S C I E N C E

INFORMATION SYSTEMS

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Editor's Note—
The following article describes work funded by the Applied Information Systems Research Program (AISRP) that is sponsored by NASA's Office of Space Science, Information Systems Branch. You may access the AISRP's World Wide Web page at: http://www.hq.nasa.gov/office/oss/aisr/aisrp.html

The ASSIST—A Uniform Interface to Software and Information

Eric Mandel, Smithsonian Astrophysical Observatory, Cambridge, and Mark Ackerman, University of California-Irvine

Personal workstations have brought many benefits to the astronomical research community, but also have led to some unexpected problems. Frequently, software tools developed to take advantage of the explosion in workstation hardware are not being used effectively in the astronomical community. These tools may have confusing, and often conflicting, user interfaces that prevent researchers from being able to master them individually or to utilize them in combination. The accompanying documentation may be scattered in different help systems. Perhaps most importantly, the knowledge about how to use these tools is not being collected and shared effectively. As a result, many researchers view powerful computer systems as being overly complex and opaque, and feel frustrated in their efforts to do research without spending all of their time learning about computers.

The ASSIST graphical user interface is an X Window System program that alleviates problems faced by researchers when trying to utilize complex and often conflicting astronomical data analysis systems. Initially prototyped in 1992-1993 under a NASA Astrophysics Software Research Aids (ASRA) grant, the ASSIST currently is being developed under the auspices of the Applied Information Systems Research Program (AISRP). The latest version of the system was released in September 1995 as part of the Smithsonian Astrophysical Observatory (SAO) Research and Development (R&D) software suite.

Managing and displaying information

The ASSIST supports the creation, organization, management, and display of arbitrary "information node types", such as documentation, help, tutorials, questions, and answers, etc. It is layered on top of the Answer Garden Substrate, a system specially designed to facilitate the collection and dissemination of organizational memory. The basic ASSIST display consists of a number of graphical "trees" arranged in a hierarchy (Figure 1). Each "leaf" on a tree represents a piece of documentation (or other information) or another branch

The purpose of the SCIENCE INFORMATION SYSTEMS NEWSLETTER is to inform the space science and applications research community about information systems development and to promote coordination and collaboration by providing a forum for communication. This quarterly publication focuses on programs sponsored by the Information Systems Branch in support of NASA's Office of Space Science. Articles of interest for other programs and agencies are presented as well.

of the tree. Pressing the left mouse button on one of the leaves will activate it, resulting in the display of either the appropriate piece of information or another part of the tree. You can traverse the branches in the hierarchy to locate specific document "leaves", and then activate these "leaves".

In addition to handling documentation, the ASSIST can organize and manipulate command-driven programs such as the UNIX shell or the Image Reduction and Analysis Facility (IRAF), a widely used astronomical analysis environment. Just as documentation, help, and other information can be represented by different graphical windows in the ASSIST, analysis programs can be represented by graphical "parameter editors". Through these parameter editors, you can inspect and change a task's parameter values, run a task, get help, view or submit problem reports, etc. Note that the ASSIST is layered on top of analysis systems in such a way that the analysis functions are handled by the target system itself. This is accomplished by means of the "Xkibbitzer", a facility for sending ASCII strings to a process running in a separate X window. The analysis program receives and processes these commands exactly as if you had typed them at the keyboard.

By organizing and managing different "information nodes" in separate graphical windows, ASSIST offers a multi-dimensional view of an analysis environment. It provides windows for viewing lists of available tasks and programs, for browsing help files and tutorials, for setting up and running tasks, and for inspecting analysis results (Figure 2).

In 1992, the Compton Gamma Ray Observatory (CGRO) adopted the ASSIST as the basis for GammaCore, an analysis environment that offered CGRO users uniform access to heterogeneous analysis software from different CGRO instruments. More recently, the ASSIST has been chosen by the AXAF Science Center as the "graphical navigator" for their ground calibration system and by the US Spectrum X Gamma (SXG) Coordination Facility as an interface to SXG software, information, and data.

New analysis and node types

An important part of the current work under the AISRP program has been to generalize the ASSIST so that it can support and manage a variety of analysis systems. The first step in this generalization has been to develop an analysis information node type. This node type allows arbitrary external programs to be managed by the ASSIST. An analysis program can be executed by the ASSIST in stand-alone mode (if a program such as an image display is expected to create its own window) or it can be started from within another window (if a command-driven program such as IRAF is meant to be started within its own xterm window). The analysis node can send initialization commands to the newly created analysis environment and it can send a kill command to the target environment when ASSIST-based processing is completed. The functionality of this new node has been tested with a variety of astronomical

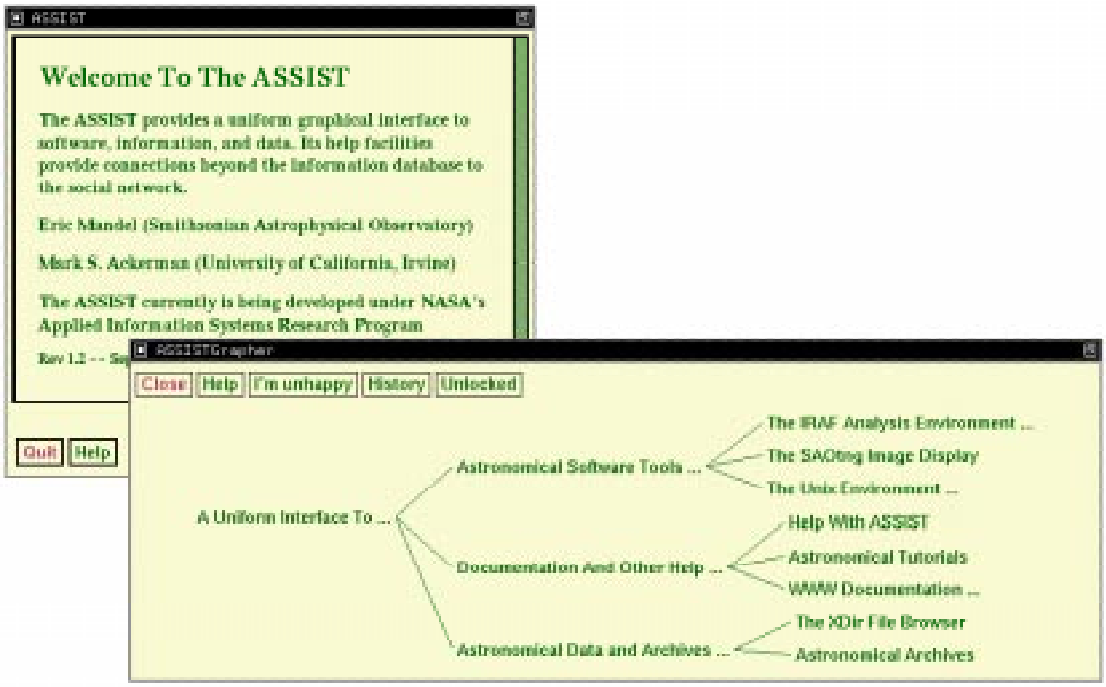


Figure 1. The ASSIST's hierarchy of graphical "trees" can be used to organize and display different types of information, software, and data.

and other programs, such as IRAF, the UNIX shell, the XSPEC spectral analysis package, the XDir directory browser, telnet, ftp, and the SAOtng image display program.

The latest release of the ASSIST also supports a World Wide Web (WWW) node as one of its basic information node types. This Hypertext Markup Language (HTML) node supports asynchronous retrieval and display of Web documents, with full interrupt capability. It uses lynx and the XPA mechanism (see below) to perform WWW retrieval, and the NCSA HTML widget as a display interface. The HTML node accepts an HTML file specifier as input and displays it as hypertext. By means of this new node, the ASSIST gives users access to "public" WWW documents in the same manner as "private" ASSIST information nodes.

The ASSIST supports the uniform integration of public and private information. When a hypertext link within an HTML document is activated within the ASSIST, the string underlying the link is analyzed. If the link points to a private ASSIST information node, that node is displayed. Otherwise, if the link points to a WWW Universal Resource Locator (URL), the appropriate WWW document is retrieved and a temporary HTML node is created within the ASSIST to display the document. The ASSIST also supports "overloading" of an HTML node with other functions; if a private ASSIST node is given the same name as a WWW URL, you can display either of these by using different mouse buttons. Thus, both public and private information can be managed with the same system and even within the same document.

One very significant aspect of this new WWW support is that you can create an HTML page that displays a hypertext document when viewed from a standard WWW browser, but that also can activate other functions (such as running an analysis program) under the ASSIST. Such a scheme is extremely valuable in cases where you want to supply general information via the Web, while also supporting more sophisticated functionality for scientific users via the ASSIST-using the same hypertext interface in both cases (Figure 3).

A step toward software cooperation

Another significant direction for the current ASSIST work is the development of software cooperation between the ASSIST and external programs and systems using the X Public Access (XPA) mechanism. XPA allows an X program such as the ASSIST to define named "points of public access", through which data and commands can be exchanged with external programs. XPA services have been added to the ASSIST to allow external processes to manipu-

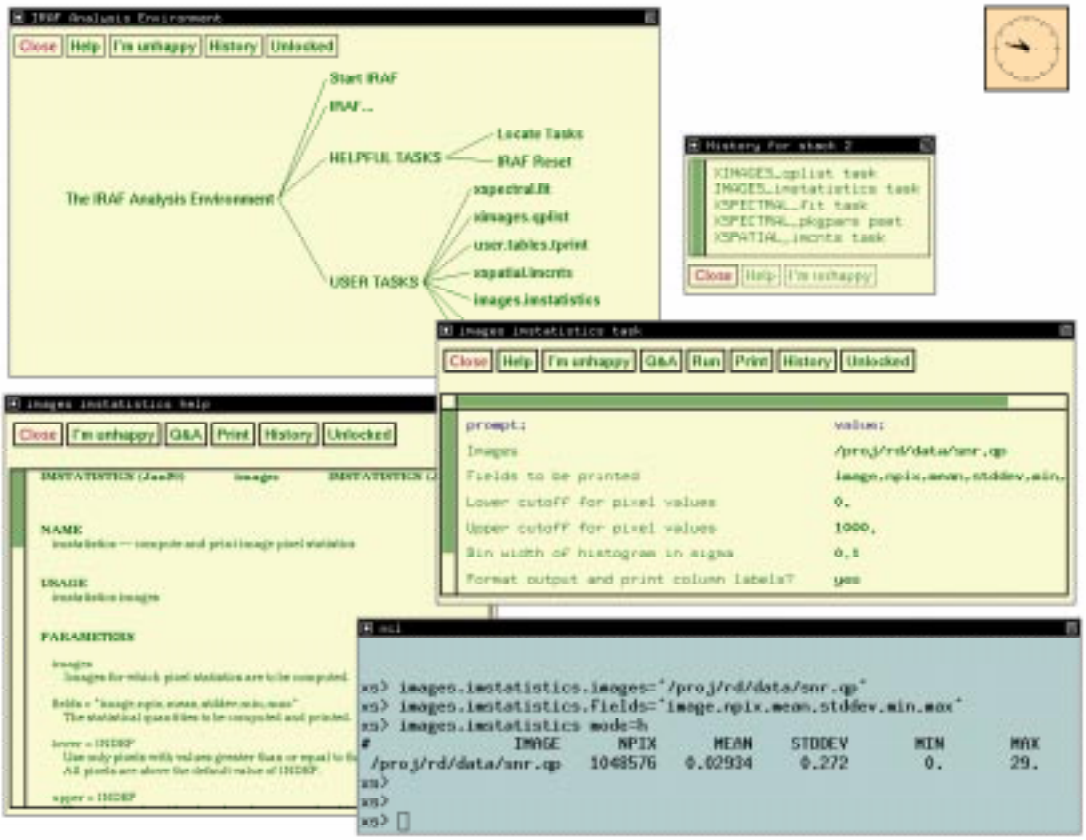


Figure 2. The ASSIST's multi-dimensional environment allows you to access available tasks (upper left), recently used tasks (upper right), the parameter state of current tasks (center), help and other documentation (lower left), and analysis results (lower right).

Prepared for the Information Sytems Branch (Code ST) through an agreement with the Jet Propulsion Laboratory (JPL). Questions on the newsletter effort may be sent to Sue LaVoie at: 818-354-5677; sue_lavoie@implmail.jpl.nasa.gov

Readers are invited to contribute articles or information regarding published works, awards, announcements (research, opportunity, or CANs), or calendar events for publication. All submittals, changes of address, or questions or comments on content should be sent to the editor, Sandi Beck, Telos Information Systems, Jet Propulsion Laboratory, 4800 Oak Grove Drive, Pasadena, CA, 91109; 818-393-3768; sandi_beck@iplmail.jpl.nasa.gov

All articles and photographs without bylines were written or taken by the editor, Sandi Beck. Editorial assistance is provided by Pat Kaspar, Ames Research Center, and Judy Laue, Goddard Space Flight Center. Newsletter layout by Michael Gregory, Jet Propulsion Laboratory.

late information nodes. Such processes can send commands to the ASSIST to activate information nodes in order to display documents and run analysis systems. External processes also can add new temporary nodes to the ASSIST or retrieve information about existing nodes. One implication of this functionality is that external programs can utilize the ASSIST as a central help system by sending "node display" commands to activate their documentation. Such programs reap the benefit of the ASSIST's special capabilities for collecting and accessing organizational memory, without having to link the ASSIST functionality into their code directly. The work in this area is a step toward developing a set of cooperating astronomical software services based on programs such as the ASSIST and the SAOtng image display.

Smart help facilities

As part of the on-going work with the ASSIST, new methods of providing help and assistance to users are being developed. Such assistance will play an increasingly critical role in helping researchers cope with the variety and complexity of scientific analysis systems. Perhaps even more importantly, focus is being placed on the need to combat the isolation engendered by the use of distributed workstations. The aim is to provide researchers with the feel of being in a common room, where they can turn to a colleague and ask a simple question.

Currently, the ASSIST allows researchers to send email for assistance or to report bugs from within the program. Commonly asked questions are re-posted within the system for others to view. A variety of tools to connect this facility into the Web are being investigated. In addition, groupware and Computer-Mediated Communication (CMC) capabilities are also being investigated. This kind of "smart help" allows you to tailor your search, with regard both to sources of information and to the order in which these sources are accessed. For example, one user might want to ask a question locally before having the question routed to a remote "expert". Another user might wish to ask questions first through bulletin board systems or by querying the Net through intelligent agents before resorting to email. A third user might only want to seek out experts or hot-line personnel. A toolkit is currently being built to provide you with a number of these types of CMC-assisted help and to integrate and manage these different kinds of help in a flexible and extendible manner. Future versions of the ASSIST will have these capabilities.

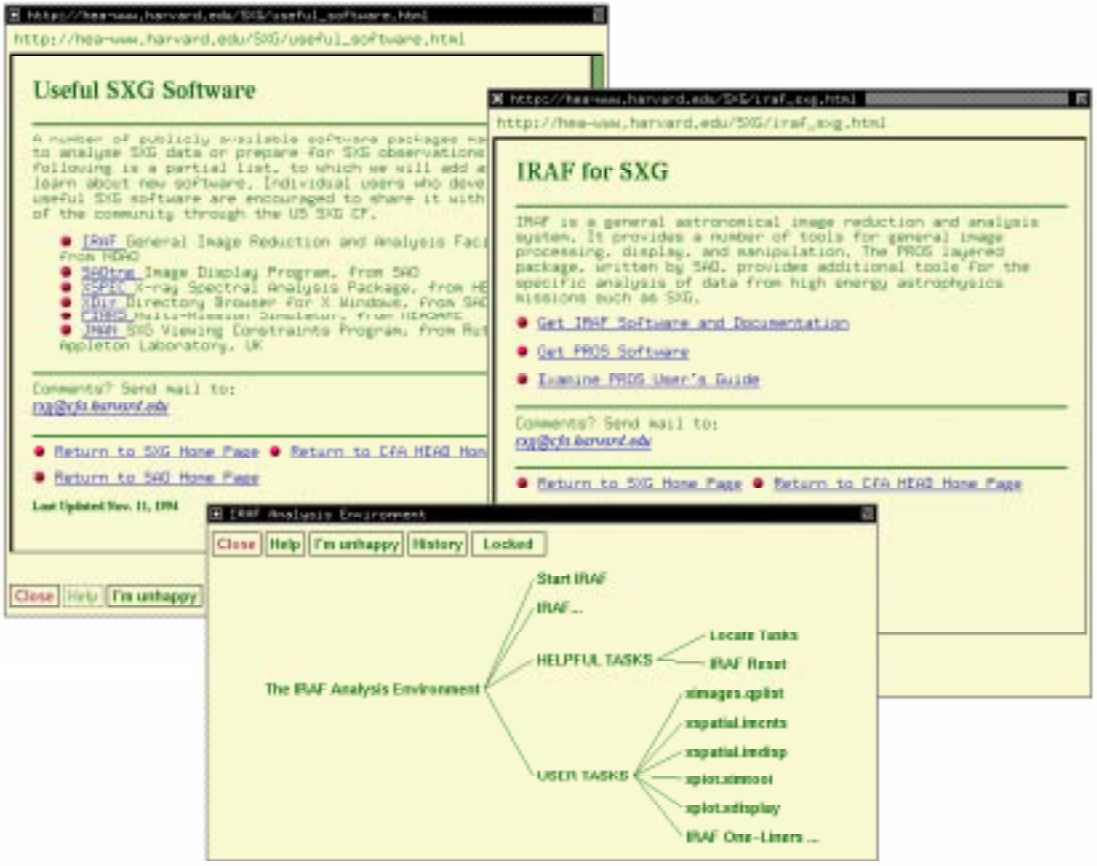


Figure 3. An example of the ASSIST's WWW support; the SAO Spectrum X Gamma Home Page offers a description of "useful SXG software" (upper left) via standard WWW browsers. Using the ASSIST, researchers can view these same WWW pages (upper right) or activate the software directly (bottom).

Availability of ASSIST

The latest version of the ASSIST is available as part of the SAO R&D software suite that also contains the SAOtng image display program, the XDir file and directory browser, the starbase ASCII data base system, and other software for scientific analysis. The software suite can be retrieved via anonymous ftp from:

ftp://sao-ftp.harvard.edu/pub/rd/saord.tar.z

The code was developed on Sun workstations under X11R5 and X11R6 (both SunOS and Solaris). Ports (with varying amounts of testing) have been done to the SGI, HP9000s700, and Dec Alpha. To build and use this software you must be running X11 (R5 or R6) and have access to the Athena widget set (Xaw). See the README, RELEASE.NOTES, and HISTORY files in the pub/rd directory for more information.

Conclusion

The ASSIST and other systems contained in the SAO R&D software suite are embodiments of an evolving software cooperation philosophy and practice that may hopefully be brought to astronomy and other disciplines. They reflect efforts on the part of a growing number of people to understand how software systems - and researchers and developers-can act in concert without sacrificing their independence.

For further information contact the author at:
eric@cfa.harvard.edu

Acknowledgments

This work was supported under NASA contracts to the IRAF Technical Working Group (NAGW-1921) and the ASSIST (NAGW-3913), with additional support from the AXAF Science Center (NAS8-39073).

