SCIENCE INFORMATION SYSTEMS NEWSLETTER

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Welcome to Issue 44

1997

The NASA Science Information Systems Newsletter (SISN) is prepared for the Office of Space Science (OSS), Science Information Systems (SIS) Program through an agreement with the Jet Propulsion Laboratory. The newsletter, which has been an ongoing task for over ten years, is a forum for the space science and applications research community to report research and development activities, outreach activities, and technology transference. SISN offers a venue for articles that are not likely to appear elsewhere and provides the opportunity for information exchange within the science community, as well as a platform for accomplishments by that community. Related articles from other programs and agencies are also published.

Questions or comments regarding this newsletter task may be emailed to Sandi Beck at <sandi.beck@jpl.nasa.gov>.

Credits: Design and format by Editor, Sandi Beck. Graphics design, animation, and rollovers by Scott Brenneisen, XTREME GRAFX. Also, thanks over the years to Calvin Yee, formerly of Telos Information Systems, Doug Steinwand, formerly of JPL, and the JPL documentation staff.

Supercomputing at Caltech, Jet Propulsion Laboratory

The California Institute of Technology, more commonly known as Caltech, and Jet Propulsion Laboratory (JPL) recently acquired the world's largest Hewlett-Packard (HP)/Convex Exemplar SPP2000 supercomputer. The supercomputer is housed on the Caltech campus and is shared by the two centers for space and Earth science research. The HP joins the two Cray supercomputers now in use by the JPL Supercomputing Project.

The Exemplar

The Exemplar has 64 gigabytes of random access memory a thousand times as much memory as a high-end desktop computer and disk space that is equal to one terabyte. The systems memory is distributed among four 64-processor partitions, but acts as a single, globally shared space. The most super feature of the Exemplar is probably its speed. Each of the 256 processors can perform at speeds up to 720 megaflops, meaning the Exemplar has a peak performance of 184 gigaflops.

The Exemplar runs on SPP-UX, the UNIX based operating system developed by Convex Corporation. SPP-UX has UNIX features plus additional utilities, such as accounting and batch processing.

Supercomputing at JPL

The supercomputer systems at JPL are used to solve problems in all areas of science and engineering. For example,they have been used in trying to determine the gravitational force of Venus and how the Venusian topology has been affected by gravity, and to model ocean surfaces to show the fine detail of small eddies. Supercomputing services also include the visualization laboratory for creating, viewing, and storing animation sequences.

The HP Exemplar will be used in Grand Challenge simulations. A Grand Challenge is a fundamental problem in science and engineering, with broad scientific and economic impact, whose solution can be advanced by high performance computing. Additionally, the Digital Sky Project will employ the Exemplar. The Digital Sky Project will collect and provide interactive access to wavelength astronomical observations, representing trillions of bytes of data. Currently the Exemplar has been processing the raw data transmitted from spacecraft into photos of the Martian landscape.

Excerpted from "Whats New in Supercomputing," published in CIS News, Volume 15 No. 3, JPL's computing and information services publication, and from the article, "Caltech/JPL Acquire World's Largest Convex Exemplar," written by Jarrett Cohen, published in the September 97 issue of NASA's High Performance Computing and Communication Insights magazine, Editor Judy Conlon. ■

Next Generation Internet Drafts Implementation Plan

The Internet has grown at nearly 100 percent per year since 1988, with an increase of traffic at approximately 400 percent per year. It is estimated that by the year 2000, more than 50 percent of the US population will have access to the Internet.

The Internet has created jobs, indeed whole new industries, and American business and government organizations are increasingly dependent on the it. The Internet is not only a mode of communication, it is a way of doing business and a source of information, but the capabilities are being strained. The Internet's current limitations are exacerbated by high bandwidth access and multimedia applications, and the solutions are beyond the scope of any one institution, company, or industry.

President Clinton stated in a State of the Union address, "We must build the second generation of the Internet so that our leading universities and national laboratories can comunicate at speeds 1000 times faster than today, to develop new medical treatments, new sources of energy, and new ways of working together."

Internet intitiative

The Next Generation Internet (NGI), a $300 million federally funded initiative, will address the current Internet's limitations. NGI will be a national network, fostering partnerships among academia, industry, and government that will keep the US at the cutting-edge of the information and communications technologies. NGI, with its broad agenda and ability to involve government, research institutions, and the business sector, is a key investment strategy in implementing the coming exponential improvements in computing and communications, benefiting both the public and American industry. The NGI initiative is possible only because of the very strong agency programs that are currently under way; the Large Scale Networking Research and Development crosscut for FY 1998 includes $100 million for NGI.

Technical advances are expected to spin off from NGI as it stimulates the introduction of new multimedia services in our homes, schools, and businesses. New technologies and architectures, designed and developed as part of the NGI, will be incorporated into products and services that are subsequently made available to the general public.

Initiative partners

NGI initiative partners include NASA, the National Science Foundation (NSF), the Defense Advanced Research Projects Agency (DARPA), the Department of Engergy (DoE), and the National Institute of Standards and Technology (NIST), as well as other agencies. DARPA will lead the initiative. The specific skills and experience that the participating agencies bring to the initiative provide the essential base upon which it is built. Because of this strong base, the initiative is expected to succeed; without that base the initiative would involve much more risk. Specific agency strengths include:

- DARPA: Pioneer of long term networking research; developed cutting-edge network technologies; great strength in network management and services.
- DoE: Long term experience in managing production and research networks; specialized skills in networking technology; great strength in mission driven applications and in system integration.
- NASA: Experience in network management and in specialized network testbeds; strength in mission driven applications involving high data rates; great strength in system engineering and integration.
- NSF: Special relationships with the academic community; experience in network research and in managing networks; great strength in scientific applications.
- NIST: Long experience in standards development, networking research, and in testbeds involving many industrial partners.
- National Library of Medicine (NLM)/National Institute of Health (NIH): Extensive experience in medical research; great strength in health care applications.

An NGI implementation team will be established to coordinate research agendas across all goals. The NGI will be under the overall guidance and direction of the NGI Implementation Team (NGI IT) reporting to the Large Scale Networking working group. The NGI IT will include appropriate agency program managers, and will include experts from academia, industry, and Federal laboratories.

Initiative goals

NGI has three goals, which are to:

- promote experimentation with the next generation of networking technologies
- develop a next generation network testbed to connect universities and federal research institutions at rates that demonstrate new networking technologies and that support future research
- demonstrate new applications that meet important national goals and missions

To achieve these goals, the NGI will be built on the base of current research and development activities and programs in the participating federal agencies.

Goal 1 activities will focus on research, development, deployment, and demonstration of the technologies necessary to permit the effective, robust, and secure management,

provisioning, and end-to-end delivery of differentiated service classes. These activities cluster into three major tasks: network growth engineering, end-to-end quality of service (QoS), and security. The challenge for this goal is to ensure that the advanced capabilities of Goal 2 networks can be made predictably and reliably accessible to a broad range of users sharing a common infrastructure. This will be joint agency effort with the DARPA as the lead and with the participation of DoE, the NIST, NASA, NSF, and other agencies.

Goal 2 addresses end-to-end connectivity (to the workstation) at speeds from 100+ million bits per second (Mbps) up to 1+ billion bits per second (Gbps.) Some networks have already achieved OC-12 (Optical Carrier) speeds (622 Mbps) on their backbone links and some experimental links are running at 1+ Gbps, but end-to-end usable connectivity is typically limited to less than 10 Mbps because of bottlenecks or incompatibilities in switches, routers, local area networks, and workstations. Goal 2 addresses these shortcomings by developments and demonstrations involving the two subgoals: high performance connectivity and NGI technologies and ultra-high performance connectivity.

The networks developed under the NGI initiative will connect at least 100 sites - universities, Federal research institutions, and other research partners - at speeds 100 times faster than those of today's Internet, and will connect of the order of 10 sites at speeds 1,000 times faster than the current Internet.

The subgoal, high performance connectivity, demonstration network fabric will function as a distributed laboratory. It will deliver a minimum improvement of 100 times (or greater) over the current Internet performance on an end-to-end basis to at least 100 interconnected NGI participating universities, national laboratories, and federal research sites demonstrating research and other important applications that require such an infrastructure. This network fabric will be large enough to provide a full system, proof-of-concept testbed for hardware, software, protocols, security, and network management that is required in the commercial NGI. This subgoal will address not only accessible but also remote sites and Experimental Program to Stimulate Competitive Research states. Experiments are anticipated to assist research in reaching beyond the current Internet infrastructure. This is a joint agency effort led by DoE, NSF, and NASA, with participation from DoD and other agencies.

The subgoal, NGI technologies and ultra high performance connectivity, addresses the development of ultra high speed switching and transmission technologies and of end-to-end network connectivity at 1+ Gbps. Because of its high risk and pioneering nature, networks involved will be limited initially to approximately 10 NGI sites, and only a limited number of applications will be implemented.

Attainment of this goal, together with the technologies developed in Goal 1, will lay the groundwork for terabit per second (Tbps) networks operated by appropriate network management and control and guaranteeing end-to-end quality of service. Working in partnership with industry is the key to a shared infra- structure that can be used profitably to support high end scientific users and large numbers of commercial users. This subgoal is a joint agency effort with the DARPA as the lead, and with the participation of DoE, NASA, NSF, and other government agencies.

