



# THE EARTH OBSERVER

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## EDITOR'S CORNER

**Michael King**

*EOS Senior Project Scientist*

I'm pleased to report that ICESat's GLAS Laser 2 was turned on at 1:15 PM EDT September 25 and successfully pointed off nadir 3° to the Goddard Space Flight Center's Building 22 at 9:21 PM EDT September 26. Approximately 20 members of the mission team saw the green pulse in a relatively clear sky. Laser 2 is emitting 3.5 million shots per day. There is astonishing detail to the cloud/aerosol data. Due to the problems experienced with Laser 1, plans are to turn Laser 2 on periodically through the seasonal cycle.

Gravity Recovery and Climate Experiment (GRACE) has released a preliminary Gravity Anomaly Map. This map is derived from data gathered during the first 111 days of the GRACE mission. The anomalies represent departures of about one-millionth the strength of the average Earth's gravity field. Even with such small anomalies, GRACE is sensitive enough to detect these gravity variations.

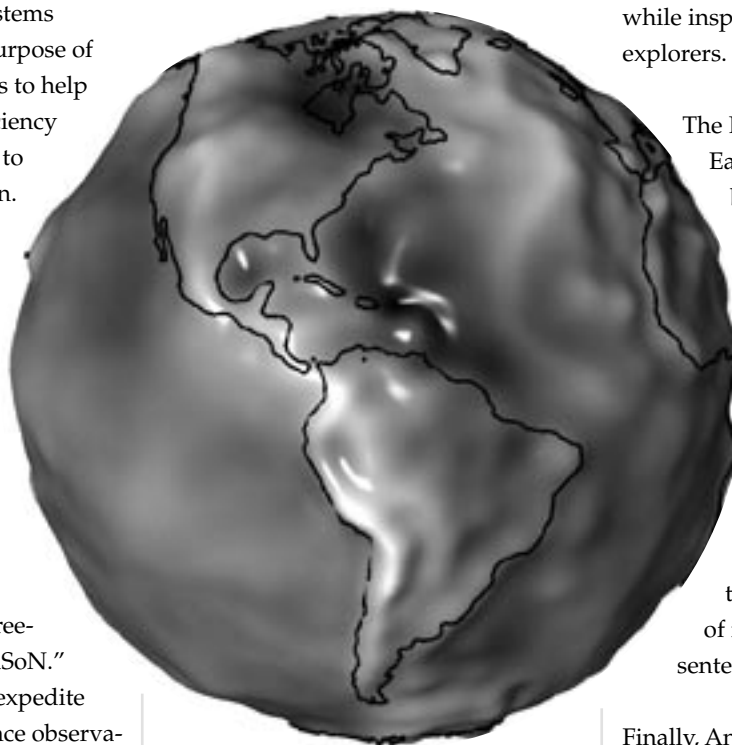
The Land Data Continuity Mission (LDCM) was cancelled, and NASA is exploring other ways to continue the expansion of the land data archive. Meanwhile, we are looking at alternative methods of using the data from the Landsat 7 archive, from multiple future passes of Landsat 7, or from other satellites to make a full image product. The scan line corrector impaired data products will be available from the Land Processes DAAC at EROS Data Center beginning November 1. No decision has been made on the cost of the data yet.

On May 30, 2003, NASA Administrator Sean O'Keefe and Secretary of Agriculture Ann Veneman signed a Memorandum of Understanding for the cooperative use of remote sensing technology to enhance agricultural productivity and environmental stewardship. This enables the USDA to draw on the best scientific and technical information available from NASA research

**Continued on page 2**

in Earth observation and systems engineering. The primary purpose of this new cooperative effort is to help increase the production efficiency of farmers while continuing to reduce the cost of production. Earth observation technologies provide insights into climate and precipitation patterns, crop health, airborne particles, and water availability.

NASA has selected 41 proposals in response to the "Research, Education, and Applications Solutions Network," a cooperative agreement notice known as "REASoN." The selected proposals will expedite the use of NASA Earth Science observational measurements, models and systems engineering capabilities. REASoN ensures that scientists studying Earth System Science have access to the most accurate and complete key geophysi-



cal observation records. Solutions that serve society will emerge from the selected proposals to help us understand and protect our home planet,

while inspiring our next generation of explorers.

The Earth Science Enterprise/ Earth Observing System will be heavily represented at the American Geophysical Union Fall Meeting December 8-12. There will be special sessions for Aura, Aqua, SORCE, and ICESat, and several Earth System Science press conferences are scheduled. Please make your plans to attend AGU to take advantage of the wealth of information that will be presented there.

Finally, Anne Kahle, longtime U.S. PI for the ASTER instrument has retired. Our best wishes to her for a long and happy retirement. Mike Abrams has succeeded Kahle as the U.S. PI on the ASTER science team.



In July 2003 the GRACE science team released this image of their preliminary findings from the GRACE satellite. The geoid above shows Earth's gravity field anomalies, areas with positive anomalies appear elevated and lighter, where areas with negative anomalies appearing as dark indentations. It is interesting to see how this technique highlights certain geographical areas, such as the Andes mountain range in South America, or the Puerto Rico Trench just to the east of Puerto Rico. More information about the GRACE experiment and Earth's gravity field can be found online at [www.csr.utexas.edu/grace/](http://www.csr.utexas.edu/grace/)

#### Erratum

In the July / August 2003 issue of *The Earth Observer*, we neglected to mention that the "CERES S'COOL Project" article originally appeared in the June 2003 Issue of *Bulletin of the American Meteorological Society* (BAMS) magazine.

## July 2003 User Working Group Meeting: Socioeconomic Data and Applications Center

— Robert S. Chen, Columbia University, [bchen@ciesin.columbia.edu](mailto:bchen@ciesin.columbia.edu)

On July 21-22, 2003, the User Working Group (UWG) of the Socioeconomic Data and Applications Center (SEDAC) met at Columbia University in New York. Prof. Michael Goodchild of the University of California at Santa Barbara chaired the meeting, and a total of 15 out of 18 members attended. A major focus of the meeting was SEDAC's progress in the five years since it had relocated from Michigan to Columbia University. The UWG also continued to give attention to SEDAC's strategic plans and new initiatives on topics such as data confidentiality.

### SEDAC's Five-Year Status Report

SEDAC was established in 1994 in Saginaw, Michigan, as one of the Distributed Active Archive Centers (DAACs) in the Earth Observing System Data and Information System (EOSDIS). In July 1998, SEDAC transferred its operations to the Lamont-Doherty Earth Observatory (LDEO) campus of Columbia University and became a part of the University's Earth Institute. SEDAC's core mission remains the same. It is dedicated to the synthesis of Earth System Science and socioeconomic data and information in support of research, applied-, and policy-users and ongoing support for an "Information Gateway" between the socioeconomic and Earth System Science communities.