Announcements and Notices

Research Announcements, Announcements of Opportunity, and Cooperative Agreement Notices

Astrophysics Data Program,
Research Announcement
November 28, 1995
Proposals due February 27, 1996
NRA95-ADP-09
Submit to:
Astrophysics Data Program, Attn: NRA
Infrared Processing and Analysis Center, 100-22
California Institute of Technology
770 S. Wilson Avenue
Pasadena, CA91125

Internet Availability

The *Science Information Systems Newsletter* is now available on the Internet at URL:

http://techinfo.jpl.nasa.gov/jpltrs/sisn/sisn.html

Please send comments or suggestions to Sandi Beck at:

sandi_beck@iplmail.jpl.nasa.gov

Calendar

JANUARY

7-11 Space Technology and Applications International Forum, Albuquerque, NM; Mary Bragg; 505-277-4950; Fax: 505-277-2814; mjbragg@unm.edu

21-25 Third International Conference/ Workshop in Integrating GIS and Environmental Modeling, Santa Fe, NM; 805-893-8224; Fax: 893-8617; sandi@ncgia.ucsb.edu

22-26 New Extragalactic Perspectives in the New South Africa: Changing Perceptions of the Morphology, Dust Content, and Dust-Gas Ratios in Galaxies, Johannesburg, South Africa; David L. Block; 27-11-339-7965; Fax: 27-11-716-3761

29 Feb 2 OSETI II: The Search for Extraterrestial Intelligence (SETI) In the Optical Spectrum, San Jose, CA; Stuart A. Kingsley; 614-258-7402; Fax: 614-258-7459

FEBRUARY

4-9 Electronic Imaging: Science and Technology, IS&T SPIE, San Jose, CA; 703-642-9090

5-7 First ISU Symposium—Space of Service to Humanity: Preserving Earth and Improving Life, Strasbourg, France; Emman Moyen; Fax: 33-88-655-54-47; moyen@isu.isunet.edu

10-15 Application of Remote Sensing and GIS on Rangelands, Society for Range Management, Wichita, KA; Douglas Johnson; 503-737-0504

12-14 Workshop on Evolution of Martian Volatiles, Houston, TX; Lunar and Planetary Institute; Renee Dotson; 713-486-2188; Fax: 713-486-2125; dotson@lpi.jsc.nasa.gov

19—21 Earth Data Information Systems, Soth African Photogrammetry and Geo-Information Society and Transvaal Association of GIS, Pretoria, Gauteng, South Africa; 021-685-4070

27-29 Environmental Research Institute of Michigan (ERIM)/Geologic Conference, Las Vegas, NV; Wallman@erim.org

MARCH

11-14 Infrared Space Interferometry Workshop, Toledo, Spain; Margie Guitart; 34-813-1161; Fax: 34-1-813-1160; irinter@laeff.esa.es

18-22 27th Annual Lunar and Planetary Science Conference, Houston, TX; Publications and Program Services Department; 713-486-2166; Fax: 713-486-2160; simmons@lpi.jsc.nasa.gov

20-23 ACM Digital Libraries ‘96, Bethesda, MD; http://fox.cd.vt.edu/DL96/

25-28 AM/FM International Annual Conference XIX, Seattle, WA; 303-337-0513; Fax: 303-337-1001

APRIL

1-3 Data Compression Conference ‘96, IEEE Computer Society TCCC, Snowbird, UT; dcc@cs.brandeis.edu; http:// www.cs.brandeis.edu/~dcc

19-25 20th International Symposium on Space Technology and Sciene and 8th International Astrodynamics Symposium, Gifu, Japan; Tomifumi Godai; 03-5473-7014; Fax: 03-5473-7814

20-24 American Geophysical Union Spring Meeting, Baltimore, Maryland; AGU Meetings; 202-462-6900; Fax: 202-328-0566

20-24 Sixteenth Annual ESRI User Conference, Palm Springs, CA; 909-793-2853; Fax: 909-793-5953; ucregis@esri.com:

24-27 2nd International Airborne Remote Sensing Conference and Exhibition, ERIM, San Francisco, CA; 313-994-1200 x3234; Fax: 313-994-5123

Wild Blue and Yonder Improve Access to Space Shuttle Earth Observations Photography

John Cloud, Geography Department, University of California Santa Barbara, CA

Space Shuttle Earth Observations Photography (SSEOP), the Earth-looking photography shot from the space shuttles, is a diverse data set that rivals any other within the history of Earth systems science. Among non-classified data, SSEOP is uniquely phenomena-centered and captured by human decision, from which an interesting duality results; astronauts work hard to frame the photographs' composition, yet the visual patterning of the earthly phenomena that are captured within the photographs are relatively unfiltered. These photographs offer a uniquely oblique perspective among space-borne sensors, and examination of the photographs reveal significant clues to a vast array of meso-scaled Earth processes. As noted by Justin Wilkinson, Lockheed Engineering Sciences Corporation geomorphologist and astronaut instructor, the principal function of SSEOP is to stimulate new ideas.

Wild Blue and Yonder began as a project to access the first of the series of NASA SSEOP videodiscs (see SSEOP resources section for information about the videodiscs and related access tools). The videodiscs were a breakthrough in SSEOP history; for the first time, you could examine the full range of SSEOP imagery without being physically present at the SSEOP archives at Johnson Space Center (JSC)—if you had access to the videodiscs. Of course, full SSEOP use still requires access to SSEOP film products, or high-resolution digital versions of the film. The videodisc frames, and their digital counterparts on the Imaging Services World Wide Web (WWW) page should be considered as aids to identifying appropriate photographs.

Major improvements in SSEOP access are underway. This article concentrates on two related SSEOP access software applications designed at the University of California at Santa Barbara (UCSB) by George Michaels, UCSB Office of Instructional Consultation (OIC), and the author. The OIC emphasizes "idiot-proof" customizations of robust commercial software, and the project proceeded along that direction. Wild Blue and Yonder were designed specifically to enhance access to SSEOP, but also represent a prototypical image access and management system that could be applied to other imagery archives.

Design philosophy

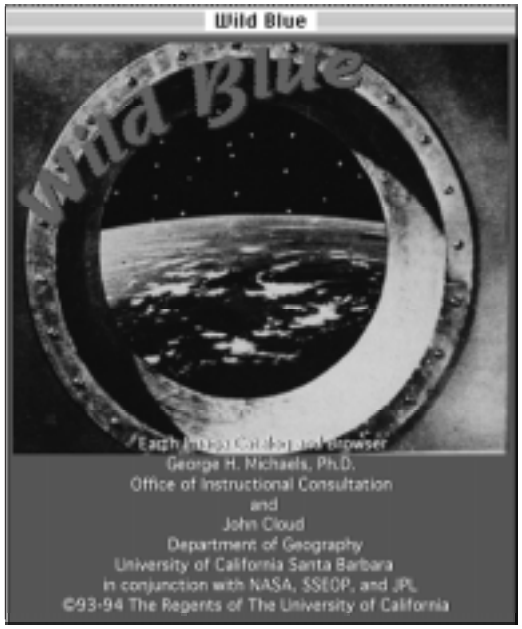
The experience of the SSEOP community at JSC demonstrated that it was important to look at many photographs, then concentrate more carefully on examination of rich subsets of the images. The process was envisioned as many iterations of a triad: querying the dataset, browsing the imagery set, and managing the images. Querying was perfomed using tools that afforded a variety of search strategies to better accomodate the great diversity of SSEOP images, and to help researchers evolve search routines that worked for them. Browsing was performed by technologies at least as fast as the image-scanning abilities of SSEOP users, to minimize or eliminate waiting for images to appear—the bane of life on the Internet. Managing was performed using tools that assist SSEOP users to cull images that don't fit their needs and flag those that do, to describe and recall images, to sort them and rank them, and in general manage them appropriately to the users' needs.

Wild Blue

The query engine and digital image browsing application Wild Blue (Figure 1) is a customized version of ACI US' Fourth Dimension relational database management system. The Wild Blue dataset is based on the SSEOP mission catalogs. In anticipation of Wild Blue's use as an archival tool, the dataset contains all pre-shuttle NASA manned missions, beginning with the Mercury Program, and includes the catalog of the Skylab missions (1973-74) that may eventually be recognized as the "King Tut's tomb" of NASA's global change datasets.

The principal function of SSEOP is to stimulate new ideas.

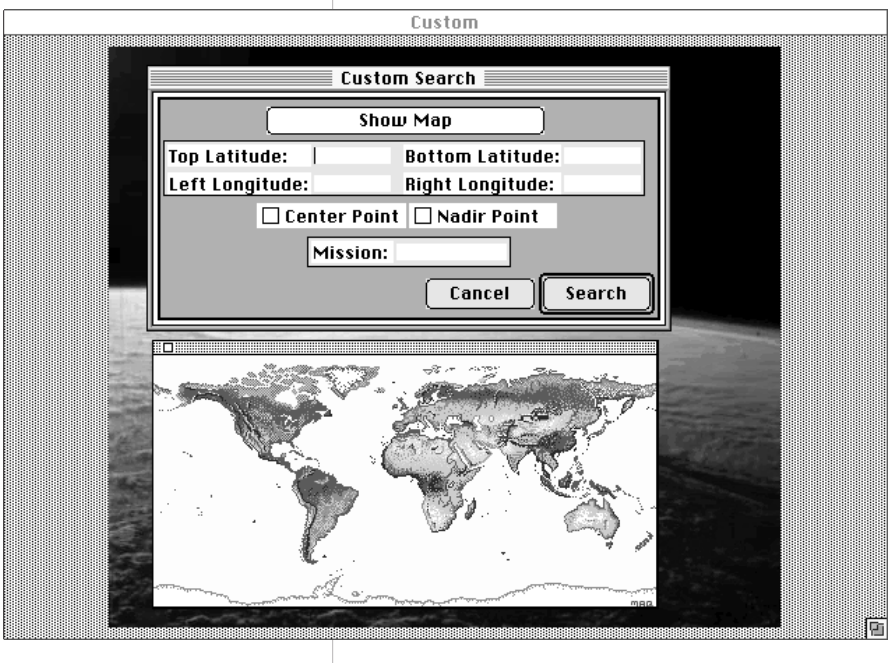
Figure 1. Splash screen



SSEOP photographs have an associated attribute dataset that is simple but functional if approached correctly. Since the most common SSEOP search query is a search based on geographic location of the photographs, the query screen was designed to allow you to establish a latitude/longitude search box by mouse clicks on a world map (Figure 2). Wild Blue users can also use the 4D search editor for queries using robust boolean operations on all the SSEOP attribute fields (Figure 3). To speed the system throughput, commonly used fields of the dataset have been indexed to allow rapid response.

Information about photographs corresponding to query results is displayed by a special data template (Figure 4) that includes thumbnail and full-size versions of SSEOP scanned photographs when they are available. Virtually all SSEOP film is now being scanned at moderate resolution (756 by 486 pixels, 24 bit color), and subsets of the growing catalog are accessible on the Imaging Services server at JSC. Because the project began as a way to "drive" the new NASA videodiscs, the image management tools were placed on the multimedia driver Yonder.

Figure 2. Search map



Yonder

Wild Blue query results are outputted to Yonder, which is a customized Hypercard application. The Yonder cards control the videodisc player, and also contain an array of simple but effective image management tools. These include buttons to easily and quickly flag better and best images, and four user-defined fields that allow Yonder users to characterize SSEOP images by their own keywords or descriptors, and easily export enriched subsets of Yonder cards corresponding to SSEOP images tailored to user desires. The Wild Blue data set presently contains about 115 Megs of attribute data. An incidental byproduct of splitting the system between Wild Blue and Yonder is that even very large query results translate into easily transportable kilobytes on Yonder Hypercard stacks so that, armed with the NASA videodiscs and a few diskettes, you can access very rich subsets of SSEOP browsing images at a speed equivalent to viewing a 35-mm slideshow.

The next iteration

Wild Blue and Yonder are presently stand alone applications. This project will continue to be developed for specific sites and local area networks as long as image data transmission speeds remain the rate-limiting steps of Internet access. The query mechanisms are relatively sophisticated compared to most WAIS servers, and you can flash through browsing images rapidly, and at your own control.

The next expansion of Wild Blue and Yonder is planned to coincide with an expansion of SSEOP's role at the premier NASA dataset. The original Apollo program and Skylab program film rolls are presently being transferred to archival film, and scanned as browsing images. It is anticipated that those images, once again accessible, may open a new chapter in global change research and education.

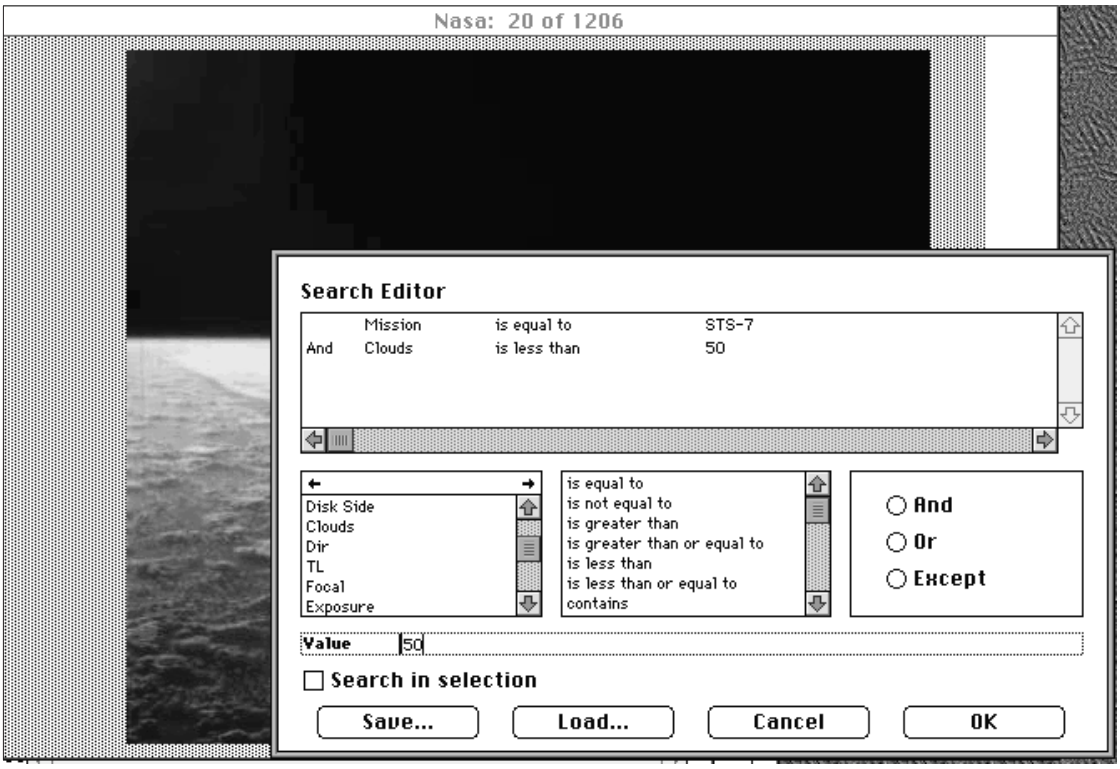


Figure 3. Search editor

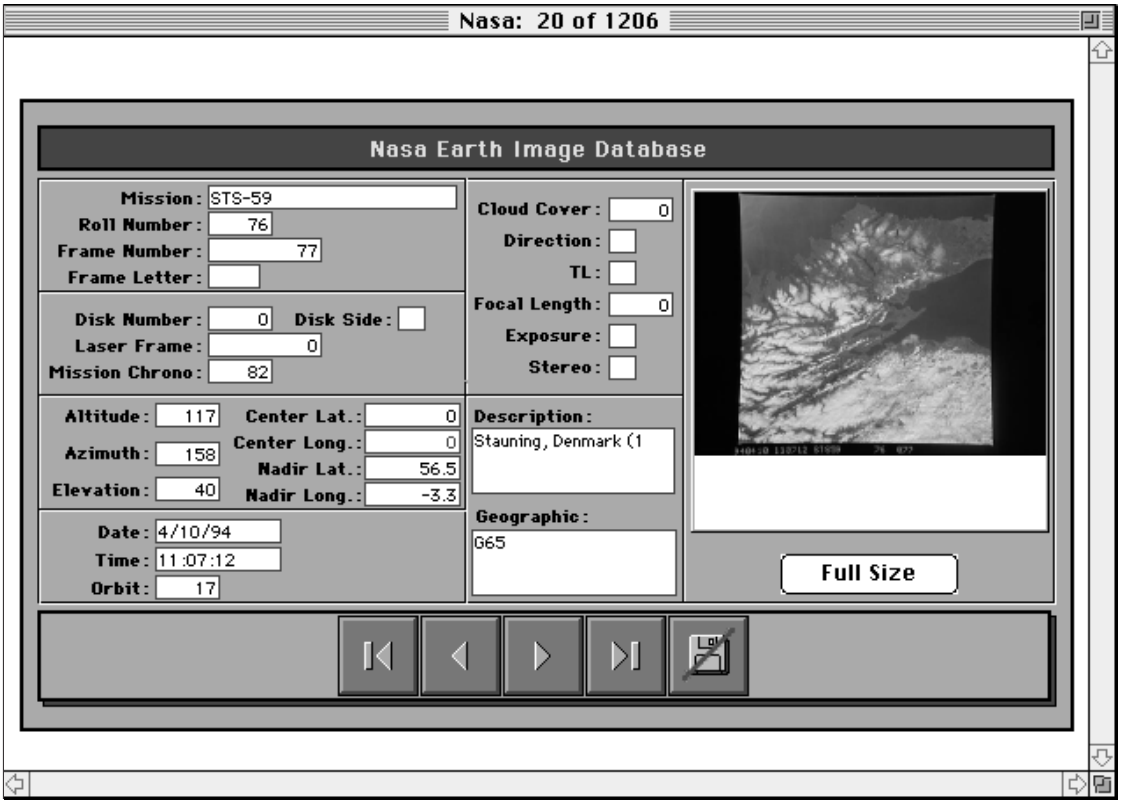


Figure 4. Single record screen

SSEOP resources

Wild Blue and Yonder are in the process of being licensed by the Regents of the University of California. For information about obtaining them contact:

Dr. Stan Nicolson
Office of Instructional Consultation
1130 Kerr Hall, University of California
Santa Barbara, CA 93106-3200
Phone: 805-893-2378
Fax: 805-893-8373
stan@id.ucsb.edu

The SSEOP office at JSC Earth Sciences Branch maintains a WWW site with information about SSEOP and its activities, and thousands of down-loadable image files. You may access this information at:

http://ersaf.jsc.nasa.gov/sn5.html

To access an updated schedule of current space shuttle flights, their planned dates, orbital inclinations, and major payloads, use finger at:

news@sseop.jsc.nasa.gov

To access SSEOP mission catalogs from the SSEOP server, use telnet at:

sseop.jsc.nasa.gov, username: PHOTOS

Imaging Services branch

The Imaging Services branch has published two archival videodiscs containing, together, over 150,000 browsing versions of SSEOP photographs from the first 57 space shuttle missions, 1981 to 1993.

The first videodisc, *Earth Observations Images: STS-1 through STS-44*, covers shuttle missions from 1981 through December, 1991. This disc contains approximately 91,000 videoframes of Earth observations photography. It is accompanied by the *Guide to Images* JSC-26056 (October, 1992) that contains useful summary descriptions of the shuttle missions and brief descriptors for the most outstanding photographs from each mission. The first videodisc may be ordered (at a charge) by contacting:

Bunny Dean
Mail Code AP2
NASA/JSC
2101 NASA Road 1
Houston, TX 77058-3696
713-483-2462

The second videodisc, *Earth Observations Images: STS Missions from January 1992 Through September, 1993 and Press Release Imagery Mercury through STS-51*, contains approximately 55,000 videoframes of Earth observations photography. It is accompanied by *Guide to Images* JSC-26643 (April 1994). The second videodisc may be orjdered (at a charge) by contacting:

NASA CORE
Lorain County JVS-NASA
15181 Route 58 South
Oberlin, OH 44074
Cathy Kaiser
216-774-1051, ext. 249/293/294

The Imagery Services WWW site contains digitized image files for press release photographs and selected subsets of Earth observations photography for all NASA manned spaceflight missions, as well as full mission image catalogs for the most recently cataloged space shuttle mission. These image files may be accessed at:

http://images.jsc.nasa.gov/html/home.htm

To obtain SSEOP photo products contact any of the following:

Media Services Corporation
NASA Johnson
P.O. 58425
Houston TX 77258
713-483-4321
Fax 713-483-4876

Earth Data Analysis Center
2500 Yale Blvd. SE, Suite 100
Albuquerque, NM 87106
505-277-3622
Fax 505-277-3614
edac@spock.umn.edu

EROS Data Center-USGS
Sioux Falls, SD 57198
605-594-6151
Fax 605-594-6589
custserv@edcserver1.cr.usgs.gov

For further information contact the author at:
cloud9@geog.ucsb.edu

The Science Information Systems Interoperability Conference Report

The Science Information Systems Interoperability Conference, sponsored by the Office of Space Science Information System Branch, was held November 6-9 at the University of Maryland. The objectives of the conference were to provide a forum for the exchange of information and ideas, discuss emerging technologies and issues related to performing scientific research, and provide the opportunity to demonstrate evolving information systems and network tools.

Guenter Riegler, Office of Space Science at NASA Headquarters, opened the conference with a discussion of the office's recent reorganization and the effect on the information system community and introduced the keynote speaker, Ben Shneiderman, who spoke on "User Interface Research for Accessing Scientific Information." Shneiderman, a professor in the Human-Computer Interaction Laboratory at the University of Maryland, presented his theory on better ways to develop user screen design.