The high speed and advanced communications capacity developed under these subgoals will enable advanced applications for DoD, DoE, NASA, NSF, and other agency users. However, increased bandwidth alone will not be sufficient to meet the dependability, classes of services, security, and real time demands of emerging and next generation applications, such as collaboration, wide area distributed computing, and teleoperation and control.

To achieve Goal 3, the participating federal agencies established procedures to identify appropriate applications to be tested. These applications require the advanced networking capabilities of Goals 1 and 2, and agencies must be willing to adapt their applications to take advantage of these capabilities. The resulting NGI applications will integrate advanced networking and application technologies.

A coordinated selection process will be used to ensure that applications tested and demonstrated on the NGI network provide robust, realistic, and complete tests of technologies that are extensible and adaptable to other applications. The selection of NGI applications is an iterative process with federal, academia, and industry participation. Applications will be derived from the federally focused applications in appropriate technology classes, for example, digital libraries, remote operation of medicine, environment, crisis management, manufacturing, basic sciences, and federal information services.

This joint agency effort will be coordinated among the participating agencies. Since most of the funding for applications will come from the applications themselves, leadership will be provided by means of domain specific affinity groups. Participation will be encouraged from a broad range of agencies with demanding networking applications. Applications will also be solicited from other interested research entities within academia and industry.

NASA's participation

The NGI initiative is important to NASA because NASA missions require the interconnections and integration of its resources, include user facilities, databases, and supercomputers, as well as geographically distributed researchers and scientists. According to Bill Feiereisen, High Performance Computing and Communications (HPCC) program manager at Goddard Space Flight Center, NASA will participate in the NGI through increased network research and applications demonstrations.

To fulfill Goal 1, NASA will deploy an appropriate suite of advanced networking services to enable high performance applications. To fulfill Goal 2, NASA will provide both a high performance network application testbed and a network research testbed for the NASA community and its partners. To fulfill Goal 3, NASA has already embarked on a number

of applications which will require the network technology acceleration of the NGI to be successful.

The NASA Research and Education Network (NREN) existing network is the cornerstone for NASA's collaboration in the NGI. NREN supports the HPCC community, NASA missions, advanced aerospace design, telemedicine, astrobiology, astrophysics, remote operations and simulations, and important national goals.

NREN Manager, Christine Falsetti, states, "NASA is involved in NGI because of its unique missions that require advanced networking technology, and because it has a quarter century of network systems engineering experience."

Learn more about NGI < http://www.ngi.gov/> and NREN <http://www.nren.nasa.gov/>. ■

Report on the NASA Research and Education Network Workshop

Pat Kaspar, NASA Internet, Ames Research Center

The Second Annual High Performance Computing and Communications/NASA Research and Education (HPCC/NREN) Workshop was held September 15 to 17, 1997, at Ames Research Center. Workshop II, which was attended by over 100 scientists and networking experts, continued the effort begun at the first NREN Workshop held in May 1996 to share information and experience about NASA's advanced networking technologies and applications and to gain user feedback on high-performance networking applications that drive the research network and network research.

Workshop II featured advanced networking application demonstrations and breakout sessions on specific areas. Participants had an opportunity to participate in one of six affinity working groups: Advanced Aerospace Design, Astrobiology, Astrophysics, Earth Science, Space Exploration, and Telemedicine. Each of these working groups produced a short White Paper identifying requirements for their disciplines.

Five highly visible applications were demonstrated to illustrate how high-performance, high-speed networks can facilitate and enhance science and research in a variety of fields. The demonstrations, which were well attended and well received, included the Virtual Simulation Laboratory (VLAB), Mars Pathfinder, Nomad Rover, Echocardiography, and the Distributed Image SpreadSheet.

Workshop participants broke out into "Affinity Groups" which brought together discipline scientists and networking engineers to look into the near future to determine what applications couldbenefit from a high-performance network-and indeed could not be performed without such a network-and to prioritize those applications as a basis for planning. Groups were provided with a suggested "roadmap" to guide discussions, and a suggested outline for their White Paper.

Initial results of the workshop enforced the need for a strong program in advanced networking for NASA missions and applications. Future applications research needs that were identified include 3-D collaborations, digital libraries, distributed computing, image processing, scientific visualization, simulation, and virtual environments.

Learn more about NREN Workshop II at <http://www.nren.nasa.gov>. ■

Extreme Ultraviolet Explorer Outsourced to University

Brett Stroozas, Center for Extreme Ultraviolet Astrophysics, University of California at Berkeley

On 14 March 1997 the responsibility for all spacecraft operations for NASA's Extreme Ultraviolet Explorer (EUVE) satellite were officially outsourced from Goddard Space Flight Center (GSFC) to the University of California at Berkeley (UCB). Since its launch on 7 June 1992 until early this year, EUVE satellite operations had been split between UCB and GSFC. The science payload was designed and built at UCB's Space Sciences Laboratory, and was operated from the Center for EUV Astrophysics (CEA) located just off the main UCB campus. GSFC designed and built the satellite's spacecraft bus the Explorer Platform (EP), and operated it out of GSFC via a contract to a Lockheed-Martin (L-M) Flight Operations Team (FOT).

The proposal

In March of 1996 UCB submitted to NASA Headquarters (HQ) an unsolicited proposal for an EUVE outsourced extended mission (OEM). This proposal called for NASA to transfer from GSFC to UCB the operational control and responsibility for the EP spacecraft, and thereby allow UCB to integrate payload and spacecraft operations and to apply its proven cost-reducing strategies in order to stretch the available funding and mission life. In April 1996 NASA Headquarters (HQ) approved the OEM proposal and outlined four prime objectives designed to maximize the outsourcing benefits to NASA and to the science community. The objective were:

- a University model for mission operations that would encourage student participation
- an educational focus to foster science and engineering training
- the continued dissemination of technical and operational innovations
- university leadership and responsibility for all mission functions

Given these objectives HQ then directed UCB and GSFC to work together to implement the OEM as quickly and effectively as possible. HQ also provided UCB with a fixed allocation of funds with which to operate as long as possible; this innovative budget model provided UCB with further incentives to reduce operations costs in order to extend the mission lifetime (current existing funding is expected to support mission operations through at least mid-1999).

Without partners

UCB had originally planned to team with an "industrial partner" who would conduct EP spacecraft operations under UCB management. A number of companies including the incumbent L-M expressed interest in teaming with UCB. However, in the end, none of these companies submitted a bid to UCB's request for proposals; presumably, this was due to the potential risks involved and to the fixed-price contract that UCB offered as a method to control costs.

In response to no industrial partner, UCB implemented its "backup plan", which was to take on spacecraft operations itself. UCB hired its own FOT and sent each member to GSFC for ~2 months in order to train with their L-M counterparts. During this training period other managerial and technical personnel at UCB and GSFC worked together to iron out the details of the new operations center, the ground system for which was heavily based on the existing one at GSFC. Over a period of months numerous waves of equipment were shipped to, and installed at, UCB; this equipment was then subjected to full-blown testing once the UCB FOT members returned from their GSFC training.

The handover

Following the training period, operational responsibility for EP spacecraft operations was then phased over to UCB. By the end of 1996 UCB had begun taking routine realtime events in order to iron out kinks in the ground systems. At the beginning of the new year in 1997 UCB and GSFC entered a "shadow operations" period to formally begin the transfer of operational control and responsibility. In early January UCB assumed all spacecraft planning and scheduling activities, with the L-M FOT at GSFC serving in a backup role. Then, in early February UCB assumed the remaining duties realtime and engineering operations, once again with the L-M FOT standing by as a backup. By mid-March, however, everyone agreed that UCB was ready for the official handover of spacecraft responsibility and control, which occurred on 14 March.

Since the handover UCB has successfully conducted integrated payload and spacecraft operations for EUVE. UCB's operations concept employs a small 8-person FOT to support single-shift operations (~8am-5pm local time) seven days per week. During the off-shift hours the spacecraft health is monitored by software that pages on-call personnel in case of anomaly. This software, which is based on the system that UCB has used since February 1995 to autonomously monitor

the science payload instruments, allowed UCB to earlier transition to single-shift and eventually zero-shift payload operations. This system has now been expanded to include monitoring of the EP spacecraft.

This outsourcing "experiment" has been successful. In a joint and collaborative effort UCB and GSFC personnel worked together tirelessly throughout in order to overcome the huge technical, programmatic, political, and idealogical challenges that were encountered. The team also completed the outsourcing on schedule and under UCB's projected budget, in the process fulfilling all four of NASA's "Prime Objectives".

The benefits

The EUVE outsourcing has also provided other benefits. UCB has demonstrated the significant cost advantages and performance improvements resulting from an integrated payload and spacecraft operations center. For example:

- The small 8-person UCB FOT conducts all EUVE satellite operations payload and spacecraft, and is ~25% of the size of the combined GSFC and UCB teams at launch.
- UCB and GSFC have cut the routine response time to EUVE "targets of opportunity" by a factor of three to three to four hours; our best effort to date has been only two hours and nine minutes from initial notification to first light on target.
- UCB and GSFC have reduced the effort in the planning and scheduling process by ~75%.