Since 1998, SEDAC has introduced a range of new data products and ser-

vices, including interdisciplinary datasets, interactive applications, and online information resources (see [sedac.ciesin.columbia.edu](http://sedac.ciesin.columbia.edu)). Data products include Version 2 of the Gridded Population of the World (GPW), the Environmental Sustainability Index (ESI), the Population, Landscape, and Climate Estimates (PLACE), the Intergovernmental Panel on Climate Change (IPCC) Special Report on Emission Scenarios (SRES), and the "Last of the Wild" and "Human Footprint" datasets. Interactive applications include the Ramsar Wetland Data Gateway, the U.S.-Mexico DDViewer, the Goddard Institute for Space Studies (GISS) Crop-Climate Database, the ESI Viewer, and a redesigned and updated Environmental Treaties and Resource Indicators (ENTRI) database. Online information resources include three peer-reviewed "thematic guides" as well as various web sites in support of specific remote sensing application areas and the human dimensions research community.

During this period, SEDAC's user base has more than doubled to roughly 100,000 unique Web users per month and several thousand file downloads per month. More significantly, SEDAC data products and services are now widely used and cited in scientific and policy literature. For example, SEDAC data and services have been cited in more than 40 different peer-reviewed natural- and health-science journals, more than 40 different peer-re-

viewed social science and policy journals, and more than a dozen different law journals. SEDAC data have been used prominently in a variety of United Nations, World Bank, and World Resources Institute (WRI) publications, several different commercial atlases and encyclopedias, and in a range of general publications such as National Geographic, Newsweek, and The New York Times. Selected SEDAC data are also accessible through online interactive mapping tools offered by the WRI and the United Nations Environment Programme (UNEP).

SEDAC is currently working closely with a variety of international scientific and policy groups on developing interdisciplinary data products and services that integrate environmental and socioeconomic data. These groups include the Millennium Ecosystem Assessment, the United Nations (UN) Millennium Development Project, the UN Human Development Report Office, the IPCC's Task Group on Scenarios for Climate Impact Assessment (TGCIA), the Ramsar Bureau, and the International Satellite Land Surface Climatology Project (ISLSCP). SEDAC has partnered with the International Union for the Scientific Study of Population (IUSSP) to develop and operate the Population-Environment Research Network (PERN) ([www.populationenvironmentresearch.org](http://www.populationenvironmentresearch.org)) and with GISS and the System for Analysis Research and Training (START) to develop and main-

tain the Data, Methods, and Synthesis Web Site for the Assessment of Impacts and Adaptations to Climate Change in Multiple Regions and Sectors (AIACC) Project ([sedac.ciesin.columbia.edu/aiacc](http://sedac.ciesin.columbia.edu/aiacc)). SEDAC's Thematic Guide on Land-Use and Land-Cover Change has been fully endorsed as a Land-Use and Cover Change (LUCC) Research Project. SEDAC has also lent substantial support to both the 2001 and 2003 Open Meetings of the Human Dimensions of Global Environmental Change Research Community and continues to work closely with international organizations such as the International Human Dimensions of Global Environmental Change Programme (IHDP), the World Data Center Panel of the International Council for Science (ICSU), and the ICSU Committee on Data for Science and Technology (CODATA).

Within the U.S., SEDAC has played an active role in the NASA DAAC Alliance and the Earth Science Information Partners (ESIP) Federation and has participated in several activities of the Open GIS Consortium (OGC). SEDAC organized and hosted a DAAC Alliance Data Interoperability Workshop (summarized in the Nov/Dec 2002 *Earth Observer*, Vol. 14, No. 6). More recently, SEDAC staff have begun supporting the NASA Public Health Applications Program, an element of the Earth Science Enterprise's Application Division, including organization of a workshop on data confidentiality issues in July 2003 in Washington DC.

The Socioeconomic Data and Applications Center (SEDAC) is currently working to complete GPW Version 3 along with a complementary urban/rural extent database. Other forthcoming products include spatial data related to the UN Millennium Devel-

opment Goals, a Landsat 7 global city collection, an interactive atlas on China, subnational environmental sustainability indicator data, and global hazard vulnerability data.

### Strategic Planning

Major challenges facing SEDAC are the rapid changes in user needs and information technology that affect data management, accessibility, and utility; continuing resource pressures; and evolving priorities in both scientific and applied arenas both in the U.S. and globally. SEDAC has developed a strategic plan to increase its data and information resources. The plan focuses on global-scale environmental and socioeconomic data through the establishment of a "Center of Excellence on Global Georeferenced Data." This Center of Excellence would promote the accessibility and ease of integration of distributed global environmental and socioeconomic databases.

The plan includes a three-tiered approach to help guide SEDAC priorities and level of effort related to possible themes of concentration, and builds on SEDAC's strengths in areas such as population distribution, georeferenced administrative boundaries, environmental agreements, emission scenarios, and sustainability indicators. SEDAC has identified key partners needed to carry out this strategic plan, including various UN centers and agencies, non-governmental organizations (NGOs), U.S. and international data centers, private sector companies, and groups within Columbia's Earth Institute.

### Comments and Recommendations

In its follow-up letter, the UWG recommended that SEDAC move to the "next level of implementation" of the Center of Excellence, including specific

plans for products and services and for identifying possible complementary resources. A major concern is developing a strong identity or "brand" for the Center of Excellence that is complementary to SEDAC's existing identity. It is important for SEDAC to increase its visibility in the long run, especially within the policy user community.

One issue that SEDAC should address is improved methods of geovisualization, taking advantage of new technologies and approaches and addressing issues that may arise when combining disparate data sets of varying quality. SEDAC may wish to acquire relevant expertise on geovisualization through training, new staff, or partnerships with external groups.

