National Space Science Data Center

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NSSDC Makes Major Data Management Advances

By Joseph King

After an extended period of planning, software development and data preparation, NSSDC has begun to implement changes yielding multiple improvements in its ability to make data and supporting material accessible to and usable by researchers and others in the near term and into the far future. The changes identified in this overview article are all further explained in companion articles in this newsletter. Also included on page 9 is a list of acronyms commonly used in these articles.

Among the improvements are:

1. Moving "deep archive" digital data from offline storage to storage on a "nearline" Digital Linear Tape (DLT) jukebox.
2. Moving much community-accessible data from a nearline optical disk jukebox (NDADS) to RAID magnetic disk for ftp access.
3. Moving beyond a vendor-specific VMS/Files-11 file management system (NDADS) to a vendor-independent UNIX system.
4. Modeling the NSSDC archive and dissemination environment after the ISO/CCSDS-standard Open Archive Information System (OAIS) Reference Model.
5. Integrating the data previously accessible from NDADS via SPyCAT with other data from the same missions previously ftp-accessible from nssdc.gsfc.nasa.gov.
6. Providing OAIS-compatible data preparation software to a real mission (IMAGE) to facilitate its data preparation and NSSDC's data ingestion.

Among the drivers for these changes were: the approaching obsolescence of NSSDC's optical disk jukeboxes; the need to move data away from vendor-specific systems of uncertain futures (VMS); the ability to exploit falling magnetic disk prices to make a large amount of data ftp-accessible for immediate user access; the need to make NSSDC's archive management more cost effective (via an automated deep archive system rather than a labor-intensive offline operation); and the desire to become compliant with OAIS for robustness of long-term archiving.

The overall activity has involved the coordinated efforts of NSSDC's acquisition scientists, data operations staffers, and multiple software teams. The integrating software for the establishment of NSSDC's new archive and dissemination environments is called DIOnAS (Data Ingest and Online Access System). DIOnAS depends on information provided to it as "listfiles" prepared by a combination of acquisition scientists and data operations staffers. These listfiles identify and characterize the data to be ingested by DIOnAS in a given job, and also specify the characteristics of the DIOnAS-output products in both the archive and data dissemination environments.

While executing, DIOnAS software calls key data processing modules for (1) the reading of input data, format transformations as specified, creations of attribute records (containing information from VMS/Files-11 extended attribute records, CRC checksums, etc.) for each data file, and the bundling of data files and attribute files into "Archival Infor-

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DIOnAS development team members (top: l to r) Pat McCaslin, Saima Zobair, Fred Pierce, (bottom: l to r) John Garrett, John Collins, Mark Hei, and Pat Higgins. See DIOnAS staff profile article "Meet NSSDC's Data Management Software Developers" on page 6.

The Open Archival Information System and the NSSDC

By Don Sawyer

A new standard is emerging that can assist digital archives, their managers, and their customers in managing and ensuring the long term preservation of, and access to, digital information. It is titled *Reference Model for an Open Archival Information System (OAIS)* (http://ssdoo.gsfc.nasa.gov/nost/isoas/ref_model.html), but is often referred to as simply the OAIS Reference Model. It has just completed balloting as an ISO Draft International Standard (DIS), and is expected to become a full standard later this year. Its purpose is to provide a framework of concepts and terminology that facilitate long-term preservation and access to digital information. Its acclaim and growing usage were highlighted in the September, 2000, NSSDC Newsletter (http://nssdc.gsfc.nasa.gov/nssdc_news/sept00/archive_ref_model.html).

The two primary modeling concepts in the OAIS are the information models and functional models.

OAIS Information Models

Two key information models are the Information Object and the Archival Information Package (AIP). The information object is defined as a data object (usually digital bits) together with its representation information object, which gives the format and meaning of the digital object bits. It is shown schematically in Figure 1. Note that the two objects constituting an Information Object need not be physically contiguous. Pointers or links in one to the other are often used. Note also that the data object's bits may represent numerical values of physical observations or they may represent text about observations, their sources, their state, etc.

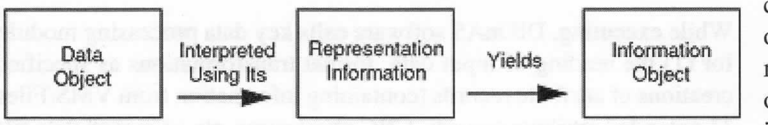


Figure 1. Information Object

The AIP is a concept for identifying a collection of information that can be preserved over the long term. It is shown schematically in figure 2.

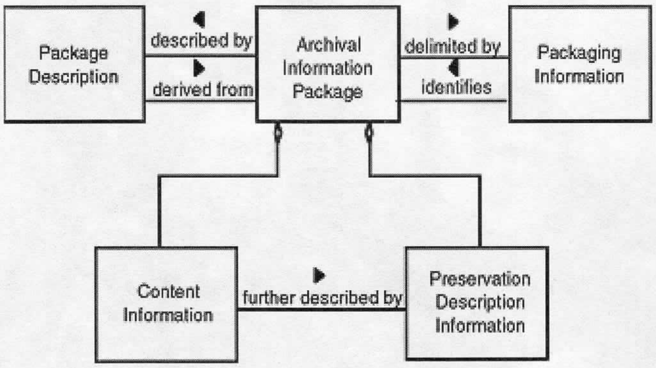


Figure 2. Archival Information Package

The primary information object the OAIS is tasked to preserve is the Content Information. Also within the AIP is an Information Object called the Preservation Description Information (PDI). The PDI contains additional information about the Content Information and is needed to make the Content Information meaningful for the indefinite long-term. It includes several categories of information addressing how the Content Information is referenced, how it is shielded from unintended alteration, how it relates to other information, and what has been the chain of custody.

Information related to the AIP is shown as Package Descriptions and Packaging Information. Package Descriptions are the information used by finding aids to assist users in determining the AIPs of interest. Packaging Information is used to bind the Content Information and PDI into a recognizable entity. These are described more completely in the OAIS Reference Model.

NSSDC and the Archival Information Package

NSSDC has adopted the AIP concept using a media independent canonical form to facilitate future refreshment and replication migrations across media types, and to improve association of needed representation information and preservation description information.

The major packaging form uses the ISO 12175 (SFDU packaging) standard to form a single file container (the AIP) containing SFDU packaging labels, an attribute object and the primary data stream of interest which is typically sensor data (see Figure 3). Each of these objects is assigned an internationally object-type-unique identifier (called the Authority and Description Identifier, or ADID) that is carried as a part of the packaging, and which points to a description of the format and meaning of the object. This provides a convenient mechanism to logically hook representation information to these objects and to support automated checking and gathering of this information. Access to the representation information is an automated service supported by Control Authorities (e.g., NSSDC) that are preserving the representation information.

The primary data stream, or data object, of interest as shown by the Sensor Data Object (SDO) in Figure 3, is held as a sequence of bytes within the AIP. It is to be interpreted using its associated representation information.

