and a temperature range of 0 to 45 eV. Expect the data processing to be completed by March with the ETC this summer, or sooner. Some data have arrived in the archive.

SAI

PI: L. Frank and J. Craven, Univ. of Iowa

With a resolution varying between 3 minutes and 12 minutes, the SAI provides auroral images in the visible and vacuum-ultraviolet wavelengths. Some data have arrived in the archive. The ETC is the end of September.

The DE 2 instruments are shown below. As noted earlier, three PIs are archiving their data on magnetic tape; all other DE data sets will be submitted on 12-inch WORM disks.

FPI

PI: P. Hays, and T. Killeen, Univ. of Michigan

Measurements of winds, neutral temperature, and surface brightness for selected atmospheric emission lines are provided by the FPI with eight-second time resolution. FPI will archive "custom" files with software to generate the parameters shown here. The ETC is this spring.

IDM/RPA

PI: IDM - R. Heelis, UTD

PI: RPA - W. Hanson, UTD

The IDM/RPA measurements are at two or four seconds, or at 16-millisecond resolution, depending on sensor used and/or mode of instrument operation. Measured parameters include: X, Y, Z components of ion velocity; ion temperature and density; satellite potential; concentrations of the following ion species — O^+, H^+, and He^+; molecular ion and high mass ion concentrations; and ionospheric irregularity. Some data have arrived in the archive. The ETC is the end of this summer.

LANG

PI: L. Brace, and W. Hoegy, NASA/GSFC

LANG measurements include 0.5-second resolution electron temperature and density, ion density, and spacecraft potential measurements. Complete data set archived on seven magnetic tapes.

LAPI

PI: J. Winningham, SWRI, and R. Hoffman, NASA/GSFC

LAPI provides, with one second resolution, differential number flux, distribution function, differential energy flux, and Geiger-Mueller tube data. These measurements of electrons and positive ions cover the range from 5 eV to 32 keV. Electrons with energies greater than 35 keV are monitored. The ETC is late winter.

MAG-B

PI: M. Sugiura, Tokai Univ., and J. Slavin, NASA/GSFC

These 62.6 millisecond resolution data consist of B_X, B_Y, and B_Z measurements in spacecraft coordinates. The ETC is this spring.

NACS

PI: G. Carignan, Univ. of Michigan, and A. Hedin, NASA/GSFC

NACS provides, with 1-second resolution, neutral concentration measurements (O, N_2, He, N, Ar). Complete data set is archived on seven magnetic tapes.

VEFI

PI: N. Maynard, AFGL, and T. Aggson, NASA/GSFC

VEFI data contain high-resolution (16 samples per second) electric field (two components) measurements in spacecraft components; and averaged DC electric field, integrated potential, averaged AC electric field, and 16-second averaged variational electric field, at 0.5-second (DC) and at 1- or 0.5-second (AC) resolution. Complete data set is archived on four disks.

WATS

PI: N. Spencer and L. Wharton, NASA/GSFC

WATS data contain neutral concentration and temperature, and wind measurements at 2-, 4-, 6-, or 8-second (mode dependent) resolution. Test tape submitted to NSSDC. The ETC is May.

Some data sets will contain significant orbit and attitude (OA) data, others will contain modest amounts of OA data, and still others contain no ephemeris data. The DE Project is providing NSSDC with the orbit and attitude data for both spacecraft on optical disk.

Richard Horowitz

Corrections:

The editor regrets that in the last issue's lead article, the scientist pictured on page 14 was incorrectly identified. In fact, she is Dr. Barbara Reagore, Director of Materials Science and Chemistry at Bellcore Corporation.

Also in that article, SMPTE was incorrectly defined. The acronym denotes the Society of Motion Picture & Television Engineers, which sets technical standards in the broadcast industry. It formed a committee of industry members to create the D (digital) standards, including D-1 and D-2.

Special Report on 8th Catalog Interoperability Workshop

Participants from Around the World Convene To Discuss and Learn About NASA's Master Directory

The Eighth Catalog Interoperability Workshop (CI-8) was held at the Washington Plaza Hotel in Washington, DC, November 18-22, 1991. This workshop brought together members of the CI Working Group, Advisory Group (CIA), scientists, data managers, and system engineers representing several U.S. and international organizations and projects to discuss recent progress on the Master Directory (MD) effort and on data system interoperability.

This forum featured status reports from the three MD nodes:
- CEOS/IDN (Committee on Earth Observing Satellites/International Directory Network),
- CIESIN (Consortium for International Earth Science Information Network), and
- EOSDIS (Earth Observing System Data and Information System).

Four technical sessions were devoted to specific topics of importance to data information system technology. These sessions focused on keywords and information retrieval, artificial intelligence, a discipline data system forum, and object-oriented approaches for interoperability.

Since CI-7 last May, the operations staff continued the population effort with 230 new Directory Interchange Formats (DIFs) generated and more than 400 DIFs revised, along with over 100 new supplementary information entries; the number of links has risen to 47. The staff continues to work closely with federal agencies, universities, research centers, and institutes to identify data for description.

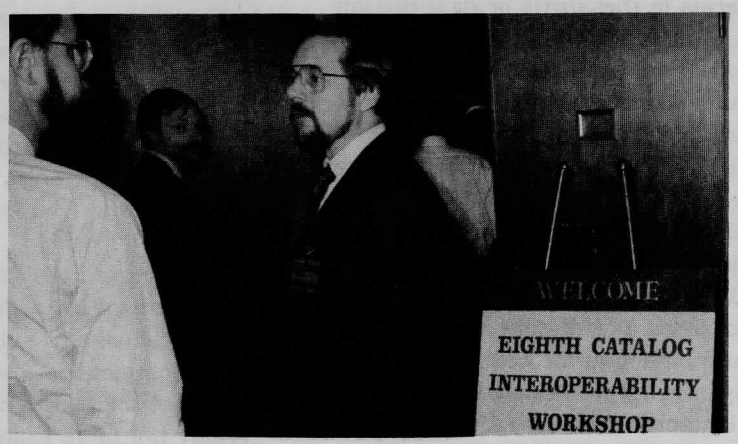
The European Space Agency (ESA) node currently has E-mail links to the United Kingdom and Germany, and future links are being discussed for the United Nations Environment Program/Global Resource Information Data Base (UNEP/GRID) and the International Geosphere Biosphere Program (IGBP). While DIFs are being identified and generated within the European community, promotional activities to increase public awareness of the MD are being carried out. Similar activities are also being conducted at the National Space Development Agency (NASDA) node for the Asian community.

The MD development group has continued to upgrade the MD and provide support to other directory groups. A client/server prototype has been developed to provide flexibility in user interfaces, and the group has added and upgraded utilities to help the operations staff maintain the data base and links as well as upgrade all three IDN nodes (at Goddard, ESA, and Japan) to the current version of directory software.

The development staff will continue to coordinate with IDN nodes in software and data base content, coordinate interoperability with other groups, develop client/server architecture, and provide technical support to NOAA, CEOS, EOSDIS, and CIESIN. The second version of the PC-based MD received higher ratings than version 1, with version 3 to be ready in 1992.