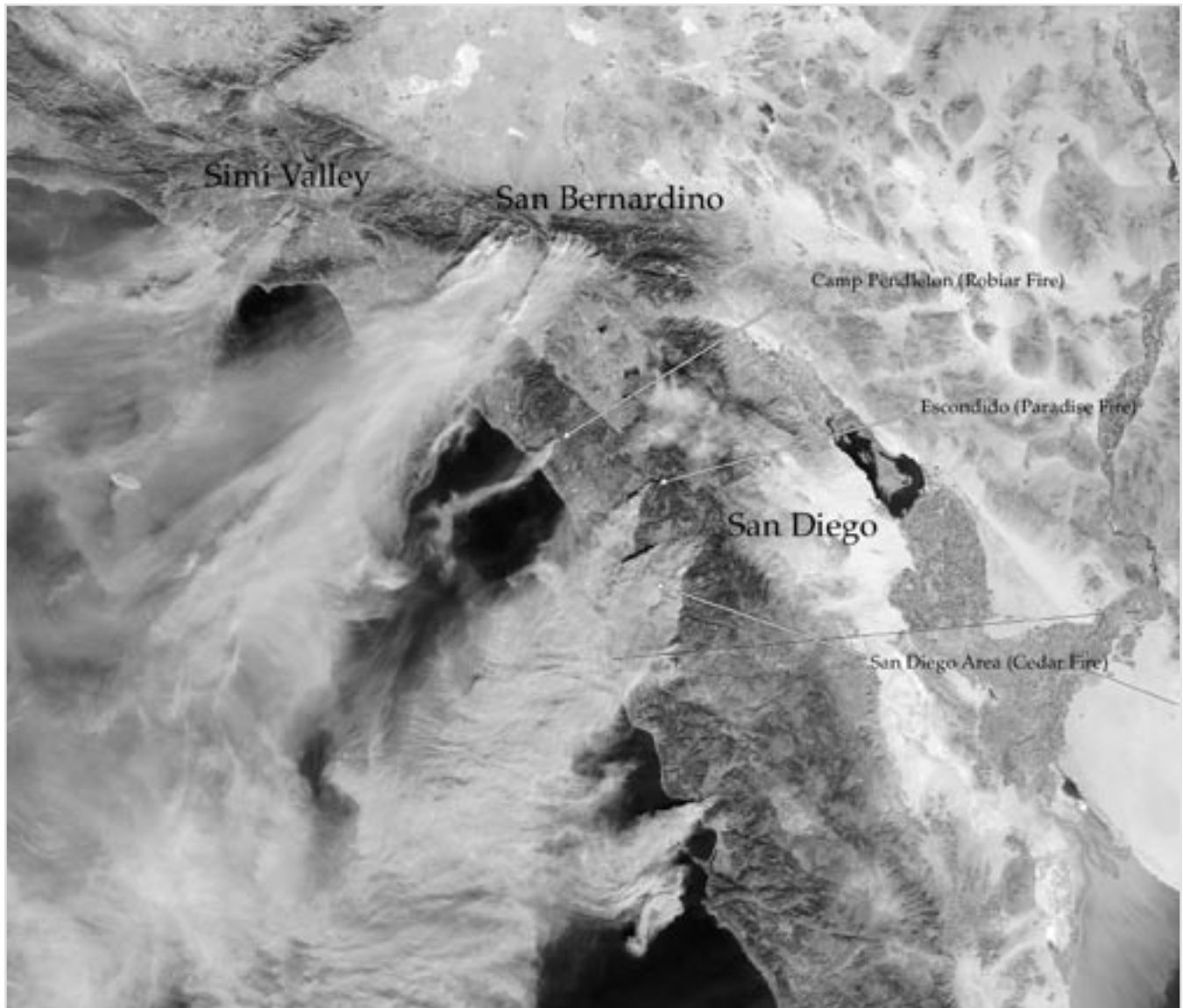
The UWG recommended that SEDAC formalize its data quality assurance policy, based on materials presented at the meeting. One concern is making sure that data undergoing review with external partners remains on restricted websites that are not made public, to avoid confusion with formally released and approved data products.

NASA's Earth Science Enterprise (ESE) continues to develop its overall strategy, and the UWG recommended continued monitoring of this effort with regard to SEDAC's role and the attention given to human dimensions issues. The UWG commended SEDAC's efforts related to data confidentiality in support of the ESE Public Health Applications Program, and urged SEDAC to explore the possibility of establishing an "enclave" program to provide secure, onsite access to social science and remote sensing data in ways that fully protect confidentiality. The UWG reaffirmed the importance of SEDAC's support for the 2003 Open Meeting in

Montreal, Canada, in October 2003, but recognized that it was sensible for SEDAC to reduce its role in future Open Meetings, which are likely to be held outside of the Western Hemi-

sphere in 2005 and 2007. The UWG also confirmed its desire to hold its next meeting in Montreal just prior to the Open Meeting, to take advantage of the opportunity to meet with IHDP staff

as well as members of the National Research Council's Committee on the Human Dimensions of Global Change.



Several massive wildfires were raging across southern California over the weekend of October 25, 2003. Whipped by the hot, dry Santa Ana winds that blow toward the coast from interior deserts, at least one fire grew 10,000 acres in just 6 hours. The Moderate Resolution Imaging Spectroradiometer (MODIS) on the Terra satellite captured this image of the fires and clouds of smoke spreading over the region on October 26, 2003. The gray polygons indicate precisely where the fires are burning, or have recently burned.

In and around Simi Valley are the Piru, Verdale, and Simi Incident Fires; the next cluster—to the right of Los Angeles—is the Grand Prix (left) and Old (right) Fires. Closer to San Diego is the Roblar 2 Fire burning in the Camp Pendleton marine base. The Paradise Fire is encroaching on Escondido. The smoke of the massive Cedar Fire is completely obscuring the coastal city of San Diego. Finally, at the California-Mexico border is the Otay Fire. At least 13 people have lost their lives because of these fires, several of which appear to have been caused by carelessness and arson. Thousands have been evacuated across the region and hundreds of homes have been destroyed.

Image courtesy Jacques Descloitres, MODIS Rapid Response Team at NASA GSFC.

## ESIP Federation Holds Its 12<sup>th</sup> Meeting

— Carol Meyer, [carol.meyer@earthsciencefoundation.org](mailto:carol.meyer@earthsciencefoundation.org), *Foundation for Earth Science*

The Federation of Earth Science Information Partners (ESIP) held its 12<sup>th</sup> meeting July 28 – August 1 in Boulder, Colorado. Hosted by Federation member Unidata and held on the campus of the University Corporation for Atmospheric Research (UCAR), the Federation spent its time exploring the week's theme of "Earth Science for Society."

The 12<sup>th</sup> Federation meeting was one of the most important meetings in the organization's history. Positioned to receive some 35 new members that come from NASA's Research, Education, Applications Solutions Network (REASoN) awards, the Federation is at a critical juncture. During the meeting, REASoN awardees who were new to the Federation were provided a half-day orientation session. Federation President Dave Jones, Foundation for Earth Science Executive Director Dick Wertz, and Federation committee chairpersons provided an overview of Federation history, future direction, and explained opportunities for engagement.

On July 28, the meeting opened with a Federation-wide poster session, organized around five broad scientific domains: Air, Land, Water, Life, and Earth Systems. In the end, more than 60 posters were displayed, representing the breadth of activity that spans the Federation. Data centers, data processors, universities, non-profits, and private companies showcased their Earth science data products, services, and ap-

plications. The poster session was used to generate questions and discussion and identify potential collaborations to be explored during the week's breakout sessions that were organized around the five domains. The poster session was well-attended, including visitors from host UCAR, the media, and a group of elite Earth science teachers, who were in Boulder for a two-week geosciences workshop.