We will continue to search for and implement additional ways to reduce costs and to further stretch the EUVE mission lifetime. These types of savings and improvements will ultimately add one to two years to the overall EUVE mission lifetime, resulting in a better return on investment for all taxpayers. ■

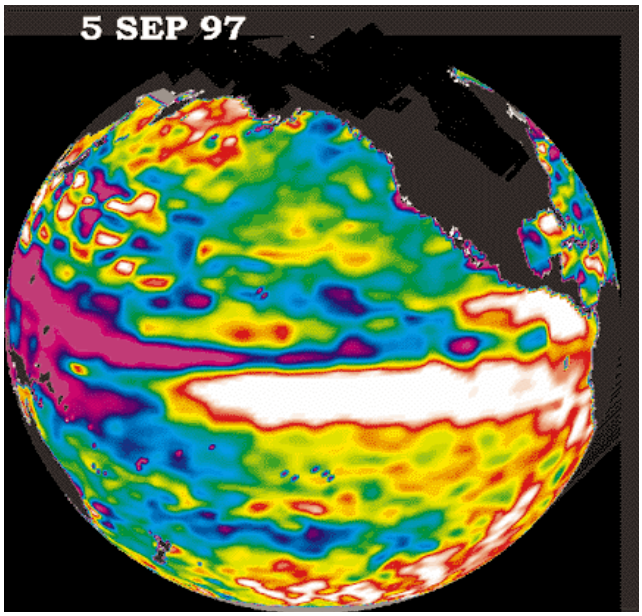
NASA Tracks El Nino With Remote Sensing Satellites

NASA's Earth-orbiting satellites are providing researchers with information on oceanic and atmospheric conditions. TOPEX/Poseidon, the Upper Atmosphere Research Satellite (UARS), and the Sea-viewing Wide Field-of-view Sensor (SeaWiFS) are collecting remotely sensed atmospheric water vapor, sea-surface height, ocean color, and global biosphere data. The recent data from these satellites is providing scientific evidence of El Nino, a weather phenomenon that is thought to be triggered when steady westward blowing trade winds weaken and even reverse direction. This change in the winds allows the large mass of warm water that is normally located near Australia to move eastward along the equator until it reaches the coast of South America. This displaced pool of unusually warm water affects evaporation, where rain clouds form, altering the typical atmospheric jet stream patterns around the world. The change in the wind strength and direction also impacts global weather patterns.

About TOPEX

TOPEX/Poseidon, launched in 1992, is a joint project between the US and France. TOPEX, managed by the Jet Propulsion Laboratory (JPL), is part of a strategic research effort to explore ocean circulation and its interaction with the atmosphere. It complements a number of international oceanographic and meteorological programs, including the World Circulation Experiment and the Tropical Ocean and Global Atmosphere Program, both of which are sponsored by the World Climate Research Program.

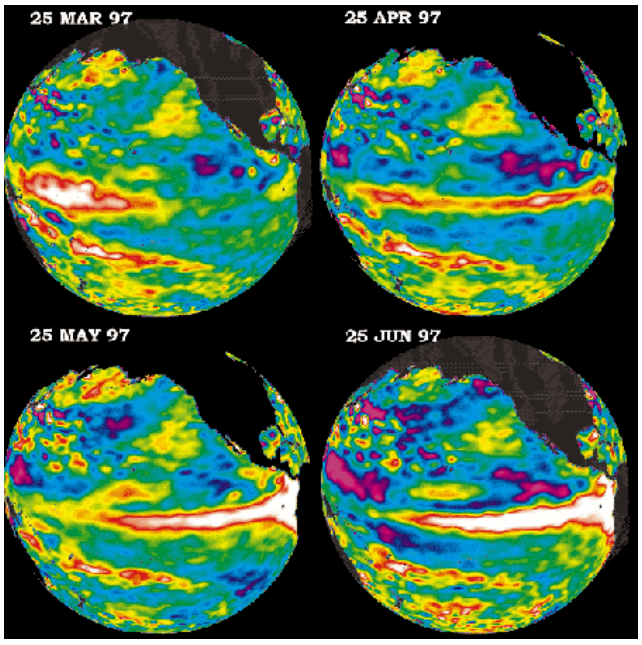
According to TOPEX Project Scientist, Lee-Lueng Fu, recent data shows that a large warm-water mass with high sea-surface elevations, about 15 centimeters (six inches) above normal, is occupying the entire tropical Pacific ocean east of the international date line.



This image of the Pacific Ocean was produced using sea surface height measurements taken by the US/French TOPEX/POSEIDON satellite. The image shows sea surface height relative to normal ocean conditions on Sept. 5, 1997 and provides more convincing information that the weather-disrupting phenomenon known as El Nino is back and getting stronger. The white and red areas indicate unusual patterns of heat storage; in the white areas, the

sea surface is between 14 and 32 centimeters (6 to 13 inches) above normal; in the red areas, it's about 10 centimeters (4 inches) above normal. The surface area covered by the warm water mass is about one and one-half times the size of the continental United States. The added amount of oceanic warm water near the Americas, with a temperature between 21-30 degrees Celsius (70-85 degrees Fahrenheit), is about 30 times the volume of water in all the U.S. Great Lakes combined. The green areas indicate normal conditions, while purple (the western Pacific) means at least 18 centimeters (7 inches) below normal sea level. The El Nino phenomenon is thought to be triggered when the steady westward blowing trade winds weaken and even reverse direction. This change in the winds allows a large mass of warm water (the red and white area) that is normally located near Australia to move eastward along the equator until it reaches the coast of South America. The displacement of so much warm water affects evaporation, where rain clouds form and, consequently, alters the typical atmospheric jet stream patterns around the world. Using these global data, limited regional measurements from buoys and ships, and a forecasting model of the ocean-atmosphere system, the National Centers for Environmental Prediction of the National Oceanic and Atmospheric Administration, (NOAA), has issued an advisory indicating the presence of the early indications of El Nino conditions. Credit: Public Information Office, JPL.

"The surface area covered by the warm water mass is about one-and-a-half times the size of the continental US," he said. "We watched this warm water mass travel eastward from the western Pacific along the equator earlier this spring. Right now, sea-surface height off of the South American coast is 25 centimeters (10 inches) higher than normal."



These four views of the Pacific Ocean were produced using sea surface height measurements taken by the US/French TOPEX/POSEIDON satellite. The images show sea surface height relative to normal ocean conditions from March 1997 through June 1997. This evolutionary view is providing oceanographers with more convincing information that the weather-disrupting phenomenon known as El Nino is back and getting stronger. The white and red areas indicate unusual patterns of heat storage; in the white areas, the sea surface is between 14 and 32 centimeters (6 to 13 inches) above normal; in the red areas, it's about 10 centimeters (4 inches) above normal. The surface area covered by the warm water mass is about one and one-half times the size of the continental United States. The added amount of oceanic warm water near the Americas, with a temperature between 21-30 degrees Celsius (70-85 degrees Fahrenheit), is about 30 times the volume of water in all the U.S. Great Lakes combined. The green areas indicate normal conditions, while purple (the western Pacific) means at least 18 centimeters (7 inches) below normal sea level. The El Nino phenomenon is thought to be triggered when the steady westward blowing trade winds weaken and even reverse direction. This change in the winds allows a large mass of warm water (the red and white area) that is normally located near Australia to move eastward along the equator until it reaches the coast of South America. The displacement of so much warm water affects evaporation, where rain clouds form and, consequently, alters the typical atmospheric jet stream patterns around the world. Using these global data, limited regional measurements from buoys and ships, and a forecasting model of the ocean-atmosphere system, NCEP of NOAA, has issued an advisory indicating the presence of the early indications of El Nino conditions.Credit: Public Information Office, JPL

During its three-year primary mission, TOPEX measured sea levels along the same path every 10 days. This information was used to relate changes in ocean currents with atmospheric and climate patterns. Measurements from NASA's Microwave Radiometer provided estimates of the total water-vapor content in the atmosphere, which was used to correct errors in the altimeter measurements. These combined measurements allowed scientists to chart the height of the seas across ocean basins with an accuracy of less than 13 centimeters (5 inches). TOPEX is now in an observational phase. Its first follow-on mission, JASON-1, to be launched in 2001 will continue this program of long-term observations of ocean circulation from space into the next century.

About UARS

UARS was launched in the fall of 1991 with the mission is to study the physical and chemical processes of the Earth's stratosphere, mesophere, and lower thermosphere. UARS, which is managed by Goddard Space Flight Center, host a variety of instruments, among which is JPL's Microwave Limb Sounder, an instrument that makes limb sounding measurements of atmospheric composition at microwave frequencies. Recently collected atmospheric water vapor data shows telltale signs of an El Nino condition in the tropical Pacific.

William Read of the Microwave Atmospheric Science team at JPL stated that the Microwave Limb Sounder experiment is detecting an unusually large buildup of water vapor in the atmophere at heights of approximately 12 kilometers (eight miles) over the centrol-eastern tropical Pacific.

"Not since the last strong El Nino winter of 1991-92 have we seen such a large buildup of water vapor in this part of the atmosphere," said Read.

UARS is an ongoing mission of global monitoring, currently completing its sixth year of operation. It was originally intended as a two year mission.