The attribute object contains additional information about the primary data object. This information can be largely categorized as PDI in that it gives checksums and byte counts to ensure the integrity of the primary data object, it gives historical information on how the primary data object originally looked when received such as original file name, source operating system, original record delimiters, and it gives some processing information related to moving the primary data object into the canonical form of the AIP. It also gives the unique identifier, called the Archival Storage Identifier (ASID), which is assigned by the NSSDC archive so that the unique content can be tracked and retrieved. An identifier of the primary collection to which it belongs is also given. These last two are types of reference information. There are also attributes giving start and stop times for the primary data object, and these may be said to be a part of giving "context."

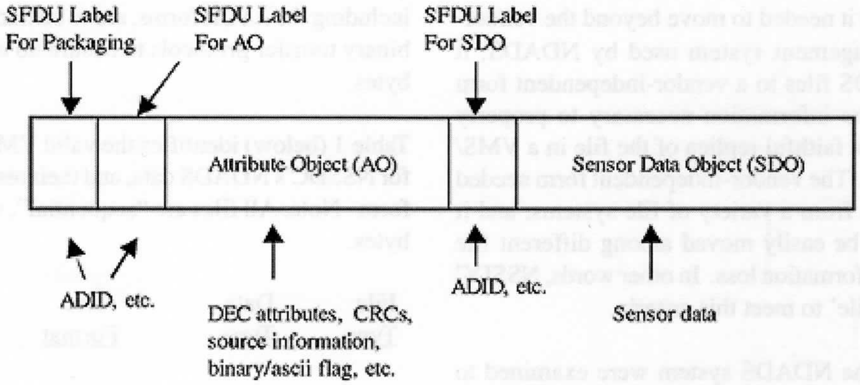


Figure 3. AIP schematic

They can be, and generally are, also extracted to be a part of "descriptive information" which is used by finding aids. The attribute object is implemented using the ISO 14961 (PVL specification) standard. A future version may use XML.

Figure 3 illustrates the concepts of the foregoing paragraphs. In the context of Figures 1 and 2, the AIP contains two information objects. One is the content information object formed from the sensory data object (SDO; referred to as "the data file" in most articles of this newsletter) as linked to its representation information which is pointed to by the ADID in the SDO's SFDU label. The other is the PDI object formed from the attribute object (AO; usually referred to as "the attribute file" in other articles) as linked to its representation information pointed to by the ADID in the AO's SFDU label. These two information objects are joined into one AIP by the additional packaging information consisting of the leading SFDU label with its ADID.

In addition to the SFDU packaging, the NSSDC also employs another form of packaging. This is a two file construct, or split package form, where the primary data object is extracted into a file with a name and extension approved by NSSDC, and where the associated attribute object has the same name as the data object, but with an extension of .att. This packaging form is used to facilitate user direct access to files placed on disk for pickup using ftp or similar tools. In this form of packaging, the association to the representation information that is stored in the Control Authority is still available for the primary data object because its ADID is also stored in the attribute object. Users accessing files from NSSDC's disk-based dissemination environment can also use readmes (or equivalent) to find format and other information needed to understand the data.

OAIS Functional Model and the NSSDC

The OAIS model envisions a standard archival system as consisting of five functional entities -

1) Ingest, for receipt of data and supporting material from providers and for preparation of AIPs for management and archiving;

2) Archival Storage, for storage, maintenance and retrieval of AIPs;

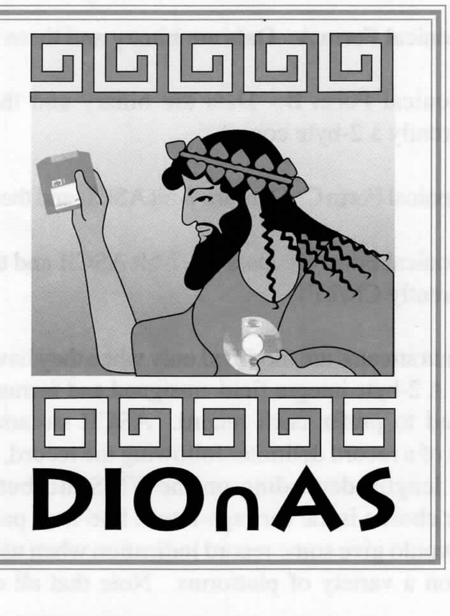
3) Data Management, for managing descriptors of archive holdings and administrative data related to archive management;

4) Administration, for managing the day-to-day operation of the archival system;

5) Access, for enabling users to find, request, and retrieve needed information products.

Each of these has its counterpart at NSSDC. In particular, the SFDU-packaged AIPs in the NSSDC DLT jukebox relate to the Archival Storage function, while the paired data and attribute files that are ftp-accessible from magnetic disk relate to the Access function.

In addition to OAIS' information and functional models, OAIS categorizes four modes of data migration, namely refreshment, replication, repackaging and transformation. These are distinguished by their impact on various components of the AIP and its packaging. These and the functional entities addressed above are more fully discussed in the online version of this article. All elements of OAIS discussed above are more fully addressed at the URL given at the beginning of this article. ❄



NSSDC Canonical File

By Don Sawyer and John Garrett

When NSSDC decided that it needed to move beyond the vendor-specific VMS/Files-11 management system used by NDADS, it needed to convert the NDADS files to a vendor-independent form while still maintaining all the information necessary to properly handle the file or to recreate a faithful replica of the file in a VMS/Files-11 management system. The vendor-independent form needed to accommodate information from a variety of file systems, and it needed to be one that could be easily moved among different file systems without significant information loss. In other words, NSSDC needed a type of 'canonical file' to meet this criteria.

The types of VMS files in the NDADS system were examined to determine the extent of the VMS problem. Of the three possible types of VMS file organization (sequential, relative, and indexed), only sequential files were present. The VMS record formats were examined and it was found that fixed-length, variable-length, and stream formats were present, while the variable-length with a control field format was absent. Of the four types of VMS record control (referred to as none, carriage_control, FORTRAN, and print), only print was absent. In addition, files types were both ASCII and binary.

The major issue in moving the NSSDC VMS files to a canonical form then was to capture information on record boundaries that was previously known and maintained by the VMS file system, but not within the file data stream itself. For binary files with variable length records, it was decided to insert an "NSSDC maintained" record separator (NMRS) into the data stream at record boundaries, in the form of a prefixed byte count, forming an NSSDC canonical file. This is documented in a separate, but associated, NSSDC attribute object so that the original data stream could be recovered as needed. The association is provided by an implementation of an AIP. This analysis and decision making process were led by Don Sawyer and Bob Candey.