Six major programs of papers and panels were presented over the four days. They were:

- Directories Workshop
- Distributed Data Management Tools
- World Wide Web Engines, Interface, and Extensions
- Effective Network Usage in a Limited Baud Rate Environment
- Distributed Data resources Policy Issues
- Netscience Approaches and Needs

Additionally, many exhibitors demonstrated science information system applications on workstation-based terminals, with connectivity provided by the NASA Science Internet. The exhibitors included:

- the Planetary Data System (PDS)
- the PDS, Planetary Plasma Interactions node, Working distributed Data Warehouse
- the Standard Format Data Unit's Science Data User's Workbench
- the Global Change Master Directory
- the Computational Modeling Systems' Computational Support for Scienctific Modeling Activities
- the U.S. Global Change Data and Information Systems Organization's Data management Working Group System's Home Page
- the Global Change Research Information Office
- the Great Lakes Regional Environmental Information System
- the Global Change Assisted Search for Knowledge
- the Satellite Active Archive
- the Astrophysics Multi-spectral Archive Search Engine
- a LinkWinds display
- the Life Science Data Archive
- the Space Physics Data System
- the National Space Science Data Center
- the Astrophysics Data System
- the Distributed Oceanographic Data System

The conference program committee was chaired by Joe Bredekamp, Information Systems Program at NASA Headquarters. Jim Thieman, National Space Science Data Center at Goddard Space Flight Center, was the main organizer for the conference.

All presenters displayed their abstracts and were invited to submit their papers for inclusion on the Web site that is viewable at:

http://nssdc.gsfc.nasa.gov/sisc/sisc.html

The papers will be part of an online conference proceedings, currently in preparation.

Navigation Ancillary Information Facility

The goal of the Navigation and Ancillary Information Facility is to provide the planetary science community with data sets and transportable software tools, appropriate for computing, archiving, accessing, and distributing the ancillary viewing geometry needed to interpret observations of solar system bodies.

Geometry and Graphic Software Update

A Tool for Planetary Observation Design and Science Analysis Visualization

Karen E. Simmons, Scott Lasica, and Brian Pape, Laboratory for Atmosphere and Space Physics, University of Colorado, CO

The update of the integrated Geometry and Graphics Software (GGS), version 2.6, has recently been completed at the University of Colorado's Laboratory for Atmospheric and Space Physics. GGS, a work in progress, is a tool for planetary observation design and science analysis visualization that uses SPICE-formatted ancillary data kernels and the Navigation and Ancillary Information Facility (NAIF) SPICELIB Toolkit on an IDL (by Research Systems Inc.) language base. Begun in 1988, GGS was initially developed as a science visualization and geometry generation tool for the Galileo science team working on Ultraviolet Spectrometer/Extreme Ultraviolet Spectrometer instruments and quickly developed into an observation planning tool. In 1994 the NASA-sponsored Applied Information Systems Research Program accepted a proposal to transform the spacecraft/instrument-specific software core to a more generic model, usable by any mission and by diverse science instruments.

GGS has now been successfully recoded and has been used on data from various missions, including Voyager, Galileo, Phobos, and the Defense Meterological Satellite Program. The Cassini Ultraviolet Imaging Spectrometer (UVIS) team used the Cassini GGS implementation to begin the designs of its Saturn observations. A spin-off version resulted that will be developed by the Cassini project. GGS is available on several computer platforms and is currently being used in the US, Germany, and France. For those interested in taking a "test drive" see the Software Support Library site at:

http://sslab.colorado.edu:2222/projects/GGS/ggs_toc.html

New science functionality

As an integrated design and analysis tool, GGS provides the predict geometry and model interfaces that allow the planetary scientist to design observations that will optimize the science return. After the data are returned, the same tool provides quick and efficient data analysis using the same models and telemetered SPICE data. By using SPICE kernels, the designs may be distributed to other team members or to the mission sequence design group for efficient sequence development. Archival is also simplified. Toward this end, recent work has been toward developing the Physical Model Interface (PMI) utility and a Bundle-of-Lines-of-Sight (BLS) slit filling routine. The PMI acts as the connecting point between the GGS graphics and geometry code and that of the science models. Information will pass both ways; geometry currently passes to the modeling software and modeled data will return to GGS where the visualization will enhance the understanding of the geometry and model relationships. The Galileo Ultraviolet Spectrometer/Extreme Ultraviolet team is currently using the PMI and BLS utilities to model the Io Torus data obtained during the Jupiter approach and to analyze the Earth 2 encounter lunar data (Figure 1).

Significant additional science analysis utilities include image mapping and science data display. Images from the Planetary Data System archive CD-ROMs can now be read and mapped directly onto the main graphic. Likewise, science data files can be read and displayed separately or mapped to the same graphic to enhance interpretation and analysis of several coordinated data sets. Also, simultaneous animated displays of multiple data sets can be used to visualize the interrelationships of the science data and the changing geometry environment, as depicted in Figure 1.

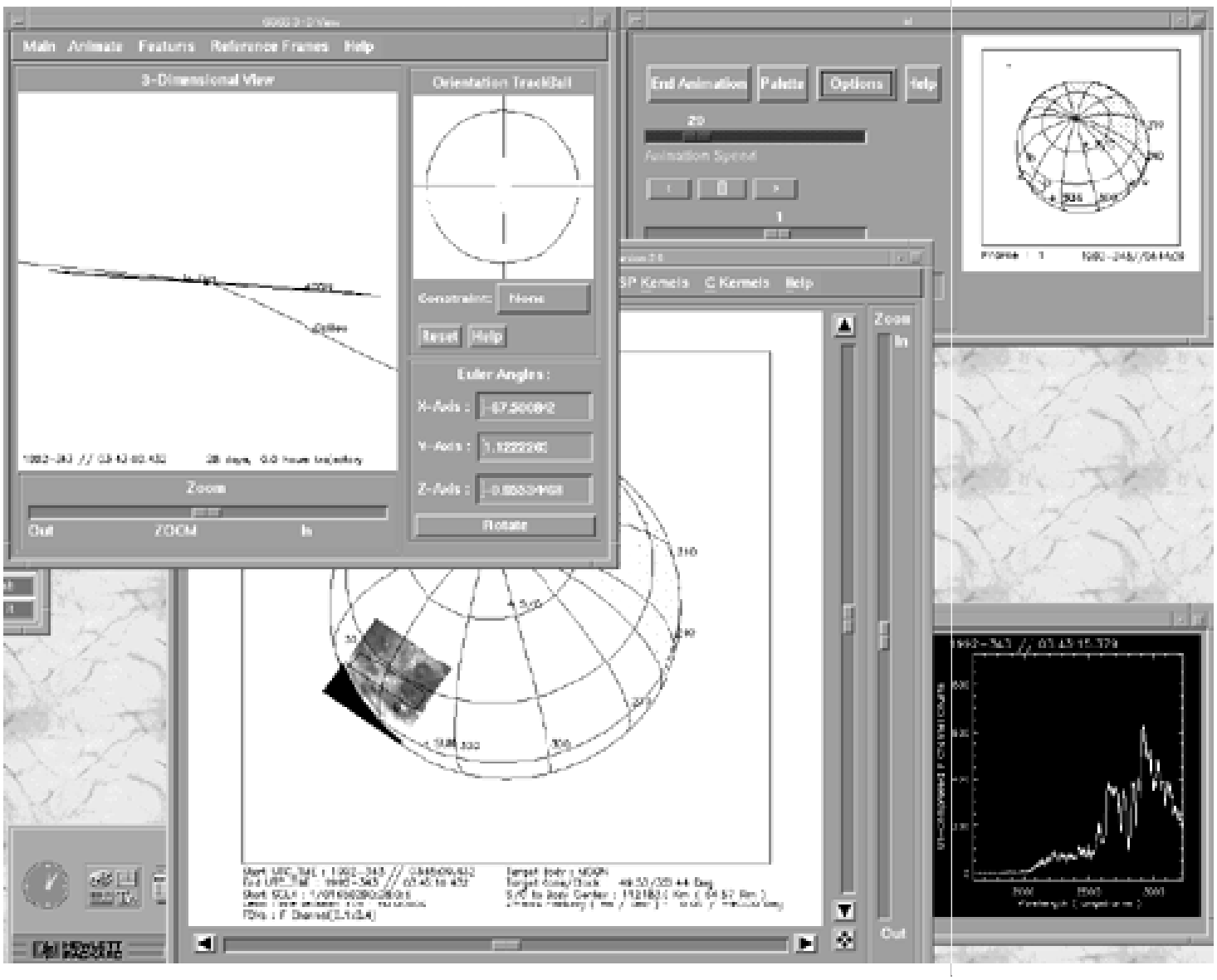
Updates to geometry utilities include the new 3D View that replaces the Top View function and allows you to view encounter trajectories from any position based on the manipulation of a track ball. The New Orbit

function that allows you to create a new tour orbit is augmented by a rubber-banding orbit feature (contributed by Cassini UVIS) that allows interactive adjustment of the classic orbital elements in order to investigate better tour orbits. Animation and Print capabilities provide additional capability on all these new features. Several of the Observation Design functions that calculate correct position and timing for specific observation types have been recoded. Limb Drift, for example, that calculated the specific boresight pointing to place the slit parallel to the target body limb at point of contact as the spacecraft drift carries the Field of Vision (FOV) across the body, is now the Stare function. You can supply pointing in several coordinate systems or by Mouse click. The Overplot function allows you to compare geometry from several pointing kernels simultaneously.

Graphical user interface updates

Significant Graphical User Interface (GUI) design changes have occurred in version 2.6 of GGS. The early "store front" GUI buttons and menus have been reduced to one button and the remainder of the user utilities and options now appear in a Motif/Windows/Mac style top-line menu bar. Some of the store front options now appear in separate pop-up windows when activated. The Track Ball (instant viewing geometry values) and the Time input windows are two cases. Accelerator keys now speed the access of many menu items. Several Default windows inform you of the operating environment and provide far more customization than previously available. A new Constraint Checking function allows rudimentary spacecraft and instrument constraint checking that warns the designer if critical health or use issues have been violated. This feature also

Figure 1. Center: Main Galileo Geometry and Graphics Software window showing the Ultraviolet Spectrometer slit drift with one Solid State Imaging image mapped onto the lunar target body. In the upper right is the instrument boresight animation window. In the lower right is the science data animation window. In the upper left is a 3D view of spacecraft/moon trajectory.



makes use of the new Command Checking option that reads the Event kernel for information about commanded parameters that affect the instrument FOV. The Galileo Ultraviolet Spectrometer F and G detectors, for example, use different slit sizes so the graphic and constraint check is based on the detector being used. The Time input window now has time increment buttons, a Session Queue and Last Entry options, and a Mission Events table to allow point-and-click time selection.

The new GUI features plot options that are now separately selectable for the main plot, animation, and printed graphics. These include colors, Auroral bands, and additional bodies such as the Earth, Sun, and Io Torus. Other updates are true-size background bodies, star view/label selectable magnitude display levels, constraint violation plot options, and overplot capability.

GGS kernel file Management and Save capabilities have been augmented. SP (spacecraft/planet) and C (pointing) kernel file managers allow you to preselect kernel files to be used to speed this interaction. The original autonomous file search functions are still available. Kernel view functions have been added to allow you to interrogate the contents of selected kernels. Default internal GGS parameter selections such as Earth Mean Ecliptic 1950 versus J2000 or Earth Receipt Time versus Spacecraft Clock Time reference frames are now user selectable. They are saved in a defaults file within your directory for recall each time you start up the GGS tool. This provides quick parameter verification. Log files are now automatically generated whenever a kernel file is saved, and document the generation and source history.

Finally, a new Help and Demo set of utilities provide more detailed help for each utility, function, button, menu item and input value. An online Demo window allows you to read instructions from a separate window while manipulating the main graphic and "test driving" the program.

The next major GGS release will include faster internal graphics handling. Also being worked is the capability to correct pointing kernels based on non-imaging science data.

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This activity is funded by NASA's Applied Information Systems Research Program. You may access this program's WWWHome Page at:
http://www.hq.nasa.gov/office/oss/aisr/aisrp.html

Publications

Editor's Note—*NASA/Office of Space Science is proud of the contributions many of its science and applications researchers, scientists, and engineers make to professional organizations and publications. Please direct all inquiries to the authors.*

The X Public Access Mechanism
E. Mandel, R. Swick, and D. Tody,
The X Resource, Issue 13, Proceedings of the 9th X Technical Conference, 1995.

Global Observation Information Network Demonstrated

Deana Bergquist-Hinz, NASA Science Internet, Ames Research Center

The NASA Science Internet's (NSI's) Mission to Planet Earth Networking Support Group at Ames Research Center, in cooperation with the National Oceanic and Atmospheric Administration (NOAA), recently supported the White House by coordinating and participating in online demonstrations of the Global Observation Information Network (GOIN) in Washington, DC. Attendees at this June 6 historic event included John Gibbons, Assistant to the President for Science and Technology Policy, Dan Goldin, NASA Administrator, and Ms. Tanaka, Japanese Minister of State for Science and Technology.

The GOIN Initiative will provide various benefits worldwide. GOIN will expedite access by scientists, educators and the general public to global change and disaster monitoring data. This access will make it easier and faster to share critical data to prepare for, respond to, and predict natural disasters. Enhanced scientific collaboration between the US and Japan, as a result of GOIN, will help to foster a better understanding of various phenomena on the Earth and their impacts on our lives. Finally, GOIN will contribute greatly to the Global Information Infrastructure and represents a major step in further leveraging national resources to meet international environmental goals.

The demonstrations culminated a two year effort to enable researchers and policy makers on both sides of the Pacific to exchange environmental data critical to predicting and preparing for such natural disasters as the Kobe and Northridge earthquakes. The GOIN Presidential Initiative is part of the "Common Agenda of the United States-Japan Framework for a New Economic Partnership" agreed to in July 1993 by US President Clinton and Japanese Prime Minister Miyazawa. Under the Common Agenda the two governments have expressed their commitment to "pursue a new joint response to the challenge in environment and other common economic issues of global implication." GOIN also contributes to the foundation for a Global Information Infrastructure by developing connectivity and interoperability through the use of common approaches, sharing of technology, and coordination of network policies.

The two part demonstrations, covered by Cable News Network, Reuters, and other news agencies, included a VIP demonstration and a

Figure 1. Attendees at demonstrations of the Global Observation Information Network at the National Oceanic and Atmospheric Administration's Silver Springs, Maryland, facility

NSI

NASA Science Internet

The NASA Science Internet program develops and operates computer networks for NASA's space science and applications community to enable researchers world-wide to connect to science databases, computational resources, and to each other for collaboration.

technical workshop to illustrate how data is being shared across the Pacific as proof of the GOIN concept. The VIP demonstration, held in the White House Briefing Room of the Old Executive Office Building, featured dignitaries in Washington and Tokyo exchanging statements via a high bandwidth satellite video link.

The Interagency Technical Workshop was held at NOAA's Silver Spring Metro Center Facility. A dozen US agencies provided demonstrations with 14 Japanese agencies and featured examples of the following: information management system interoperability, data set exchanges, scientist-to-scientist conferencing, information server access, and Global Schoolhouse interactive conferencing. Included in the attendance at the workshop were high-level representatives from NASA, NOAA, and the Japanese Embassy, including Charles Kennel, Associate Administrator for NASA's Mission to Planet Earth (MTPE), and Dixon Butler, Director of Information Systems for MTPE.

GOIN is an ongoing activity. In the current phase, Japanese and US agencies have agreed to cooperate on a bilateral basis to increase the availability and access to global observation data. In addition, the agencies are cooperating to provide increased access to developing countries and to expand the GOIN initiatives to a global context through such activities as the Committee on Earth Observations Satellites and the Global Earth Observation System. A five-year plan to coordinate the efforts of US and Japanese government interagency communities interested in expanding electronic exchanges of global change data is outlined in the GOIN Implementation Plan.

For further information about the GOIN Initiative access the World Wide Web sites at:

http://www. nnic.noaa.gov/GOIN/GOIN.html

http://www.goin.nasda.go.jp/

Participating United States agencies currently include:

- National Oceanic and Atmospheric Administration
- National Aeronautics and Space Administration
- National Science Foundation
- Department of State
- Environmental Protection Agency
- United States Geological Survey
- National Telecommunications and Information Administration

Participating agencies of Japan currently include:

- Environment Agency
- Ministry of Foreign Affairs
- Ministry of Education, Science and Culture
- Ministry of Agriculture, Forestry and Fisheries
- Ministry of International Trade and Industry
- Ministry of Transport
- Ministry of Posts and Telecommunications
- Ministry of Construction
- Science and Technology Agency

Cooperating Japanese entities (under the supervision of agencies of Japan) include:

- Earth Resources Satellite Data Analysis Center
- Japan Information Center of Science and Technology
- Japan Marine Science and Technology Center
- National Space Development Agency of Japan

Texas McDonald Observatory Gains Connectivity

Joann Nelson and Pat Kaspar, NASA Science Internet, Ames Research Center

The NASA Science Internet (NSI) staff has completed negotiations to install Internet connectivity to observatories on two mountains in Texas.This arrangement satisfied the requirements of a variety of programs in the Office of Space Science and the Office of Mission to Planet Earth, while ensuring that there would be no interference with the frequencies utilized by the nearby National Radio Astronomy Observatory (NRAO).

Researchers at the University of Texas in Austin needed increased network connectivity to the McDonald Observatory on Mt. Locke in order to transfer data, taken each night from the observatory computer, to remote collaborators at other institutions. They also needed to accomplish real-time debugging of telescope control software and data acquisition systems. Mt. Fowlkes, the next peak over from Mr. Locke and the site of the McDonald Laser Ranging System (MLRS), will also benefit from increased bandwidth. It has been operating with a slow, costly 9.6-kb/s NSI connection. Many of the NASA-funded MLRS projects will shift to the Spectroscopic Survey Telescope (SST), the major new ten-meter class optical telescope under construction on Mt. Fowlkes, when it is ready in late 1997.

Anita Cochran first discussed the McDonald Observatory's requirements with the Solar System Exploration Requirements Manager at the Division of Planetary Sciences conference in 1993, but several problems had to be overcome in order to provide this service. Digital facilities had to be brought into these remote mountain tops, a solution had to be designed that would not interfere with the frequencies utilized by the nearby NRAO, and an arrangement had to be made with the University to extend the network service from Mt. Locke to Mt Fowlkes and to take responsibility for ongoing management of the the service.

The agreement, now being finalized, spells out the responsibilities of each party in a Letter of Agreement. Under this arrangement, NSI will provide T1 service between the McDonald Observatory on Mt. Locke and the University of Texas's Permian Basin Campus in Odessa, Texas, paying for the circuit installation and monthly recurring circuit charges in support of validated science requirements at these observatories. The University of Texas in Austin will provide Internet routers at these two sites to route the observatories' traffic to and from the Internet. It will also manage this tail-circuit to ensure network availability for NASA-funded scientists.

The University has agreed to extend this Internet service by providing a local area network (LAN) from the McDonald Observatory on Mt. Locke to the MLRS and the SST on Mt. Fowlkes. The only requirement the LAN extension must meet is to ensure that all three observatories—McDonald, MLRS, and SST—have equal access to the bandwidth, and that the network design does not use spread spectrum or microwave that may impede science at the nearby NRAO site. The NRAO was concerned about its radio telescope receiving potentially harmful interference by direct, harmonic, or intermodulated transmission from a transmitter.

Some of the programs supported by this T1 service include Solar System Exploration, Planetary Astronomy, Origins of Solar Systems, Planetary Atmospheres, and Space Geodesy and Altimetry Projects.

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NASA Hosts Committee on Earth Observation Satellites

Regina Duda, NASA Science Internet, Ames Reasearch Center

The NASA Science Internet's (NSI's) Mission to Planet Earth Networking Support Group hosted a 10 day conference for the Committee on Earth Observations Satellites (CEOS) Working Group on Data (WGD) Subgroups September 7-15 in San Francisco, California. The CEOS WGD facilitates the use of data from Earth observation missions by coordinating and standardizing aspects of data management. CEOS was created in 1984 as a result of the International Economic Summit of Industrialized Nations and serves as the focal point for international coordination of space related, Earth observation activities. Policy and technical issues of common interest related to the whole spectrum of Earth observation satellite missions and data received from them are addressed under the auspices of CEOS.