Several other national and international groups are generating directories of data and information. The CIESIN group has developed a global environmental directory that provides access to data, information, and geographically distributed resources, with an emphasis on the human sciences. The Australians have established a National Resource Information Center (NRIC) to develop a directory of natural resource data sets.

The Interagency Working Group on Data Management for Global Change (IWGDMGC) is proposing an "Interagency Reference" on CD-ROM as a companion product to the MD; it contains reports, policies, procedures, conferences, bulletin boards, and other information relevant to global change. The Argonne National Laboratory is developing an electronic Scientific Data Base Bulletin Board (SCID3B) to spur collaborative efforts among scientists and data base researchers. EOSDIS has devel-



George Saxton pauses before going in to the next CI-8 session.

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oped a Version 0 prototype using four Distributed Active Archive Centers (DAACs) that will expand in functionality and extend to remaining DAACs in 1992.

Summarized reports from each of the four technical sessions follow.

Technical Session #1

Keywords and Information Retrieval

Chair: Carol Watts (NOAA)

Speakers:
Jessica Milstead (JELEM Company)
David Batty (CDB Enterprises Inc.)
Martha W. Hood (USDA/NAL)
Martha T. Bhartia (CIESIN)

Carol Watts provided an overview of issues involved in subject access to the information contained in the Global Change Master Directory (MD). She discussed several differing points of view brought up by developers and users of the system. Some of these individuals believe that the system needs an authoritative list of terms (a thesaurus or data dictionary) to provide more consistent and effective access to the records of MD data sets. Others believe that full text searching will obviate the need for a list of terms. Both groups want a keyword structure that is practical and effective in accessing data sets described in the directory. Since there are alternatives that have been explored and designed in the library and bibliographic communities, four speakers were selected to address "keyword" problems and solutions.

Jessica Milstead described two basic approaches to subject control. One approach attempts to control the terms used at the time of input by use of an authoritative list of terms. Another approach is to use techniques such as truncation of search terms, natural language processing, artificial intelligence, etc., to control terms at the time of searching. Systems have been developed that use one or the other, but the most useful approach is to use both, e.g., subject terms supplied at input, plus full text searching with sophisticated machine assistance.

David Batty gave an entertaining overview of the development of information retrieval methods over the years and noted some of the perspectives necessary to approach the construction and maintenance of thesauri. One must take the context of the data base into account, i.e., the nature of the discipline, the sophistication and heterogeneity of the user group(s), etc. He noted the way that the growth of information/data in a particular field advances from fission (creation of more esoteric areas of concern) to synthesis (creation of interdisciplinary areas of concern), as is the case with the MD. Another perspective is the one of the language itself. Semantic or syntactic differences can occur between different languages, different disciplines, different users, and even among different individuals. Batty punctuated his talk with numerous examples of how language serves to confound the information retriever.

Batty stressed the importance of having a centralized authority to develop any thesaurus or subject term list. He recommended a small working group of the lexicographer and preferably not more than three or four subject specialists familiar with the discipline(s), with the lexicographer having the final say in which terms should be included in the prescribed list of terms. The professional lexicographer would best be able to make objective decisions about terms and bring consistency to the product.

Martha Hood, head of the Thesaurus Management Section at the National Agricultural Library (NAL), recounted her experience in simultaneous thesaurus development among organizations. NAL works in conjunction with CAB International (publisher of the CAB Thesaurus), and the United Nations Food and Agriculture Organization (publisher of the AGROVOC Thesaurus) to move toward integrating three separate thesauri in the agricultural sciences—CAB, AGRIS, and AGRICOLA—into a Universal Agricultural Thesaurus.

Hood explained that the integration of thesauri in similar subject areas is in some ways more difficult than thesauri in disparate areas since there exists a good deal of overlap in terms and concepts. The process is slowed by the large number of people and organizations involved and the geographic distances between the international organizations involved. She stressed two important points. One is that the decision-making process needs to be carefully structured. Another point was that there is no substitute for face-to-face meetings when it comes to resolving the issues in an undertaking this large.

Martha Bhatia serves as a manager in the Information Technology Division of the University of Michigan. She has been assigned to the CIESIN project for the last six months, and in that capacity, gave an overview of how CIESIN structures its "DIF"-creation process, a process that in-

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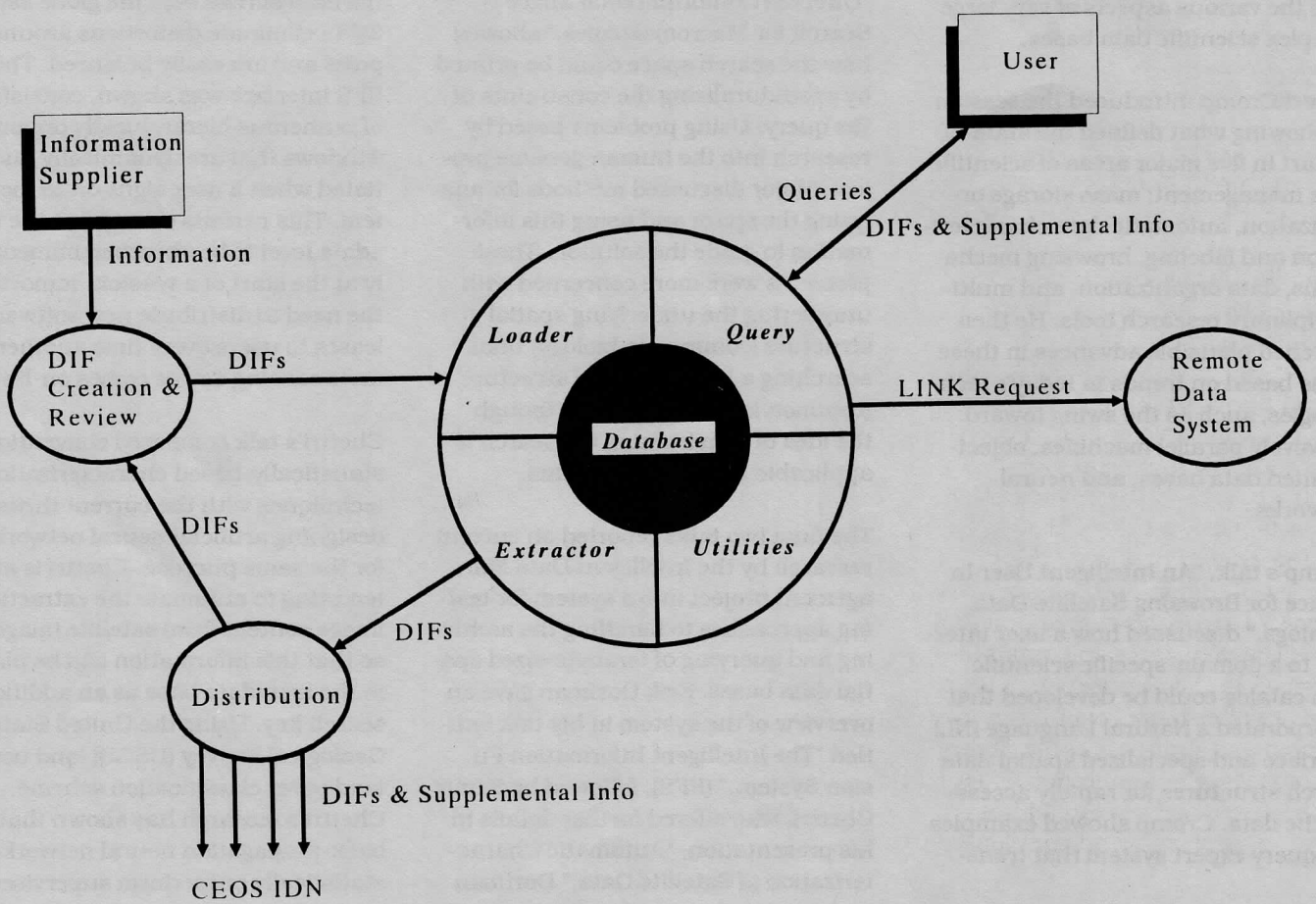
cludes assigning subject terms. CIESIN uses an iterative consensus-building model, in which writers of DIFs submit their records to subject specialists. These subject specialists offer feedback to the writers who incorporate suggested changes into an amended version of the record. This process can repeat several times until agreement is reached on a final product. Bhatia also discussed the importance of the interaction among four groups: the user community, the discipline experts, the experts involved in information technology systems, and the librarians/lexicographers.