Some of the VMS 7-bit ASCII files with fixed record lengths, and those with variable record lengths, also needed the insertion of an NMRS. This led to the definition of four NSSDC canonical forms, labeled "A", "B", "C", and "D", and defined as follows:

1. Canonical Form A: Data are binary and there are no NMRSs

2. Canonical Form B: Data are binary and there are NMRSs (currently a 2-byte count)

3. Canonical Form C: Data are 7-bit ASCII and there are no NMRSs

4. Canonical Form D: Data are 7-bit ASCII and there are NMRSs (currently CR/LF)

Binary data streams are modified only when they have variable length records. A 2-byte integer field, unsigned and formatted Big Endian, is inserted to prefix each record. ASCII streams may need the insertion of a record delimiter following the record, whether fixed or variable length, depending on the VMS attributes. The record delimiter chosen is the carriage-return line-feed pair because it was felt this would give some record indication when used with common utilities on a variety of platforms. Note that all canonical forms, including the ASCII forms, are to be transferred among systems using binary transfer protocols to ensure no unintended conversion of any bytes.

Table 1 (below) identifies the valid VMS file attribute combinations for NSSDC's NDADS data, and their resulting mapping to a canonical form. Note: All files are "sequential", with record sizes up to 32767 bytes.

File Type	Data Type	Rec Format	Rec Control	Canonical Form
1	7 bit ASCII	Fixed	None	C
2	7 bit ASCII	Fixed	CC	D
3	7 bit ASCII	Fixed	Fortran	D
4	7 bit ASCII	Stream_LF	CC	D
5	7 bit ASCII	Undefined	None	C
6	7 bit ASCII	Variable	None	D
7	7 bit ASCII	Variable	CC	D
8	7 bit ASCII	Variable	Fortran	D
9	Binary	Fixed	None	A
10	Binary	Undefined	None	A
11	Binary	Variable	None	B

Table 1. Mapping of VMS File Types to NSSDC Canonical Forms

When files are generated on non-VMS platforms, such as UNIX, and are to be put into AIPs, information on record boundaries is not carried by the underlying file system. In this case the canonical forms used will be A and C for binary and 7-bit ASCII respectively, which means that there is no change between the original data stream and the canonical form. ❄

SSDOO scientists show award won for "Blackout" video about terrestrial effects of solar storms. Pictured are (left to right): Tom Smith, Sten Odenwald, Jim Green, Bill Taylor. See online version of the Newsletter for the complete article.

The Functions of the DIOnAS and Related Software

By Pat McCaslin, Mark Hei, and John Garrett

This article describes the logical functioning of the DIOnAS software developed by NSSDC's primary data management software development team plus the functioning of the associated modules developed by the NSSDC/NOST team.

This software creates and ingests Archival Information Packages (AIPs), writes these to a Digital Linear Tape (DLT) jukebox for long term archiving and writes the AIPs' constituent files (data file and attribute file) to magnetic disk for external access via ftp or http, and builds an Oracle database of information about the locations and other attributes of the AIPs and their files. The database (1) is used in setting up and controlling data ingest/migration jobs, (2) provides long term NSSDC data management capabilities and (3) offers NSSDC the option to eventually build user interfaces to data at higher levels of functionality than ftp and http.

The DIOnAS software was developed by the NSSDC data system development team. The major DIOnAS software elements are the ingest manager server and the ingest manager client. The server uses and populates the database, invokes the NOST software (see below) and writes data to DLT. The client provides an operator GUI (graphical user interface) and performs some front end validation of operator-provided processing instructions.

The NOST team's Data Migrator Utility (DMU) software (called by DIOnAS) reads VMS files, converts them as needed into platform-independent canonical formats, creates the companion attribute files including information needed to support backward-migration of data to VMS, bundles the data and attribute file pairs into AIPs and delivers these to DIOnAS.

For writing data to magnetic disk for customer access, DIOnAS calls NOST's PSU software which splits the sensor data file and the attribute file out of the AIPs and writes these into the relevant directory on nssdcftp.gsfc.nasa.gov.

DIOnAS pipeline processing operations are organized into discrete "jobs" defined by externally prepared "listfiles." Listfiles contain the information necessary for DIOnAS processing: names of the source data files to be processed; the destination AIPs, destination DLT, and destination canonical data files; processing flags; and other metadata not obtainable from the source file itself. All files in a given job are of the same data type and the resulting AIPs are bundled into one tar file by DIOnAS for writing to DLT.

The following describes, at a high level, the DIOnAS processing pipeline for a single job:

1. The DIOnAS operator using the GUI selects a prepared listfile for processing.
2. The selected listfile is checked for format and syntax.
3. The validated listfile information is inserted into the database - at this point a job has been created.
4. The necessary processing information (source, destination, metadata, etc.) for all entries in the job are obtained from the database and passed to the DMU software.
5. The DMU software reads the files on the remote VMS machine and creates AIPs on the DIOnAS host machine.
6. Entries destined for DLT are identified and the AIPs (tarred into whole-job files) are written to DLT.
7. Entries destined to be placed in the ftp area are identified and the necessary information (source, destination, etc.) for those entries is passed to the PSU software.
8. The PSU software operates on the AIPs to split out the original data file in its canonical format and the attribute file and writes these to magnetic disk.

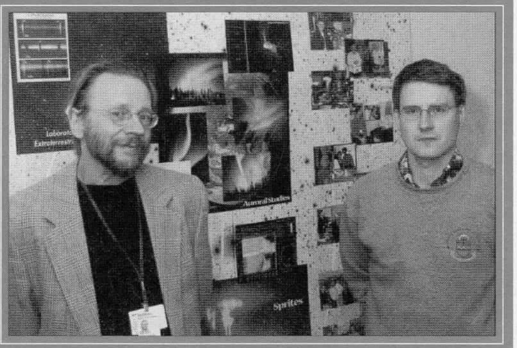
The existing DIOnAS/DMU subsystem is capable of accepting data submitted in the form of individual files. A version of DIOnAS with the ability to automatically accept and process data already packaged as AIPs is under development with deployment anticipated early in 2001. Two new NOST software utilities support this new capability. The Package Generator Utility (PGU), an extension of the DMU software, provides external data suppliers (initially, IMAGE) the ability to create AIPs. The Extractor Utility provides DIOnAS with the ability to extract from AIPs the information needed by the DIOnAS database. ❄

Visitors from Spain and Czech Republic at NSSDC

By Dieter Bilitza

Young scientists from both Spain and the Czech Republic recently had multi-day visits to NSSDC. The purpose of these visits was to foster collaborations connected with the evolution of the International Reference Ionosphere (IRI). They were hosted by Dr. Dieter Bilitza, who chairs the IRI Working Group (a joint project of the Committee on Space Research, COSPAR, and the International Union of Radio Science, (URSI)). Dr. Manuel Hernandez-Pajares and Dr. Jaume Sanz from the Polytechnical University of Cadalonia (UPC) in Barcelona, Spain, visited NSSDC from September 21 to 29. The UPC group has developed its own algorithms for deducing ionospheric total electron content (TEC) information from GPS data using the data provided by the International GPS System (IGS) data distribution. The goal of the collaboration with Dr. Bilitza is the use of GPS and TOPEX data to update IRI TEC predictions globally.

During the month of October, Dr. Bilitza hosted a visit by Dr. Vladimir Truhlik from the Institute of Atmospheric Physics of the Czech Academy of Sciences in Prague, Czech Republic.