On the second day, the meeting continued with several key speakers from NASA Headquarters. The presentations given this day focused on the future of the Federation, including how the organization would diversify over the coming years. The Federation has grown nearly four-fold during its history, with an increasingly diverse set of interests represented. Members representing key federal agencies, major universities, non-profit organizations, and commercial entities work together in this dynamic organization. The Foundation for Earth Science, the Federation's administrative arm, will pursue funding diversification by marketing the Federation's value to other federal agencies and beyond.

The meeting continued with breakout sessions, organized around the five domains. Each breakout session identified core issues for its domain, identified potential collaborations, established goals, and explored how each could utilize the Federation's committee structure to further its objectives. The

domain structure will continue within future Federation activities as one way to organize discussions.

The Federation also elected its officers, committee chairs, and committee members during the meeting. Dave Jones, President and Chief Executive Officer of Storm Center Communications, was elected to an unprecedented second term as Federation President. John Townshend, Professor of Geography at the University of Maryland, was elected Vice President. The Federation will consider several important pieces of internal business at its 13th meeting, scheduled for January 5 – 9, 2004 in Orlando, Florida.

The last two days of the Federation meeting were devoted to Technical Workshops. The Technical Workshops were sponsored by the Federation's Information Technology and Interoperability Committee. The focus of the Technical Workshops was to provide a platform for member organizations to showcase their latest technology developments. In addition to the workshops, the Committee sponsored a one-day technical poster session.

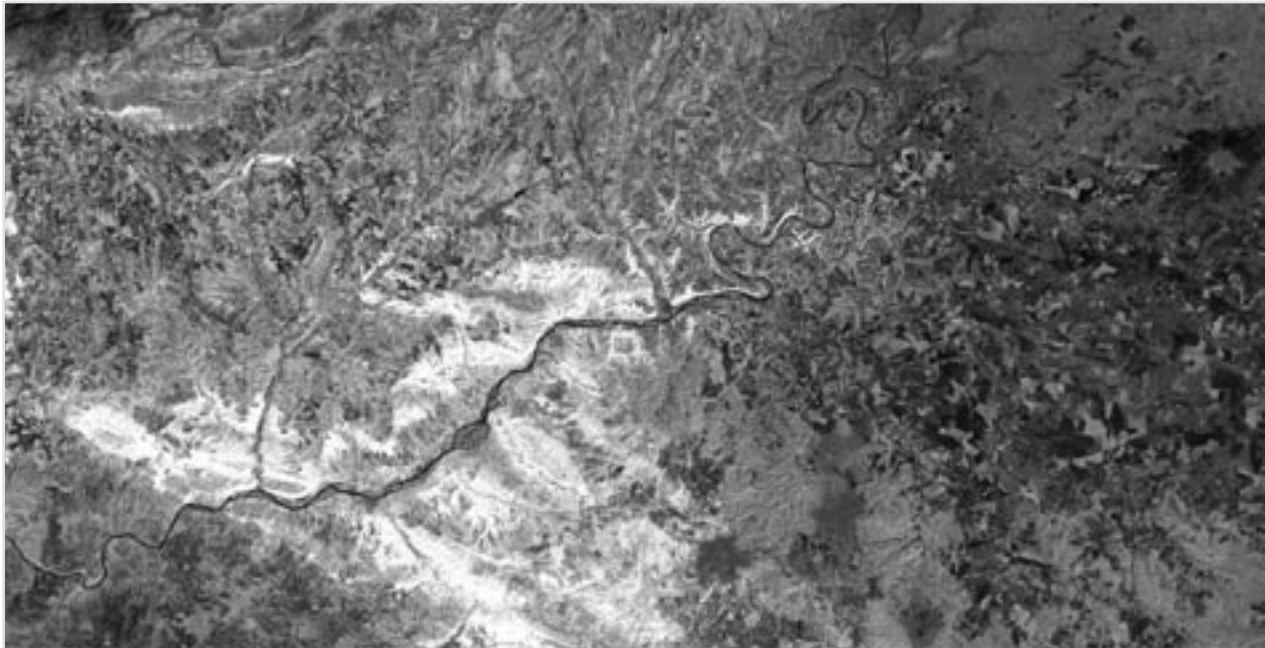
The ESIP Federation was created by NASA to develop Earth science data into usable products and services that would be available to a broad community of users. The Federation has successfully leveraged its talent by stressing collaboration among member organizations, who are positioned on the

leading edge of Earth science research, technology transfer, and applications development. Federation membership continues to grow, with an increase to some 80 members expected by late 2003. For more information about the ESIP Federation, visit [www.esipfed.org](http://www.esipfed.org) or call 877.870.3747.



Turkey's Ataturk Dam was completed in 1990. It is the largest of a series of dams along the two major rivers of the region, the Tigris and Euphrates, which both have their headwaters in southeastern Turkey. Built both to generate electricity for the region and to irrigate the plains between the Euphrates (on which it sits) and the Tigris (to the east), Ataturk Dam is the centerpiece of a huge public works program within Turkey known as the Southeastern Anatolia Project. When the entire program of reservoirs, power generation stations, and irrigation channels is constructed, it will irrigate some 1.7 million hectares (4.2 million acres). In this pair of Landsat images, the dramatic growth of the Ataturk Dam Lake in the space of 19 years is quite apparent. The newly formed lake, sometimes referred to as a sea by locals, covers some 817 square kilometer (320 square miles) in total surface area. These images were acquired by the Landsat 4 Multispectral Scanner (MSS) and the Landsat 7 Enhanced Thematic Mapper Plus (ETM+) instruments. The first image was acquired by MSS on August 20, 1983, and the second by ETM+ on August 24, 2002. The Landsat 4 MSS image was obtained from the University of Maryland's Global Land Cover Facility. The Landsat 7 ETM+ image provided courtesy of USDA Foreign Agricultural Service Production Estimates and Crop Assessment Division (PECAD).

August 20, 1983



August 24, 2002



## LP DAAC Update

— John L. Dwyer, [dwyer@usgs.gov](mailto:dwyer@usgs.gov), Land Processes Distributed Active Archive Center (LP DAAC)

### MODIS LDOPE Tools Version 1.3 Released

The Land Processes Distributed Active Archive Center (LP DAAC) announces the release of the Land Data Operational Product Evaluation (LDOPE) Tools Version 1.3. This version adds four new tool capabilities to the existing suite of LDOPE tools supporting the HDF-EOS data format for MODIS Land (MODLAND) products. New functionality includes copying the projection information for LDOPE-created HDF-EOS files, reporting specific data values, masking of data values, and reporting projection information for an HDF-EOS file. Several of the tools may also be used to manipulate non-MODLAND HDF-EOS products.