All of the speakers seemed to agree that a central authority was necessary for the creation of a thesaurus or subject term control, although several different models were suggested. The process of creating a full-blown thesaurus is not cheap—either in initial development or maintenance (and maintenance is crucial to its continued usefulness). However, improved access to the information may be more cost-effective in the long run, although this is difficult to determine. It is fairly easy to measure the costs involved, but much more difficult to measure the benefits obtained.

The question of how to go about developing and maintaining better subject access was the main thrust of this session. A key question that emerged was "who should have the final say in adding or deleting terms?" The outcome of the session included some strategies that professional lexicographers use to develop subject access to data bases by building a thesaurus. It included their perspectives that a professional lexicographer should work with those who have subject specialties, with the lexicographer deciding on the structure of the thesaurus and the inclusion of terms.

Functional Components of the CI/MD System



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Technical Session #2

Artificial Intelligence and Catalog Interoperability

Chair: Robert Cromp (GSFC)

Speakers:
Francois Major (NIH)
Erik Dorfman (Hughes STX)
Samir Chettri (Hughes STX)

This session examined the uses of artificial intelligence for issues related to catalog interoperability, concentrating on how advanced computer science methodologies can be applied to deal with the various aspects of very large complex scientific data bases.

Robert Cromp introduced the session by showing what defined the state-of-the-art in five major areas of scientific data management: mass storage organization, automatic data characterization and labeling, browsing mechanisms, data organization, and multidisciplinary research tools. He then sketched plausible advances in these areas based on trends in today's technologies, such as the swing toward massively parallel machines, object-oriented data bases, and neural networks.

Cromp's talk, "An Intelligent User Interface for Browsing Satellite Data Catalogs," discussed how a user interface to a domain-specific scientific data catalog could be developed that incorporated a Natural Language (NL) interface and specialized spatial data search structures for rapidly accessing the data. Cromp showed examples of a query expert system that transparently converted NL queries into SQL, which could then be sent to the underlying data base management system for retrieving the appropriate information. A comparison between the NL query and corresponding Structured Query Language (SQL) was given as a query to the International Ultraviolet Explorer catalog. The NL query was concise and understandable, requiring no special start-up time for using the system, whereas the SQL was close to one page long, bulky, and required an intimate understanding of the data base schema. Finally, it was shown how the spatial search time could be improved from a linear search to one which ran in logarithmic time by indexing the catalog entries using a quadtree.

The second talk by Francois Major, "Directed Conformational Space Search for Macromolecules," showed how the search space could be pruned by proceduralizing the constraints of the query. Using problems posed by research into the human genome project, Major discussed methods for analyzing the space and using this information to guide the solution. These problems were more concerned with uncovering the underlying spatial structure (common in biology) than searching a known spatial structure (common in Earth science), though the idea of constraining the search is applicable to all large domains.

The final two talks reported on current research by the Intelligent Data Management project into a system for testing approaches to handling the archiving and querying of terabyte-sized spatial data bases. Erik Dorfman gave an overview of the system in his talk entitled "The Intelligent Information Fusion System," (IIFS), followed by Samir Chettri, who offered further details in his presentation, "Automatic Characterization of Satellite Data." Dorfman offered an architecture for an intelligent information fusion system that incorporates a client/server relation between users and the metadata base. The metadata base consists of indices over a variety of search attributes from which the supporting images could be retrieved. Dorfman's talk compared object oriented and relational data base management systems (OODBMS and RDBMS, respectively), showing how OODBMSs offer more flexibility, but require a higher degree of set-up time and are still striving for maturity. Dorfman pointed out that in an OODBMS, an existing RDBMS can be treated as another object, so there are methods for querying relational tables from object oriented systems.

The use of spherical quadtrees (SQT) was recommended for organizing spatial data spread over the globe because SQTs eliminate distortions around the poles and are easily balanced. The IIFS interface was shown, consisting of numerous hierarchically organized windows that are dynamically instantiated when a user signs on to the system. This permits changes at the metadata level to be absorbed immediately at the start of a session, removing the need to distribute new software releases to users every time another remote sensing device comes on-line.

Chettri's talk compared conventional statistically-based characterization techniques with the current thrust of designing artificial neural networks for the same purpose. Chettri is attempting to automate the extraction of image content from satellite imagery so that this information can be placed in the metadata base as an additional search key. Using the United States Geological Survey (USGS) land use/land cover classification scheme, Chettri's research has shown that back-propagation neural networks statistically outperform supervised

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Bayesian classifiers on characterizing image data by about 5% accuracy (approximately 70% against 65%). Once trained, both methods run in constant time and can be used to derive a characterization vector which describes the percent break-down of classes within an image.

In the final hour of the session, Cromp fielded questions from the audience and oversaw discussions among workshop participants. Topics touched upon included the need for standard data formats, the existence of AI characterization systems that have outperformed conventional methods in blind tests (such as Cheeseman's Autoclass), and the need to balance expenditures in data management systems compared against data gathering. Overall, the session generated a lot of interest and discussion, and emphasized the importance of designing practical scientific data management systems.

Technical Session #3

Discipline Data System Forum

Chair: Larry Preheim (JPL)

Speakers:
Suzanne Craig (JPL)
Sue McMahon (JPL)
Blanche Meeson (GSFC)
Lola Olsen (GSFC)
Rick Pomphrey (JPL)
John Goode (Lockheed)
Lyn Oleson (USGS)
Richard Murphy (SWRI)
Jim Willett (NASA)
Susanne Leech (Bionetics)
Joseph King (NASA/GSFC)

The session addressed three main themes. The first was to promote a direct communication among the persons responsible for Discipline Data Systems definition, development, maintenance, evolution and operations. The second was to report to the group on what's coming out of NASA's Discipline Data Systems Lessons Learned effort. The third was to discuss the status of the System Building Blocks development effort.