Dieter Bilitza and Vladimir Truhlik

Dr. Truhlik is working on new models for the electron temperature and ion composition in IRI using a large volume of data from the Russian Cosmos and Interkosmos satellites. His models will

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Software Development Approaches and Teaming at NSSDC

By Joseph King, Pat McCaslin and Don Sawyer

Development of the software enabling the NSSDC data management improvements described in the other articles of this newsletter was the result of coordinated and complementary efforts of two NSSDC software groups - the DIOnAS group and the NOST group.

As NSSDC's data management requirements were emerging, NOST (D. Sawyer) and NSSDC (J. King) recognized that NSSDC's data management practices could be made more robust, and the OAIS concepts realized in a major science archive, by committing the NOST software team to work with the DIOnAS team in adapting and extending NOST's already existing prototype software to meet NSSDC needs in a mode complementary to the basic DIOnAS software. System engineering staff from both groups developed an overall system design that allowed largely independent but complementary code development efforts.

The basic DIOnAS software and database were developed by a team of a few Raytheon ITSS developers who constitute NSSDC's primary data management software team.

DIOnAS was developed in response to system requirements established by the SSDOO/NSSDC Configuration Control Board (CCB). The CCB consists of a mix of senior technical and management NASA and Raytheon ITSS personnel and is chaired by Ms. Nancy Laubenthal, the SSDOO Associate Chief. The CCB monitored DIOnAS developments through formal reviews (e.g., requirements review, design review) and status briefings at its regular meetings.

The basic DIOnAS package consists of approximately 20,000 lines of code written mostly in Java. About 12 months of effort transpired between the start of the DIOnAS effort and the operational deployment of DIOnAS in August, 2000.

Key software modules called by DIOnAS were written by the NSSDC/NOST software team consisting of one Raytheon ITSS developer plus part of a system engineer. This group, guided by NSSDC's Don Sawyer (Head of NOST) and jointly funded by NSSDC and NASA's System Operations and Management Office, has for some time been developing software for implementing various aspects of the ISO/CCSDS-sponsored OAIS model.

The NOST team used object-oriented software engineering practices and generated about 25,000 new lines of mostly C code in its direct support of NSSDC and DIOnAS.

Besides the original system design and the design, coding and integration of each module, a significant effort was put into testing of these products. For example, another 5,000 lines of code were generated for testing the NOST products. Once testing of the individual NOST and DIOnAS modules was completed, software integration was done and further integrations testing and operations testing was done.

Other articles in this newsletter describe the workings of and close coupling between the DIOnAS software and the NOST-created DMU and the PSU software now being used to move data from NDADS to DLT and to magnetic disk. ❄

Meet NSSDC's Data Management Software Developers

By Natalie Barnes

Many NSSDC staffers, including acquisition scientists, systems engineers, software developers, and data operations personnel have been involved in the planning, building and implementation of the data management upgrades described in many other articles in this newsletter. This article offers a profile the system engineers and software development personnel who designed and built the systems. These include Pat McCaslin, Pat Higgins, Fred Pierce, Bill Wood, and Saima Zobair of the DIOnAS team and John Garrett and Mark Hei of the NOST team.

Pat McCaslin is a senior systems engineer who is responsible for requirements analysis and design. After spending many years on the Cosmic Background Explorer (COBE) project, Pat came to the NSSDC in the summer of 1996 and joined the DIOnAS team in 1999.

John Collins joined the DIOnAS project in late 1999 after spending 17 years as a software engineer — the previous 2 working exclusively on Java projects similar to DIOnAS. John is currently working on DIOnAS as a senior Java developer. He studied computer science at Virginia Polytechnic Institute and became a Sun certified Java Programmer in 1998.

Fred Pierce has been the NSSDC data base administrator since November of 1997. He is responsible for DIOnAS data base design and administration, and coding of data base stored procedures. Prior to joining NSSDC Fred's work at Goddard included data base administration for the Data Distribution Facility and the Upper Atmosphere Research Satellite.

Pat Higgins is a senior test engineer with DIOnAS. Pat has been in the IT industry for more than 30 years and is retired from IBM. He has been with the DIOnAS project for 15 months.

Bill Wood is a senior software engineer responsible for requirements analysis, design, implementation, and maintenance of DIOnAS software. Specific responsibilities include development of Java software that provides the external interface to the ingest management mechanism of DIOnAS. Bill has been assigned to the DIOnAS project since July, 2000 and has nearly twenty years experience in the software development field.

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Meet NSSDC's Data Management Software Developers

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Saima Zobair joined NSSDC after spending four years as a software developer for the High Energy Astrophysics Science Archive Research Center (HEASARC) at Goddard. She is currently working on DIOnAS as a Java application developer. Saima received a B.S. in computer science from Utah State University in 1994 and an M.S. in computer science from Marquette University in 1996.

John Garrett is a principal software analyst who has been supporting the NOST task at NSSDC for ten years. As a system engineer, John participated in developing consensus for the interface specifications between NOST products and the DIOnAS system discussed in this newsletter. He has been very involved in the CCSDS/ISO-sponsored activity creating the archive reference model (OAIS) that has contributed to NSSDC's new data management approaches.

Mark Hei is a software analyst who has been supporting the NOST program through Raytheon for two years. Prior to that he was associated with NOST software projects through other companies for approximately four years. Mark has developed all the NOST-related software packages identified in the companion articles: DMU, PSU, PGU, and Extractor. He works remotely from his office in Western Maryland. Mark is an NSSDC legacy - his father, Dr. Donald Hei, was one of NSSDC's earliest space physics acquisition scientists.

NSSDC would also like to thank Colin Klipsch, Arthur George and David Hardin who were instrumental in the success of DIOnAS but have since moved on to other projects. ❄

International Meeting of World Data Center Directors Held

By Joseph King

The second meeting of Directors of World Data Centers (WDC) was hosted by the WDC for Climatology at its Asheville, NC, location on November 6-8, 2000. This WDC is itself hosted by the National Climate Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA). Attending were Directors from most of the 47 WDCs, which are located in Japan, China, India, Russia, seven European countries, and the United States. The first such meeting had been held in 1995 in Wageningen, The Netherlands. The WDC system is described later in this article.

The theme of the Asheville meeting was the enhancement of the WDC system through the best use of current and emerging internet technologies. A series of six reviews of the state of the WDCs in six areas of the world was given, followed by multiple sessions of splinter groups for (1) overcoming barriers and enhancing capabilities and (2) opportunities possible through incorporation of new technologies.

Among the findings and recommendations coming out of the meeting were: WDCs should have simple html lists of their data collections to be indexed by targeted search tool(s) to facilitate users' data finding; a technical task group should be established for such things as addressing standards for data archiving and curation, developing tools that encourage and facilitate data submission, ingestion, and management, reviewing best current practice in data browsing, retrieval, etc.; more extensive use of mirror sites should be made; and several others.

One of the more surprising assertions made was that most users find data via commercial web search engines (Yahoo, Alta Vista, etc.) rather than through the data directories of the various data centers. This author would be especially interested in feedback from any NSSDC scientific or general public users as to how they initially found NSSDC.