The MODIS LDOPE software tools were developed by Sadashiva Devadiga, Yi Zhang, and David Roy at the LDOPE facility, NASA Goddard Space Flight Center, to assist the quality assessment of the MODLAND products. The tools have been developed with feedback from the MODLAND science team and incorporate the scientific knowledge, experience, and insights gained during the substantial MODLAND product development period. These software tools are invoked as stand-alone executables from a command-line interface. The software is supported on Irix, Solaris, Linux, and Windows operating systems. Although there are no distribution or re-use constraints associated with this software, developers using or modi-

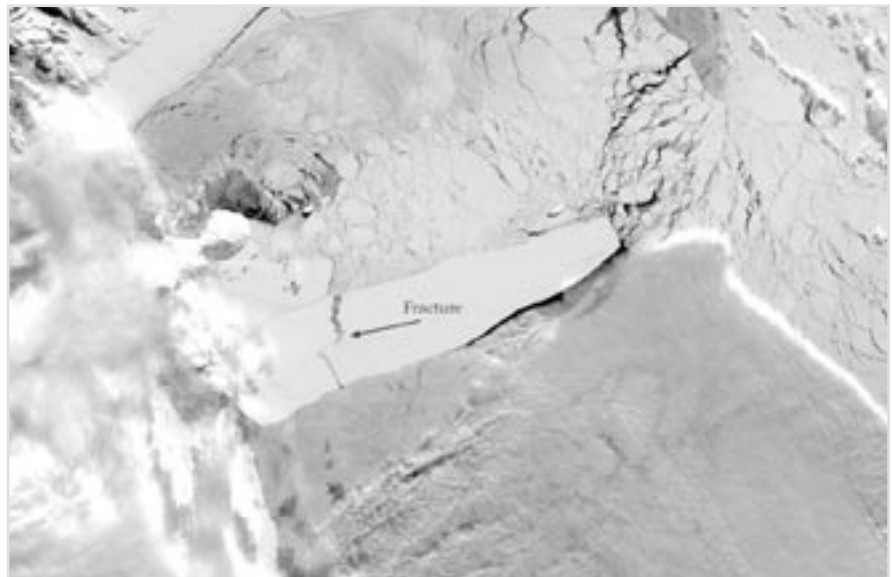
fying this software should credit the original authorship of these tools. The LDOPE Tools Version 1.3 and further information are accessible from: [lpdaac2.usgs.gov/landdaac/tools/ldope/index.asp](http://lpdaac2.usgs.gov/landdaac/tools/ldope/index.asp)

### LP DAAC Website Update

There have been several recent enhancements to the MODIS Reprojection Tool (MRT) and LDOPE Tools websites. Users previously registered for either the MRT or LDOPE tool are now automatically registered to download the other tool by using the same username and password. Users previously registered for both tools will only need to keep track of one username/password combination.

We have also made it easier for you to retrieve your password if you are having difficulty logging in, or if your password has been misplaced. By visiting our Password Retrieval webpage, you can simply enter your username and email address, and your password information will be emailed directly to you.

As always, if you have any questions regarding any of these updates, simply contact us through our Customer Service interface at: [LPDAAC2.usgs.gov/custhelp/](http://LPDAAC2.usgs.gov/custhelp/) or send us an email at [edc@eos.nasa.gov](mailto:edc@eos.nasa.gov).



A massive iceberg that had been blocking traditional shipping routes to McMurdo Station, the National Science Foundation's research station in Antarctica, snapped in two seemingly overnight. This Moderate Resolution Imaging Spectroradiometer (MODIS) image captured by the Terra satellite on October 9 shows the iceberg in two pieces. The largest section, right, is about 75 miles long, and the shorter section is 20-25 miles long. The B-15A iceberg broke off the Ross Ice Shelf in 2000 and drifted to its present location. Image courtesy Jeff Schmaltz, MODIS Land Rapid Response Team at NASA GSFC.



## International Conference on “Studying Land Use Effects in Coastal Zones with Remote Sensing and GIS”

— Garik Gutman, [ggutman@nasa.gov](mailto:ggutman@nasa.gov), NASA LCLUC Program, NASA Headquarters

— Ronald Rindfuss, [ron\\_rindfuss@unc.edu](mailto:ron_rindfuss@unc.edu), University of North Carolina, LUCS Science Steering Committee

### Introduction

Close to 90 participants gathered in Kemer/Antalya, Turkey on August 13-16, 2003 at the conference “Studying Land Use Effects in Coastal Zones with Remote Sensing and GIS,” which was held as the first part of the new International Colloquium Series on Land Use/Cover Change Science and Applications under auspices of the NASA Land-Cover/Land-Use Change Program (LCLUC) and the Land Use/Cover Change (LUCC) Project of the International Geosphere-Biosphere Program (IGBP) and the International Human Dimensions Program (IHDP). NASA was the primary sponsor of this meeting. Additional sponsorship came from the Humboldt Foundation, the German Academic Exchange Services and the Goethe Institute, all located in Istanbul, Turkey, and the Scientific Committee on Oceanic Research, Baltimore, USA. The meeting was hosted by the Istanbul Technical University, Turkey with the kind help of the municipality of Kemer/Antalya.

The new International Colloquium Series on Land Use/Cover Change Science and Applications is devoted to the most important issues of changes in land cover and land use over the globe, with the emphasis on remote sensing capabilities and interactions between humans and ecosystems. The Series

will cover various topics, such as deforestation in tropical regions, boreal zone processes, land cover and land use and water resources in mountainous regions and in arid regions, forest fires, and others, aiming at linking people, pixels, and ecosystems. The focus of this colloquium is on how remote sensing and GIS can help in studies of land-use impacts on land cover, ecosystem services, hydrologic and carbon cycles, species distribution and biodiversity, and human social and economic systems. Special attention is devoted to analysis of human sensitivity (vulnerability) to these impacts. Current remote sensing multi-spectral observations provide important tools for these studies and include passive optical sensors with spatial resolution ranging from a few hundreds meters to one meter, active optical sensors (lidars), and passive and active microwave sensors. An integrated approach to understanding a complex phenomenon would also include usage of airborne and *in situ* observations, basic process studies and case studies, field campaigns, modeling and integrative data analysis using data and information systems (e.g. GIS). Additionally, long-term data sets that have been accumulated in both fine and coarse spatial resolution allow analysis of changes in land cover during the past three decades. This colloquium addresses areas that need more immediate attention. Its goal is

to identify state of the art and scientific directions to fill in gaps in knowledge.