Suzanne Craig presented an overview of the Physical Oceanography Distributed Active Archive Center (PO.DAAC) at JPL. PO.DAAC is a VAX cluster at JPL supporting NASA's oceanography community. This system is undergoing active evolution from its role as the NASA Ocean Data System (NODS) to one of the DAACs supporting EOSDIS Version 0. Much of the discussion concerned data ordering in the EOS era.

Blanche Meeson described the Pilot Land Data System (PLDS) with a strong focus on the transition from a developmental system to an operational one. The PLDS is also becoming part of the GSFC DAAC in the near future. The publication of data sets was discussed as part of the typical research scenario supported by PLDS.

Lola Olsen reviewed the NASA Climate Data System (NCDS) which will become the core of the Goddard DAAC. NCDS offers many data sets online in the Common Data Format (CDF) and many additional data sets for "on the fly" translation from native format to CDF. The staff is currently producing a global warming CD-ROM with 53 data sets—all in CDF. Data can be subset or visualized within the system. A new user interface, JYAAC's Application Manager (JAM), with direct "hooks" into the NCDS data base has provided tremendous savings in maintenance. These savings are especially important for growing data volumes. Porting of NCDS to the UNIX environment is planned for early 1992.

Sue McMahon provided a review of the Planetary Data System (PDS). PDS is a distributed system with nodes representing various areas of specialization within planetary science (e.g., field and particles). PDS is organizing to deal with a flood of planetary data resulting from the Magellan mission. Much of the focus for PDS is in the mastering and distribution of CD-ROM-based data.

Rick Pomphrey presented an overview, the current status, and future plans for the Astrophysics Data System (ADS). The ADS is currently operating a production level distributed data access and processing system in support of the astrophysics research community. The client-server architecture provides a platform for mounting user services. The initial service provided is access to tabular data which is physically distributed at many locations throughout the country on heterogenous systems. The ADS provides transparent access to these locations by providing a layer above these systems which employs Structured Query Language (SQL) and enables transparent user access. In the future, the ADS will expand the available data, provide a graphical user interface, and begin providing data processing tools.

Lyn Oleson talked about the Global Land Information System (GLIS) from the United States Geological Survey's EROS Data Center. GLIS is a repack-

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aging (mostly) of services and infrastructure already available at EROS to support the user in interactive data search, browse, and ordering of data products.

Richard Murphy presented a synopsis of the Southwest Data Display and Archive System (SDDAS), which contains principal-investigator-supported space physics data. The SDDAS supplies its analysis and client-server software to other space physics systems. Packaging and distribution of the software are current areas of active development.

Jim Willett reviewed the proposed Space Physics data system concept. Space Physics data are now held in a geographically-dispersed set of data systems provided by the principal investigator (PI). The concept is to link the existing systems using non-Space-Physics-provided infrastructure elements and allow them to mature over time (in the same manner as the Space Physics Analysis Network—SPAN—was grown).

John Goode delivered a commentary on the plans for a Life Sciences Discipline Data System. Near-term events include writing a project data management plan, adopting archival standards, and providing DIFs for existing data to the Master Directory.

Susanne Leech described the current Microgravity Science and Applications activities for defining and establishing a discipline data system. Microgravity will provide a distributed system with the data and samples residing with the PIs. They are gathering requirements and resource estimates for a prototype activity involving three disciplines.

Joe King talked about a Lessons Learned document being written about the OSSA funded discipline data systems for the benefit of those disciplines just planning their archives. An overview of the purpose, scope, and flavor of the document was presented. Specific lessons as mentioned in the day's session were given as examples of items for inclusion in the document.

Larry Preheim provided a brief history and status for the System Building Block activity being funded under an OSSA Information Systems Branch task. The audience was asked for suggestions to improve the applicability of the task efforts to discipline data system needs.

Technical Session #4

Object-Oriented Approaches for Interoperability To Support Collaborative Research Among Researchers

Chair: Girish Pathak (Xerox)

Speakers:
Arnon Rosenthal (MITRE)
Nagi Wakim (GSFC)

The purpose of this session was to discuss and gain an understanding of various scientific data interoperability issues that can be addressed through object-oriented approaches and systems.

Girish Pathak opened the session by explaining the theme "collaborative research environments," in which researchers collaborate with each other and analyze the research data (managed by organizations around the globe) through their discipline-specific languages.

He described a four-layer approach to build software systems that will manage the diversities and autonomies of research data systems and support collaborative research. These include networks and hardware, data bases, scientific data analysis/processing tools, and discipline-specific languages and support for collaborations.

Within the context of the four-layer approach, Rosenthal presented a position statement on heterogeneous databases, Wakim talked about network interfaces, and Pathak discussed an execution framework for tool and data base interoperability.

Rosenthal started with an overview of the state of the art in data base management systems (DBMS) and object-oriented data base technology. He described the barriers to interoperability and transparency in heterogeneous and autonomous data management systems. An issue about the local arrangements for sharing information versus standards was raised. Finally, he discussed the management of a metadata base to handle diversities and the reasons for choosing an object-oriented interoperability architecture.

Wakim first discussed why network management issues are important for scientific data systems. He explained the current state-of-the-art in communication networks and their relationship with operating systems. Then he described how networks need to be enhanced with features, such as integrated data and mail systems, to support collaborative research environments. Wakim con-

cluded by explaining a prototype communication framework that could handle the diversities of networks.

Pathak described an object-based execution framework that preserves the autonomy of constituent systems, supports tailorability for researchers, provides seamless integration to existing software, and is extensible for future technological evolutions.

This framework is based on three basic primitives: objects, types, and functions. It was mentioned that a de facto standard consortia of about 100 industries, an object management group, is working on a framework similar to the one presented by Girish.

Questions from the audience were fielded as each panelist described his or her position statement. At Raymond Walker's suggestion, the panelists reviewed existing system development efforts and their experiences for the development of science data systems at NASA. They concluded that the software industry is generally aware of the discussed research issues but that progress is slow toward commercial off-the-shelf systems.

John Scialdone

To Learn More About the MD . . .

Names and addresses of people you may contact for information about CI-8 or other aspects of the Master Directory are listed on the following page (the back page of this special section).

Many MD publications are available upon request. Some of the most frequently requested ones are:

- MD brochure
- DIF manual
- Previous workshop proceedings
- *MD User's Guide*
- Global change document (lists global change-related data described in the MD)
- *Quick Reference Guide*

John Scialdone

How To Reach the Master Directory

You can reach the MD by **dialing directly**, using thefollowing procedure:

1) Set your modem to 8 bits, no parity, 1 stop bit.
2) Dial (301) 286-9000 for 2400 baud, or dial (301) 286-4000 for 9600 baud.
3) At the username prompt, type NSSDC. This brings you to the NODIS menu.
4) Select Option 1 on that menu, which connects you to the Master Directory.

Via **NSI/DECnet** (formerly SPAN), you can reach the MD this way:

1) Type SET HOST NSSDCA.
2) Type NSSDC at username prompt.
3) Select Option 1 on the NODIS menu.

From **INTERNET**:

1) Type TELNET NSSDCA.GSFC.NASA.GOV.
2) Type NSSDC at username prompt.
3) Select Option 1 on the NODIS menu.

The MD data base is available on floppy diskette with display and retrieval software, featuring full-text searching. It can be used on any IBM-compatible PC. A Macintosh version of the MD data base is currently under development.