Proceedings of the meeting are available at:

http://www.ngdc.noaa.gov/wdc/allwdc/agenda.html

The WDC system was established in the 1950's to facilitate the exchange and preservation of data from the 1957-8 International Geophysical Year. The system includes sites specializing in the Earth's solid body, surface, oceans, atmosphere, ionosphere and magnetic field, plus the sun, cosmic rays, space science, and the impact of humans on the environment. Many WDCs are hosted by national data centers. A few include spacecraft data in their holdings or provide a conduit for international access to the space data archives of their host national data centers.

NSSDC hosts WDC for Satellite Information (WDC-SI). Until recently, the name was WDC-A for Rockets and Satellites. WDC-SI makes satellite launch announcements to an international recipient list within a day or two of all launches worldwide. Monthly summaries of launch information are contained in NSSDC/WDC-SI's Spacewarn Bulletins (http://nssdc.gsfc.nasa.gov/spacewarn/). WDC-SI also serves as the pathway by which non-US scientists and others gain access to NSSDC's extensive data archives.

The WDC system has an array of web pages (http://www.ngdc.noaa.gov/wdc/wdcmain.html) through which much more detail on the history and present state of the WDC system is available. The WDC system is under the auspices of the ICSU (International Council for Science) Panel on World Data Centers (Director: Dr. Ferris Webster, U. Delaware). Evolution of the U.S. component of the WDC system is coordinated by the U.S. National Academy of Sciences (Dr. Anne Linn). ❄

NSSDC Makes Major Data Management Advances

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mation Packages" (AIP, a central OAIS concept) and for (2) the splitting of AIPs into their constituent data and attribute files. These modules, developed by the NSSDC/NOST (NASA Office of Standards and Technologies) software team, are called the Data Migrator Utility (DMU) and the Package Splitter Utility (PSU).

The DIOnAS software itself, created by NSSDC's primary data management software group, controls overall jobs and writes AIPs to a DLT jukebox for permanent archiving while the PSU writes separated files to RAID magnetic disk for user access. In addition, DIOnAS builds an Oracle information base of the locations and other attributes of the AIPs on DLT and data files on magnetic disk.

DIOnAS software runs on a Sun Enterprise 3000 computer called "nssdcftp." A 264-slot ATL 2640 DLT jukebox is hosted by nssdcftp and is used for producing and storing the permanent archive DLT tapes. A 1-TB (expandable to 10 TB) Metastore RAID disk array, also hosted by nssdcftp, holds the customer accessible online data.

Most of the data files being transferred from NDADS were readily transferrable to UNIX, with no likely impediments to future usage. However, certain data sets (e.g., those whose VMS files had variable record sizes) had to be converted to one of several NSSDC canonical formats.

Migration of data through DIOnAS started in August of 2000 with the movement of virtually all IMP 8 data from NDADS. Currently a few hundred GB of ISIS ionospheric data are being moved. Several additional space physics data sets are in the queue. Migration of all appropriate data from NDADS will be completed in 2001.

Large volumes of astrophysics data now on NDADS will not be moved through DIOnAS to magnetic disk, as these data are now mostly community-accessible from various NASA/Astrophysics Science Archive Research Centers (SARCs). The exception is IRAS data, which will pass from NDADS through DIOnAS. NSSDC-held deep-archive copies of SARC-provided data (and appropriate pre-SARC data) will eventually pass through DIOnAS to NSSDC's deep archive DLT jukebox.

NSSDC will gradually pass all its offline-archived digital data through DIOnAS to the DLT jukebox and, for at least most data not otherwise network-accessible, also to the UNIX/RAID environment for easy user access. NSSDC will also move all the data and services that are now ftp-accessible from nssdc.gsfc.nasa.gov to this UNIX/RAID environment on nssdcftp. In fact all IMP data have already moved to nssdcftp from both NDADS and nssdc.gsfc.nasa.gov, thereby providing users a simple and integrated interface to IMP data.

Note that the changes discussed above do not relate to the CDF-based CDAWeb or SSCWeb systems. In fact, the CDF-formatted data in these systems are ftp-accessible from the machine hosting those systems (rumba). On the other hand, the OMNIWeb and COHOWeb systems, while mainly CDF-based, access some ASCII data ftp-accessible from nssdcftp, so their software packages and CDF data have been ported from rumba to lewes, a SUN Enterprise 250 tightly coupled (NFS-mounted) to nssdcftp. Top level Web pages for all these systems remain unchanged at their respective URLs.

The SPyCAT interface through which users found and accessed space physics data on NDADS will not be rebuilt in the UNIX environment, at least in the near future. A note to this effect has appeared on the top SPyCAT Web page for months, with almost no user feedback. We believe that the basic spacecraft organization of the directory structure and ftp-accessibility will provide adequate user data finding and access. (User input is always welcome on this.)

It should be noted that selected data sets ftp-accessible from nssdcftp have an extra graphical browse and subset capability from "Ftphelper" running on lewes.

Selected relevant URLs:

New UNIX/RAID ftp environment: ftp://nssdcftp.gsfc.nasa.gov/

Older ftp area being superseded: ftp://nssdc.gsfc.nasa.gov/

NDADS/SPyCAT: http://nssdc.gsfc.nasa.gov/space/ndads/spycat.html

OAIS Reference Model: http://ssdoo.gsfc.nasa.gov/nost/isoas/ref_model.html

Ftphelper: http://nssdc.gsfc.nasa.gov/ftphelper/ ❄

SWAS Data Available

By David Leisawitz

Data from the Submillimeter Wave Astronomy Satellite (SWAS) are available from the NSSDC. SWAS, a NASA Small Explorer (SMEX) satellite, was launched on December 2, 1998. Its chief science objectives are to determine the composition of interstellar molecular clouds and the means by which such clouds cool as they collapse to form stars and planets. SWAS measures emission in five molecular and atomic spectral lines in the submillimeter band, in some cases mapping the line emission from extended sources.

On schedule, in June 2000, data from the first six months of the mission were transferred via ftp from the SWAS Science Center at the Harvard-Smithsonian Center for Astrophysics to the NSSDC, where they are now safely archived. These data were promptly linked to a Web interface developed by the Astrophysics Data Facility in collaboration with the SWAS team. The SWAS Data Archive Web site at http://space.gsfc.nasa.gov/astro/swas provides descriptions of the data products and the data processing pipeline, a bibliography of SWAS team publications, a list of sources observed, and on-line access to the data in FITS and CLASS formats. Quick-look and browsing capabilities will be added in the coming months. Future SWAS data releases will occur at six-month intervals.

Thanks on behalf of the community to Drs. Nils Odegard, Rene Plume, and Thomas Sodroski for their professional support, and to the SSDOO's Space Science Visualization Lab for assistance in developing the Web interface. ❄

Data Preparation and Transfer Operations

By Kent Hills, Barbara Rowland and Joseph King

This article is intended to give readers a high level understanding of the operational processes and procedures NSSDC went through in moving data from the VMS-based optical disk jukebox environment (NDADS) to DIOnAS and thence to a UNIX-based DLT jukebox for permanent archiving and to a UNIX-based RAID magnetic disk environment for online user access to data.