The first conference in this colloquium series was devoted to changes in coastal zones related to land use. The coastal zone is the interface between land and water bodies where interaction between various natural processes and human activity are most active. Up to 40% of the Earth’s human population lives on or near the coast. In the U.S. about half the population will soon be living in the coastal zone. The coastal zone provides land for urban development, tourism, agriculture, industry, and transportation, as well as a location for leisure and recreational activities. The coastal zone is a geologically, chemically, and biologically dynamic environment. It is subject to considerable natural variability. Growing socio-economic pressures pose a major challenge for proper management of natural resources. Such areas are often subject to intense development, urbanization, and industrialization; they are areas of high biological productivity and natural diversity and areas of high recreational value. Thus, coastal ecosystems are areas of multiple, competing resource uses. Water plays an important role in transporting and redistributing particulates and solutes, and remote sensing can be used to collect data to establish baselines for impacts.

Satellites offer an important but, as yet, under-utilized set of tools to manage the transition towards sustainable coastal zone uses. The conference focused specifically on the application of remote sensing and advanced information technologies, such as GIS, to the social and physical studies of the coastal zone. The goal of the conference was to bring together scientists working on the issues of land use effects in coastal zones and analyze the state-of-the-art approaches in studying these issues by means of remote sensing and GIS, as well as examine the commonality and differences of the above effects in different geographic regions of the globe. Many papers included the use of satellite and airborne imagery but very few combined remote sensing and/or GIS with social science surveys and published census data in application to coastal land use monitoring and planning. Some papers considered coastal zone effects caused by human populations and land use change on water quality.

Additionally, this conference offered a set of four hands-on workshops and tutorials on specific sensors and GIS. The four workshops were held on the first day and in parallel with one another: 1) MODIS, 2) Landsat, 3) IKONOS, and 4) GIS; they were well received. This feeling was reinforced by the many positive comments from the participants about how helpful the tutorials were and the support system behind the data. For example, there were many people from other countries at the conference that were not aware of the existence of MODIS data and how it could benefit their research. One improvement suggested was that there should be more interactive projects and visualization tools on the tutorial CDs or the desktop PCs that can provide

the kind of hands-on experience that the users want. It was noted that this workshop was unlike the others that have been conducted in the past in that there were PCs available for the attendees to access data, read data product information pages, and use the online visualization tools.

#### Technical Sessions

The conference was split into technical sessions that considered coastal zones of several geographic regions and consisted of oral and poster presentations (see [www.ins.itu.edu.tr/rslucoat1/program.htm](http://www.ins.itu.edu.tr/rslucoat1/program.htm)): the northern Eurasian, the Mediterranean, the non-tropical Atlantic, the non-tropical Pacific, and the tropical/subtropical coasts. Following the overview lectures, the rest of the day was devoted to five-minute presentations of the posters and running the four workshops.

The Northern Eurasia session, led by Serge Viktorov (Institute of Remote Sensing Methods for Geology, St. Petersburg, Russia), consisted of reports on the Baltic, the Caspian, and the Black sea coasts. The coastal zone beyond the Arctic Circle was not considered, although it was noted that there are processes under way due to both the climate change and human impacts. Discussion of specific problems related to imagery processing and pattern recognition focused on radiometric sensitivity and object-oriented spectral band selection, problems in very high resolution stereo images, temporary objects in the images, and sub-classes in very high resolution images. Of common interest appeared to be the problem of time scales in land-use/land-cover (LULC) change analysis based on remote sensing data. Two main questions were discussed: 1)

what is the quality of 'old' data? and 2) what temporal resolution is required in typical application areas? The temporal scales covered in presentations varied between a few recent years up to 350 years back (in the latter case verbal descriptions and historical maps of the landscapes were used). There was a common understanding that LULC change analysis requires comprehensive time series of satellite images and good knowledge of natural variations of phenomena and processes under investigation. But in most studies less than five images were used (for various reasons, including financial aspects). It was noted that the prices for IKONOS-type satellite imagery and all types of airborne data are too high for scientific applications. Some authors noted that they need satellite imagery of better quality (spatial resolution, re-visit time, etc.) than space agencies are able to offer at present. All-weather high-resolution radar imagery is of prime interest for LULC change studies in northern Eurasia, but the application areas are still limited. Concerning regional peculiarities, it was noted that the region of northern Europe is the region with many 'economies in transition'. In the states of the former USSR and the countries of Eastern Europe, drastic political and economic change results in LULC change with noticeable changes in the state of the coastal and marine environments. In this context it was emphasized that quantitative and even qualitative links between LULC change in watersheds and processes in coastal zones are not clear in many cases. Proper attention should be paid in future research activities to problems of time delay, chemical 'time bombs', transformation of substances, indirect effects, socio-economic factors, etc. This will require application of multi-factor analysis techniques. On the other hand,

the main methodological peculiarity of the region under consideration is a low amount of cloud-free days, which leads (or will inevitably lead) to the orientation on radar imagery in operational tasks and harmonized synergy of radar, visible, and thermal infrared (IR) imagery in non-operational applications.

The Mediterranean session was jointly led by Derya Maktav (Istanbul Technical University, Turkey) and Vittorio Barale (the EC Joint Research Institute, Italy). The number of presentations by Turkish investigators was greatest, as could be expected. The common issues summarized at the end of the meeting emphasized that cost is the main restrictive factor for the data selection, which dictates the design and the use of low-cost equipment. It was also concluded that there is a need for new digital image processing algorithms for high-resolution data analysis. The use of new classification techniques such as Artificial Neural Networks was encouraged.

In the non-tropical Atlantic and Pacific coastal zones sessions, led by Tom Fisher (University of Maryland, USA), the common themes were deterioration of water quality due to turbidity and Chlorophyll a (algal blooms). Causes of deterioration seem to be mainly human populations (wastewater), land use change and intensity (erosion and fertilizers), and conversion of forests/wetlands to urban/agriculture thereby losing natural filters. One commonality was urbanization of coastal areas: increasing populations along the coast and conversion of forest and agriculture to urban uses. The non-tropical coastal areas are different from other regions in that they have larger seasonal variations in temperature and water clarity. They are characterized by less-

transparent waters and by more severe environmental impacts from industrial land use. On the other hand, there have been more efforts to reverse the adverse impacts in non-tropical coastal zones.