The MD project is led by Dr. James Thieman at NASA/GSFC. The MD operations staff includes Dr. Joy Beier, Dr. David Irvine, Dr. Paul Kuin, Dr. Lu Gan, John Scialdone, Angelia Bland, and Kathleen Moreland. The MD development staff includes Patricia Bailey, manager, along with Constance Li, Jon Mitchell, Janis Shipe, and Lorena Marsans.

Plans for Ninth CI Workshop Are Finalized

As this issue of *NSSDC News* goes to press, the Ninth Catalog Interoperability Workshop (CI-9) is taking place in Newport, Rhode Island at the Hotel Viking, May 5-7, 1992.

This meeting continues to focus on the MD effort and its relationship with other remote data systems. The CI-9 Workshop also features technical sessions on Level 3 Interoperability; the Role of Visualization/User Interface in Searching and Locating Data; A Distributed, Client-Server-Based Catalog System for Locating, Visualizing, Retrieving, and Analyzing Satellite and Oceanographic In-Situ Data; and The Evolution of the Global Internet.

The latter two sessions are being conducted at the University of Rhode Island's Bay Campus, where computer demonstrations are being given and exhibits presented. Proceedings from the workshop will be available from the MD Directory User Support Office (MDUSO).

Special Report on 8th Catalog Interoperability Workshop

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Magellan Data Arrive from Venus

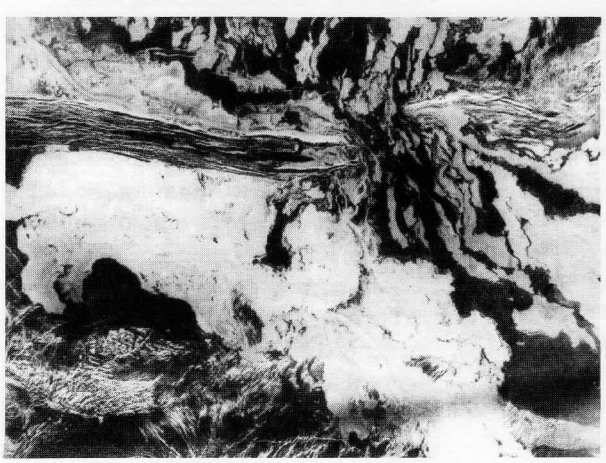
The Magellan spacecraft, launched on May 4, 1989, has now completed more than 3600 orbits of the planet Venus since its arrival on April 10, 1990, providing almost complete radar imagery of the surface with a resolution of better than 100m. Altimetry and radiometry measurements have also been made throughout this period.

Although the scope of future observations has been threatened by proposed funding cuts, ongoing radar observations continue to fill gaps, look for surface changes, and provide views from different angles; and it is hoped that spacecraft-tracking data will be obtained (especially after an appropriate change in orbit) to provide a map of the planet's gravitational field, which can be interpreted in terms of internal structure.

Small amounts of atmospheric data are also being obtained by recording the attenuation of signals from the spacecraft as it passes behind the planet and then re-emerges.

Magellan is the first project to work closely with the NASA Planetary Data System (PDS) since starting to generate data products. The PDS is supervising the delivery of copies of the data products to NSSDC, which will be responsible for providing a permanent archive and will do the bulk of the early data distribution. All the most highly-processed (and most easily used) radar image products from the first mapping cycle (where each mapping cycle corresponds to a complete rotation of the planet under the spacecraft's orbit) are now available from NSSDC, and many Cycle 2 products will soon be available, together with the first altimetry and radiometry data.

Magellan data are recorded by the stations of the Deep Space Network on Orbital Data Record (ODR) tapes. These are used to produce Experiment Data Records (EDRs), the largest of which is the SAR (Synthetic Aperture Radar) EDR. SAR-EDR data are processed by a radar correlator to produce Full Resolution Basic Image Data Records (F-BIDRs), which are long, 20-km wide 'image noodles.' F-BIDRs for selected areas on the Venus surface are being assembled into Full Resolution Mosaic Image Data Records (F-MIDRs). Over 220 F-MIDRs have been produced from Cycle 1 data, covering more than 15% of the surface. More will almost certainly be assembled later. Similar format 'compressed' mosaics (C-MIDRs) are being made, covering the whole surface at three resolutions. C1-, C2- and C3-MIDRs have been spatially compressed to give resolutions of 225m/pixel, 675m/pixel and 2025m/pixel, respectively (compared to 75m/pixel for the F-MIDRs). MIDR data are available both on CD-ROM (with each CD typically holding ten MIDRs) and as photo products (positives, negatives, or prints).



This image from the surface of Venus is an example of the high-resolution imagery now available.

NSSDC currently holds 48 MIDR CD-ROMs and some 520 MIDR photographs. The Data Center also has more than 80 official press release photographs, which have usually been enhanced to illustrate a particular feature, and a short videotape including computer-simulated flights over the Venus topography.

Estimates of radiothermal emission from the surface, elevation, Fresnel reflectivity, and quasispecular-scale rms slopes are gathered and compiled into an Altimetry and Radiometry Composite Data Record (ARCDR). These data will soon be available for Cycle 1 on ten CD-ROMs. Some global data records will be produced from the ARCDRs, including the Global Emissivity Data Record, the Global Topographic Data Record, the Global Surface Slope Data Record, and the Global Power Reflection Coefficient Data Record. All of the global data records (referred to collectively as the GxDRs) have roughly a 5 km picture element spacing.

These basic imagery, altimetry, and radiometry data will be submitted incrementally to the PDS and NSSDC. Many other data sets will be transferred toward the end of the mission, including some low-level radar data sets, gravity products, and many special products that have been useful to the Magellan scientists.

The PDS is providing comprehensive support for all the Magellan data sets as they become available, largely through the PDS Geosciences Node at Washington University, St. Louis, which is producing detailed data catalogs and has already established a Magellan Data Products Support Office. This office can provide information about data and help in ordering the data products. (Call 314-935-5493, or send E-mail to mgnso@wurst.wustl.edu.)

Paul S. Butterworth

Representatives from NSSDC and Headquarters Meet To Discuss Transition of Earth Science Data

Dr. Len Fisk, Associate Administrator of the 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).

The NSSDC, which now manages and archives both space and Earth science data, has been asked to develop a plan for transitioning 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.

An Earth science data transition meeting was held at Goddard Space Flight Center on March 12, 1992, to discuss outstanding transition issues. Valerie Thomas gave a presentation on the NSSDC Earth Science Transition Plan. Issues raised during this meeting included the following:

- NSSDC's interim operations and user support to the soon-to-be-formed Global Change Data Center (GCDC) during FY92.
- The source of funding for Earth science data restoration that is to be completed by FY94.
- A schedule for the DAACs' operational readiness for logistical planning purposes.
- Data management and archival support for new data sets during the transition period, which ends in FY94.
- A permanent archive facility for non-active Earth science data sets.
- The importance of DAAC staffing for the development of the Project Data Management Plans (PDMPs) for Earth science data.