About SeaWiFS

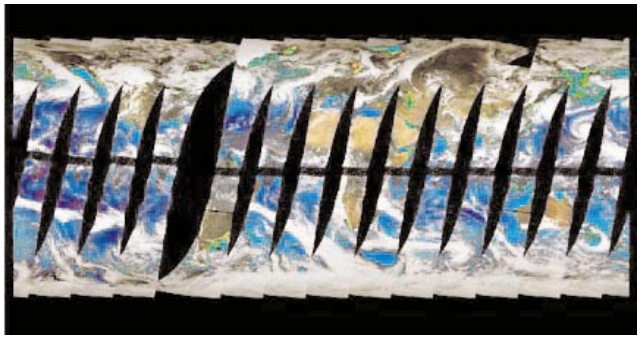
The SeaWIFS instrument is aboard a commercially built and operated satellite called OrbView 2, owned by Orbital Sciences Corporation. SeaWiFS is a follow-on sensor to the Coastal Zone Color Scanner (CZCS), which operated aboard NASA's Nimbus-7 satellite from 1978-1986. CZCS was significant in that its use proved that satellite sensors could detect ocean-color from space. SeaWiFS improves on CZCS by providing global coverage every 48 hours.

The first readily available ocean-color images in more than ten years are being provided by SeaWiFS. These data are expected to play a major role in studying the ongoing El Ni–o and in other global warming research. Ocean color is largely determined by the concentration of microscopic marine plants called phytoplankton. Accurately measuring phytoplankton concentration is important to climate change research. The SeaWiFS data also is giving scientists their first continuous look at the global biosphere the combination of living organisms and their environment.

SeaWiFS data, which is being processed at Goddard Space Flight Center (GSFC), is passing expectations, according to oceanographer Gene Feldman, head of the data processing team.

"The images are more than we ever could have hoped for," said Feldman. "Although originally designed to just study the oceans, we've also discovered a way of using it to study the land as well, and as a result, we can study the global biosphere for the very first time.""

Thirty-eight ground stations spread over 18 countries will receive data from the SeaWiFS and more than 300 scientists representing 35 countries have registered to use this data. Additionally, NASA has developed software, called the SeaWiFS Data Analysis System (SeaDAS), to process these data. Training on the use of SeaDAS is being conducted at GSFC. Approximately 150 scientists have been trained to date, with another 79 scientists from 11 countries expected to attend training sessions this fall.



This image shows the first 24-hours of data from Sea-viewing Wide Field-of-view Sensor (SeaWiFS) taken on Sept. 16, 1997. The red colors show high concentrations of chlorophyll in the water, the yellows/greens indicate intermediate concentrations of chlorophyll and the blues/purples show low concentrations of chlorophyll. Where there are black swaths this indicates there is no data due to gaps between the orbits. SeaWiFS observes the Earth from a noontime sun-synchronous orbit which means that the sensor is always viewing the Earth around local noon at an altitude of 440 miles (705 kilometers). This orbit provides data at the maximum solar illumination most desirable for detecting concentrations of microscopic green plants, called phytoplankton, which live just beneath the ocean surface. These green plants absorb sunlight during photosynthesis, the most basic and essential chemical process necessary for live on Earth. The gaps between the swaths of data are filled the following day, thus providing complete global coverage every two days. Nearly complete cloud-free coverage is achieved over the course of about one week as cloud patterns shift. SeaWiFS data will allow routine assessment of global vegetation patterns, both land and ocean, needed to understand the world's ecosystems and global change. The SeaWiFS instrument will observe the world's oceans from space to measure "ocean color." SeaWiFS is an essential component of NASA's Mission to Planet Earth, an ongoing effort to study how the global environment is changing. Using the unique perspective available from space, NASA will observe, monitor and assess large-scale environmental processes, such as the oceans' productivity, focusing on climate change. Credit: SeaWiFS project.

Confirming El Nino

These recently collected data confirm the predictions of NOAA, which issued an advisory in May of this year regarding the presence of early indications of El Ni–o conditions. Subsequent forecast activities supported by NOAA indicate the likelihood of a moderate to strong El Ni–o in late 1997. The forecast model operated NOAA's National Centers for Environmental Prediction used data collected TOPEX.

Excerpted from the JPL Universe, Volume 27, article by Mary Hardin, JPL, from NASA press release 97-211, written by Lynn Chandler, GSFC, and from public information available on NASA World Wide Web sites.

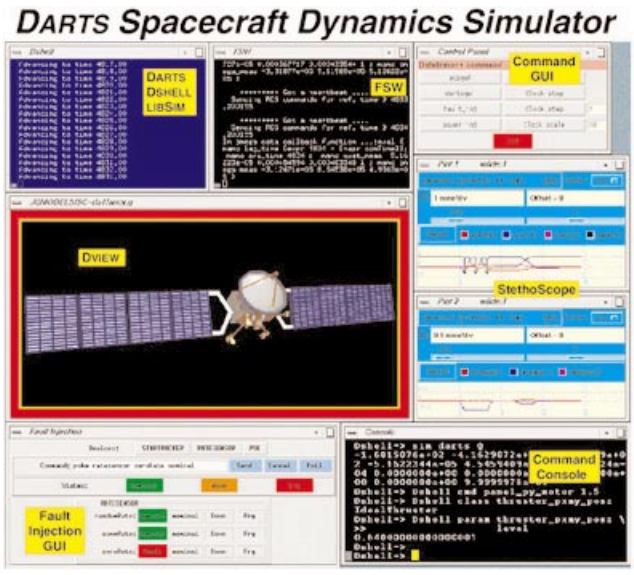
Learn more about TOPEX <http://topex-www.jpl.nasa.gov/>, UARS <http://tornado.badc.rl.ac.uk/data/uars/>, and SeaWiFS <http://seawifs.gsfc.nasa.gov/SEAWIFS.html>. ■

NASA Software of the Year Award –

Dynamics Algorithms for Real-Time Simulation

Software used in the NASA/National Science Foundation's Grand Challenge and on the Mars Pathfinder mission has been selected as the winner of the 1997 NASA Software of the Year Award. The software, Dynamics Algorithms for Real-Time Simulation (DARTS), was developed at Jet Propulsion Laboratory to generate real-time simulations to test and verify flight software and hardware for a variety of spacecraft missions.

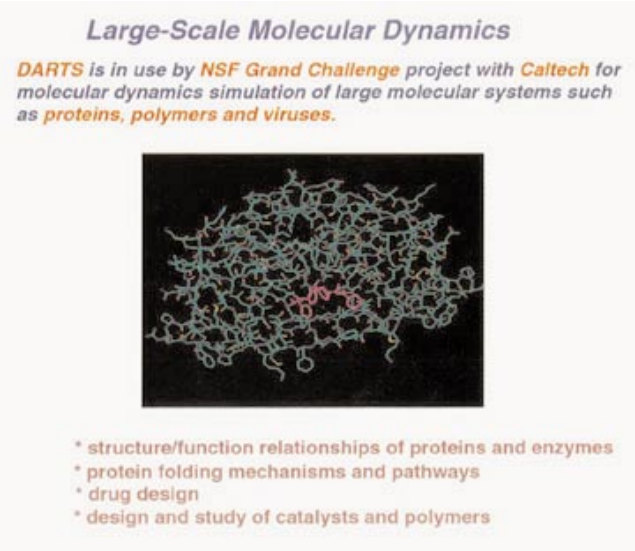
DARTS is a high-fidelity, flexible multibody dynamics simulator used for real-time hardware-in-the-loop design, integration, and testing of spacecraft flight software. DARTS meets critical mission needs throughout the spacecraft design, test and verification, and operations phases of missions. It allows the use of high-fidelity spacecraft dynamics models without sacrificing simulation speed, enabling more reliable flight software design and testing, reduced development costs and reduced mission risks. DARTS is a multi-mission spacecraft simulator used by several flight project for their various simulation needs.



Screen dump of DARTS software program

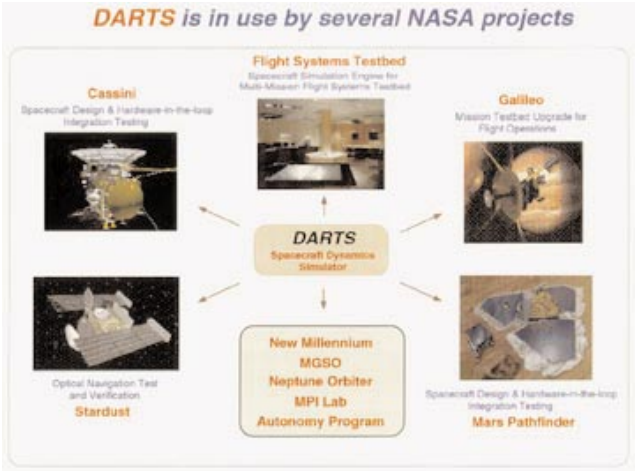
The DARTS simulator is based upon state-of-the-art computational algorithms from the Spatial Operator Algebra formulation for multibody dynamics. The Spatial Operator Algebra is a mathematical approach for modeling the dynamical behavior of complex, articulated collections of bodies interacting with each other in free-space or in contact with the environment.

DARTS has also been adapted to develop the NEIMO software, which is used as part of a NSF supercomputing Grand Challenge Project. NEIMO is in use at the California Institute of Technology for the simulation and analysis of protein folding, drug design, catalysts, virus mechanisms and other applications.



Abhinandan Jain, Guillermo Rodriguez, and Guy Man of Jet Propulsion Laboratory developed DARTS. The team received an award for development of the new algebra three years ago.