The data sets ("data types" in NDADS terminology) to be moved from NDADS to DIOnAS have a variety of formats. Each data set has a record in the NDADS information environment with a number of higher level attributes (e.g. project, data set name, data file_name format, proprietary status, data mode) common to all the files of that data set. In addition, an extended version of these records was generated for each data set, adding further attributes (e.g., new directory and filename structure, binary or ASCII mode, NSSDC ID numbers, documentation pointer IDs) needed in the transfer of data sets through DIOnAS. These new records are called generalized dataset attribute records (GDARs). In many cases, much of the GDAR information was automatically retrieved from existing NSSDC information, but acquisition scientists still had to complete and review them.

At the beginning of the planning process, prior to making the GDARs, a series of meetings was held during which user-optimal conventions for the magnetic disk environment were addressed and standardized. These related to directory hierarchies, numbers of files per directory, file naming, and the like. Thus the new directories generally have a common structure: spacecraft_series/spacecraft/investigation/data_set/time_interval/data_file. Variants occur as judged user-effective in individual cases. Time_interval subdirectories (e.g., 1997,1998) are used when needed to limit the number of files per directory to about 400 or less.

Most file names begin with the start time of the data (YYYY...) to group multiple user-downloaded files by time, assuming the accumulating of many files for individual time-defined events will be the most common user mode. In general files have long and descriptive names. This was done with the expectation that virtually all users will interact with file names via point-and-click rather than by keying them.

In parallel with the preparation of the GDARs by acquisition scientists and their review by NSSDC management, the NSSDC data operations staff was staging data from optical disk platters to VMS magnetic disk to facilitate the migration of these data to DIOnAS. Approximately 100 GB of NSSDC disk capacity was committed to this purpose.

A given DIOnAS data-ingest job involves the processing of a great many files of a given data set into AIPs by DIOnAS/DMU, the tarring of all such AIPs per job into large files for writing to DLT, and the splitting of AIPs into their constituent data files and attribute files for writing to RAID disk. Prior to each such job the data operations staff would create a "listfile" to group the information from the GDAR (common to all files in the data set) with information from the NDADS database on each specific file to be migrated. The listfile information was used in various algorithms that generated specific values (e.g., file names) for the individual AIPs and files produced. An automated procedure to generate listfiles for any future incoming new data files is currently being prepared.

In general, migration of data from optical platters is a relatively slow process. In the first three months of DIOnAS operations, NSSDC has experienced an average rate of 75 KB/s in staging data from platter to magnetic disk. During the first 3 weeks of operation, 5 IMP 8 data sets were migrated from NDADS to DIOnAS, a total of 7.4 GB of data. Subsequent to the IMP data move, some 100's of GB of ISIS data are being moved. In the coming months, data from the remaining 13 space physics missions, plus IRAS, will be moved.

At the end of the data migration from NDADS, the NDADS VMS optical disk jukebox system will be retired. NSSDC's data operations staff will then turn their attention to other data not yet passed through DIOnAS, including data which had been ftp-accessible from NSSDC magnetic disk (in particular, from nssdc.gsfc.nasa.gov/spacecraft_data) and data which are still in the NSSDC offline archives only.

List of Acronyms

AIP	Archival Information Package
AE	Atmospheric Explorer
ADID	Authority and Description Identifier
AO	Attribute Object
CD	Compact Disk
CDF	Common Data Format
CD-R	Compact Disk-Recordable
CD-ROM	Compact Disk-Read Only Memory
COSPAR	Committee on Space Research
DMU	Data Migrator Utility
DIOnAS	Data Ingest and Online Access System
DIP	Dissemination Information Package
DIS	Draft International Standard
DLT	Digital Linear Tape
FITS	Flexible Image Transport System
GB	Gigabyte
GDAR	Generalized Dataset Attribute Record
GSE	Geocentric Solar Ecliptic
GSM	Geocentric Solar Magnetospheric
GUI	Graphical User Interface
IMAGE	Imager for Magnetopause-to-Aurora Global Exploration
IMP	Interplanetary Monitoring Platform
IRAS	Infrared Astronomical Satellite
ITSS	Information Technology and Scientific Services
KB	Kilobyte
NDADS	NSSDC Data Archive and Distribution System
NMRS	NSSDC Maintenance Record Separator
NOST	NASA Office of Standards and Technology
OAIS	Open Archive Information System
PDI	Preservation Description Information
PGU	Package Generator Utility
PI	Principal Investigator
PSU	Package Splitter Utility
SFDU	Standard Formatted Data Unit
SIP	Submission Information Package
SOHO	Solar and Heliospheric Observatory
SPyCAT	Space Physics Catalog
SSDOO	Space Science Data Operations Office
TB	Terabyte
UA	Unified Abstract
UDF	Universal Data Format
VMS	Virtual Memory System
XML	Extensible Markup Language

New Interball-Tail Magnetic Field Data Available

By Dr. Ramona Kessel

NSSDC has recently acquired definitive magnetometer data from the 1995-launched Russian Interball-Tail spacecraft for the years 1995-1997. These data are available on CDAWeb at http://cdaweb.gsfc.nasa.gov/ in the *Public Data from Current Space Physics Missions* database. The data consist of magnetic field magnitude and Cartesian and polar components in GSE coordinates. The data are at 6-sec resolution and were prepared and submitted by Dr. Valery G. Petrov of the Space Magnetic Research Laboratory in IZMIRAN, Troitsk, Russia with some NASA support. The later 6-sec magnetometer data from the still-active Interball-Tail spacecraft are expected to be archived at NSSDC at a later date.

Magnetic field measurements on-board the Interball-Tail Probe are carried out by the FM-3I and MIF-M instruments. FM-3I consists of two flux-gate magnetometers (M1 and M2) covering two different ranges: 200 nT and 1000 nT. The M2 instrument is mostly used to perform the attitude control of the Interball-Tail spacecraft. M1magnetometer data are transmitted to the scientific SSNI telemetry system at rates 0.125-16 vectors/s depending on the instrument operating mode. The magnetic field data from the M2 magnetometer are transmitted at the rate 1 vector per 6 sec. to the BNS attitude control system. The MIF-M magnetometer has the following parameters: measured range 0.3-37.5 nT, frequency range 0-2 Hz, sampling rate from 1/4 to 8 measurements per second. The FM-3I M2 magnetometer failed in February 1996 while FM-3I M1 and MIF-M are still working. The PI and key scientists on FM-3I are M. Nozdrachev from the Space Research Institute (IKI), Moscow, Russia and V. Styazhkin from IZMIRAN, Troitsk, Russia. For MIF-M they are S. Romanov and M. Nozdrachev from IKI and V. Korepanov from SDD ASU, Lviv, Ukraine. Further details are available at http://www.iki.rssi.ru/tail/.