The CEOS meetings hosted by NSI included the Catalog Interoperability Experiment (CINTEX) Workshop and Meetings of the Catalog, Format, Auxiliary Data, and Network Subgroups. Participation included a wide range of international agencies including NASA, National Oceanographic and Atmospheric Administration, the European Space Agency, EUMETSAT, the European Commission, the United Nations Environment Programme, and counterpart space and Earth observation agencies from Australia, Brazil, Canada, France, Germany, Italy, Japan, Norway, Russia, and the United Kingdom.

In addition to coordinating this international conference, NSI presented briefings to the CEOS Subgroups on the following topics and workshop participation:

- network performance monitoring tool development and network performance measurements in cooperation with international agencies
- network security
- the Global Observation Information Network VIP Exchange and Technical Workshop held June 6, 1995, with the participation of multiple agencies in Japan and the US
- Network Services Registry
- US/NASA Country Report
- NSI's Activities and International Cooperative Agreements

A half-day tour of Ames Research Center was included in the 10 day conference schedule for the CEOS meeting attendees. The program was emceed by the Distributed Systems Division's Acting Division Chief, Herb Finger, with opening remarks made by the Center Director, Ken Munechika; the Computational Sciences Division's Chief (Acting), Ron Deiss; and the NASA Science Networks' Program Manager,Tony Villasenor.

The group then visited three designated demonstration locations, including the NSI Network Operations Center and two research sites in Information Systems and Earth Sciences. The tour of the NSI Network Operations Center was led by the NSI Project Manager, Christine Falsetti. The tour of the Network Operations Center was led by Jeanine Kamerdze (group lead) and Carlos Burgos (network operations analyst). The tour of the Intelligent Mechanisms Branch was led by Butler Hine III (group lead), and the tour of the Earth Science Division, Ecosystem Science & Technology Branch, was led by Branch Chief, David Peterson.

For further information access the CEOS World Wide Web site at:

http://gds.esrin.esa.it:80/CCEOSinfo

Global Data Sets for Land-Atmosphere Models Now Available

Blanche Meeson, Goddard Space Flight Center, Frank Corprew, and James McManus, Hughes STX

A five-volume CD set of temporally and spatially consistent global data sets for global climate studies is now available free of charge. Responding to needs of modelers, algorithm developers, and field experiment scientists within the land-atmosphere interaction research community, the set's creators compiled a consistent collection of high priority global data sets using existing data sources and algorithms. These data are currently being used to drive land-atmosphere models and to support soil moisture modeling, modeling of net primary productivity for the terrestrial component of Earth, and global climate models. They may also be used for a wide variety of other research and educational purposes, including teaching Earth systems science. Many more uses for these data are anticipated. The data sets on this five-volume CD set cover the following areas:

vegetation

hydrology and soils

snow, ice, and oceans

radiation and clouds

near-surface meteorology,

These data sets span the 24-month period, 1987-1988, and all but one are mapped to a common spatial resolution and grid (1° x 1°). Temporal resolution for most data sets is monthly. The data within each of these areas were acquired from a variety of sources including model output, satellites, and ground measurements.

How are these data sets unique?

This CD set provides a diversity of parameters in a uniform and consistent manner that has undergone a comprehensive peer review by potential users of these data. This CD set contains a suite of global (1° x 1°) images for 67 parameters derived from satellite and ground measurements, model output, and one ground-based, point measurement data set (river runoff). The full suite of parameters available on these CDs is shown in Table 1 along with the contributing organizations and the temporal resolution of the parameters. The data were compiled from a variety of sources throughout the world. Several of the parameters that appear here were produced specifically for this CD set, while others were assembled from existing yet uncollated data sets or obtained from archives or individuals' private collections.

These data are useful because they have a simple structure and a high degree of uniformity, thereby enabling similar handling and use of all the data sets. The data are consistent in composition, format, and documentation. In composition, they have similar temporal and spatial coverages and resolutions and similar fill values, masks, and treatment of holes (Table 2).

The format is identical for all of the data sets except one (river runoff). They are all gridded to exactly the same grid, and the format is simple (ASCII and ISO 9660 standards are used throughout), so that no platform-dependent hardware or software is required to use them. Finally, the documentation uses a common outline for all data sets (Table 3). To illustrate this consistency, examples of parameters from each of the groups listed above are depicted in Figure 1.

Well reviewed data

These data and companion documentation have gone through an extensive five-stage peer review process by current and potential users that included individual hands-on use of individual data sets and workshops where data sets were compared for consistency. Where reviewers deemed necessary, corrections to data sets and documentation were made to address their comments. Moreover, a formal peer review is published on the CD to address items found during the reviews whose corrections were not considered essential before publication.

You can examine the documentation and browse sample images from the publisher's World Wide Web (WWW) page at:

http://daac.gsfc.nasa.gov/

Table 1. Data sets on the CD (temporal resolutions are given in the right hand column)

Table 1

Notes:

- "Monthly 3-hourly" refers to values that are monthly means of 3-hourly data. Thus, all the 000Z values for a month are averaged into a single value, also, the 0300Z values, etc.
- The snow-free albedo data set in Section A is based on NDVI fields and a model calculation, the albedo field in Section D is based on ERBE data, and the fields in Section E originate from a survey of in-situ work.
- The documentation for the vegetatin class data in Section A includes vegetation morphological and physiological parameters associated with each vegetation type in the S!B2 model of Sellers *et al*. (in prep.)

A. VEGETATION-LAND COVER AND BIOPHYSICS—(NASA/GSFC, CSU, U. Maryland)

NVDI, FASIR-NDVI	Monthly	Background (soil/litter) refectance	
FPAR, LAI Greenness	Monthly	(Vis, NIR)	Fixed
Surface roughness, snow-free albedo	Monthly	Vegetation class	Fixed

B. HYDROLOGY AND SOILS
(GPCP, GROC, U. Arizona, Trent U. NCAR, FAO, NASA GSFC, NASA GISS)

Precipitation (GPCP)	Monthly	Lake, river, marsh cover percentage	Fixed
River runoff (GRDC:14 basins)	Monthly	Soil texture, depth, slope	Fixed

C. SNOW, ICE, AND OCEANS
(NOAA/NESDIS/ Rutgers U., USAF, NOAA/NMC, US Navy, NCAR)

Snow cover	Weekly	Sea ice, SST	Monthly
Snow depth	Monthly	Land-ocean Boundary	Fixed

D. RADIATION AND CLOUDS (U. of Maryland, NASA LaRC, ISCCP, NASA/GISS)

Surface and TOA incoming and outgoing shortwave	Monthly 3-hourly	Surface net shortwave, net longwave, net radiation fluxes	Monthly
Surface incoming PAR fluxes	Monthly 3-hourly	Cloud amount, cloud top pressure	Monthly
Surface incoming shortwave and longwave radiation fluxes	Monthly	Optical thickness, water path	Monthly
		Clear-sky albedo (ERBE)	Monthly

E. NEAR-SURFACE METEOROLOGY
(ECMWF, NASA/GSFC, NOAA/NMC, NASA/LaRC, GPCP)

(i) Prescribed/diagnostic fields

Soil moisture	Monthly	Surface sensible and latent heat fluxes	Monthly
Deep soil temperature and soil wetness	Monthly 6-hourly	Net surface and TOA short-wave, longwave fluxes	Monthly 6-hourly
Snow depth	Monthly		
Albedo, surface roughness	Fixed		

(ii) Monthly 6-hourly forcing fields		(iii) Diurnally resolved (6-hourly) forcing fields	
Surface pressure, air temperature, dew point, wind magnitude	Monthly 6-hourly	Surface pressure, air temperature, dew point, wind magnitude	6-hourly
Surface temperature	Monthly 6-hourly	Hybrid longwave and shortwave incoming radiation fluxes	6-hourly
Mean sea level pressure	Monthly 6-hourly	Hybrid total precipitation and convective precipitation	6-hourly
u, v wind speed and stress	Monthly 6-hourly		

Table 2

DATA

- All same time period: 1987-1988
- Temporal resolution, driven by models
  - † Most Monthly; some Monthly 3 hrly, Monthly 6 hrly, and 6 hrly
- Requires no special software to read
- All same coverage; Global
- All same grid scale; 1° x 1°
- All same fill values
- Most no holes (i.e., no missing values)
- All same land/sea mask

FORMAT

- All in exactly the same format
- All gridded to the same grid
- Format extremely simple

DOCUMENTATION

- All are thoroughly and uniformly documented

Table 2. Uniformity of data files

Table 3

1. TITLE
   - 1.1 Data Set Identification
   - 1.2 Data Base Table Name
   - 1.3 CD-ROM File Name
   - 1.4 Revision Date of This Document
2. INVESTIGATOR(S)
   - 2.1 Investigator(s) Name and Title
   - 2.2 Title of Investigation
   - 2.3 Contacts (for Data Production Information)
   - 2.4 Requested Form of Acknowledgment
3. INTRODUCTION
   - 3.1 Objective/Purpose
   - 3.2 Summary of Parameters
   - 3.3 Discussion
4. THEORY OF MEASUREMENTS
5. EQUIPMENT
   - 5.1 Instrument Description
   - 5.2 Calibration
6. PROCEDURE
   - 6.1 Data Acquisition Methods
   - 6.2 Spatial Characteristics
   - 6.3 Temporal Characteristics
7. OBSERVATIONS
   - 7.1 Field Notes
8. DATA DESCRIPTION
   - 8.1 Table Definition With Comments
   - 8.2 Type of Data (Parameters, Units, Range)
   - 8.3 Sample Data Record
   - 8.4 Data Format
   - 8.5 Related Data Sets
9. DATA MANIPULATION
   - 9.1 Formulas
   - 9.2 Data Processing Sequence
   - 9.3 Calculations
   - 9.4 Graphs and Plots
10. ERRORS
    - 10.1 Sources of Error
    - 10.2 Quality Assessment
11. NOTES
    - 11.1 Known Problems With the Data
    - 11.2 Usage Guidance
    - 11.3 Other Relevant Information
12. REFERENCES
    - 12.1 Satellite, Instrument, Data Processing Documentation
    - 12.2 Journal Articles and Study Reports
    - 12.3 Archive, DBMS Usage Documentation
13. DATA ACCESS
    - 13.1 Contacts for Archive, Data Access Information
    - 13.2 Archive Identification
    - 13.3 Procedures for Obtaining Data
    - 13.4 Archive, Status, Plans
14. OUTPUT PRODUCTS AND AVAILABILITY
    - 14.1 Tape Products
    - 14.2 Film Products
    - 14.3 Other Products
15. GLOSSARY OF ACRONYMS

Table 3. Standardized documentation format for the data sets

CAMPAIGN_DOCS/ISLSCP/islscp_i1.html

To obtain these data, free of charge, call or send e-mail to NASA Goddard Space Flight Center Distributed Active Archive Center (DAAC) help desk:

NASA Goddard Space Flight Center
Goddard DAAC Help Desk
Code 902.2
Greenbelt, MD 20771

Phone: (301) 286-3209
FAX: (301) 286-1775
daacuso@daac.gsfc.nasa.gov

To place an online order connect to the WWW page at:
http://daac.gsfc.nasa.gov/CAMPAIGN_DOCS/ISLSCP/islscp_i1.html

Note: This address is case sensitive, so enter it exactly as shown here.

Acknowledgments
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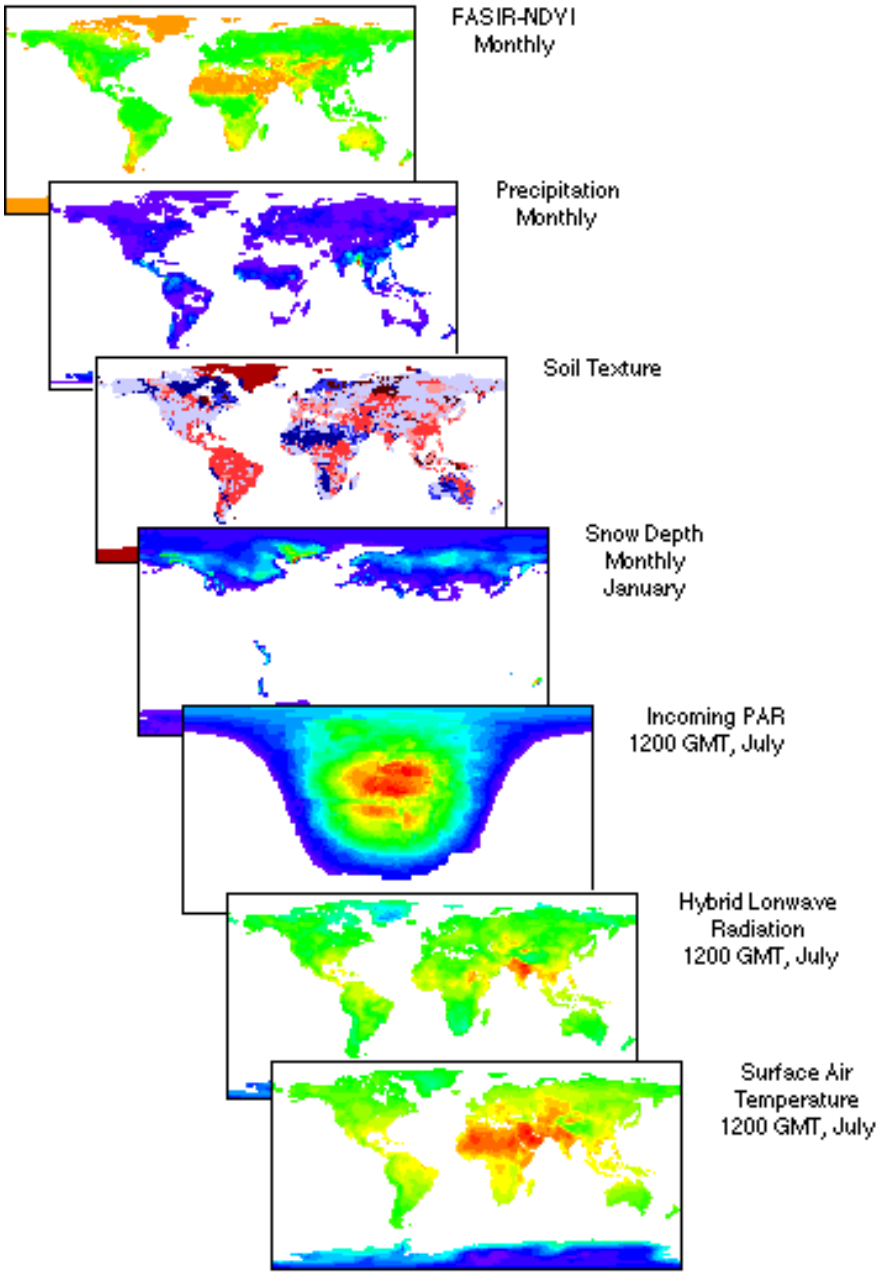

Figure 1. Parameter samples, July 1997

Network Notes

JOAN C. THOMPSON

Additions to the NASA Science Internet include:

- EER Systems Corporation, Montrose, CA
- Cherokee Nation, Tahlequah, OK

Through an arrangement with the Texas Higher Education Network (THEnet), both the McDonald Observatory and the McDonald Laser Ranging Station situated outside of Ft. Davis, TX, are running at T1. The connection is supplied by NSI but managed by the THEnet.

Upgrades:

- Connectivity to Chinese University, Hong Kong, has been upgraded to T1

Center for Extreme Ultraviolet Astrophysics Offers a Guest Investigator Program

Ken Anderson and Brett Stroozas, Extreme Ultraviolet Explorer Science Archive, Center for Extreme Ultraviolet Astrophysics, University of California at Berkeley, CA

NASA's Extreme Ultraviolet Explorer (EUVE) satellite was launched on June 7, 1992, for the purpose of performing a six month all-sky survey in the extreme ultraviolet wavelength region (60-740 Angstroms), followed by a multi-year program of guest-observer (GO) pointed spectrometer observations.The survey phase of the mission has been completed and EUVE is now beginning its third year of GO observations. To encourage and promote scientific research using these unique data sets, the Center for Extreme Ultraviolet Astrophysics (CEA) at the University of California, Berkeley, is offering a Guest Investigator (GI) Science Program. This program acts as an information system, providing archival researchers with the information and training necessary to use the publicly available EUVE data sets. The GI Program offers the research community the technical experience and intricate knowledge of the EUVE data residing at CEA and is open to all interested researchers: astronomers, technologists, engineers, educators, as well as the general public.

EUVE public data sets

A variety of EUVE data are now publicly available. In 1994 the proprietary rights expired for the all-sky survey data and for data from GO observations of more than 100 individual targets. Additional GO data sets become public each month.

The basic EUVE data sets are catalogs, skymaps, and photon event lists from the survey phase, and multichannel spectral data (e.g., one-dimensional spectra, spectral images, and telemetry tables) from the GO Program. These data, all in the astronomical standard Flexible Image Transport System format, as well as various associated services are available via the CEA World Wide Web (WWW) site:

http://www.cea.berkeley.edu/

Benefits of being a GI

Registered GIs receive a variety of benefits and individualized services from CEA, including the following standard package of support:

- quick and complete access to all public EUVE data
- five working days (or more, if necessary) of dedicated individual support from knowledgeable CEA scientific and technical experts
- education and hands-on training to understand the EUVE data sets, the processing and analysis software, and use of the powerful CEA computing facilities
- personal access to the experience and intricate knowledge of the EUVE data residing at CEA

These services are available to all GIs, whether remote users or local visitors at CEA. Once cycled through the program, a GI researcher should be fully equipped with all the necessary knowledge, understanding, and tools to independently analyze EUVE data.

Who can be a GI?

Because EUVE is a science mission, CEA established the GI Program primarily to educate, train, and support astronomical researchers in the use of the EUVE scientific data. However, because of the expanding interest of other communities in the various activities at CEA (see the WWW site for more information), the GI Program is being opened up to all interested parties: astronomers doing EUV science, technologists interested in testbed technology transfering activities, engineers concerned about long term exposure of hardware instruments to the space environment, educators working to establish hands-on science lesson plans, and the general public. As an example of current support provided, the GI

program helps astronomers use EUVE data to prepare, validate, and enhance programs on other observatories (e.g., Hubble Space Telescope) in order to ensure efficient use of those facilities.

Becoming a GI

Becoming an EUVE GI is a very easy process. Simply fill out the simple registration form available via the CEA WWW site at:

http://www.cea.berkeley.edu/

or contact the EUVE Science Archive at:

GI Program, EUVE Science Archive
Center for EUV Astrophysics
2150 Kittredge St.
University of California
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CEA encourages your participation.

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Introducing Land Processes Distributed Active Archive Center

Steve Johnson, User Services, and Tom Kalvelage, Systems Engineer, Earth Resources Observation System Data Center

The use of network in data distribution may be more critical in the future as data volume increases.

The Earth Resources Observation System (EROS) Data Center Distributed Active Archive Center (EDC DAAC) was established as a part of the Mission to Planet Earth program and the Earth Observing System (EOS) to promote the interdisciplinary study and understanding of the integrated earth systems. As one facet of EOS, the EDC DAAC supports Earth and global change scientists through enhanced access to relevant land data products and by the application of those data products to the Earth sciences.

The EDC DAAC is one of nine DAACs in a single, but distributed system, referred to as the Earth Observing System Data and Information System (EOSDIS). Each DAAC offers expertise focused on a specific discipline, geared towards the scientific use of data, data management, and use of data information systems. The EOSDIS Version 0 Information Management System (V0 IMS) is an online working prototype that provides access to EOS data and information services housed at the DAACs. The V0 IMS also serves as a testbed for the EOSDIS Core System (ECS). The ECS is being built to accommodate the vast amounts of data expected from the EOS instruments to be launched.

Working prototype

While the V0 IMS is currently an online working prototype, and the ECS is in the process of being built, interim data distribution at the EDC DAAC is accomplished by the EDC DAAC Data Distribution System (DDS). The DDS had, from the start, several objectives. The first objective was to act as a technology demonstrator, using RAID, hierarchial mass storage software, digital linear tape robotic jukebox, a Hypertext Markup Language (HTML)-based user interface, and Internet-based data distribution. All of these technologies either will be used, or are likely to be used, in the operational ECS. The second objective was to provide an operational data archive and distribution system for the EDC DAAC's Version 0 products.

The DDS project was formally started in September of 1993. While system definition, specification, and procurement of the system

was being done, the project team began work on an interim version of the system, using an existing EPOCH hierarchical mass storage system with a HTML-based user interface. The interim system allowed the team to work out system design, operational work flow, archive, ordering, and integration issues, enabling them to be prepared for the delivery of the operational system.