In the tropical coasts session, led by Frank Muller-Karger (University of South Florida), it was noted that the tropics are differentiated from other regions by more rapid and unmanaged development of coastal zones, which leads to apparent larger-scale negative impact from runoff and pollution. In the tropics, urban infrastructure expansion, deforestation, and agriculture extension are amongst the main driving forces of the land-cover and land-use changes. The impact of sediment plumes from soil erosion upstream affects coastal ecosystems in terms of water quality, species of zooplankton biomass, and health of the coral reefs. Dispersion from oil pollution or non-point sources of pollution from suspended sediment affects the dynamics of coastal ecosystems. From the presentations, it seemed clear that dynamic coastal ecosystems are affected by human activities. However, no work was presented that linked human activities to the impacts observed. Population projections suggest that increased migration from inland agriculture areas to coastal communities will occur and may impact coastal ecosystems. Examples from the work by local researchers in the tropics are still at a preliminary stage. For example, the amount of biomass collected in the field due to land-use and land-cover changes from the activities of urbanization over a temporal space of 10 years could not be compared to longer-term historical data, as these data do not exist. The present work sets a baseline for future studies, useful in the monitoring of the changes of the biological coastal

ecosystems.

### **Remote Sensing and Social Sciences Panel**

In addition to the technical sessions, a special panel was held on "Remote Sensing and Social Sciences," moderated by Ronald Rindfuss (University of North Carolina, USA). The distinction between land cover and land use was central to this session. The difficulties in blending remote sensing and social science expertise include opportunity costs (going across disciplines requires time and budgetary investments, and the problem is exacerbated when bridging natural and social sciences), organizational boundaries (collaboration across disciplines is difficult due to the organizational structure of government agencies and universities), and specific languages of the disciplines (communication is often difficult across disciplines due to discipline-specific jargon). The mere move from studying land cover to studying land use, obtaining a more refined descriptive understanding and, finally, investigating the drivers of land cover change – all these dictate the need for joining remote sensing expertise with social science. There was a discussion of distinctions between decision-making applications and social science. Concerns about the possible misuse or misinterpretation of data were also discussed. The issue was how much processing should take place before releasing data. It was also noted that remotely sensed data could be important in generating concern about environmental degradation and helpful in stimulating motivation to ameliorate the degradation. If this were translated into a social science question, the question would be under what circumstances will the availability of remotely sensed images lead to the

mobilization of concern about environmental degradation. The session concluded, noting that the number of studies that use both remote sensing and social science information is growing. This process and the formation of research teams that include both social science and remote sensing expertise should be encouraged.

### Future Directions

The link between remote sensing monitoring with ground truth validation should be encouraged, in addition to the input of the socio-economic factors. A multi-disciplinary holistic approach should be adopted in future research efforts. With the projection of an increase in global population that can put pressure on land-use and land-cover changes, remote sensing can facilitate monitoring and visualization of unsustainable development. The participants agreed that there needs to be greater diversity of image types to

The Strait of Messina Bridge Project, if completed, would stand as one of the landmark bridges of the 21st century. It would be the longest suspension bridge ever built. The Strait of Messina divides the island of Sicily from Calabria in southern Italy, and is 3 km wide. While the overall length is not a big problem, the economics, water depth, wind, and earthquakes all have to be accounted for. To avoid the problem of the deep water, the solution was to design the longest suspension bridge ever. It will have a 3,300-meter main span and 180-meter side spans (an overall length of 3.7 kilometers). The main piers will be founded in 120 meters of water. The aerodynamic features of the bridge will allow it to withstand winds up to 216 km per hour. The bridge will also be able to face magnitude 7.1 earthquakes without damage. The bridge will be 60 meters wide and will have twelve lanes for traffic and two lanes in the middle for trains. This will allow up to 140,000 vehicles and 200 trains to cross per day, reducing transit times of up to 12 hours down to minutes. This image was acquired by the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER), aboard NASA's Terra satellite, on June 14, 2002.

Image courtesy NASA/GSFC/MITI/ERSDAC/JAROS, and U.S./Japan ASTER Science Team.

address questions of land use effects in coastal zones. An important issue is the integration of small areas of high-resolution imagery with larger areas of low-resolution imagery. Better integration of terrestrial land use changes and aquatic processes via satellite imagery, GIS, databases (e.g., river monitoring and census data), and existing paper maps or aerial photography was considered a crucial point for further advancement. Additionally, it was pointed out that greater integration is needed between agencies, universities, commercial operations, national/local governments, UN and other programs, as well as within and among countries.

### Acknowledgement

The following individuals contributed to this article: Frank Muller-Karger (University of South Florida, USA), Serge Viktorov (Institute of Remote Sensing Methods for Geology, St. Petersburg, Russia), Tom Fisher (Univer-

sity of Maryland, USA), Darryl Nickless (NASA, USA), Mastura Mahmud (University Kebangsaan, Malaysia), and Derya Maktav and Filiz Sunar Erbek both at Istanbul Technical University, Turkey. We thank Vittorio Barale (the EC Joint Research Institute, Italy), Roland Doerffer (GKSS Research Center, Germany), and Anatoly Gitelson (University of Nebraska, USA) for their introductory lectures and Helmut Geist (LUCC Project Office) for contributing in the preparation of the conference. Special thanks go to David Palandro, Damares Pulliza (both at University of South Florida), Michael Williams (University of Maryland), and Darryl Nickless and Dana Ostrenga (both at NASA Goddard Space Flight Center) for organizing the hands-on workshops. Finally, we express our gratitude to the Turkish hosts—Derya Maktav and Filiz Sunar Erbek—for their warm hospitality and a great job in organizing the meeting logistics.



## SAGE II Version 6.2 Data Set Now Publicly Available

— Joseph M. Zawodny, *Joseph.M.Zawodny@nasa.gov*, NASA Langley Research Center

[Editor's Note: The Stratospheric Aerosol and Gas Experiment (SAGE) II sensor was launched into a 57-degree inclination orbit aboard the Earth Radiation Budget Satellite in October 1984.] The SAGE II version 6.2 data set is now publicly available. SAGE II continues to operate, and nearly 19 years of Ozone, Aerosol Extinction, Nitrogen Dioxide, and Water Vapor profile data are available. The improvements in this release are detailed below. The data can currently be obtained by anonymous ftp at: *ftp-rab.larc.nasa.gov* from the */pub/sage2/v6.20* directory. Sample software to read the data files can be found in a zipped tar file in the same directory or as individual files under the */pub/sage2/readers* directory. The data will be available through the EOSDIS system after October 28, 2003.

You can learn more and also access the data via your browser at: *www-sage2.LaRC.NASA.gov*. This site will be kept up to date with information on known limitations of the data set and other quality-related information as well as new data.

### Changes for Version 6.2

The primary change to the algorithm deals with the improvement in the water vapor product. The SAGE II V6.1 data have not been publicly available after mid-2000 due to an altitude registration problem. This has been tracked down and corrected. The release of V6.2 contains all data through

September 2003, and subsequent months will be released on approximately the middle of the following month. An error in the interpolation of the National Centers for Environmental Protection (NCEP) Met data used to remove Rayleigh scattering from the transmission profiles has also been corrected.