The recently acquired data are a combination of the data of all magnetometers, but preferentially FM-3I M1. If M1 data are absent for a time interval, then MIF-M data are used. If neither M1 nor MIF-M data are available, then FM-3I M2 data are used.

For several years NSSDC has been acquiring Interball-Tail one-minute magnetometer data as part of the ISTP key parameter database. These consist of vector magnetic field in GSE and GSM Cartesian coordinates as well as the magnetic field magnitude, and power in magnetic field fluctuations at 2 Hz and 725 Hz. In addition, Interball-Tail supplies other one-minute resolution key parameter data sets: ion and electron moments, energetic particle and ion composition data, and AKR radio emission fluxes. These data were prepared by A. Petrukovitch of IKI, Moscow, Russia and are accessible from CDAWeb for 1995-1998. Data for 1999 are expected in early 2001.

The 1996-launched Interball-Aurora also supplies one-minute magnetic field data and energetic particle data for 1996-1997. There is a ground-based component to the Interball program which supplies a polar cap activity index. Both Interball-Tail and Interball-Aurora have subsatellites supplied by the Czech Republic.

Interball is the key Russian contributor of data as part of the Inter-Agency Consultative Group (IACG)-sponsored multi-spacecraft, multi-national program. The objective of this program is to promote further understanding of the complex plasma environment surrounding the Earth, other planets, and in interplanetary space. ❄

SECEF Plans Solar Events for Classrooms and Museums

By Elaine Lewis

As we begin a new millennium and the Sun undergoes another solar activity maximum, the Sun-Earth Connection (SEC) Education Forum (SECEF) is sponsoring a series of "Solar Events" during 2000-2001 to feature and celebrate the active Sun and its connection to our lives. In partnership with museums, educators, and space scientists around the country, SECEF is supporting a national "Sun-Earth Day" and an international total solar eclipse webcast from Southern Africa. Solar events will allow a broad community to learn about NASA's SEC theme and its missions.

Sun-Earth Day, scheduled for April 27, 2001, as part of National Astronomy week and the fifth anniversary of the SOHO (Solar and Heliospheric Observatory) launch, will engage schools and classrooms nationwide. Scientists can get involved by visiting their local schools and sharing with students the discoveries of the Sun. An education kit is available to support the visits. Included in the kit is a CD called "Making Sun-Earth Connections" that was created for use in a classroom as a motivator to pique students' interest. Scientists can use the CD to develop their presentation with little additional time required. Through visits with the scientists, teachers and students will get the opportunity to increase their awareness of the Sun-Earth connection. Other opportunities will be made available for scientists to participate in email mentoring and online chat sessions. To participate either as a volunteer scientist or benefiting classroom and to learn more about the solar events, access the Web site: http://solarevents.org.

The June 21, 2001 total solar eclipse webcast from southern Africa, hosted by the San Francisco Exploratorium, will give science museums in the US and abroad the opportunity to host their own events for the public and special interest groups. "Eclipse 2001" will build on the successes of two previous webcast events in 1998 and 1999—viewed by millions of internet and live participants—that were conducted as part of the partnership between the San Francisco Exploratorium and SECEF. Eclipse 2001 will feature a live 30-minute downlink to science museums from the International Space Station (ISS), highlighting NASA's Living with a Star initiative by addressing the effects of the active Sun on ISS astronauts. Scientists can join local museums to support the events for the general public. To participate either as a volunteer scientist or benefiting museum, and to learn more about the solar events, access the Web site: http://solarevents.org/.

SECEF is a NASA-sponsored education and outreach organization that is a partnership between NASA Goddard Space Flight Center and the University of California, Berkeley. The GSFC part has many SSDOO and NSSDC personnel involved on a full or part time basis. SECEF promotes the theme of SEC science on a national level via outreach to schools and the general public. ❄

NSSDC Integrates Data Pathways

By Joseph King and Natalia Papitashvili

For many years NSSDC has provided space physics data by each of several pathways. Most data sets were only supported by a subset of the pathways, providing a challenge to NSSDC's users (and to NSSDC) to ensure that users would know of all relevant and available data sets for any given user need.

Primary pathways to spacecraft data have been:
via ftp at nssdc.gsfc.nasa.gov/spacecraft_data;
via SPyCAT to the data held on the NDADS optical disk jukebox;
via CDAWeb, OMNIWeb, and COHOWeb to data held in CDF;
via ATMOweb and Ftphelper to selected ftp-accessible ASCII data.

Note that the first two of these provide file level access while the latter two provide graphical browsing and subsetting by parameters within data records.

NSSDC is now migrating much data from NDADS through DIOnAS software to a UNIX environment with a Sun Enterprise 3000 server and attached 1 TB of RAID disk. With the NSSDC intent to make this environment the primary server for ftp-accessible data and services (whether DIOnAS-involved or not), this computer has been designated nssdcftp.

The directory nssdcftp.gsfc.nasa.gov/spacecraft_data will host an increasing amount of data moved from both NDADS and nssdc.gsfc.nasa.gov/spacecraft_data. All IMP 8 data from both sources have already been moved to nssdcftp. These data include 5 data sets from NDADS (including one with data from 4 IMP experiments) and 4 data sets from nssdc/spacecraft_data for a total of 9 data sets from 8 experiments. The data sets from these two sources are indistinguishible from an ftp-user perspective, except that the DIOnAS-involved data sets have subdirectories for the attribute files discussed elsewhere. Additional integrations of data sets by spacecraft (currently in transition: ISIS) from NDADS and from nssdc/spacecraft_data will be realized as the data migration efforts proceed over the coming months.

Because ATMOWeb and Ftphelper are alternate pathways to ASCII and gzipped ASCII data that were ftp-accessible from nssdc/spacecraft_data, and those data were being moved from nssdc to nssdcftp, it was necessary to move the ATMOWeb and Ftphelper software to a new machine (a Sun Enterprise 250 server named lewes) which is tightly linked (NFS-mounted) to nssdcftp. This has been done.

Further, because OMNIWeb software accesses either CDF-formatted data or ASCII data according to the user's run-time specification of time resolution of interest (CDF for hourly, ASCII for daily or 27-day averages) and because those ASCII files were moving to the nssdcftp machine, the OMNIWeb software and the CDF files were moved to lewes from the machine rumba which mainly hosts CDAWeb and SSCWeb data and software. (It should be noted here that the CDF-formatted data underlying CDAWeb are ftp-accessible from rumba.) Finally, because COHOWeb is managed similarly to OMNIWeb, the COHOWeb software and CDF-formatted data were moved to lewes from rumba.

Also moved to nssdcftp/spacecraft_data from nssdc/spacecraft_data were selected data from spacecraft other than IMP 8 which were both ftp-accessible and accessible through the ATMOWeb and/or ftphelper interfaces moved to lewes, namely: Atmospheric Explorer and Dynamics Explorer UA data plus data from the Hinotori, ARCAD-3, Prognoz, and Magsat spacecraft. Finally, nssdcftp also holds selected data from IMAGE, ISIS and a series of Russian spacecraft with particle data from Moscow State University. Again, much more will be added in the future.