The interim version of the DAAC DDS received good reviews on its service to users and input into how to build a HTML-based user interface. The DDS allowed the DAAC to see what the real user demand was. The operational system was installed in early 1995. It's hardware uses an ATLproducts ACL2640 robot holding 2.4 terabytes of storage on 10 GB Digital Linear Tapes. The robot is managed by Advanced Archival Products, Inc.'s AMASS storage system software running on a 2 CPU SGI Challenge L deskside machine with 30 GB of hard disk. RAID is used to store the AMASS storage cache. Experience to date has been positive. However, due to unrelated hardware problems, the RAID controller has been the persistent trouble spot. As the system is broken in and better understood (including the vendor), it's operability and reliability improves.

Increased support

Operations with the DDS have lead to the procurement of more memory (256 MB RAM) and hard disk storage (2 x 9.1 GB hard drives). This will allow the system to accommodate more users, by supporting increased compression/decompression loads, and allowing better management of products moved to hard disk. Use of network in data distribution will be more critical in the future as data volumes increase with the ingest and distribution of Version 1 products. The EDC DAAC will continue to gather and make data sets available through the user interface. Data sets currently planned to be made available include Landsat Pathfinder, Aircraft Scanners, processed "precision" SIR-C data, and others.

As the Internet and HTML's popularity continues to grow, EDC DAAC will continue to improve the HTML user interface, with the intention of integrating it with the EOSDIS IMS. The IMS contains substantially more functionality than the HTML interface, and will be used to make more complex queries against the increasingly large and diverse data sets of the Version 0 system. Eventually the Version 0 systems in place at the EDC DAAC will be overshadowed and replaced by the Version 1 systems. With the knowledge gained by working with the Version 0 systems, the Version 1 systems will be robust enough to serve the land processes scientific community.

Accessing the EDC DAAC

Currently EDC DAAC land processes data sets and related information can be accessed via the V0 IMS or through the DDS interfaced with National Center for Supercomputing Applications' World Wide Web Mosaic. Orders for current ingested data projects in the V0 IMS can be placed at the EDC DAAC, as well as the other EOSDIS DAACs. You may access the EOSDIS V0 IMS by telnet to any one of the following internet addresses:

eosims.cr.usgs.gov 12345

eosims.jpl.nasa.gov 12345

eosims.esd.ornl.gov 12345

eosims.saa.noaa.gov 12345

eosims.colorado.edu 12345

eosims.larc.nasa.gov 12345

eosims.gsfc.nasa.gov 12345

eosims.gi.alaska.edu 12345

eosims.msfc.nasa.gov 12345

Information on EDC DAAC data can also be accessed through the EDC DAAC homepage:

http://edcwww.cr.usgs.gov/landdaac/landdaac.html

EDC DAAC data product availability is not exclusive to the V0 IMS and the EDC DAAC Home Page. For inquiries into offline data availability as well as data online, please contact the EDC DAAC User Services office. EDC DAAC User Services personnel are available Monday through Friday, 8:00 a.m. to 4:00 p.m. central standard time. You may contact the EDC DAAC User Services office via any of the following methods:

EDC DAAC User Services
EROS Data Center
Sioux Falls, SD 57198
Phone: 605-594-6116
Fax: 605-594-6589
edc@eos.nasa.gov

The US Geological Survey's Window To The Internet

John Faundeen, Hughes STX, Earth Resources Observation System Data Center, SD

The US Geological Survey's (USGS) Global Land Information System (GLIS) is an online, interactive program used by researchers seeking sources of information about the Earth's land surfaces. GLIS contains metadata, or descriptive information, about regional, continental, and global land information. Using GLIS researchers can evaluate data sets, determine their availability, place online requests for products, and preview sub-sampled digital browse imagery. User activity on GLIS provides a window into the makeup of the Internet community.

GLIS is accessible via dialup modems and Internet-connected PCs, Macintoshes, and UNIX workstations accessing GLIS through text or graphical interfaces. The vast majority of GLIS access is through the Internet as illustrated in Figure 1. While the number of Internet accesses tends to vary, the number of modem connections remains relatively flat. Researchers using the Internet to access GLIS range between 85% and 95% of all connections made to GLIS. Currently, GLIS is averaging over 4000 Internet connections per month compared to around 370 modem connections.

The USGS tracks GLIS user organizations to help characterize the community it serves. Using the last characters of a user's email address, patterns of access by GLIS registered users are grouped into four main categories (Figure 2). The first category, GOV, is composed of US government users of GLIS whose Internet addresses end in .gov or .mil. The next category, EDU, includes all GLIS users whose Internet addresses end in .edu. The third category (ORG/NET) encompasses .org, .com, .net, .cg, .or, .h, and .us suffixes. The fourth category, INT, includes addresses whose Internet domain address is non-US. The number of countries connecting to GLIS has averaged 99 since March of 1994 (Figure 3).

Over the last two years, the four main category splits of Internet GLIS users have averaged 10% government, 30% education, 43% organizations/networks, and 16% international in makeup. Not surprisingly, the education and organizations/networks categories have been the most dynamic with the government category being the most static.

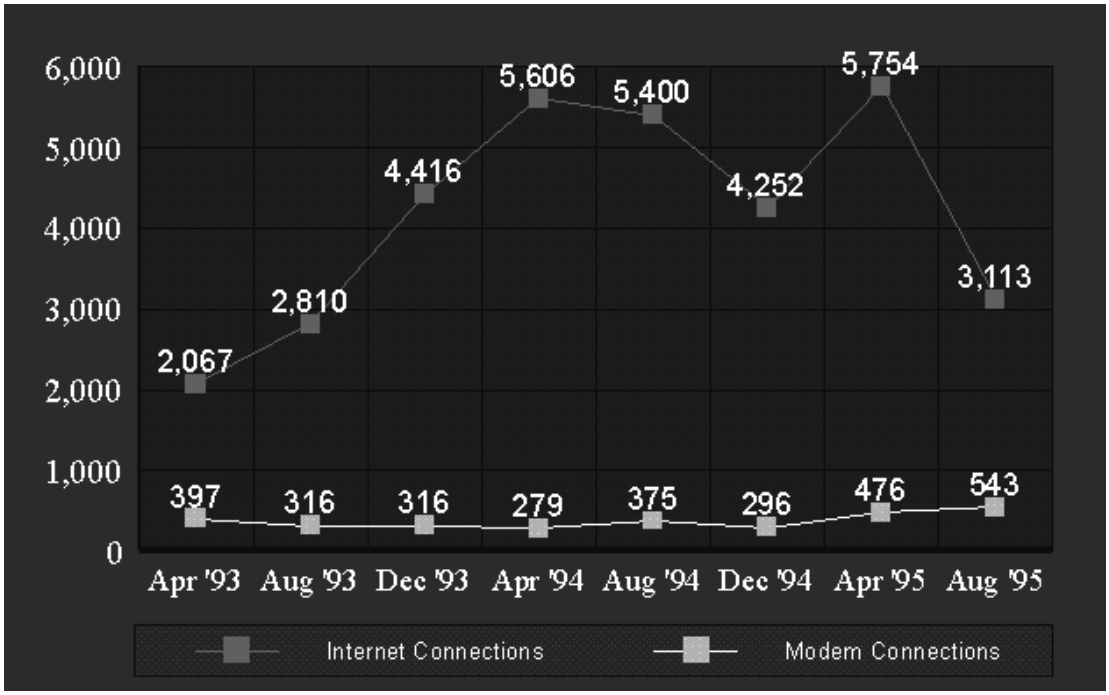

Figure 1. Internet and modem connections

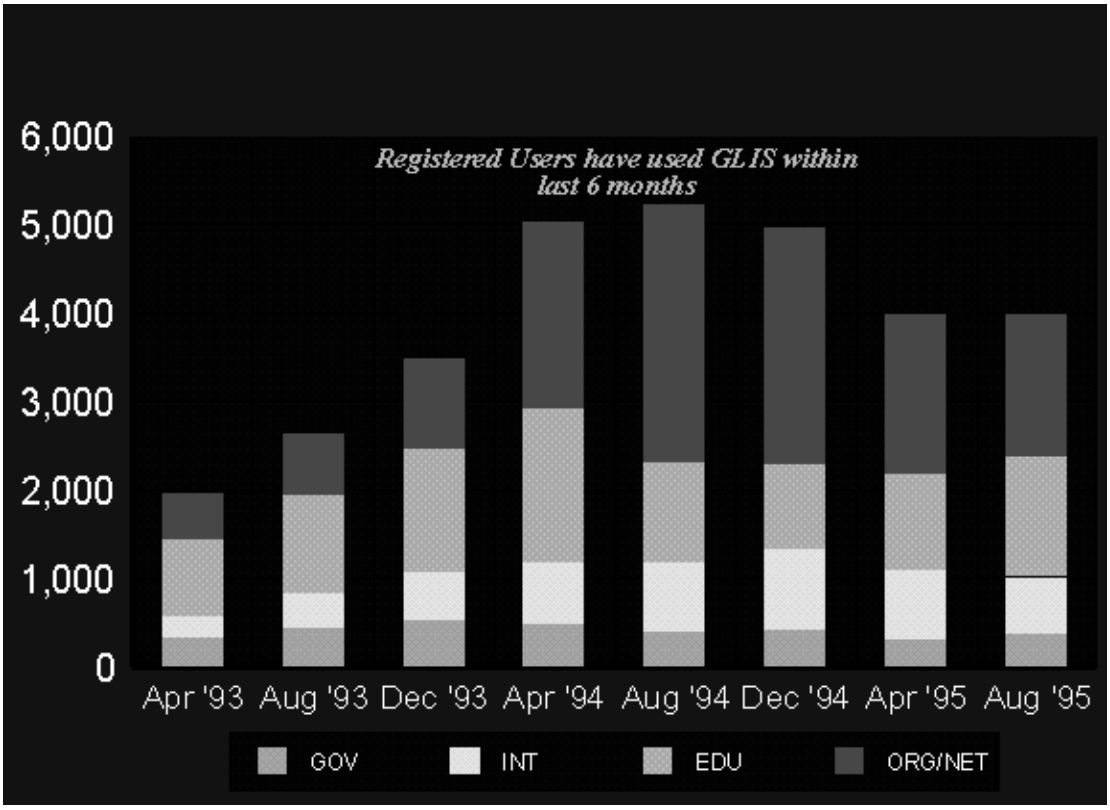

Figure 2. Registered users by category

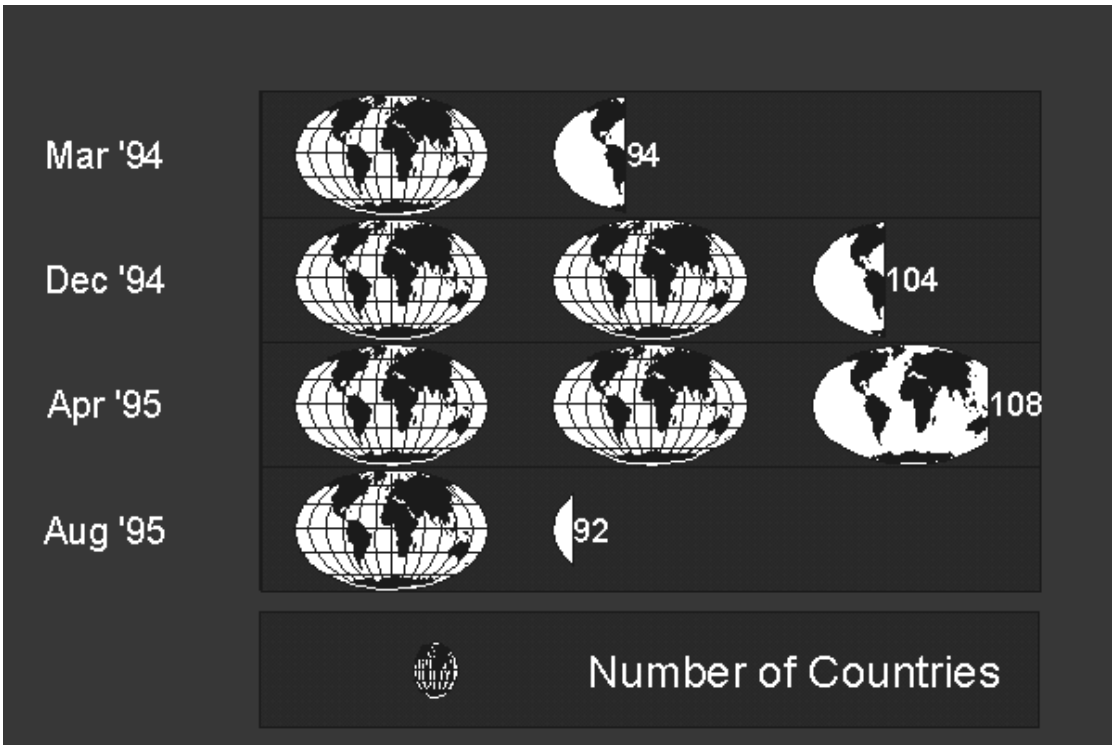

Figure 3. Chart of international use

With the increased worldwide access to the Internet combined with the many commercial Internet services available, it will be interesting to see how the categories of Internet GLIS users change. The explosion of Internet traffic attributed to the World Wide Web will certainly continue to draw new and existing users to the Internet. GLIS will continue to evolve to better serve the Internet community of users based on the information gathered from this study and direct feedback from the users themselves.

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Video On Demand Research Being Developed At Ames Research Center

Pat Kaspar, Contributing Editor, Ames Research Center

Today researchers at Ames Research Center (ARC) are developing Video On Demand (VOD), a technology that will allow scientists to retrieve high-quality video presentations over computer networks with the ease of using a VCR. One day soon this resource will be available NASA-wide for such activities as training at the desktop and scientific and engineering demonstrations.

According to David Meyers, Digital Video Lab engineer, VOD technology provides the functionality of a large-scale digital VCR that allows you to share audio/video materials with colleagues throughout the network. VOD is available now on a limited basis at ARC and will be supported at select NASA science and mission centers within the next few months. "Today's Web browsers require you to download a compressed video clip to your local disk before you play it," said Meyers. "Our model plays video in real-time from the server and requires no local disk storage."

The consumer electronic industry is developing "SetTop" VOD that will be available to consumers by the year 2000. The ARC project is similar but focuses instead on scientific and managerial desktop requirements. Because of NASA's large, installed base of workstations and personal computers, the digital video architecture has been designed to take advantage of NASA's investment in workstations and its investment in current and planned future networks.

VOD features

VOD technology will serve large distributed groups but can also be scaled down for use in small groups. According to Meyers, a workgroup server or even a personal server can stream the video off for viewing by a small group, such as the four workstations in the Digital Video Lab. Ethernet local area networks (LANs), for example, can be micro-segmented to support larger numbers of people using VOD and videoconferencing simultaneously. With fewer workstations on each segment, there will be enough bandwidth per segment for desktop and near-broadcast-quality digital video. VOD clients can run over existing legacy Ethernet and Fiber Distributed Data Interface networks, but the technology anticipates the development of fiber-based asynchronous transfer mode networks.

Video information is compressed at a ratio of 100:1, making it cost effective for storing scientific visualization and mission video on computer disks. Decompression can be accomplished in software on workstations, Pentiums, and PowerMacs.

VOD support of retrieval and playback has been sucessfully demonstrated in the Digital Video Lab. In addition, researchers are working on developing network video recorder technology that will allow you to record video directly from lab experiments, wind tunnels, and animation sequences, and place the data directly into the VOD server for sharing throughout the research community.

Experimental use

An experimental version of VOD is currently operating over the Bay Area Gigabit Network (BAGNet). BAGNet is a metropolitan area network extending over 100 miles of fiber optic cable (Figure 1). The server is installed at Lawrence Livermore National Laboratories and the client is at ARC. VOD has been run experimentally from a server at Jet Propulsion Laboratory to ARC over a T3 network (45 Mb/s), a distance of 500 miles, proving the feasibility of VOD over greater distances. VOD can also be run on LAN backbones but would require increased storage capability for more video clips.

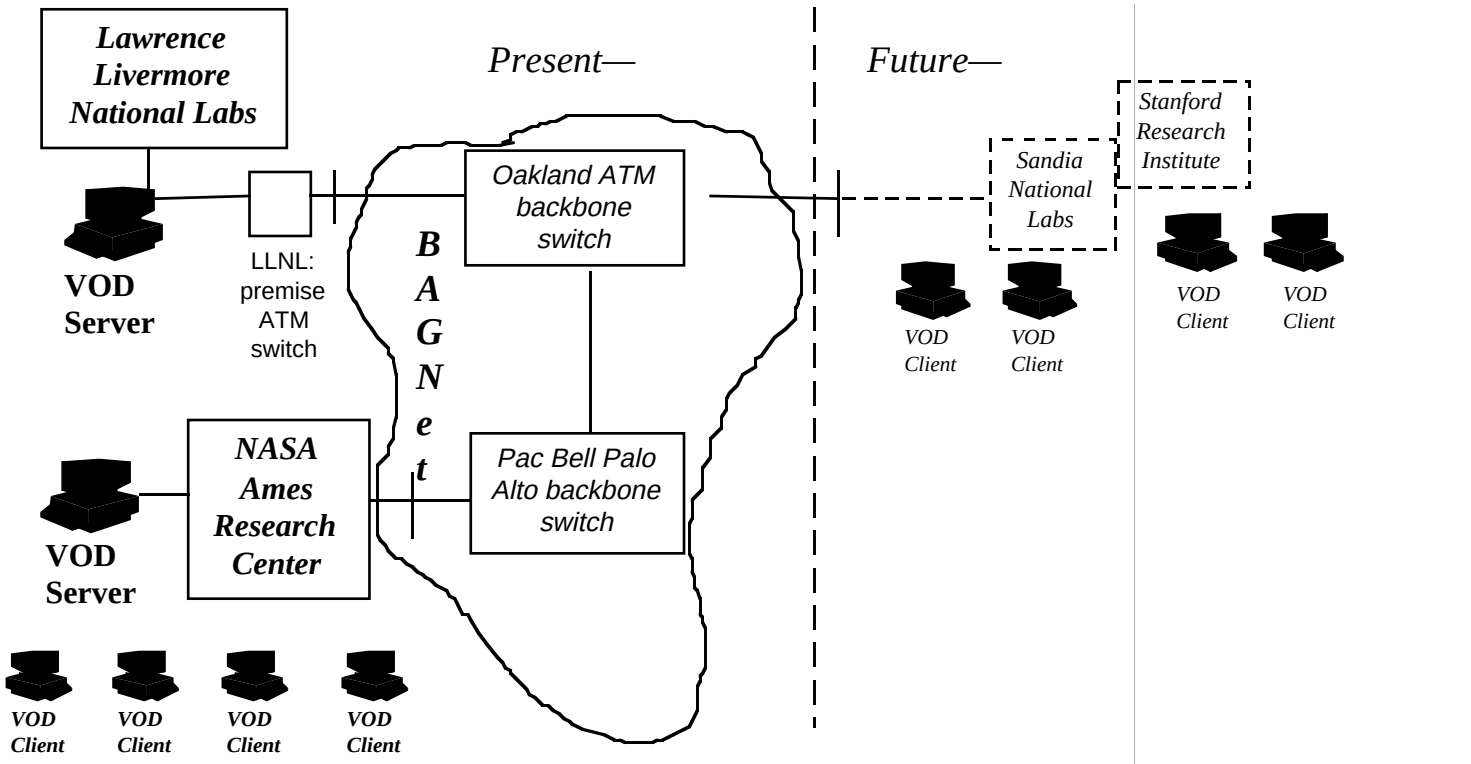

Figure 1. Client/Server Video On Demand over the Bay Areas Gigabit Network

The picture quality of VOD is rapidly improving. VOD currently uses MPEG-1, an International Standards Organization compression algorithm, but by the end of the year, when VOD employs MPEG-2 compression, picture quality will improve fourfold (to 700 x 480 lines of resolution). MPEG-2 offers the picture-quality level necessary for such areas as continuing medical and scientific education, examination of wind tunnel vortex streams, virtual reality, and telemedicine.

Interest in the project is high. There are potentially large numbers of programs in which VOD can be used—kindergarten through grade 12 education, science, and shuttle, as well as more specialized digital libraries. The technology is already acceptable for educational uses and is improving rapidly.

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The Digital Video Laboratory is part of the Wide Area Networking Group headed by Christine Falsetti at Ames Research Center.