NASA engineers calculate phenomenal improvements in simulation speed and fidelity up to ten million timeswhich is the result of the use of a brand new form of mathematics, known as Spatial Operator Algebra. In addition to Mars Pathfinder, DARTS has been used on the Cassini, Galileo, Stardust, New Millennium, and Neptune Orbiter missions.



The winning software has saved over $10 million to date on NASA missions. NASA presented the award at the Technology 2007 Conference held in Boston, Massachusetts, this past September.

You may learn more about the Software of the Year Competition at <http://www.hq.nasa.gov/office/codei/swy97win.html>and about the supercomputing Grand Challenge at <http://sdcd.gsfc.nasa.gov/ESS/grand-challenges.html>. ■

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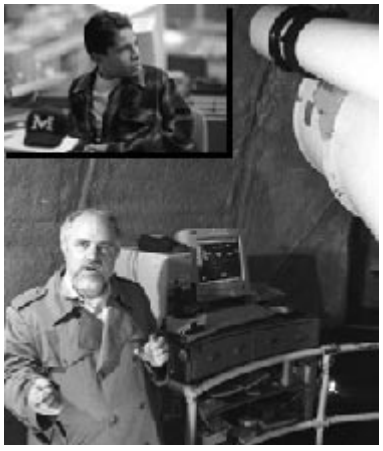
Students as Astronomers -

Gaining New Vision With the Mount Wilson Telescope

Jarrett Cohen, Science Writer, Goddard Space Flight Center



Thanks to Gil Clark (bottom) who gives schoolchildren access to the stars, National City student Gabriel Salda–a (top) comes into school at night once every two weeks for astronomy sessions. Science magnet students have a total of 36 nights on the Mount Wilson telescope this year.

Edwin Hubble determined that the universe is expanding. Albert Michelson measured the speed of light for the first time. George Ellery Hale grasped that sunspots are huge magnetic fields.These and many more of the 20th century's most pivotal astronomical discoveries were made at the Mount Wilson Observatory, a mile above Los Angeles. Today, students from around the world are using personal computers and modems (soon, the Internet) to control a 24-inch reflector telescope on the mountain, gaining first-hand experience with the modern tools of astronomy.

"Usually in science you learn what other people have done," said third-year observer Carina Marquez, a senior at the Crossroads School for Arts & Sciences in Santa Monica, California. With this telescope, "you can apply it.

Carena Marquez

It is like being a real scientist; they delve deeply into all their own questions."

Making these explorations possible for Crossroads and 250 additional sites ranging from elementary schools to universities is Telescopes In Education (TIE), a joint effort of the NASA Jet Propulsion Laboratory (JPL) and the Mount Wilson Institute.

An idea born in the woods

Few members of JPL engineer Gil Clark's Boy Scout troop had a natural interest in science, but Clark worked it in through measuring heights and distances in the woods. Several boys earning astronomy badges inspired Clark to start building TIE.

A 1993 invitation from Mount Wilson director Robert Jastrow secured the telescope and dome. While the 24-inch telescope had ensured the solidity of the moon's surface for the astronauts in the 1960s and later became a training tool for Caltech graduate students, it lay dormant in storage for eight years. Equipment donations and volunteer renovators readied the telescope for remote observations.

"The hard work for me was getting the telescope on-line because I had only a few volunteers," said Clark, now TIE's director. "Once NASA saw the interest, the funds came."

Additions included a mounting with an electronic control system; an SBIG ST6 CCD (charged-coupled device) camera, whose sensitivity skirts light pollution from the Los Angeles basin; and specially designed versions of Software Bisque's TheSky and SkyPro packages.

NASA's High Performance Computing and Communications Program and NASA Headquarters' Office of Space Science pay for one-half of Clark's and JPL assistant Lori Paul's time and for full-time Mount Wilson chief operator Steve Golden, who runs the telescope in the earliest morning hours. For all other jobs "the volunteers took over," Clark said, about 100 of them doing fundraising, classroom lectures and much of the operations.

The volunteer operators come from all walks of life, and most had never used a research-quality instrument before. Several weeks' training from Golden readies them for the task. Barrett Duff, TIE project scientist, is a semi-retired energy consultant with 20 years in amateur astronomy.

As a telescope operator, "you have to suggest objects for them to look at and suggest exposure times," Duff said. "I ask them questions, if they know what the object is and how far away it is, to see what they are interested in learning about it."

Another volunteer operator, Shelley Bonhus, a writer and photographer, gleefully described the role of a volunteer operator as being "like astronomical dee-jays."

The night sky unfurled

TheSky software also is crucial for drawing up the schools' cosmological play lists. In a sky diagram, students click on their chosen objects, and the telescope slews to that region. Isidro Garcia, an eighth grader at National City Middle School near San Diego, showed off another feature: He entered "Pegasus" in a finder window, and a list appeared with all the deep sky objects around the constellation. SkyPro's image processing capabilities, which schools spend the most time on, embrace a variety of false color schemes "to make things stand out," said eighth grader Michael Grabau.

As in many developed TIE programs, National City students first must consult a catalog to get "the magnitude for the exposure time" and other information, explained science and math teacher Karen Prosser, National City Middle School. In this third year of participation, 60 science magnet students are designing their observing runs around constellations.

Karen Prosser

"The kids research constellations to determine where to look for particular space objects. So far, we've observed about 100 objects—planetary nebula, spiral galaxies, and as many other different objects as we can in each constellation." Prosser said.

Other students find themselves contributing to astronomical knowledge, occasionally even helping NASA. In 1995, seniors at Thomas Jefferson High School for Science and Technology in Alexandria, Virginia, did a series of observations so they could more precisely pin down Pluto's orbit. According to Lee Ann Hennig, Astronomy Laboratory director, students then sent the data to JPL for designing the Pluto Fast Flyby mission.

Whatever approach they use, most of these teachers and students come in on their own time, explained Bonus. National City students, for instance, will be at school until 10 or 11 p.m. for 27 nights during term and for nine Astronomy Camp sessions.

"TIE started out as a summer program at Crossroads back in 1994," said W. M. Keck Math/Science Institute director, Joe Wise, who secured private funds to pay the students, including several from other schools, in order to afford them a research experience in lieu of traditional summer jobs. "It got so big that we had to take it year-round as an independent study course."

TIE meshes with a growing collection of scientific instruments, including a donated scanning electron microscope. A $250,000 grant from the W. M. Keck Foundation of Los Angeles pulls these resources together into an integrated math/science curriculum - for example, according to Wise, math classes looking at astronomy data.

Science teacher, Joe Wise discusses image processing with Crossroads School for Arts & Sciences tenth grader Aaron Parker (standing) and twelfth graders (left to right) Lindsay Weiss, Corinne De Coste, and Anne Hiura. Crossroads has begun re-observing globular clusters studed by renouned astronomer Allan Sandage.

Left to right: Eighth graders Michael Grabau, Gabriel Salda–a and Melissa Pulido are among 60 National City (Calif.) Middle School students observing and imaging deep sky objects associated with constellations.

Budding science careers are one result of this immersion. Crossroads' Marquez intends to study biology, and two or three Jefferson TIE students major in physics or astronomy each year. Irrespective of vocation, how people find information is going to be critical in the future, Wise explained. His students use books and journals but also contact scientists via electronic mail and search the World Wide Web for data.

"The other thing is they have vision," Wise added. "They see what might be as opposed to just sitting in the classroom. They see possibilities and start looking for answers."

"We have bimonthly updates on our research on the Web," said 12th grader Anne Hiura. "People contact us, and we make new connections."

Broadening the experience

Recent telescope enhancements will improve the quality and increase the kinds of observational answers. TIE's chief engineer Larry Smith, a JPL avionics engineer by day, has affixed a rigid mounting for more precise movement and a second layer of aluminum for better mirror reflectivity. Most important is his piggy-backing of a six-inch refractor with CCD camera on top of the 24-inch. Smith explained that with a refractor "you get better contrast and better planetary images andsome deep space stuff."

Clark stated that they want to image NASA's Mars Pathfinder series and will follow Cassini to Saturn. The augmented telescope also furthers an opportunity for Crossroads to re-observe globular clusters studied by Allan Sandage of Pasadena's Carnegie Observatories. Globular clusters comprise hundreds of thousands to millions of ancient stars, but 10th grader Aaron Parker explained that they are "concentrating on about several dozen to 90 variable stars within the clusters, plotting their light curves" to resolve their exact brightness. According to Parker, you can get all of the images in two nights, but it takes a long time to analyze them. Sandage helped to show that variable stars' brightness translates into distance and thus is useful for pinning down the age of the universe.

TIE's next phase will establish such collaborations on a more widespread basis. In SCHOLAR, for Students Conducting Hands-On Learning in Astronomy Research, kids will work internationally, with a US school teamed with a foreign school.

"We will have a professional astronomer guide them. They will work as co-investigators and even publish," Clark said. Schools from Australia, Great Britain, Japan and Taiwan have participated on their own. Yet, in cross-national teams "they can learn about each other and other cultures...and have these links that weren't there before."

Widening access to international telescopes is a twin goal. With instruments in Russia and Australia, for example, the scholastic teams could watch objects 24 hours a day, particularly special events like supernovae and comets and asteroids, which have dynamics, Clark explained. Also, according to Thomas Brennan, education technology consultant for Delaware, the kids could be on-line during the day.