CDAWeb and SSCWeb are unaffected by the changes reported above. The URL's for the OMNIWeb, COHOWeb, ATMOWeb and Ftphelper top Web pages remain unchanged (http://nssdc.gsfc.nasa.gov/...) ❄

Longevity of CDs at NSSDC

By George Fleming

What causes Compact Disks (CDs) to fail, and what is NSSDC doing about it? While failures of CDs are rare, they do have an expected, if not clearly defined, lifetime. With care, most will likely outlive many readers of this article. A greater problem would likely be the longevity of the read mechanism and the software used to interpret the data. This doesn't mean that we can expect zero failures in the next 25 years, however. And, if there's an expected 25-year lifetime, a few will fail years before then.

As of December, 2000, NSSDC's library has multiple copies of 1,489 titles on factory-stamped CD-ROMs, 11,776 unique CD-Recordable (CD-R) disks and no CD-Read/Write disks. The vast majority of CDs shipped from NSSDC in response to user requests are stamped CDs, but a small percentage are CD-Rs.

Stamped CDs are very stable; their structure is simple, and as long as the (typically) aluminized reflective layer is protected from oxidation, they should last many decades. (See http://www.sigcat.org/articles/white/smart1.htm for more information). CD-Rs have a more complex structure, and rely on various organic dyes enabling the writing process. While claims for CD-Rs of a 200+ year lifetime have been made (for instance, see http://www.kodak.com/US/en/digital/cdr/features.shtml), they are still susceptible to degradation by excessive heat and moisture. The age of the CD-R before writing is also a factor. As an aside, due to the way data are recorded, any cleaning of the surface should be done radially from the hub outwards, not along the circumference.

Errors are encountered on all CDs. Errors accumulate due to manufacturing defects, recording errors, physical scratches and fingerprints, the effects of exposure to sunlight, high temperature and humidity, and in the read process. Thus, all CDs employ at least one level of error correction coding (ECC). Audio CDs employ one level, with CD-ROMs employing additional levels of ECC, such as Cross Interleave Reed-Solomon Code (CIRC). Data are interleaved for additional protection. As non-zero block error rates are encountered on all CDs, ECC is necessary. Indeed, any degradation of a CD is hidden by the ECC employed. Errors are quite hidden from the casual user, and are usually not even reported from the CD reader.

NSSDC is presently reviewing various commercially available hardware/software modules that might be procured and attached to a current NSSDC PC to monitor CD degradation. ❄

IMAGE Sends Archival Information Packages to NSSDC

By Donald Sawyer and Richard Burley

The IMAGE project elected to use NSSDC's archival storage, preservation, and distribution facilities to support the science community's need for long term access to IMAGE's science data products. The "Level-0.5" products are mostly organized as sets of daily, instrument-specific Universal Data Format (UDF) files bound together as daily tar files. A higher level product in CDF is also provided to NSSDC for CDAWeb access.

While IMAGE was preparing its ground processing system, NSSDC was in the process of upgrading its systems to work with AIPs. This presented an opportunity to test the hypothesis that projects could, if given proper tools, significantly improve the ability of archives to ingest and manage project data products for long term preservation and access without adding a significant burden to the projects.

As the IMAGE project was already planning to run a script that would push files into an NSSDC staging area on a daily basis, it was decided to provide the project with a set of software that would convert the "Level-0.5" data files into NSSDC-conforming AIPs. This required an upgrade to the DMU software, to the Package Generator Utility (PGU) software, and a port to DEC Alpha. It also required that a number of attributes, previously generated in the NSSDC environment, be generated in the IMAGE Science and Mission Operations Center (SMOC) environment. This was accomplished by including a number of configuration files to set key values from which the NSSDC attribute object and packaging information could be derived. Since each AIP has a unique Archival Storage Identifier (ASI) under the control of NSSDC, it was necessary to develop a scheme to assign these Identifiers remotely. This was accomplished by configuring this Identifier to have a project specific prefix, as set in a configuration file, followed by a sequence number maintained in another file. In this way unique ASIDs are generated automatically as needed whenever the PGU software is executed.

The IMAGE SMOC runs a master script to generate science data products and copy certain products into an input staging area (nssdcin) on an Alpha UNIX, and then it invokes the PGU. Input to the PGU is a pointer to this staging area, plus the same inputs as with the DMU. The valid source filenames are used to generate an input listfile, which is in turn used to generate resultant AIPs into a target staging area (nssdcout) on the Alpha. Then, if all source files have been processed, the source files are removed by the PGU from the input staging area, leaving the AIPs and accompanying log files in the target staging area.

In more detail, this is accomplished by the PGU with five processes named *packgen*, *makelist*, *makepack*, *fileget*, and *cleanup*. Functionally, the main program, named *packgen*, starts via Telnet or a Shell Script and manages the entire AIP creating process. The *migrator* starts the *makelist* process, which generates a listfile containing information to continue the AIP creation process. Then the *makepack* process collects the information necessary to generate AIPs. In turn, *makepack* starts the *fileget* process that accesses UNIX file and record information. Finally the *cleanup* process reviews the resultant AIPs and status information to determine if all AIPs were created, and at this time it removes the source files from nssdcin.

When the IMAGE script detects that the input source file directory is empty, it proceeds by creating a manifest of all the files in the target staging area. It then pushes the AIPs, output log files, diagnostic file, and manifest file to an NSSDC input staging area.

Periodically NSSDC checks its input staging area and moves the newly arrived files to a processing area. Currently NSSDC operations staff run the PSU to put the attribute objects and tar files into appropriate directories. When the DIOnAS system upgrade is completed, (as shown in Figure 1 of the online version of this article) it will run the NOST- developed Extractor Utility to inventory the AIPs (which might be a subset of those actually created in the IMAGE run) and to generate a table of values used by the DIONAS database. The AIPs will be stored on DLTs and split automatically.

Users can access the NSSDC anonymous ftp site to obtain the UDF tar files and associated attribute objects as they require. In the future they will be able to access instrument-specific UDFs with software provided by C. Gurgiolo of the IMAGE team that will be running on our lewes machine. ❄

Visitors from Spain and Czech Republic at NSSDC

continued from page 4

be introduced as a new option for the electron temperature in the next version of the IRI model. During his visit he helped to implement the new option into the IRI code. He also studied some of the older ionospheric data sets at NSSDC and their potential for improvements of IRI. Another project involved the study of the light ion ratio (He+/H+) with data from the 1978-launched Japanese ISS-B spacecraft. ❄

NSSDCNEWS

NSSDC News is published quarterly by NASA's National Space Science Data Center. Please send your address changes and requests to the appropriate address listed in the box below. Your comments are welcome.

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To access NSSDC's WWW home page, enter http://nssdc.gsfc.nasa.gov/
To access NSSDC's education home page, enter http://ssdoo.gsfc.nasa.gov/education/education_home.html