Understanding the Joint Digital Libraries Initiative

Eugene Miya, Distributed Systems Division, Ames Research Center

The Joint Digital Libraries Initiative (DLI) is a four-year research effort exploring the technical requirements for future digital libraries. The Joint DLI is sponsored by the National Science Foundation (NSF), Advanced Research Projects Agency (ARPA), and NASA. The Joint DLI is a project of the federal Internet Infrastructure Technology and Applications Working Group of the High Performance Computing and Communications Initiative. Digital libraries add value and content to the communication, computation, and infrastructure of the Internet and are viewable among data sources on the Internet.

The DLI does not intend to replace books and magazines; it intends to supplement them. Libraries are no longer mere book collections. Basic modern information sources include journals, reports, maps, pictures (still, moving, stereograms, and many other kinds), music, even individual mathematical formulae. Library users, while a minority of the general population, range from the very young (grades kindergarten through grade 12) to senior professional researchers, and "Harry Homeowner". Libraries and communications make a ubiquitous, hands-on, participatory technology.

Let's discuss: Why is this happening? Why is NASA involved? What is happening? What are the reader's options for direct involvement?

Why digital libraries?

As previously stated, digital libraries are not intended to replace books and existing libraries, but the idea "seems logical" to authors attempting to publish reams of information. "Seems logical" is the result of the interplay among:

- the authors or creators of new publications, especially those who expect royalties and hold a copyright
- the publishers who edit and disseminate these works and pay the associated publication cost
- libraries, governed by various conventions and laws, that hope to further distribute publications
- readers/users with changing/dynamic requirements

The readers and users of libraries are changing their habits. For instance, video is a major new medium that directly influences the budgets of libraries, publishers, and authors. The needs and dissemination costs of printing are changing because authors are submitting machine-readable copy, which has editorial advantages. Why print paper when you can get a disk copied almost directly from the author? The compact disk revolution illustrates the use of a single, physical publishing medium replacing several older media: numerous magnetic disk and tape formats (hard or floppy; various reel-to-reel, various cassette (computer and VCR {Umatic, Beta, VHS, etc.})), phonograph records, earlier optical disk formats, etc. Additionally, every person in the US is familiar with the advantages of word and document development systems.

The emergence of the Internet, and specifically the World Wide Web (WWW), raises even more serious questions about the economics of disseminating data, reports, books, video, audio, and other diverse media. The situation is similar to that between the owners of word processing systems and owners of typewriters; typewriters and their owners are disappearing fast. Remember slide rules? Highly flexible digital formats have many advantages.

Digital libraries offer many access advantages (e.g., speed and performance) with new functionality. Indexing and searching are faster. Addenda and errata are more easily handled. Print size is not a restricted fixed printed page; font sizes or types are changeable for improved readability or perhaps output using a speech

synthesizer using the author's own speaking inflection. Providing "access" is the watch word for digital libraries.

Digital library ideas are not unique to the US. However, all participants realize that initially most digital library content will come from the US (like bluejeans), and this may have profound implications around the world.

NASA involvement

NASA is involved, because it "authors" lots of "content". Digital libraries require an early investment to see a long-range cost saving. NASA is a major producer of data and information from its centers and from remote sensing platforms based on aircraft and spacecraft. NASA is also a major Internet component, and wants to team with some of the other Internet players. NASA was invited to join NSF and ARPA, because, foremost, NASA communicates with producers of other scientific data that have consistent conventions and protocols between digital libraries, although at the present time it is a little too early to discuss standards. Secondly, it is not affordable, nor desirable, for NASA to develop digital libraries alone. Thirdly, a unified initiative carries the appearance of greater significance in contrast to several smaller piecemeal initiatives. And lastly, digital libraries must interoperate with other portions of the Internet.

The downside of a joint initiative is the greater required communication cost, but the consensus of the Joint DLI participants believe that the diversity brings long-term interdisciplinary advantages. It would be nice to see computer scientists working with librarians and in turn working with physical, and other, scientists in new topic areas. Interdisciplinary science may be the frontier of new discoveries.

What's happening?

The Joint DLI is funding six universities to explore the problems of placing vast quantities of information online. The six universities are:

- University of Michigan at Ann Arbor: the University of Michigan Digital Library (DIRECT), an image-based library system
- Carnegie-Mellon University (CMU): the Infomedia Project
- Stanford University: the Stanford Integrated Digital Library Project with the Infobus
- University of Illinois at Urbana-Champaign: the Interspace
- University of California at Santa Barbara (UCSB): the Alexandria Project
- University of California at Berkeley (UCB): the Environmental Electronic Library

The CMU Informedia Project is principally adapting speech recognition technology to create scripts from video recordings. Scripting allows cataloging, both syntactic and semantic text searching, and the creation of synthetic dialogues. The presumpton of Infomedia is that reading is moving to other kinds of media like video. On this basis, Infomedia will bring new capabilities to video and the accompanying video.

The Universities of Illinois and Michigan are augmenting engineering and scientific education by placing journals and other media on the Web. These schools are exploring the technology undergraduate and graduate students and their professors require. These schools face difficult problems, such as handling special characters (called "penality" copy in the publishing trade) from mathematics to chemical symbology. Keyboards do not have these characters so entry, search, and display have conflicting problems.

Stanford University is exploring a concept called the Infobus to attempt integrating diverse library services from annotation by virtual Post-It™ notes to royalty and copy management. Stanford is particularly concerned about the interoperation of these library components.

UCB and UCSB are concentrating on geographic information systems and their interfaces on environmental databases. Remote sensing databases must work on networks essentially developed for digital text-based systems. Image databases have vastly different functionality and performance problems when compared to simple text-on-demand libraries. Many other kinds of images must also be considered, but this is wide open research.

The list presented here is brief; greater detail

Digital libraries add value and content to the communication, computation, and infrastructure of the Internet.

can be obtained from the Joint DLI Web page. It should be noted that the DLI should not be confused with a separate effort under funding by Congress and its Library of Congress (LoC). The LoC has a project called The National Digital Library (NDL), and it had an earlier prototype project called the American Memory Project. The NDL is currently digitizing public domain literary works and early photographs, such as Matthew Brady's Civil War photographs. The NDL is attempting to avoid the complex problems of copyright for which the LoC also has responsibility. Further NDL information may be found on the LoC Web page at:

http://www.loc.gov

While the DLI is keeping contact with the NDL, the DLI is not coordinating its research with the NDL. The NDL's goal is to be a functioning digital library, not a research project as is the DLI.

Getting involved

Uniform Resource Locators (URLs) publicly describing these projects are available on request. It is strongly advised that interested NASA staff make initial contact with the projects through the Initiative's NASA liaison to prevent overwhelming DLI principal investigators. The WWW URLs for the Joint DLI are:

- Digital Library Project,
  University of Michigan
  http://www.sils.umich.edu/UMDL HomePage.html

- Building the Interspace: Digital Library Infrastructure for a University Engineering Community Institution
  University of Illinois, Urbana-Champaign
  http://www.grainger.uiuc.edu/dli

- Environmental Electronic Library: A Prototype of a Scalable, Intelligent, Distributed Electronic Library,
  University of California - Berkeley
  http://http.cs.berkeley.edu/~wilensky/projhtml.html

- Informedia: Integrated Speech, Image and Language Understanding for Creation and Exploration of Digital Video Libraries, Carnegie Mellon University
  http://fuzine.mt.cs.cmu.edu/im/improposal.html

- Stanford Integrated Digital Library Project,
  Stanford University
  http://www-diglib.stanford.edu

- Alexandria Project: Towards a Distributed Digital Library with Comprehensive Services for Images and Spatially Referenced Information
  University of California - Santa Barbara
  http://alexandria.sdc.ucsb.edu

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Help us update our subscription database—please send your email address to:

sandi_beck@iplmail.jpl.nasa.gov

KidSat Captures the Imagination of Students

JoBea Way, California Institute of Technology/Jet Propulsion Laboratory, Elizabeth Jones Stork, The Johns Hopkins University Institute for Academic Advancement of Youth, and Sally Ride, University of California—San Diego, California Space Institute

An instrument on the Space Shuttle turns and points, taking a picture of the Earth below. The instrument is being guided not by astronauts in space or scientists in NASA's mission control center, but by a student in an urban school engaged in the study of ancient trade routes. Even more compelling is that the instrument was configured by students, in concert with scientists and engineers, and is dedicated to the advancement of learning.

Young people are fascinated with space, their own environment and technology. KidSat is designed to capitalize on the human instinct to learn and explore. Imagine the excitement of learning through interaction with a real space mission and control of real cameras and instruments operating hundreds of miles above Earth. Learning now has a new purpose. It is compelling and inspiring. That is the vision of KidSat; to become a catalyst for pre-collegiate education by bringing the resources of NASA, the excitement of space and an astronaut's view of our planet to young people across America—JoBea Way

The KidSat Concept

KidSat is a set of Earth-viewing cameras and instruments that will eventually be based on the International Space Station. Early pathfinder missions will be carried out on the Shuttle, and prototype instruments may be mounted on Mir as part of the joint US/Russia Space Station program. KidSat is also a mission control structure that allows many schools around the country to participate in the operation of the instruments; a data system that provides images to children across the country in real time over the Internet; and a coordinated set of curricular materials that lays the educational foundation, an effective means to disseminate them, and a teacher training and evaluation program that ensures KidSat's continued impact on learning.

The exact specifications for the KidSat instruments will be made by students. Potential instruments that might form the basis of the instrument package include a digital camera, an optical sensor, and an imager from a different part of the electromagnetic spectrum. The use of telepresence in parallel with some of the instruments will give children an opportunity to view the Earth as the astronauts do; students will have the opportunity to explore. Every effort will be made to use instruments that are already available. Since the Space Station will be visited by the Shuttle on a frequent basis, there will be opportunities to modify existing instruments or bring up new ones. This ensures there will always be an opportunity for interested students to work on the instrument design and camera configurations.

The mission control scheme will include a KidSat mission control "gateway" (staffed by students) that will communicate with NASA's Mission Control Center in Houston. More importantly, it will also act as a communications gateway to participating schools. Student mission operations centers will be located at many schools. These are centers that could be easily replicated at any participating school, and would not require sophisticated technology. Through the Internet, the Gateway will also support imaging requests from students not directly involved in a mission operations center.

Data from the instruments will be made available to schools over the Internet in real time during the mission, then archived and made available to any interested student. The KidSat images will be used by students and teachers in support of classroom instruction in science, math, geography, history, art, and current events.

Students learn more readily when they area

part of the process. By utilizing a multidisciplinary approach and encouraging the individual pursuit of knowledge, KidSat becomes a compelling example of exemplary teaching and learning practices. KidSat seeks to make educational history by allowing students and teachers to request images of the Earth from their own instruments in space. Students will be engaged in complex tasks extending across many subject areas thus increasing their level of understanding and knowledge. KidSat will have the greatest impact on instruction if it includes curriculum guides, resource materials, teacher training, and long term support as part of the project. Educators, students, engineers and scientists are working together to create the most appropriate curricular modules and implementation plans. The materials will be available in a variety of media and will be disseminated through comprehensive training sessions.

KidSat is designed to capitalize on the human instinct to learn and explore.

KidSat Partners

The KidSat concept was inspired while working with high school students on a Space Shuttle project at the Jet Propulsion Laboratory (JPL). It has since developed through collaboration with The Johns Hopkins University Institute for Academic Advancement of Youth (IAAY) and the University of California's California Space Institute (CalSpace). Though each institution will be involved in all aspects of the project, each will take primary responsibility for particular elements. JPL will take the lead role in the project management of KidSat and the development of the remote sensing instruments and cameras. CalSpace will take the lead role in the mission operations, and IAAY will lead the curriculum development, teacher training and evaluation.

Where Are We Now?

In 1994 seed funding was received from National Science Foundation (NSF) and NASA to develop the KidSat concept. During the summer, groups of students and teachers were brought together to discuss curriculum topics and to consider various options for the instruments, mission operations and data system designs. In September and January 1995, teachers met at NSF-sponsored workshops to begin developing the first elements of KidSat curriculum. A group of five core teachers is now under contract to establish the first three sets of prototype curricular materials. In early 1995, NASA agreed to fund a three year pilot program using the Shuttle; the first flight will occur in the spring of 1996 on the Shuttle's third flight to Mir (STS-76).

Digital cameras and video will provide the core set of KidSat instruments. Six schools located across the country will participate in the pilot phase. It is anticipated that KidSat will then move forward to the Space Station phase in which a more capable set of remote sensing instruments will be employed to allow participation by children and teachers around the country.

KidSat gives young people a piece of the space program. It acknowledges their value as young explorers and citizens of the future. KidSat is designed to capture the imagination of students and motivate them to learn by engaging them in an exciting, hands-on project that contributes materially to their education.

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Watsonville High School Inaugurates Internet Connection

Pat Kaspar, Contributing Editor, and Mark Leon, Information Infrastructure Technology and Applications, Ames Research Center

Early this year Watsonville High School (WHS) commemorated the school's official entry onto the Information Superhighway by transferring an engineering drawing over the Internet from Ames Research Center (ARC) to the high school's computer aided design/computer aided manufacturing (CAD/CAM) lab. The file, a diagram of the 7 x 11 foot unitary wind tunnel, was transferred via a high-speed TI Internet connection that carries data a 1.5 millinon (mega) bits per second. After a year of collaboration with NASA, WHS students were able to access files such as these, as well as generate their own, make or suggest changes, and transfer the files back to ARC engineers for their comments.

The Watsonville Superintendent of Schools, Anthony Avina, was highly pleased with the program, saying "The equipment, the program, the way the students work, and the products they produce are all impressive."

Replacing old methods

Drawing boards have been replaced by 28 computers, a plotter, and a printer. The computers, software, and network are utilized by three CAD/CAM classes of around 30 students each as well by a 7 to 9 AM physics class and a woodworking class. The CAD/CAM classes smoothly integrated grade levels, sexes, and races.

The catalyst for this program has been CAD/CAM teacher Victor Patino, who developed the lab with funding from the Perkins Act and cooperation from community business leaders. Patino then arranged with ARC to gain Internet connectivity. WHS has been a leader in CAD/CAM on the West Coast but has previously had no Internet infrastructure to allow its students to interact with outside institutions and companies. Since that first transmission, agreements have been negotiated to expand on the school's connectivity to ARC and allow students to interact with universities and aerospace companies.

Eligibility and involvement

"To be eligible for the CAD/CAM class, students must have completed either an integrated mathematics program class or have completed or be enrolled in algebra or calculus," said WHS Principal Lorrain-Sandoval. "They have to understand coordinates."

Many of the CAD/CAM students are involved in MESA—the Mathematics, Engineering, and Science Achievement group that focuses on helping minorities. The group meets Saturdays and after school under the leadership of its advisor, Grace Patino. Participation in the group is enthusiastic and two of its members have been accepted to Standford. MESA is supported by community leaders, such as Watsonville's Granite Construction, who have underwritten the cost of the program for five years.

Getting connected

The successful connection of WHS to the Internet was accomplished by a cooperative effort between the Ames Kindergarten Through 12th Grade Internet Initiative and several other groups. ARC engineers Kevin Jones and Dora Lopez designed the WHS local area network (LAN), and the NASA Science Internet is providing the wide area networking connection to the school. I-NET Engineering Manager, Michael Wells, and his staff conducted the original site survey for the LAN and I-NET subcontracted and verified the installation. The Ames Program Support Communications Network representatives Don Foreman, Bill Jones, and Don Riordan provided WHS with a channel service unit/data service unit, which was crucial to their coming online. Working with Don Jensen, a volunteer from Watsonville's Granite Construction Company, I-NET also helped to arrange free applications software, saving the school between three to five thousand dollars. Jensen also provided critical support in the midst of the recent

Objectives: Universal Technology Research Education Access Community Hands on

Outreach

The goal of the Science Information Systems Outreach Department is to promote to the general public an understanding of how the results of space science research make significant contributions to American educations systems and to institutions dedicated to improving science literacy. This department provides a vehicle for demonstrating how applications, hardware, and research and development used for space science research can be adapted for use by teachers and their students and by non-NASA organizations.

Watsonville floods by helping load the TCP/IP software. The efforts of these groups was greatly appreciated.

Pioneering new technology

"Watsonville High School is pioneering a new and unique technology," said Mark León, Deputy Manager of the Information Infrastructure Technology and Applications Program at ARC. "Other schools may benefit from the work done here. Watsonville is also the only high school in the country that does CAD/CAM work focusing on aeronautics over the Internet."

During the summer months WHS partnered with ARC and Hughes STX to develop curriculum units on CAD and aeronautics. Additonally, WHS CAD/CAM and Internet instructor, Victor Patino, attended a one-week training session in Washington state that was sponsored by his software developer. Subsequently, Patino submitted his newly developed fall semester curriculum to NASA. ARC plans to publish the curriculum on the Internet for use by other US secondary schools.

A great deal of trust is being placed in this program," said León. "The curriculum developed here will be made available online to the entire country, and eventually worldwide, over the Internet."

Speakly directly to the students, León said, "Information explorers will pave the way to the next century. Those of you who are computer literate and show talent in information systems will be the future leaders."

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Drawing boards have been replaced by 28 computers, a plotter, and a printer.

JPL's Open House A Success

JPL held its annual Open House on July 22 and 23, inviting the public to visit the facilities and participate in a wide range of activities. This event was well received; it was reported by one of the major networks as one of the seven interesting things to do that weekend. In addition to the thousands of public visitors, several television stations and other media representatives were in attendance.

JPL librarian in the Library & Information Center demonstrates how to connect to the World Wide Web

The emphasis of this year's event was on childrens' activities, especially geared toward Kindergarten through Grade 12. As young visitors entered the main gate, they were given a "space passport", an entree to a game that encouraged them to visit as many exhibition sites as possible. Each official passport-game site affixed a stamp to the passpost, representing "travel". When the youngster collected eight stamps, the passport could be redeemed for a special prize.

Open House exhibitions included video presentations of space exploration, multimedia presentations, information booths for various planetary and solar missions (Galileo, Voyager, Ulysses, Cassini, Mars Pathfinder, the New Millineum, to name a few), 3D imaging and animation demonstrations, and various imaging, global positioning, and remote sensing technology displays. The popular Mars Yard, a representation of the Martian surface, featured prototypes of the Mars rover that will be used to traverse the red planet. Elsewhere, instrument models and testbeds were displayed and computerized science data, including interfrerometry and radar imaging, was demonstrated. The Library and Information Center connected visitors to the World Wide Web (WWW) and distributed a list of all

Young visitors "line up" to let the Mars rover traverse the terrain. *Photo courtesy of the JPL Universe. Photo taken by JPL Photo Lab.*

Tony Horton, Radio Science Operations engineer, explains Ulysses' gravity wave investigation.

Youngters sign up to send their names to Saturn on the Cassini spacecraft.

Danika Jensen, Planetary Applications Group explains the activities available in the Multimission Imaging Processing lab.

This little girl is ready to launch her paper rocket, in an exercise to learn about propulsion.

southern California public libraries that provide Internet access. JPL's amateur radio was on hand to explain how astronauts use amateur radio to talk to schoolchildren and the public. Many visitors, young and old, will have their names encapsulated and sent to Saturn on the Cassini spacecraft.

There were a myriad of interactive exhibits. For example, visitors were able to surf the web, have their pictures taken "among the stars", operate a thermal infrared camera, and "fly through space". The children's activities included making paper rockets (to learn about propulsion), being a planet in the solar system, building a spacecraft, and viewing nature science demonstrations and educational displays. And of course, there was the ever popular face painting. Some youngsters became terrain and allowed the Mars Pathfinder rover to motor across them.

The atmosphere was festive, the exhibits educational and interesting, and there was virtually something for everyone.

Visiting Students Enriched in Information Systems Technology

Judy Laue, Contributing Editor, Hughes STX, and Marilyn Mack, Goddard Space Flight Center

Eleven years ago Milton Halem, Chief of Goddard Space Flight Center (GSFC) Space Data and Computing Division (SDCD), founded the Visiting Student Enrichment Program (VSEP) to encourage students to continue their studies in computer science. Since then, this unique summer program has been a growing achievement for Goddard. Today, VSEP "... may be the only program at Goddard where the projects are all computer-related," said Marilyn Mack, VSEP organizer and chairperson. "The projects directly or indirectly involve computers, from super-computers to PC's, and the majority of projects involve information systems," Mack added.