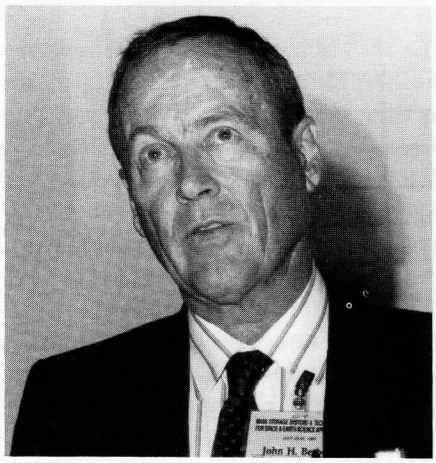
Attendees at the meeting included NASA HQ representatives Joseph King, Greg Hunolt, and Martha Maiden. For NSSDC, representatives were James Green, Valerie Thomas, and Gene Major; GCDC representatives included Dot Zuckor, Roger Dilling, and Carey Noll; and from the Earth Science Project Office, Erich Stocker attended.

Most of the issues were not resolved at this meeting, and there will need to be a follow-up meeting.

Valerie Thomas

Berbert Contributed to Success of July '91 Mass Data Storage Conference

The lead article in the last issue of NSSDC News *inadvertantly omitted this report on John Berbert's key efforts in the Mass Data Storage Conference held last July.* —*Editor*



John Berbert discusses Earth science data management in his presentation.

John Berbert, the EOSDIS DADS Study Task Manager, leads the task that provided the major support for the conference, including the stages of early planning, screening of submissions, selecting contributions, inviting speakers, and finally publishing the conference proceedings. Additional support was provided by the NSSDC Systems Engineering task, headed by Conference Coordinator Ben Kobler.

Berbert made a presentation outlining the characteristics and requirements of the EOS Data and Information System's Data Archival and Distribution System (DADS). In his presentation, Berbert stated that the goals of EOS are to acquire, access, and analyze Earth science data as NASA's contribution to the Global Change Research program. EOS will reach full capability via a phased implementation, which started with Version 0 in 1990. Versions 1 and 2 are part of the separately funded EOS Core System (ECS); a request for proposals for the ten-year contract to build the ECS was released by the Government on July 1, 1991.

Version 0 includes existing land, ocean, and atmospheric data totaling nearly 33 terrabytes. Version 1 will double that by adding Earth Probe data from missions such as the Tropical Rainfall Measurement Mission. Version 2 will add data from the 14 European Space Agency instruments.

Berbert further explained that DADS is part of a Distributed Active Archive Center (DAAC), of which seven are planned for EOS; each DAAC also has a co-located Product Generation System and the distributed part of the Information Management System. DADS must perform these major functions:

see Berbert, *p. 19*

Berbert, *from p. 18*

1. Ingest data from the PGS and from the Customer Data Operations System (CDOS, now called EDOS) at a high rate.

2. Archive the four levels of data products and the ingested data.

3. Process orders that may require retrieving, subsetting, reformatting, and staging for delivery.

4. Manage the system, monitor and report system status, schedule operations, and back up data.

5. Distribute the data; the key requirements include making data available on the network within five minutes of order receipt, or within 24 hours if the distribution is to be on physical media.

According to Berbert, processing to higher-level products expands the input data volume by a factor of 3.6 over the ingested volume. The magnitude of these numbers can be appreciated if one considers the data volumes at just the DAAC located at Goddard Space Flight Center.

He further pointed out that storage of all data acquired and generated in just one day would require 2,445 of the 3480 cartridges, or 1,223 of the 3490s, or 100 8-mm helical scan cassettes. Berbert calculated that this would mean that in less than 2½ days, there would be enough 3480 cartridges to fill a Storage Technology 4400 silo!

One potential bottleneck in the system, Berbert cautioned, is slow data transfer rates from existing storage drives. Unfortunately, these rates have not improved by the same factor that data storage densities have over the past decade.

Al Dwyer

Astrophysicist Cheung Joins NSSDC Staff

The NSSDC is happy to introduce one of its newest staff members, Dr. Cynthia Cheung. She came on board in January 1992 as Archive Scientist for the High Energy Astrophysics Archive Research Center (HEASARC), a joint effort between the NSSDC and Goddard's Laboratory for High Energy Astrophysics.

Dr. Cheung manages NSSDC activities related to HEASARC's archives. HEASARC is responsible for storing of all X-ray and gamma ray astrophysics mission data and for providing on-line access and distribution of that data. The Compton Gamma Ray Observatory, the Roentgen satellite (ROSAT), the Einstein Observatory, and Ginga are some of the observatories that provide data to HEASARC.

From 1986 until early this year, Dr. Cheung worked with the Astrophysics Division at NASA Headquarters. Her duties involved program management and technical support. She supported various scientific reviews and was involved in the study that set up the Astrophysics Data System. Dr. Cheung also wrote the *Project Data Management Plan* for the Compton Gamma Ray Observatory. From 1983 to 1986, Dr. Cheung worked at the Hubble Space Telescope Science Institute in Baltimore as an operations astronomer, writing software that commands science instruments. Before that, from 1980 to 1983, she worked in the Laboratory for Extraterrestrial Physics at Goddard. While earning her Ph.D., Cheung worked as a graduate research assistant, studying stellar structure and modeling at two Goddard laboratories: the Laboratory for High Energy Astrophysics and the Laboratory for Astronomy and Solar Physics. She received her Doctorate in astronomy from the University of Maryland in 1980 and her Bachelor's degree in astronomy from the University of California at Berkeley in 1972.

Cheung was born and raised in Hong Kong but came to the United States to attend college. A classical pianist and a cat lover, Cheung's favorite hobbies include doing jigsaw puzzles and cooking gourmet Chinese food.

Kenneth Silberman

Dr. Cynthia Cheung manages activities related to the High Energy Astrophysics Archive Research Center.

NSSDC Shows Interactive Data Services to Astronomers at AAS Meeting

The NSSDC demonstrated a range of interactive data services and distributed hundreds of CD-ROMs containing astronomical data at the 179th meeting of the American Astronomical Society (AAS), held in Atlanta, Georgia, on January 12-16, 1992.

The interactive services demonstrated included two established ones: the NASA Master Directory and the Astronomical Data Center Online Information System; two new services: the NSSDC Data Archive and Distribution Service system (NDADS) Automated Retrieval Mail System and the NDADS Remote Browse Service; and one prototype system: the IUE Archive Query System.

Over 400 copies of the Astronomical Data Center (ADC) CD-ROM, "Selected Astronomical Catalogs, Volume 1" were distributed at the meeting. This CD set contains 114 of the most requested astronomical catalogs from the ADC's holdings. FITS table-browsing software for PCs was included with each ADC CD-ROM set. The NSSDC team demonstrated this software for meeting participants.

During the meeting, a special shipment of the new CD set "IRAS Sky Survey Atlas" was delivered to NSSDC's demo team. The 100 discs in this shipment were distributed in less than two hours to interested scientists at the meeting. The NSSDC exhibit proved to be very popular, keeping its demo staff busy throughout the meeting.

Since the meeting, there has been a marked increase in remote access to the on-line services shown in Atlanta.