With the state wiring all its classrooms by the year 2000, Brennan will facilitate the schools "gathering data that is useful to somebody" through a Delaware State University course for teachers in astronomy and observing techniques. Similarly, Wise envisions Southern California having a network of schools and research projects, with Crossroads possibly serving as a coordinator.

"They could be studying things like earthquakes with seismometers at schools, air quality with electron microscopes and the ultraviolet and visible aspects of the sun with telescopes," he said. "I could see quite a few schools coming into the Internet to share resources."

Gil Clark describes how students remotely control Mount Wilson's 24-inch telescope via personal computers and modems. Internet access is being added this year.

Rolex Award - Telescopes In Education founder and director Gilbert Clark was one of the five 1996 "Rolex Awards for Enterprise" Laureates, receiving a $50,000 grant to further the program's goals. Clark received the honor for giving "school children on four continents access to the stars" and

"making science exciting and fun for young people." There were 2,400 international entrants.

Reprinted, with format and style modifications, from Insights magazine, September 97 issue, with permission of the Editor, Judy Conlon. All photographs by Judy Conlon.

Learn more about Telescopes In Education at <http://www.mtwilson.edu/Science/TIE/> and the Crossroads School student research results at <http://kmsi.org/>. ■

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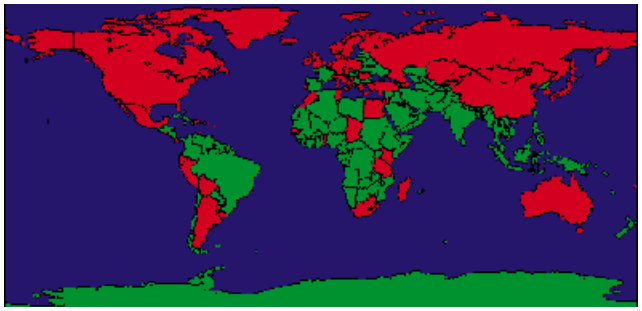
Update on the Global Observations Program

The Global Learning Observations to Benefit the Earth (GLOBE) is a worldwide network of scientists, teachers, and students, who work together to learn about the global environment. Scientists from various US universities and institu tions provide guidance in the fields of atmosphere and climate, soil moisture, biology, and geology. Teachers are provided with educational materials and online resources as well as opportunities for training. Students make daily, weekly, and seasonal evironmental observations and send their data, via the Internet, to the GLOBE Student Data Archive. The data is processed with the support of the Goddard Space Flight Center Scientific Visualization Studio, and posted to the World Wide Web.

GLOBE schools

GLOBE participation is worldwide: North America, South America, Europe, and Asia.



Countries represented in red are part of the GLOBE program. Credit: graphic retrieved from the GLOBE Web site.

Student Data Archive

Student Data Archive continues to grow, with reports coming in from all over the world. Young scientists in GLOBE schools have been reporting data since March 1995, with the 700,000th student data report submitted on September 17 of this year by students at the Peter Stuyvesant College in the Netherlands Antilles. Working with GLOBE Teachers Robby Griffith and Jacintho Pantophlet, this team of 12-18 year old students reported cirrus, altostratus, and stratocumulus clouds from their island school in the Caribbean. The school is in the capital, Willemstad, on the island of Curaco.

Earlier this month (September), the 2,000th school reported data to the GLOBE Student Data Archive. A team of sixth, seventh, and eighth grade boys at the Liberty School in Quincy, Michigan contributed to this success by reporting the current temperature, cloud cover, and precipitation level at their school on September 9, 1997. These students are part of a unique program designed for young people who benefit from more individualized attention, often difficult to obtain in traditional classroom settings.

"GLOBE has given my students the opportunity to do science, and for their work to be meaningful," explained GLOBE Teacher Melissa Walligorksi. "GLOBE gives them the opportunity to use the computer, and for their work to be purposeful.

Measuring El Nino

For the first time since GLOBE students began taking measurements, and El Nino is underway in the tropical Pacific. Based on past El Nino events and on models of the

circulation of the atmosphere and oceans, scientists are predicting abnormally wet, dry, warm, or cold conditions for different regions at different times. All early indications are that this El Nino will be a big one.

GLOBE students will be helping to test El Nino predictions or hypotheses by taking measurements faithfully and carefully during the coming months. Such tests and measurements by GLOBE schools can help scientists understand this important phenomena.

Scientists at Jet Propulsion Laboratory will be available to answer the students, and the publics, questions regarding their work on El Nino. They are Timothy Liu, Wenqing Tang, and Paulo Polito.

Electronic journeys

Teacher Lorna Metzger of Poughkeepsie, New York, is offering a special opportunity to GLOBE students. Metzger has invited them to join her as she begins a five year journey around the world on a tall ship. During the trip, Metzger will be a crew member, scientist, and educator on-board the tall ship Alvei.

"The Alvei will be an extension of my classroom. As I journey to remote areas of the planet, I hope to inspire and instruct children to realize that together we can make a difference. We can use the technology of today to become united as a global community. Even though we are separated by distance, we share a common purpose," Metzger reports."

From Metzger's web site, GLOBE students are invited to join the voyage by sharing and discussing their GLOBE data with each other through chat sessions, to participate in global scientific and cultural projects, and to submit articles directly online focusing on relevant environmental and cultural issues.

Metzger joined the crew of the Alvei in the Kingdom of Tonga on September 18, 1997. She plans to post GLOBE weather and hydrology data daily on her website. A link is also provided from the GLOBE Student Data Server Resource Room to the Tidal Passages web site in the Electronic Journeys category.

Other ongoing electronic journeys include the JASON project and Live From Antarctica. The JASON project allows students to participate in a real field research trip with scientists. JASON ViIII, Journey From the Center of the Earth, compares the climate, geology, volcanic activity, and biodiversity of Yellowstone and Iceland. Live From Antartica allows students to travel with scientists aboard the research vessel, the Polar Duke, as it sails from Punta Arenas, Chile, to Palmer Station, Antartica. Scientists post their daily observations and activities to an online journal and answer email.

Additionally, the Learning Expedition, June 30 - July 4, 1998, is opportunity for teams of GLOBE students to meet one another, learn together, and showcase the results of their GLOBE projects. Students who can't actually travel to Helsinki, Finland, will be able to participate electronically. An Internet Cafe will feature web chats and virtual presentations. The goals of the Learning Expedition are to build the GLOBE community and to allow for educational. scientific, and cultural exchanges among the students and teachers. The Expedition will use Internet and other technologies to allow the participation and contribution of as many members of the GLOBE community as possible.

Sister Cities

In August of this year, GLOBE ans Sister Cities International signed a Memorandum of Understanding (MOU), establishing a new partnership between the two organizations. This MOU fosters meaningful partnerships between schools in sister cities, based upon their participation in the GLOBE program. GLOBE will provide content for for collaboration and a mechanism for communication between schools in sister cities. Sister Cities will encourrage schools in member cities to become GLOBE schools.

Visualization server

The GLOBE visualization server at GSFC's SVS, provides maps and graphs of environmental data worldwide. Most of the images are of measurements by students in the GLOBE Program. Other are reference data from the Environmental Modeling Center or from satellites in Earth orbit.

The visualization server has recently been revamped. You can now create maps of GLOBE data for any locaton on the Earth, for any date since the beginning of GLOBE, zooming in to an area as small as 25x25 kilometers and you can create graphs of data from any GLOBE school.

Excerpted from various GLOBE Bulletins and from material on the GLOBE web site. GLOBE logo retrieved from the GLOBE Web site.

Visit the GLOBE web site to take a tour and learn how to become involved in the program <http://www.globe.gov/>.■

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Quest's Learning Technologies Offer Variety of Online Education Resources

Marc Siegel, NASA Learning Technologies, Ames Research Center

NASA's Quest team specializes in on-line Kindergarten Through Grade12 projects that focus on the diverse and enthusiastic people who work on NASA projects. Biographies help kids understand various career paths. So called "Field Journals" tell stories about what happens behind-the-scenes. For example, the job title "astronomer" is well known, but few people know what an astronomer actually does. Field Journals help kids visualize a variety of real jobs. But these projects aren't about just reading stories. Interactions between classrooms and NASA experts are arranged through email and chats. These activities help kids feel like they've actually met NASA's people, not just read about them.

At all times we try to maximize the impact in classrooms while minimizing the effort required of the professionals. For example, in July, we worked with the Mars Pathfinder team in responding to 1350 personal emails; only a small fraction of these questions actually required support from the busy Pathfinder folks. This school year we have five separate projects underway: Shuttle Team Online (STO), Live From Mars (LFM), Women of NASA (WON), NeurOn, and Aero Design Team Online.

- Shuttle Team Online shares the adventure of astronaut trainers, shuttle launchers, mission controllers, payload preparers and the many other people involved in NASA's shuttle team.
- Live From Mars is following NASA's Mars Pathfinder and Mars Global Surveyor missions, as well as other Mars efforts.
- Women of NASA provides an opportunity to meet some of NASA's women via scheduled live WebChats. This project is designed to encourage female involvement in math and science careers.
- NeurOn's focus is the NeuroLab space shuttle mission (STS-90) which will conduct brain research to study neurological and behavioral changes in space.
- Aero Design Team Online is about NASA's exciting aeronautics mission. To start, the focus will be on huge wind tunnels and the world's best flight simulators.