Mack's management of the program for the past five years has increased the number of Goddard organizations that provide funding and mentorship to VSEP. Originally, VSEP was supported solely by the SDCD. The 1995 VSEP, which the SDCD hosted from June 5 to August 10, received support from seven other organizations at Goddard, including: the Mesoscale Atmospheric Processes Branch in the Laboratory for Atmospheres, the Global Change Data Center, the Space Science Data Operations Office, the Flight Dynamics Division, the Flight Systems Technology Division, and the Mission to Planet Earth.

The number of students chosen for the project also has grown from less than 10 students several years ago to 24 students in 1995. This year, VSEP funded seven high school students, 12 college students, and five graduate students to work with the GSFC mentors. The mentors selected the students based on academic background and abilities, and then involved them in relevant projects. The 1995 VSEP projects provided "...many educational and professional opportunities for both the students and the mentors, with many of the projects providing lasting benefits for NASA as well," stated Mack.

For example, Ryan Drake, a Penn State undergraduate, worked with mentor Adina Tarshish, system administrator for the NASA Center for Computational Sciences, UniTree mass storage system. Drake programmed a variety of utilities to aid UniTree system administration. According to Tarshish, Drake's utilities "...already have helped us a great deal, and we expect to realize even greater benefits as his programs are fully utilized." Other student-mentored projects included:

- John Frisk, University of North Iowa, built a model server for Video on Demand (interworking applications of digital video) to help scientists visualize their work.
- Timothy Folta, Sherwood High School, Olney, MD, participated in evaluating encryption/decryption software.
- Chandra Krintz, California State University, Northridge, CA, performed benchmark testing of a CRAY J916 to determine if it would meet the computing needs of Morgan State University.
- Charles Gartrell, Watkins Mill High School, Gaithersburg, MD, and Steven I. Geller, Duke University, worked together to develop electronic management systems utilities that use Internet technology to streamline database management for various NASA divisions, including the Re-engineering NASA Directives group.
- Edward Hogan, University of Maryland, College Park, developed a tool to strengthen the security backbone of NASA computers linked over the Internet.
- Amy McGovern, Carnegie Mellon University, Pittsburgh, tested a voice recognition system for the GSFC Digital Library Technologies program.

In addition to preparing projects with their mentors, the 1995 VSEP students were given the opportunity to participate in a variety of enrichment activities. Students attended the VSEP lecture series, consisting of 11 talks by GSFC scientists and administrators on both technical and management topics. Students received tours of GSFC (including the SDCD

computer facilities), the Wallops Flight Facility, VA, and the Goddard Institute for Space Studies, NY. As required by the program, students presented oral reports to a review committee, participated in a Goddard Atrium Teas and Posters session, and submitted written reports.

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A complete list of the 1995 VSEP students, mentors, and projects is currently available on the World Wide Web (WWW) at:

http://http://sdcd.gsfc.nasa.gov/DIV-NEWS/contents.html

Reports from each of the 1995 VSEP projects, including those above, will be posted to the WWW by early 1996. This article was edited by Trish Cunningham, Hughes STX.

Low-Cost Networking Technology Opens Internet Access for the Nation's Kindergarten-Grade 12 Schools

Sandy Dueck, K-12 Internet Project, Michael Mewhinney, PublicAffairs Specialist, and Pat Kaspar, Contributing Editor, Ames Research Center

A new low cost networking technology developed by Langley Research Center, Hampton, VA, will soon make it possible for remotely located kindergarten through grade 12 (K-12) schools to gain affordable access to the Internet. Two high schools in California's Mojave Desert were recently connected to the Internet under this program by the Information Infrastructure Technology and Applications program, part of the High Performance Computing and Communications initiative.

This unique networking solution is based on high-speed asynchronous modems using data compression and World Wide Web (WWW) disk caching to emulate a high-bandwidth connection. High-bandwidth connections are generally so costly that they are beyond the reach of K-12 schools, but data services over phone lines that emulate high-bandwidth connections should bring these services within their reach.

Silver Valley High School (Yermo, CA) and Barstow High School (Barstow, CA) were chosen as the initial sites for this technology based on their remote location in the Mojave Desert and their proximity to Dryden Flight Research Center, Edwards, CA, which collaborates with Langley. This effort demonstrates that the educational benefit of a National Information Infrastructure (NII) can be extended to all Americans regardless of their geographic location or economic circumstances, and that remotely located schools can economically be placed "next door" to the rest of the nation's schools as they plug in to the NII.

The schools have been outfitted with a premiere network solution that is inexpensive by contemporary terms, upwardly compatible for new network infrastructures, and that can be duplicated across the country. Silver Valley and Barstow will immediately broaden their outreach to the entire educational community on the Internet, reaching all 50 states and over 170 countries around the world. Teachers from the two high schools will attend Internet training workshops where they will develop computer proficiency and network literacy and be instructed on computer system administration, security, and ethics.

Funds for the computer hardware, software, training, Internet connections, and systems development for this project were provided by NASA. Well designed, executed and publicized pilot programs such as the one planned for Silver Valley and Barstow will accelerate and make affordable new NII technologies for the K-12 community, and federal government support for such 'pathfinding' demonstration pilot projects will hasten the introduction of technology into America's schools.

For further information access the WWW home pages for these schools at:

http://www.svhs.silver.k12.ca.us
http://www.bhs.barstow.k12.ca.us

The IITA program is managed by Ames Research Center and is coordinated with the Education Division at NASA Headquarters.

Cherokee Nation Establishes a Network Node

Sheli Meylor, NASA Science Internet, and Pat Kaspar, Contributing Editor, Ames Research Center

The Cherokee Nation is working to develop the self-reliance and independence of its people by enhancing their knowledge, skills, and self-responsibility.

The Cherokee Nation Tribal Complex in Tahlequah, Oklahoma, is now connected to the Internet. Due to the combined efforts of NASA Headquarter's Life & Biomedical Sciences & Applications Division and the NASA Science Internet (NSI) at Ames Research Center, they are an official node on the network—with a 56-Kb/s line to the Internet. Under the terms of the Space Act agreement signed in February 1995, NASA's Outreach and Education project, in conjunction with representatives from NSI, will provide telecommunications technologies to the Cherokee Nation's Tribal Complex. The Cherokee Nation will establish and support a local area network that will serve as a hub to extend the technology to nearby schools and communities. The Office of Life and Microgravity Sciences and Applications' Outreach and Education project is led by Rose Grymes, with the support of Colorado State University's Gary Coulter.

The Cherokee Nation is composed of geographically remote and widely separated communities. Access to modern telecommunications technologies will allow them to address their most important needs, including access to quality education, quality health care, and information that can help stimulate economic development and foster better government-to-government relations.

According to Sheli Meylor, technical lead for NSI on this project, "The partners in this venture have similar goals. The Cherokee Nation is working to develop the self-reliance and independence of its people by enhancing their knowledge, skills, and self-responsibility. NASA, through its partnership with the Cherokee Nation, is working to channel the excitement and uniqueness of NASA's missions to Native American students, and support the development of future space scientists and engineers."

The long-range goal of the program is to extend Internet connectivity over time into the Native American community at large through a program of education and community involvement. NASA will guide these communities through targeted outreach programs showing them how to obtain local support from businesses and industry, and how to maintain a program that will ensure broad and sustained access to the global information infrastructure. The ultimate goal is to make the Internet programs in these communities self-sustaining.

Over the summer, three educators from nearby Sequoyah High School participated in the Summer Teachers Enhancement Program (STEP) held at the Johnson Space Center (JSC). The STEP program, hosted by Gerry Taylor and Robert Fitzmaurice at JSC, presented training on NASA's missions and demonstrated using the Internet to access online educational resources and to keep abreast of NASA's activities. Through the Internet, these educators will be able to use NASA's teacher resources, communicate with the astronauts (via the online service, Spacelink), and share information with educators from other Native American tribes.

Signatories of the February 1995 Space Act Agreement included the Director of NASA's Life & Biomedical Sciences & Applications Division, Joan Vernikos, the NSI Program Manager, Tony Villasenor, and the Director of Education for the Cherokee Nation of Oklahoma, Jim Quetone.

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Outreach Activities

Ames Research Center

- NASA's Life and Biomedical Sciences and Applications Division's Requirements Manager participated in a Shuttle/Mir Outreach and Education teleconference in support of a life science plant experiment that flew on a shuttle mission that docked with the Russian Mir space station in late 1995. The Ames Life Science office modeled its plant experiment educational program after other successful kindergarten through grade 12 programs completed at ARC.

- NASA Science Internet suggested Moscow State University (MSU) as a possible host site for Russian schools participating in Multicast Backbone (MBone) sessions since MSU can now receive MBone sessions.

- NSI is working with the US Agency for International Development (USAID) to bring fully integrated, low cost, global internetwork access to approximately 50 international locations. Internet access will make it possible for remotely located and isolated communities to have access to a storehouse of global information in such fields as medicine, education, science and technology. Installations have been successfully completed in Guatemala, Honduras, Costa Rica, and El Salvador.

- NSI is providing an Internet link to the Cherokee Nation in Tahlequah, Oklahoma, and NASA is working with Cherokee Nation representatives there to discuss future projects between the two groups. The NASA effort includes NSI, Ames Life Sciences, and NASA Headquarters Life and Biomedical Sciences and Applications. Several teachers from Tahlequah attended the Summer Teachers Enhancement Program (STEP) at Johnson Space Center.

- NSI co-chaired the review of NASA's Occupational Health and Aerospace Medicine Division's Space Bridge to Russia's Telemedicine Project, held October 10-12 at ARC. The meeting covered preliminary requirements and design that would allow clinicians from NASA and several US and Russian hospitals to perform real-time interactive analysis of selected medical cases over the Internet. Information transfer would be facilitated over NSI and non-NSI networks using videoconferencing (unicast and multicast) and Web services.

Information provided by Pat Kaspar, ARC, and Sheli Meylor, Sterling Software, ARC

Jet Propulsion Laboratory (JPL)

- JPL hosted an open house in June aimed at kindergarten through grade 12. Various activities included: simulating rocket propulsion, understanding the solar system, surfing the net, experiencing the Mars rover, and "flying through space", to name just a few.

- The Kidsat project is well underway. This project is manifested to place Earth-viewing cameras and instruments on the Shuttle, to be used students across the country. The exact specifications of the KidSat instruments are being made by students. Data will be made available over the Internet in real time during mission, then archived and made available to any interested student.

Information excerpted from a series of NASA press releases

- JPL has launched a partnership, called Project Los Angeles Endeavour, with the California Museum of Science and Industry. This partnership supports teacher training, family science programs, and science field days, etc, for the diverse central and south-central Los Angeles area. JPL's Director, Ed Stone, was on hand August 12, along with NASA Associate Administrator for the

Office of Equal Opportunity Programs, Dr. Yvonne Freeman, to celebrate this partnership by helping to launch a volley of model rockets into the sky above the museum. The rocket launches were part of a neighborhood science program for elementary school children. JPL's Javier Bautista, Communication Ground System Section, serves as Endeavour project scientist. Dave Tralli, Earth Geosicences Research Element 3235, will be putting the Science Education Resource Center on the information superhighway.

Information provided by Jim Doyle, Public Affairs Office, JPL

Goddard Slpace Flight Center

- The Science Data Processing Systems Section and the Science Data Management and Archiving Section, have completed development of a prototype system that provides a graphical interface to planetary image data sets, with supporting documentation, to educational institutions and the general public.The Public-Access-to-Planetary-Data system supports interactive access to complete planetary image data sets using an automated system based on CD-ROM jukebox technology, in an automated manner that requires a minimum level of operational resources. Educational institutions (kindergarten through grade 12) were involved in evaluating the tools and access methods used in the development of this system.

- The Minority University-Space Interdisciplinary Network (MU-SPIN) Project selected seven minority university-led teams from proposals received for the Cooperative Agreement Notice on "Minority Universities Information Network for Education." The teams will establish regional Network Resources and Training Sites (NRTS) to stimulate Internet use via computer networks as an integral part of the minority institutions' interdisciplinary research and education programs. Over 90 Histroically Black Colleges and Universities and Other Minority Institutions will be involved in this effort. A map illustrating the statewide coverage of the NRTS' and other information on the MU-SPIN Project are available at: http://muspin.gsfc.nasa.gov/

- The " Astronomy On-line: Ask Dr. Sue" project, funded through NASA's Astrophysics' Initiative to Develop Education through the Astronomy (IDEA) program, hosted several teachers at Goddard to develop curriculum for a set of Web-based lessons. This curriculum is currently being implemented on the Web at: http://dlt.gsfc.nasa.gov/Ask/

- Susan Hoban (Hughes STX), Information Systems Technology Branch, Space Data and computing Division, gave an invited talk entitled "An Introduction to the Internet for Kindergarten Through Grade 12 Educators" at the Anne Arundel County Board of Education's Leadership Workshop at North County High School, Linthicum, MD. The talk provided information on how teachers can use the Internet as both an instructional tool and an information resource.

- The High Performance Computing Center conducted the fifth NASA Summer School in High Performance Computational Physics to train the next generation of computational scientists in the use of HPCC computing technologies. Sponsored by GSFC and organized by the University space Research Association, the summer school provides an intensive lecture series in computational physics each July for 16 graduate students from across the country. Experienced computational physicists present lectures on advanced topics in computational fluid dynamics, while vendors of scalable parallel computer systems (this year the Cray T3D and the MasPar MP-2) hold lab sessions on developing software for their machines. The program is geared to computational scientists with some interest in physics, astronomy, meteorology, and oceanography who are working toward PhD's in the Earth and space science disciplines.

Information provided by Judy Laue, Hughes STX Corporation, GSFC

General

- The *NASA Science Communications Strategy, The Final Report of the NASA Science Communications Working Group*, now available on the Internet, presents NASA's strategy for developing science communications programs and underscores the Agency's long-term commitment to improving the way science is communicated to the public. This report is viewable at: http://dlt.gsfc.nasa.gov/cordova/scicom.html

Information excerpted from NASA press release I95-13, October 2, 1995

- The SpaceLink program, an agency-wide communications program managed and operated by the K-12 Education Programs at Marshall Space Flight Center (MSFC) , provides an online Teacher Resource Center where educators can access lesson plans and teaching activities on a variety of subjects, chat with other educators, and participate in more formal, moderated online conferences. Spacelink recently hosted a computer conference with approximately 40 educators, where Donna Shirley and Carl Pilcher of the Mars Exploration Program Office were "Mars Experts", answering questions about Mars. Spacelink can be accessed at:

  http://spacelink.msfc.nasa.gov

Information provided by Jeff Ehmen, K-12 Education Programs, MSFC and excerpted from MEP Significant Events, 10/10/95

- "NASA...On the Cutting Edge", a live educational NASA television broadcast, is a series of three, one hour interactive program that features students using computers to study science. The first in the series was aired on November 7, demonstrating how telerobotic and virtual reality systems are developed and how they push the limits of space explorations. In other sessions, students will examine how the Sun interacts with Earth and the solar system, explore the international space station, and preview NASA's future exploration and scientific advancements. NASA TV bradcasts on jC-band, Spacenet 2, transponder 5, 69 degrees west longitude.

- The Planetary Society's (Pasadena) competition to name the Mars six-wheeled exploratory rover has culminated in NASA's selection of the name "Sojourner", after the Civil War-era abolitionist and women's rights activist, Sojourner Truth. The competition was announced in the *National Science Teacher Association*, January 1995, magazine, inviting students to select a heroine and write an essay on her historical accomplishments. Over 3500 entries, in essay form, were submitted from all over the world, including Canada, India, Israel, Japan, Mexico, Poland, and Russia. Mars Pathfinder project scientists and engineers at Jet Propulsion Laboratory and Planetary Society staff members judged the entries. Marie Curie (discoverer of the elements radium and polonium), was selected as second prize winning name, with Judith Resnik (the late astronaut), winning third prize. Other names submitted included Sacajewea (Indian explorer), Amelia Earhart (female aviator), Athena (Greek godess of wisdom), Harriet Tubman (political reformist), and Thumbelina (a Hans Christian Andersen fairy tale character). The Mars Pathfinder lander and rover will be launched in December 1996, cruising to Mars over a seven month period. Once on Mars, the solar powered rover will explore the chemistry of rocks and other features of the planet.

Information excerpted from NASA press release 95-1112

Siggraph '95—The Latest in Computer Graphics and Interactive Techniques

The 22nd annual SIGGRAPH conference, 1995, took place at the Los Angeles convention center in California August 7-11. SIGGRAPH is an international technical forum for presenting research results in computer-based interactive media development—for use in the science, entertainment, engineering, art, and business industries. A well attended event, this year's conference rated a seven page write-up in the Hollywood trade paper, the *Daily VARIETY*, with articles focusing on computer-aided achievements within the entertainment industry.

The four day technical program consisted of papers and panels, courses, and technical sketches of works in progress. On the fifth day a technical program of papers and panels was presented specifically for educators. In addition to the technical programs, attendees could view the Interactive Media Festival art show in the digital gallery; the latest commercial multimedia computer hardware, software, and services in the exhibit showroom; visit the Interactive Communities and the Interactive Entertainment venues; preview animated clips from the Electronic Theater; or apply for a job.

SIGGRAPH's one day program for educators focused on educational issues in computer graphics and interactive techniques at both the kindergarten through grade 12 and college level. The program included courses on teaching interactive media, technical presentations on computer graphic projects from various educational institutes, informational materials, and computer graphics workshops. The Education Committe hosted, for the tenth year, the Student Poster and Animation Competiton Exhibition, displaying 48 posters and several students animation clips. The competition is open to students in elementary school through university. Teachers participate in the selection of entries.

A myriad of virtual reality (VR) "rides" and activities were available in the Interactive Entertainment venue, including a VR music video using the NASA-developed (Fakespace) boom, a glider ride through the Grand Canyon, a fully-immersive race to mine ore on the planet Mars, and more. Attendees experiencing theVR exhibits in both the Interactive Entertainment and the Interactive Communities venues were introduced to immersive head-mounted displays (VR, motion, and surround sound), data gloves, and full-size pods.

In the Interactive Communities, various research and educational institutions presented a variety of interactive-media information systems, such as:

- an asynchronous transfer mode (ATM) cross-country telemedicine patient center
- a cancer patient support program
- an interactive visualization tool for the wheel-chair disabled
- a demonstration of the Internet's multicast backbone
- the Global Learning and Observations to Benefit the Environment system
- a speech visualizaton system
- a digital learning center (microbial ecology)
- a virtual globe navigation system
- an electro-optical thermal scene generation simulator
- a hyper-real museum (3D art appreciation system)
- SIGKids online production lab
- an interactive collaborative Internet art experience using CU-SeeMe and email

Also, for the first time in the conference's 22 year history, the Electronic Theater, a montage of cutting edge computer-animated shorts, was made available for public viewing. Electronic Theater, a forum for presenting the newest computer graphics techniques, showcased 72 clips from around the world in this year's two hour show.

The conference was supported by GraphicsNet, a collaboration formed by the various networks components used at SIGGRAPH. GraphicsNet used the most advanced communitcations technology—ATM sychronous optical network, high performance interface, and integrated digital network—to support teleseminars, teleconferences, telemediciane consultations, and distributed visualization spaces.

For information on SIGGRAPH '96 access the Web at: http://www.siggraph.org/conferences/siggraph96/cfp/

Information Systems Program Highlights

Major accomplishments achieved by NASA's Information Systems Office (Code ST) are highlighted below. They cover work performed from August 1995 through November 1995, and reflect the combined efforts of many people.

Ames Research Center (ARC)

National Science Foundation (NSI)

- The NSI Requirements Manager attended the Neurolab Investigators Working Group in Tiburon, California, to discuss Internet connectivity and security. The presentation to 75 U.S. and international Neurolab attendees emphasized NSI's worldwide infrastructure and touched on future technologies that may be used by scientists to accomplish their scientific goals, including 3D modeling over the Internet and participating in videoconferencing testbed activities.

Goddard Space Flight Center

Mass Storage and Scientific Computing Branch (MSSCB)—Nancy Palm

- Negotiated a Cray contract modification to replace the NCCS C98 with J90+ systems delivering 9.6 gigaFLOPS initially and 19.2 when upgraded in November 1996. The NCCS received a CRAY J916/16 as an interim platform for benchmark codes and data migration to the CRAY J916/32 that will replace the J916/16 this fall. The J916/16 has 2 GB of memory, 216 GB of disk, and HiPPI, FDDI, and Ethernet connections. Each cpu runs at approximately 200 megaFLOPS as opposed to the 1 gigaFLOPS per cpu of the existing CRAY C98/6256. Code 931 is leading a tiger team to convert user codes to multitasking to take full advantage of the new CRAY J processors prior to removal of the C98.