Descriptions of the services demonstrated at the AAS meeting follow:

Astronomical Data Center (ADC) CD-ROM

The Astronomical Data Center (ADC) CD-ROM, Selected Astronomical Catalogs, Volume I, is a two-disc set containing 114 astronomical catalogs of astrometry, photometry, spectroscopy and other miscellaneous data for stellar and non-stellar objects. At the demonstration, the ADC FITS Table Browser program will be used to display catalog data in tabular form, and to extract selected records to magnetic disk for further use. A list of other CD-ROMs available from the NSSDC was distributed.

ADC Online Information System

The ADC Online Information System provides information on all catalogs held at the ADC and allows interactive submission of requests for copies. It is built around the Status Report of Machine-Readable Astronomical Catalogs and supplemental brief descriptions of the catalogs. The catalogs are available through the NASA Science Internet and NSI/DECnet computer networks; 9-track magnetic tape; CD-ROM and microfiche and/or microfilm. Not all catalogs are available in all forms.

The NDADS Automated Retrieval Mail System

The NDADS Automated Retrieval Mail System is a service which permits researchers to rapidly retrieve selections from the Data Center's holdings currently loaded on the NDADS system. These data reside on optical disk jukeboxes which allow automated access with no intervention by NSSDC staff. Requests are submitted by electronic mail, and the data may be retrieved via anonymous FTP or default DECnet copy.

The NDADS Remote Browse Service

The NDADS Remote Browse Service permits researchers to examine image, numerical, and text data in the NSSDC archives from their home institution. They can then make their selections and issue requests for data of interest for retrieval via anonymous FTP or default DECnet copy. The demonstration will illustrate these capabilities using the IUE archives, the first data set which can be browsed using this service.

NASA Master Directory

The NASA Master Directory (MD) provides high-level on-line information about NASA data sets for a range of scientific disciplines, including astrophysics and planetary and space physics. This information describes the data sets, their sources, and how to access them. The MD also permits users to link directly to other online data systems.

IUE Archive Query System

A prototype query system for the International Ultraviolet Explorer (IUE) catalog was developed as a research project by the NSSDC's Intelligent Data Management (IDM) group to demonstrate possibilities of new techniques in spatial data management. Users can graphically select regions of interest from a map of observations, then issue English language queries to retrieve catalog information for specific observations which fall within the selected regions.

James Gass

newsbriefs newsbriefs

IGBP Meeting Brings Data and Information System Closer to Reality

Dr. James Thieman attended the third meeting of the International Geosphere-Biosphere Program Data and Information System (IGBP-DIS) Standing Committee in Paris, France, March 9–10, 1992. Representatives from a variety of organizations around the world discussed the strategy for implementation of an IGBP-DIS. In particular, the IGBP-DIS will make use of the International Directory Network coordinated through the Catalog Interoperability/Master Directory project at the National Space Science Data Center. Data Coordinators for each of the estimated 10 core projects within IGBP will be named to assure the input of information about data sets held by the core projects and also to make known the data needs of those projects. The IGBP-inspired 1-km resolution Advanced Very High Resolution Radiometer (AVHRR) data set is the top priority data need and was a primary topic of discussion. Encouraging progress has been made toward completion of this data set.

Jim Thieman

ISAS Scientists Visit SDAC and Tour NSSDC

On March 24, Dr. Yoshiaki Ogawara and Dr. Takeo Kosugi visited GSFC as part of their preparations for analysis and archiving of data from the joint Japanese/U.S. spacecraft Yohkoh (a solar X-ray observer, formerly named Solar-A). Drs. Ogawara and Kosugi are from ISAS, the Japanese agency equivalent to NASA. One of the four instruments aboard Yohkoh is an X-ray imager, built by U.S. scientists at Lockheed Palo Alto Research Lab. The NASA tracking stations are carrying much of the telemetry load from the spacecraft; hence, the Japanese and American instrument teams have agreed to share all data from all the instruments, making NSSDC one of the ultimate repositories. Yohkoh is currently returning approximately 50 Gbytes per year of science data.

The visitors from ISAS discussed collaborative research with Solar Data Analysis Center (SDAC) staff. The SDAC is the Discipline Data Center for solar physics, which has evolved from the Solar Maximum Mission (SMM) Data Analysis Center. The SDAC holds the archive of SMM data products under an agreement with the NSSDC, and the SDAC staff serve to maintain a high level of accessibility and expertise in using the SMM data for the solar science community. NASA Headquarters plans to continue funding the SDAC as a center for solar research, which can grow to support future missions—Yohkoh in particular, as well as the Solar and Heliospheric Observatory (SOHO). Our ISAS visitors received a briefing about the respective roles of the NSSDC and SDAC and the ramifications for Yohkoh data.

Dr. David Batchelor briefed the ISAS scientists (as well as several SDAC staff members) on NSSDC's history and functions. Ogawara and Kosugi requested clarification on points regarding the respective duties of the SDAC (solar science expertise and SMM data distribution) and NSSDC (permanent NASA-wide archive and large-scale volume replication support). The visitors also became interested in NDADS' (the NSSDC Data Archive and Distribution Service) potential to fulfill the archiving and distribution needs of Yohkoh. Accordingly, a tour of the NDADS facility was arranged by Batchelor.

The ISAS scientists and several representatives of the SDAC were given a tour of the Building 28 NDADS facility by Dr. Michael Van Steenberg, who demonstrated the optical disk jukebox hardware, described the technological challenges and how they were being met to serve other archives (IUE, etc.), and answered their questions. The visitors took back with them the information that they needed to evaluate how NDADS may support the Yohkoh mission archive.

David Batchelor
Michael Van Steenberg

Workshop Relates Human Brain to Computer Services

The Department of Health and Human Services held a workshop in support of the Human Brain Project Computer and Information Sciences, April 6-7, 1992. The goal of this workshop was to discuss potential research opportunities for this initiative in the areas of computer and information sciences.

The project is aimed at accelerating and coordinating the use of computer and network technology in neuroscience research. The Institute of Medicine established a Committee on a National Neural Circuitry Database, involving more than 150 scientists, and it concluded that the time was right to develop neuroscience computer data bases that will be accessible to scientists via network systems. The goal of this workshop was to discuss potential research opportunities for this initiative in the areas of computer and information sciences.

William Campbell and Robert Cromp, both of NSSDC, were invited to participate. Campbell discussed "An Intelligent Information Fusion System for Handling Terabyte-Sized Spatial Databases." Cromp gave an overview of

how the ISTO uses artificial neural networks, knowledge bases, and expert systems to characterize objects within imagery as well as to link those objects to an intelligent user interface. Also participating in this workshop were guest speakers from other government research laboratories and universities in the medical and computer science disciplines.

William Campbell

Data Archive and Distribution System Benefits Missions

A special task provides suppport for the development of a data archiving and distribution system for International Solar-Terrestrial Physics (ISTP), Space Physics, and High Energy Atmospheres Science Archive Research Center (HEASARC) programs, including configuration, integration, development, management, and customization of the data archiving and distribution system. The task objectives are ISTP, Space Physics, and HEASARC operational concept determination, client design, project support, and active participation in other related NDADS activities. ISTP missions that are supported include GEOTAIL, WIND, POLAR, LANL, IMP 8, and ground-based missions. The ISTP Archival and Distribution System will support an estimated annual volume of over 45 GB of Event data (EV), over 40 GB of Definitive-parameter (DP) data, and over 20 GB of Key-Parameter (KP) data. An estimated cumulative on-line archive of over 400 GB KP, DP, and ED will be suported for ISTP missions. According to estimates, more than 330 GB of level 0 data will be generated annually from ISTP missions.