Shuttle Team Online

In addition to live interactions with NASA experts and students, weekly sessions are held to connect adults using the project with one another and with Shuttle Team Online staff. The webchats are available using QuestChat, a technology that allows simultaneous chatting (typing) using your computer keyboard and a modern web browser.

Chat events are scheduled one to two months at a time. NASA experts scheduled for chats during October include a space station desinger, a computer scienttist, and a mechanical systems engineer. Those scheduled for November include a network communications instructor andd a shuttle ground support engineer. There is also a link to a chat room for unmoderated discussions with STO staff members.

At the STO web site you may retrieve past and current NASA press release on shuttle activity. For example, a recent press release announced the results of earthquake research done aboard the Mir.

Live From Mars

From the LFM web site you may take a virtual tour of the Ares Vallis or play video on various subjects, such as "Evidence of Water" or "Geologic Story of the Landing SIte". LFM offers interesting classroom activities at varying levels of sophistication. The activities relate directlly to the National Science Standards and are designed to complement a teachers Earth, space, or general science curriculum. Some of LFM's activities offer classrooms certificates of participation.

Women of NASA

Throughout history women have made valluable contributionss to the fields of math, science, and technology. The WON interactive project showcases outtstanding women who are enjoying successful careers in these disciplines, which are still dominated by men.

The WON web site offers a virtual "Take Our Daughters to Work Day" where an archived chat dialoque, held on April 24th of this year, is available. The Chat includes discussions with professional women in in business and industry, the president of the women's college, Smith, a musician with the Boston symphony orchestra, a senior correspondent with Cable News Network, a space shuttle astronaut, an attorney, a US senator, the director of the Santa Barbara, California, Breast Cancer Institute, the director of NASA's Mars Exploration Program, and Tipper Gore, the wife of the Vice President.

This site also offers essays from prominent professional women, in "A Day in the Life ...", as well as teaching tips and resources.

NeurOn

NeurOn is a new project this fall which will focus on the NeuroLab space shuttle mission to study the brain. The NeurOn Online site will become active this November featuring webchats with NASA experts and a collaborative activity, the "Great Habitat Debate". During this activity, students are to simulate the activities of a life scientist in the sesign of th ideal, space-worthy of habitat of an animal in space. Students will brainstorm what aspects need to be consideredd and how to best solve problems.

Aero Design Team Online

The Aero Design Team Online is another new project this fall. At this web site students will have the opportunity to learn the history of aeronautics, how airplanes fly, and how to plan a career in engineering. When this site becomes operational in November, students and teachers will be able to engage in chats with aeronautics experts and learn what NASA engineers are currently doing in this field.

Learn more about any or all of these programs at the Quest site <http://quest.arc.nasa.gov/interactive/>. ■

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Public Invited to Visit NASA Centers This Summer

Jet Propulsion Laboratory (JPL), Ames Research Center (ARC), and Goddard Space Flight Center (GSFC) opened their doors to the public this summer, where visitors were allowed to tour the facilities, view exhibits, attend lectures, and interactively participate in demonstrations. For JPL and GSFC these public days are an annual event. ARC's Open House was the first in the 58 year history of the center. JPL hosted its annual Open House in early June, while GSFC and ARC opened their doors in September.

Jet Propulsion Laboratory

JPL, a center for planetary exploration, featured exhibits and demonstrations about ongoing research and space exploration missions of the past, present, and future. For example, in the popular Mars Yard, a recreation of the Martian surface, two full-scale models of Sojourner, a 10-kilogram (25 pound) microrover that has since landed on Mars as part of the Mars Pathfinder mission, were demonstrated. Full-scale models of the in-orbit Galileo and the soon-to-launched Cassini spacecraft were on exhibit. The Galileo display also contained colorful images of Jupiter's moon, Europa, thought to have a water ocean beneath its icy surface.

Microelectronic, robotic, computing, and imaging technology was displayed at various venues around the central mall. The venues included exhibits of:

- miniaturized instruments and sensors for future microspacecraft
- the small, futuristic, xenon ion propulsion engine

- Hubble Space Telescope's Wide Field Planetary Camera lithographic views of the universe, stars, nebulae, and the solar system and models of the telescope
- a robotic-assisted microsurgery system, designed to aid surgeons perform delicate eye, heart, or brain surgery
- possible spacecraft of the future
- Mission to Planet Earth radar images and computer demonstrations of an educational CD-ROM
- a laser sensing system designed as part of a larger automated system to provide drivers with instant traffic information while on the road

The Commercial Technology Office displayed consumer products utilizing technology developed at JPL. The products included such devices as an ear thermometer, a styrofoam insulation box for transporting fozen foods, and an eye tracker for the disabled.

Educational and public information films were shown throughout the two day event. Additionally, there were a variety of activities for school-age children: building a space probe or straw rocket, crate a planet, designing a "sciencecraft", space science workshops, a reduced-gravity demonstrator, and the ever popular face space painting.

JPL Open House visitors line up to view models of the Hubble Space Telescope and the Wide Field Planetary Camera and to pick up lithograph space images.

Boy Scouts and their leaders get the latest data on the KidSat project

Visitors on the mall get information on ongoing and future space missions.

Goddard Space Flight Center

GSFC hosted tours of the facility and presented puppet theater, "Living in Space" and "Puppets in Space" to entertain young visitors. An employee, Claire Parkinson, who was recently published presented a lecture on her book, Earth From Above, and distributed copies of the book to attendees. The day concluded with a rocket launch in the rain. This month GSFC is hosting the Education Showcase for employees and local area teachers, as well as other members of the general public.

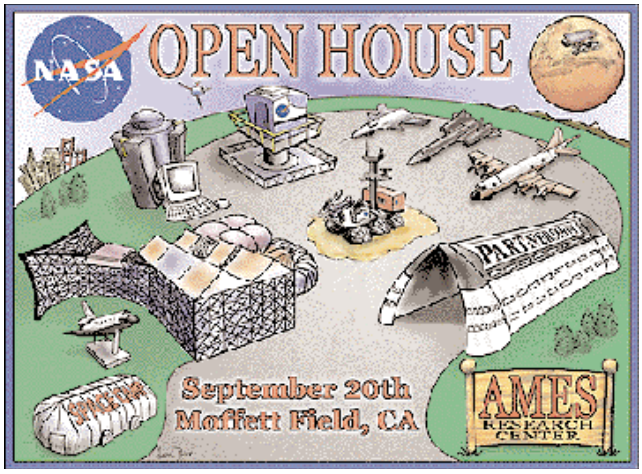
Ames Research Center

ARC hosted tours of the "World's Largest Windtunnel", the flight simulation laboratory, the on-site US Space Camp, and a virtual tour of Mars, using up to date imagery from the Mars Pathfinder mission. The Marsokhod rover, hybrid of a Russian-built rover chassis and advanced US-made sensors and computer intelligence, roamed around a Martian "sandbox." Historic Hanger One was the venue for various displays, demonstrations, and entertainment that showcased the many partnerships of NASA and other federal agencies with local governments and commercial entities.

ARC's supercomputing facility featured a glimpse of the future of computer technology and the Next Generation Internet, which will be 1000 times faster than today's Internet. Additionally, visitors were shown a demonstration of a NASA-developed robotic surgical tool used in brain surgery. They were also given the opportunity to crashor notinto the dock of the space station Mir using the computer animated spacecraft docking software.

Open House guests had the opportunity to run a model wintunnel and design an airplane on a computer at the Aerospace Encounter, an interactive educational program hosted in a renovated supersonic wind tunnel on site. Encounter hosts 4th, 5th, and 6th grade class fieldtrips where children spend 30 miniutes in each of four different fields of study: space sciences, aeronautics, space station environment, and mission control/Earth science.

The Open House event culminated in the final round of the student robot competition. The object of the competition-sponsored by ARC, local schools and universities, and local companies was to build, within a six week period, a robot that would collect, transport, and lift inner tubes onto a goal post.



Credit: Graphic retrieved from ARC Open House Web site. ■

NASA's wealth of technology is being re-used in the fields of medicine, industry, and education and by the military to develop products and processes that benefit many sectors of our society. Spinoff applications from NASA's research and development programs are our dividends on the national investment in aerospace.

NREN and the Space Station Will Bring High Tech Medical Care to Remote Areas on Earth

Soon people who do not live in or near large cities with major medical facilities will have expert medical care readily available. Patients in remote or medically underserved areas of the country will benefit from an experiment in advanced telemedicine conducted jointly by Lewis Research Center (LeRC), Ames Research Center (ARC), and James Thomas, M.D., FACC, of the Cleveland Clinic Foundation, Cleveland, Ohio.

Recently, a "patient" undergoing an echocardiographic examination at Lewis was "remotely" diagnosed by Dr. Thomas at ARC. He viewed a real-time display of echocardiographic video images transmitted over the broadband NASA Research and Education Network (NREN). Dr. Thomas interactively guided the technician administering the procedure through a two-way voice link between the two sites.

"I was very pleased with the diagnostic quality of the echocardiograms," said Dr. Thomas. "Digital echocardiographic equipment will be on the International Space Station when it is operational. Echocardiography is more practical for life in space than other imaging techniques, such as magnetic resonance imaging (MRI) because it requires less power, is noninvasive, is small and versatile, and is not magnetic or radioactive. The early results of our experiment support our belief that this technology holds great promise for use in space as well as use on Earth by means of telemedicine."