- The NCCS upgraded the Cray robotic storage systems by installing a Powderhorn robot in place of the StorageTek robot in the Automated Cartridge System silo attached to the Cray C98. The new robot has been observed to decrease average tape mount time from 41 seconds to 21 seconds and increase the maximum tape mounts per hour from 135 to 350. The new robot will improve migrate and recall throughput and allow the silo to handle more requests. The NCCS attached a WolfCreek silo (.8TB capacity) to the Powderhorn silo on the Cray C98 system. Finally, StorageTek delivered six Timberline 36-track tape drives that are rated to transfer data at 6MB/sec.

- The NCCS Convex/UniTree is providing real-time data archiving support for the first time in support of a field experiment to monitor fires in Brazil. B. Ridgway is archiving 3 GB per day (1 375-MB file every 3 hours) of Geostationary Operational Environmental Satellite data onto the UniTree system via FDDI in support of the experiment.

- Due to the consolidation of Agency administrative IBM machines and functions at Marshall Space Flight Center, termination of NASA Center for Computation Sciences (NCCS) support for Multiple Virtual Storage (IBM operating system) will coincide with the removal of GSFC's information Technology and Services Division processor.

Scientific Applications and Visualization Branch (SAVB)—Horace Mitchell

- To better serve its sponsors and simplify the requirements gathering of its yearly reauthorization process, the NASA NCCS redesigned its fiscal-year reauthorization package into electronic format. For the first time, the over-180 NCCS sponsors will be able to access specific forms via the Web and email the information back. The electronic format frees sponsors from what has been a burdensome paperwork process.

Accomplishments

- Scientific Visualization Studio (SVS) personnel worked with the Global Learning and Observations to Benefit the Environment's (GLOBE) Principal Investigators to identify supplementary categories and sources of remotely sensed data. The project, which currently supports seven total data sets, will support 20 to 25 total data sets by the time Phase II begins this fall. Other work performed for GLOBE consisted of:

  Continued production of daily visualization products, and the weekly videos for Cable News Network and other broadcasters

  Production of special public relations products at the request of GLOBE Headquarters

  Design and implementation of a new scheme for higher resolution local view

  Development of new color scales for the data in consultation with the Principal Investigators and GLOBE HQ

  Initial design and prototyping of student data analysis interface and tools

  Development of upgrades for GLOBE network (mirroring, ftp, and email services) with Tony Villasenor's group, Office of the Mission to the Planet Earth, and Ames Research Center.

- The SVS is assisting scientists with using virtual reality environments to analyze their data. For further assistance contact S. Maher at: stephen.maher@gsfc.nasa.gov

- The "Parallel Processing Workshop for NCCS Users" focused on parallel processing concepts and tools to get started on the massively parallel computers available through the NCCS, including the High Performance Computing Center (HPCC) MasPar and the JPL CRAY T3D. This was the first course of a training program designed to prepare for the HPCC Cooperative Agreement Notice testbed expected in March 1996.

Computer Networks and Communications Branch (CNCB)/Code 933—Pat Gary

- The Earth Science Directorate's Data System Advisory Committee, chaired by Pat Gary, completed the first draft of the *Earth System Science Network (ESSN) Strategic Plan: FY95-FY99*. The plan documents the introduction of Asynchronous Transfer Mode (ATM) and switched Ethernet into the Earth Sciences Directorate's local areas networks (LAN) to effect higher performance networking. Marking the official beginning of the inter-building deployment of the ESSN strategic plan's high performance component, the CNCB installed an ATM-based network switch in Building 22 and interconnected the switch at 310 Mbps via optical fibers with the existing ATM-based LAN in Building 28. The ESSN now supports approximately 25 ATM-attached hosts, each with 155 Mbps connections.

- The CNCB enabled GSFC's first use of the ATM-based National Research and Education Network and conducted memory-to-memory transfer tests between Sun SPARCstation 20's at LeRC and GSFC's Building 28, achieving approximately 30-Mbps throughput over the intervening 45-Mbps wide area network link. This throughput is approximately two orders of magnitude faster than what is achieved between LeRC and GSFC using the NASA Science Internet.

- The CNCB's development contractor Scientific and Commercial Systems Corporation (SCSC) expanded the Earth Alert System for household use. A new receiver model is compatible with Hawaiian commercial AM radio stations and can be modified to other specifications. The new receiver incorporates and turns on a radio in the event of an emergency. SCSC is ready to fill purchase orders. For additional information on the Earth Alert System see http://

sdcd.gsfc.nasa.gov/DIV-NEWS/earth.alert.html.

High Performance Computing Center (HPCC)—Jim Fischer

- The final report from the Workshop on Enabling Technologies for PetaFLOPS Computing Systems, held February 1994 in Pasadena, CA, is available in book format. The workshop conducted the first comprehensive assessment of the petaFLOPS computing systems field. The book covers applications and algorithms, device technology, architecture, and software technology. It identifies technical challenges and provides recommendations on actions that will initiate the process towards petaFLOPS computation. The book was edited by T. Sterling/CESDIS, P. Messina/Caltech, and P. Smith/HQ RC (MIT Press, ISBN 0-262-69176-0).

- Established PetaFLOPS Enabling Technologies and Applications (PETA) on the World Wide Web. PETA is a reference index for the emerging interdisciplinary field of petaFLOPS computing. The Web site is a source of references to related work from across the country. Peter Kogge, University of Notre Dame, and Rick Stevens, Argonne National Laboratory, PETA Senior Editors, manage dynamic and evolving reference sources from specific disciplines including device technology, parallel architecture, scalable applications and algorithms, and system software. Access PETA at: http://cesdis.gsfc.nasa.gov/petaflops/peta.html

- Completed the Beowulf-2 demonstration system, a high performance-to-cost multiple computer workstation. In the spirit of cheaper/better/faster, this project demonstrates the potential of exploiting very inexpensive and widely available components for high-performance computing. Beowulf-2 incorporates advances in commodity technology, including 16 Intel Pentium processors (100 MHz clock), 512 MB of memory, 20 GB of disk storage, and dual 100 Mbps Fast Ethernet internal networks. The Linux operating system running on Beowulf-2 has been augmented with advanced channel-bonding software to support efficient, user-transparent, multiple parallel Ethernet network channels. Important systems software advances include ports of the Message Passing Interface protocol and the Condor job stream scheduling subsystems. Extensive studies of the Beowulf-1 parallel communications and file transfer performance characteristics have been conducted and the findings published at professional conferences.

National Space Science Data Center (NSSDC)—Joe King

- The NSSDC added a Digital Linear Tape jukebox, front-ended by an Silicon Graphics, Inc., Challenger IRIX (UNIX) workstation, to its mass data storage environment. This system has a 2.4 TB capacity, not including effects of data compression, and will be managed by Unitree software. Primary initial use will be for the management and dissemination of data from the X-Ray Timing Explorer (XTE) spacecraft to be launched in November 1995. Once a steady state is attained, 2.5 GB/day inflow is expected. Initial access to non-proprietary data will be by file transfer protocol (FTP). Key roles in planning the effectiveness of this system as a pathway to XTE data have been played by Goddard's High Energy Astrophysics Science Archive Research Center (HEASARC), the Astrophysics Data Facility of the Space Science Data Operations Office, and NSSDC.

- The NSSDC Common Data Format team was selected as one of five runners-up for the 1995 NASA Software of the Year Award. Sharing the credit and award are present government and contractor staffers Greg Goucher, Jason Mathews, Rick Burley, Jeff Love, and Tami Kovalick, and former staffers Lloyd Treinish, Mike Gough, Howard Leckner, and Ravi Kulkarni.

- During the June-August 1995 period, NSSDC acquired new astrophysics, space physics, and planetary data on 273 CD titles (some CD-Write Once, others

mass-replicated), 80 9-track tapes, and 34 8-mm tapes; in addition 98 GB of new data arrived electronically. NSSDC brought 233 GB of data to a state of network accessibility.

- During the same period, 4075 accesses to NDADS (NSSDC's nearline mass storage) produced a 33 GB data outflow, while 13,700 non-NDADS files were anonymous FTP—downloaded by users. Close to 2.2 million files were downloaded from NSSDC's various World Wide Web pages. Finally, data were shipped via US mail on 3894 CD-ROMs, 122 9-track tapes, and 12 4- or 8-mm tapes in response to 574 distinct requests.

Editor's Note—*the following article provides information excerpted from the* Final Report, Director's Discretionary Fund Activity, Prototype System Supporting Public Access to NASA's Planetary Data.

Providing Public Access to Planetary Data

The Science Data Processing Systems Section and the Science Data Management and Archiving Section at Jet Propulsion Laboratory (JPL) have completed development of a prototype system that provides a graphical interface to planetary image data sets, with supporting documentation, to educational institutions and the general public. The Public-Access-to-Planetary-Data system supports interactive access to complete planetary image data sets using an automated system based on CD-ROM jukebox technology, in an automated manner that requires a minimum level of operational resources.

This prototype, funded by the JPL Director's Research and Development Fund, had two primary objectives: development of a demonstrable prototype providing broad general access to a selected subset of NASA's planetary image database, and provision of educational access to JPL data sets and other resources. This activity was able to capitalize on work funded by the Planetary Data System (PDS) and the Solar System Visualization Project to provide sophisticated access tools to the complete Magellan and Viking Lander missions' image databases and supporting documentation via the Internet. Another public domain tool, CU-SeeMe from Cornell University, was used to support interactive video and audio interaction over the Internet. Students in classrooms linked under the Global Schoolhouse project were able to get online and "ask the JPL Scientist" questions supporting the curriculum work in their classrooms. Planetary and Earth-based data was provided in response to live queries and discussions held during Internet sessions with over a dozen schools around the world.

The User interface

Keeping the primary objective of this task in mind (to provide simple, intuitive access to the Magellan data in a format useful to both the scientific community and the general public), a display tool using Hypertext Markup Lanquage (HTML) that interfaces with the Internet using a World Wide Web (WWW) browser was created. Due to the phenomenal growth of tools and standards supporting Internet access, and the spread of Internet access to the private sector, a large number of users are already fully equipped to access data this way. Also, because some WWW browsers are freely available on the Internet, there is no cost involved in gaining access to the data. Moreover, the problems of interfacing to different platforms (UNIX, PC, and

Macintosh) are largely handled by these browsers, which precluded the effort to develop platform-specific tools.

It was determined that the best candidates for immediate access were reduced data sets containing processed data, including the Magellan Mosaicked Image Data Record CD-ROM collection and the Mars Mosaicked Digital Image Map CD-ROM collection. Further, the accompanying documentation, *The Guide to Magellan Image Interpretation* (JPL Publication 93-24) and *The Magellan Venus Explorers Guide* (JPL Publication 90-24), provide excellent introductions to the mission and image datasets.

These datasets are accessible via CD jukeboxes maintained by the Central Node of the PDS and the PDS Imaging Node. When accessed, you are presented with an imagemap of Venus (a feature accomplished using the forms-handling capability of most WWW browsers). You then select coordinates, which

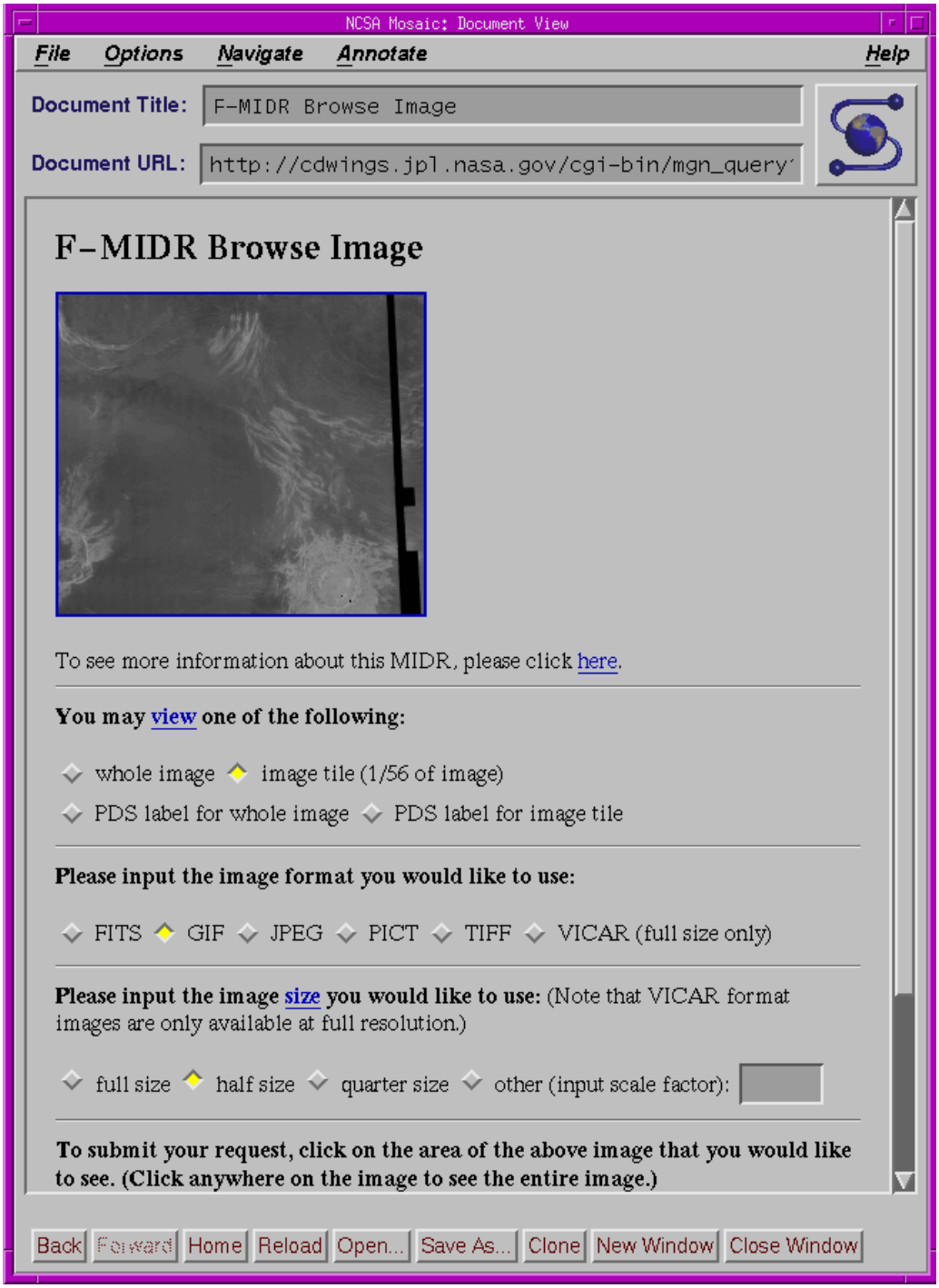

Figure 1. World Wide Web page clickable image allows you to select location, size, and format type you wish to download

are calculated by a program using Perl scripts, and are subsequently presented with an image of the desired location. This image, or "product", is downloadable in various formats (Figure 1). Alternatively, if exact latitude and longitude of an image is known, you may specify that information directly instead of clicking on the map. Thus, a planetary researcher who knows the product name may easily obtain that specific product. Also, to allow for slower connection rates (of most home users) to the Internet, the full-resolution image can be scaled down before being downloaded.

Using hypertext links, the PDS image browser is connected to a number of related resources on the Internet (Figure 2). For example, by clicking on product names on a help page, you may access the PDS Central Node's Data Set Catalog to obtain detailed information about each product. Or, from other points in the browser you are referred to the Central Node's *Guide to Magellan Image Interpretation* or the online version of the JPL document, *The Magellan Venus Explorer's Guide*. Future development may permit you to link to other related data sets, such as the US Geological Survey-produced Magellan FMAPs, or the 3D rendered images and movies of the surface of Venus produced at JPL. A similar browser for the Viking Lander image data has also been developed and placed online.

In addition to the image browsers, a list of other online resources related to various NASA missions is provided by the Imaging Node. You are also provided with direct links to the National Space Science Data Center and the Regional Planetary Image Facilities, both of which provide further services for people interested in planetary data. Links to free, available image-processing and image-conversion software are currently accessible from the Imaging Node Home Page. An electronic request form is available to NASA funded researchers for ordering data directly from the Imaging Node. In the near future you will be provided with WWW-based user friendly interfaces to the product catalogs for the various planetary missions. These too, will eventually be tied in to the image browsers.

The HTML version of the *Guide to Magellan Image Interpretation* provides overviews of the mission, radar system, and data collection, as well as image data descriptions, applications, and techniques for interpreting characteristics and properties of the data. It is an example of a useful document that has been available to only a tiny fraction of its potential users.

A WAIS source is provided to support full-text searches. You can select individual chapters to view or perform a full-text WAIS search that will identify which chapters contain the information desired. All references to figures, tables, and citations are clickable for viewing related information. For example, the figure references display the figure caption and a thumbnail version of the image or diagram. The thumbnail can then be clicked on to view a full-resolution version.

Live classroon interaction

Schools in the greater Los Angeles area (kindergarten through college level) have always had access to the expertise of space and Earth scientists at JPL; both formally, through the JPL's Speakers Bureau, and informally, by personal invitation. The rest of the country is not so fortunate; such experts are not as easily accessible. This prototype provides access to JPL's space and Earth science experts and to the JPL space program's extensive image archive to students all across the country by establishing discussions via desktop video-conferencing (Figure 3) using the Cornell University software, CU-SeeMe. Specific times and subjects for discussion are set with each site. Also, a JPL scientist may "hang out" on a central node where students can connect on a "drop in" basis. JPL imagery is also available using both an anonymous ftp server and graphical Internet browsing software.

Many kindergarten through grade 12 schools are not equipped with direct Internet connections. Therefore, a 9600-baud modem connection was installed on the Data Distribution Laboratory's Sparc 10 workstation (stargate.jpl.nasa.gov). This connection provides reasonable access to the prototype information collection. The image server's ability to subsample Magellan images works very well, allowing users to ensure that the desired image has been selected before committing 10 or 15 minutes to downloading a full size (1K x 1K) Magellan image tile. However, the image files in the online documents are too large for comfortable downloading. They need to be converted to JPEG format

Figure 2. World Wide Web page of the Magellan to Venus online resources

or provided in several resolutions as are the Magellan image tiles.

The results

In summary, two prototypes, not just one as originally planned, were developed. Both provide broad public access to planetary data and resources at JPL. First, external users can query and retrieve data from the complete Magellan and Viking Lander datasets and supporting documentation via Internet access. Secondly, students can interact directly with JPL staff personnel, using audio and video support tools, across the Internet. JPL space and science expertise and image data can be made available to any school in the country, or the world. At several key schools, this availability has become a resource that has been utilized on a constant basis.

For further information contact

Figure 3. Illustration of live classroom interaction and access to JPL imagery

A JPL scientist may "hang out" on a central node where students can connect on a "drop in" basis.

Bill Green at:
Bill_Green@iplmail.jpl.nasa.gov

This activity was managed by the Science Data Processing System Section Manager, Bill Green, and the Science Data Management and Archiving Section's Data Distribution Laboratory Manager, Mike Martin. Online video interactions were achieved in cooperation with the Global Schoolhouse activity. The Global Schoolhouse is a project that is partly funded by the National Science Foundation and by local and national businesses.

CU-SeeMe is a desktop video conferencing program written for the Macintosh family of computers by Cornell University. Initial efforts weere funded by the Advanced Technology group in the Network Resources division of Cornell University's Information Technology department. Since October 1, 1993, the CU-SeeMe project has been funded by the National Science Foundation. This software, or further information about the program, is available via anonymous ftp from Cornell (gated.cornell.edu/pub/video). The graphical user interface to the Magellan database access was developed by Elizabeth Duxbury, based in part on earlier work by Paul Andres, Myche McAuley, and Steve Levoe, all under direction by Bill Green. Under the direction of Mike Martin, the online Magellan documentation task and the product server software for the Kubik Jukebox were produced by Gail Woodward, with support from Ann Bernath, Kristy Kawasaki, Rene Peralta, and Mark Takacs. Steve Hughes tested the dial-up access to the online data collection in a classroom setting.

Illustration on this page created by Sandi Beck, Editor, and Scott Brenneisen, graphic illustrator/animator.