ISTP Requirement Analysis and a high-level design are being performed to identify and define the scope of the system. A draft version of the ISTP Data Archival and Distribution Requirements document was completed. The initial system will probably be configured using the current NDADS system architecture, and it will be developed using the existing metadata information. Also, the development team will analyze some of the existing NSSDC software (NCDS, CDAW, and NGS systems). The team will develop a baseline ISTP Data Archival and Distribution system to demonstrate the data archival and distribution capabilities using a front-end user interface.

Prem Ramamurthy

New CD-ROMs Are Available

NSSDC recently archived three new CD-ROM sets, which are available from NSSDC's Coordinated Request and User Support Office (please refer to the back page of this newsletter):

- TOMS image data - Total Ozone Mapping Spectrometer measurements
- ISSA - IRAS Sky Survey Atlas
- MDIM - Mosaicked Digital Image Models of the Martian Surface taken by the Viking Orbiters; also known as the Mars Digital Image Map.

TOMS Gridded Ozone Data (Version 6) CD-ROM Information: The NSSDC has available two CD-ROMs containing Total Ozone Mapping Spectrometer (TOMS) data from the Nimbus 7 spacecraft. The first disc contains daily gridded ozone data and statistical data from November 1, 1978 to December 31, 1988. The second disc contains color images of ozone in daily and monthly averages from November 1, 1978 to March 31, 1991.

The second disc contains color ozone image data that can be displayed in three projections: a simple latitude/longitude projection, a north polar projection, or a south polar projection. Users can display mulitple images simultaneously or in series, rescale the data, and select one of five predefined color palettes or create a new color palette.

Both discs are written specifically for an IBM PC (or compatible). While the first disc contains only ASCII data, the second disc contains image data and display software that require a VGA graphics board (or a board with better resolution which supports the VGA models). It is recommended that the program be run on a 386 machine for reasonable performance.

ISSA CD-ROM Information: InfraRed Astronomical Satellite (IRAS) Sky Survey Atlas (ISSA) from the Infrared Processing and Analysis Center (IPAC). ISSA is composed of coadded and three individual HCON (hours confirmation) 12.5 x 12.5 deg. images, centered every 10 deg., with 1.5 min. pixels. Images are in Flexible Image Transport System (FITS) format. Initial release in or about January 1992 has four discs covering absolute ecliptic latitudes greater than 50 deg. Remaining images covering the lower latitude sky will be released this summer 1992.

MDIM CD-ROM: Mosaicked Digital Image Models, also known as Mars Digital Image Map (MDIM) from the Mars Observer Program, the Planetary Geology and Geophysics Program, the Planetary Data System (NASA), and the U.S. Geological Survey. MDIM is a cartographic extension of a previously released set of discs containing individual Viking Orbiter images. It contains cartographic compilations made by processing the raw images to reduce radiometric and geometric distortions, and to form geodetically controlled MDIMs. The six-volume set contains, besides the mosaicked images, shaded airbrushed relief maps and a listing of all International Astronomical Union approved feature names of Mars.

Carolyn Ng

NSSDC Plays Role in ATLAS Investigation

This article was written before the Shuttle/Spacelab launch in March. It has been updated in a general way, but the outcome of the project is explained in the final two paragraphs.
—Editor

The ATLAS 1 mission flew on the Shuttle/Spacelab in March 1992. Among the many Earth science, space physics, and astrophysics investigations carried on ATLAS is SEPAC (Space Experiments with Particle ACcelerators). As part of the SEPAC investigation, electron beams were emitted in a pulsed mode to generate electromagnetic waves at the pulsing frequency of the beam. Some of these radio waves, at frequencies of 50 Hz to 7 kHz, propagated through the ionosphere and atmosphere to the Earth's surface along frequency-dependent paths that are not known in advance.

The INSPIRE (Interactive NASA Space Physics Ionosphere Radio Experiment) Project—conceived by Dr. Bill Taylor of NASA Headquarters, Bill Pine, a California high school teacher, and a few others—enlisted the aid of many people with radio receivers on the ground to determine whether the SEPAC waves reach their ground location, as functions of wave frequency and of spacecraft location. This would help determine the propagation paths of the waves, which would in turn shed light on the processes by which radio waves and ionospheric plasma interact.

Most of the ground observers were expected to be high school classes, although elementary schools, colleges, amateur radio operators, and others also expressed their interest to the INSPIRE coordinators. In order to coordinate the radio receiving operations of this large distributed network of amateurs, it was important that they have access to current information about when and where SEPAC electron emissions would be performed. INSPIRE coordinators arranged multiple paths for this information to flow to the distributed participants.

One of the paths is to load daily updates on SEPAC operations plans into the STEP (Solar Terrestrial Energy Program) Bulletin Board, which is electronically accessible (computer network or dial-up) on the no-password NODIS (NSSDC Online Data & Information Service) account.

Nathan James of the NSSDC staff has worked with Bill Taylor to make that emission data available to participants. NSSDC enjoyed supporting INSPIRE for both its intrinsic scientific importance and its community outreach, whereby young people in their formative years are brought into the NASA space science endeavor.

Note Added after Mission:

The SEPAC instrument failed part way through the mission. However, some successful operations in the early mission phases were accomlished.

According to Taylor, ". . . the valuable service that [NSSDC] and the STEP Bulletin Board provided contributed significantly to INSPIRE's success. The STEP Bulletin Board was used by many participants, [both] before the mission to receive valuable information and during the mission for operational information and orbital parameters."

Plans are now being formulated for the next phases of INSPIRE and their observing campaigns.

Joseph King

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
Goddard Space Flight Center
Greenbelt, MD 20771
Telephone: (301) 286-6695
FAX: (301) 286-4952
Telex: 248496 or 197640
TWX: 7108289716
NSI-DECnet: NCF::REQUEST

OUTSIDE UNITED STATES

Data Submissions

Dr. James L. Green, Acting Director
World Data Center A for Rockets and Satellites/Code 930.2
Goddard Space Flight Center
Greenbelt, MD 20771 U.S.A.
Telephone: (301) 286-7354
FAX: (301) 286-4952
Telex: 248496 or 197640
TWX: 7108289716
NSI-DECnet: NCF::GREEN

Data Requests

World Data Center A for Rockets and Satellites/Code 930.2
Goddard Space Flight Center
Greenbelt, MD 20771 U.S.A.
Telephone: (301) 286-7354
FAX: (301) 286-4952
Telex: 248496 or 197640
TWX: 7108289716
NSI-DECnet: NCF::REQUEST

calendar

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

June 1-3, 1992
Inter-Agency Consultative Group Workshop for Working Group 1
Washington, DC

June 15-17, 1992
First Thematic Conference—Remote Sensing for Marine and Coastal Environments
New Orleans, Louisiana

August 24-28, 1992
STEP Symposium-COSPAR Colloquium No. 5
John Hopkins University/Applied Physics Laboratory
Kossiakoff Center, JHU Campus
Columbia, Maryland

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