Echocardiography is a medical technique that applies the methods of ultrasound imaging to the cardiac system, providing a "motion picture" of the heart in action. A small, rural clinic may have access to an echocardiograph machine but not to a technician specially trained in its operation, or to a staff cardiologist. If the clinic were connected to a major met-

ropolitan medical facility through a high-speed communications network, a minimally trained technician could carry out the procedure under the supervision and guidance of qualified echocardiography personnel.

While many telemedicine requirements can be satisfied by the transmission of still images (e.g., X-ray photographs), the challenge of procedures such as echocardiography is that high-resolution, moving images must be transmitted in real time. This requires a reliable broadband network and a robust data-compression mechanism.

"In the demonstration, we used the NREN to assess the clinical feasibility of conducting remote echocardiography, as well as the technical feasibility of supporting remote echocardiography, by determining the minimum network needed and the maximum video compression required to produce a transmission of high-resolution medical imagery," said Christine Falsetti, NREN project manager at ARC.

NREN is NASA's cornerstone project of the interagency Next Generation Internet (NGI) Initiative. In October 1996, President Clinton and Vice President Gore announced their commitment to the NGI initiative based upon the strong research and development programs across Federal agencies.

"This experiment was a step toward reaching the goals of the NGI," said David Foltz, networking project manager at LeRC. "Pushing current networking technologies to the limit helps us understand how to design, build and operate a national communications network for the future."

Reaching these goals will affect health care on Earth and will pave the way for physicians on Earth to view the heart function of an astronaut aboard the International Space Station.

During the experiment, Lewis provided network engineering staff and hardware support to Dr. Thomas, while ARC provided overall network management of the NREN and related technical support to Lewis personnel. The Cleveland Clinic Foundation provided echocardiograph equipment and support personnel used to examine the volunteer "patient" at Lewis.

This experiment is a part of the cooperative agreement involving a two-year, $4 million grant to support the research and development of a digital echocardiography lab at the clinic, that NASA announced earlier this year.

Excerpted from NASA press release 97-197, written by Sally Harrington, LeRC, Michael Mewhinney, ARC, and Rob Whitehouse, the Cleveland Clinic.

You may learn more about NREN at <http://www.nren.nasa.gov> and NGI at <http://www.nren.nasa.gov/aboutngi.html>. ■

NASA's wealth of technology is being re-used in the fields of medicine, industry, and education and by the military to develop products and processes that benefit many sectors of our society. Spinoff applications from NASA's research and development programs are our dividends on the national investment in aerospace.

Next Generation Internet Showcased at Technology 2007

The Next Generation Internet (NGI), a new Internet that is a thousand times faster and more reliable than today's Internet, was the subject of a plenary session speech given by Christine Falsetti, NGI project manager at Ames Research Center (ARC), for attendees of the Technology 2007 Conference. The annual conference was being held on September 22-24 at the Hynes Convention Center in Boston, Massachusetts.

"The research needed for the Next Generation Internet requires a partnership of the private sector, government, and universities, due to the risk and long term challenges associated with the effort,"Falsetti said.

She also reviewed the national economic reasons for investing in new networking technologies and explained some goals of the NGI program and the government's role in the program.

Following the address, a breakout session was held for representatives of organizations wanting to become partners with the agency in the NGI program. Currently, other federal agencies involved in the project include the National Science Foundation, the Defense Advanced Research Projects

Agency, the Department of Energy, the National Institutes of Health and the National Institute of Standards and Technology.

A major goal is to develop at least two Internet testbeds connecting universities and federal research laboratories. One testbed of about a hundred universities is projected to be about a hundred times faster than today's Internet. A second testbed will include approximately 10 sites and will run about a thousand times faster than the Internet. The two testbeds will also be connected to each other.

Another goal is to make 'co-laboratories' by linking laboratories, computers, data bases, and scientists from around the world via the new internet to do research faster and better. These virtual laboratories could be set up quickly to provide universal access to unique scientific facilities across the nation, according to Falsetti.

"Ultimately, the Next Generation Internet will have a huge beneficial economic impact after network speed increases and new service advances are migrated to today's Internet," said ARC Director, Henry McDonald.

Some newer uses of NGI technology include telemedicine, video teleconferencing, distance learning, environmental monitoring, and virtual scientific research.

Falsetti explained that NASA wants a network for researchers that is more reliable from 'end to end.' "We will work with private companies on 'routers,' switchers, and computer work stations that will send computer information much faster than today's machines can send it," she said. "More reliable computer communications will be need in years to come, as well."

In addition to the NGI technology, other NASA briefings at Tech 2007 included development of an advanced networking technology lab at ARC. This testbed will be open to NASA's research and development partners, particularly those organizations with expertise in: gigabit/terabit technologies, hybrid networking (including terrestrial, wireless, nomadicity), internetworking, Internet Protocol, multicast, network management strategies and technologies, quality of service, routing-with-switching, security, traffic aggregation, and virtual networks.

"NASA is driving the cutting-edge, and we're redoubling our efforts to get those technologies into industry's hands by sending NASA technologies to conventions as well as by taking other actions," said Michael Weingarten, manager for business development, NASA Headquarters. "Our goal is to bring space know-how down to Earth so US companies can access new developments and improve US competitive strength."

According to Weingarten, NASA invests more than $5 billion in technology development annually.

"It makes sense to bring that cutting-edge technology back to US taxpayers when such a huge investment is being made. Companies can work with NASA or with licensed NASA technicians in efforts that will lead to new company products. We can explore the best way to partner depending on each client's needs," he explained.

Learn more about NASA inventions by calling 1-800-678-6882 or by accessing the NASA Commercial Technology Network (NCTN) web page. More information about the Next Generation Internet can be obtained on the researchers' internet page on the NGI web page <http://www.ngi.gov/>. ■

NASA's wealth of technology is being re-used in the fields of medicine, industry, and education and by the military to develop products and processes that benefit many sectors of our society. Spinoff applications from NASA's research and development programs are our dividends on the national investment in aerospace.

Supercomputers and New Network Tool Aid Flight Simulation

John Bluck, Public Information Office, Ames Research Center

Supercomputers are being used at Ames Research Center (ARC) to predict the design feasibility of airplanes prior to building the models. David Korsmeyer, deputy project manager at ARC, explained that eight-hour runs on the fastest computers on Earth are used to simulate wind flow over just a piece of the wing.

Wind tunnel testing

The process works fairly well for testing straight, level flight, according to Korsmeyer. However, what happens during take-off and landing is difficult to predict with supercomputers because air turbulence occurs.

"The wind sneaks back around and does unexpected things." he said. "That's where wind tunnel testing comes in. Testing a model in a wind tunnel, you get actual physics because you have real wind blowing over a wing."

Wind tunnels are chambers through which air flows during tests of airplane shapes. In the tunnels, air is blown around airplane and rocket models to simulate flight. Pressure gauges, strain gauges, and other instruments attached to the models take readings while air blows through wind tunnels during experiments. Data streaming from the model instruments tell aerospace engineers how much lift, drag, and maneuvering performance an airplane model can generate through different angles of flight, and at various speeds, altitudes and conditions. New knowledge about airplane designs gained during wind tunnel tests helps engineers to decide if their ideas are working, or if design changes must be made before expensive, full-size prototype airplanes are built.

Aerospace models used in the tunnels often cost more than $1 million each because they must be exactly to scale, and they must be extensively instrumented. Running a large wind tunnel can cost tens of thousands of dollars per hour, with the exact cost depending upon the tunnel, the number of personnel needed, as well as any special equipment required. Engineers would prefer not to have to return to a tunnel for follow-up test cycles with modified airplane or spaceship models.

New network tool

Now, in addition to supercomputers, ARC researchers are using a NASA computer network tool that promises great savings in time and money for airplane makers and the government by providing faster access to information to help shorten the aircraft design and test process by about 25 percent. Called "Darwin," the network will revolutionize the way airplanes are developed by using wind tunnels linked with computers that send nearly instant test results via a network to geographically separated companies and laboratories. Prior to using large computer networks to deliver data, wind tunnel systems were very good at capturing data for later analysis, but they were not good at 'serving' the data.

"With Darwin, we're helping reduce the aerospace design cycle time by around a quarter, and we're providing information access to cut the number of independent design cycles," said Korsmeyer. "Our purpose is to get results and data out of NASA wind tunnels faster. Previously, such knowledge had to be derived by scientists and engineers in the days and months following wind tunnel tests."

Darwin is similar to the Internet, but is not available to the public. The system is able to link NASA, the aerospace industry, and academic centers that may be located thousands

of miles from one another. A computer program that many people use to browse the Internet from their home computers is used in the Darwin system, which collects data for translation into a useable form. Darwin also can provide access to data for researchers where they want it. The system can distribute secure data to many places at once. The key to Darwin's success is its ability to funnel wind tunnel data into a server computer, and then send knowledge back to researchers in "near real time" within about 30 seconds to five minutes.

"The kind of data Darwin can provide to researchers is in a standard format so people can easily understand the data. In addition to the normal graphs and charts engineers use, they also can step through images like frames of a movie to see changes of colorized air pressure and wind speed. You can see changes more easily than if you were to study each image individually," Korsmeyer said. ■