### Data Since July 2000

In the middle of July 2000, SAGE II experienced a failure of its azimuth gimbal system. This was corrected and operation at a 50% duty cycle was re-established by November 2000. A few months after the return to operation it became apparent that there were sporadic problems in quality of the data products. Many potential sources (Y2K, instrumental, ephemeris epoch, and operational interferences) were suspected. After a lengthy investigation it appeared that the problem periods followed a peculiar pattern of an abrupt change in quality at midnight GMT on Sundays and Thursdays. It was also observed that the problem was consistent with an altitude registration problem of up to 3 km, or more in some cases. Working with the flight operations and flight dynamics people it was determined that the problem was due to a change in the software used to produce the final satellite ephemeris from the tracking data. The change-over occurred at essentially the same time as the gimbal failure. The software has been changed to closely match the per-

formance of the pre-2000 software and has been used to produce a new satellite ephemeris data set from January 1, 2000, onward. The data after mid-2000 now exhibit the proper behavior.

### Water Vapor

The SAGE II water vapor retrieval has been significantly updated in this version. Version 6.1 exhibited a significant dry bias that was as large as 2 ppm in the vicinity of the hygropause. Since water vapor is never more than 10% of the total signal in the nominal 'water vapor channel', the commonly held view is that the problems in water vapor are related to clearing interfering species including molecular scatter, ozone, and particularly aerosol. During a critical evaluation of the aerosol model used in the water vapor algorithm, it became apparent that it was not possible for aerosol to produce the observed bias in the water vapor product. Further examination strongly suggested that, like the filter-based NO<sub>2</sub> channels, the filter-based water vapor channel had significantly drifted in spectral response, particularly in the first year of operation. While it is difficult to determine the details of the modified response, we have forensically deduced that the channel has moved approximately 10 nm toward longer wavelengths and widened slightly. With this new location, the Version 6.2 water vapor product, at least in the absence of significant volcanic aerosol perturbations, no longer exhibits the

dry bias and matches the Halogen Occultation Experiment (HALOE) water vapor climatology well from 15 to 30 km (slightly wetter at the upper end of this range).

### Water Vapor Caveats

Given the drift in the spectral response and the limited ability to fit its time dependence, it is quite likely that any trend derived from this data would reflect a trend in the goodness of the fit as much as an actual trend in water vapor itself.

Since the bulk of the spectral shift occurred in 1985, we have not developed a time-dependent model for this period, and caution should be used in making use of this data. In 1984 and early 1985, retrievals using the nominal channel location look reasonable. Version 6.2 uses the nominal location for 1984 and 1985 and an abrupt shift to the new channel location beginning in 1986.

Water vapor is very sensitive to aerosol loading and, based on sensitivity studies, we do not recommend using SAGE II water vapor in the stratosphere when the associated 1020-nm aerosol extinction exceeds  $4.0 \times 10^{-4} \text{ km}^{-1}$ . This criterion eliminates at least some data in 1985-1986 and again in 1991-1994. Other periods are mostly unaffected by this limitation.

### Ozone

For the most part, the ozone density profiles have changed on the order of 0.5% or less from version 6.1. The changes may be larger above 50 km, due primarily to the correction of an altitude registration problem in our NCEP gridding algorithm. The increase

in the retrieved water vapor in the troposphere results in even lower ozone values below 10 km.

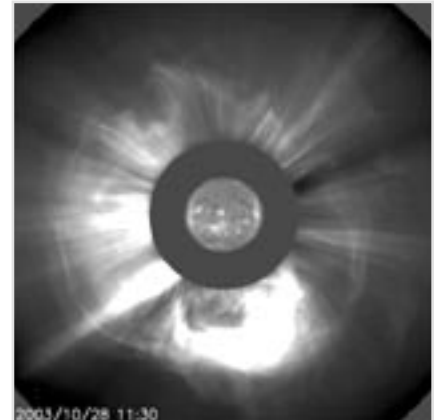
### Bit Flag Changes

In version 6.20, the meanings of some of the bit flags in the two quality vectors have changed. These vectors are the elements called "infvec" in the index and species structure files. The complete set of bit flag descriptors is available in the IDL structure file "bitinfo\_620.pro."

Three new bit flags have been added to the quality vector in the index file, relating to changes in the water vapor processing. These are bits 5, 6, and 7, all of which were spare bits in version 6.10. Bits 5 and 6 are used to distinguish aerosol clearing models for the water vapor channel. If bit 5 is on, the model is the El Chichon model. If bit 6 is on, the model is the Pinatubo model. Both bits 5 and 6 are turned on during a transition period between the two models. If neither of these flags is turned on, the model is the same as in version 6.10. Bit 7 serves as a signal that the filter function for the water vapor channel was changed from earlier versions. This bit is on for all events after 1985.

Changes have also been made to the bit flags in the altitude-dependent information vector, found in the species structure file. Bits 11 and 12 in version 6.10 were the "large 525 OD" bit and the "large 1020 OD" bit that were set when the total optical depth in those channels becomes very large, possibly signaling the presence of a cloud. In the current version, the "Large 1020 OD" bit has been moved to bit 5 (formerly a spare) and bits 11 and 12 are replaced with the result of a cloud test [Kent,

G. S., P.-H. Wang, M. P. McCormick, and K. M. Skeens, Multiyear SAGE II measurements of upper tropospheric aerosol characteristics, *J. Geophys. Res.*, **100**, 13,875- 13,899, 1995]. Testing for clouds occurs starting in 1985 between 6 km and 25.5 km altitude. If the test is performed and the result is well determined, then bit 11 is turned on, and bit 12 shows whether a cloud is present (on) or absent (off). If bit 11 is off, bit 12 shows whether the test was indeterminate (on) or not performed (off).



A massive solar flare erupted from the surface of the Sun at 9:51 UTC on October 28, 2003. The solar flare persisted for more than an hour, peaking at 11:10 UTC. Associated with the flare was an ejection of a billion tons or more of gas from the Sun's tenuous outer atmosphere, or corona. Both the flare and the coronal mass ejection accelerated electrically charged particles to very high energies and hurled them at near the speed of light directly towards Earth. It takes light roughly 8 minutes to travel from the Sun to Earth. (A time-series of the event is on page 21.)

To put this event in perspective, NOAA predicted the impacts of the coronal mass ejection on the Earth's magnetosphere to be a "4" (severe) on a scale of 1 to 5. The flare is the third largest ever recorded in the 30 years since NOAA began observing soft X-ray emissions from the Sun. This flare is listed as an X17.2, with an X20 being the most intense flare ever observed in that time.

Image courtesy Solar & Heliospheric Observatory (SOHO).

## Recent Warming of Arctic May Affect Worldwide Climate

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Published on the Earth Observatory Website: [earthobservatory.nasa.gov/Newsroom/NasaNews/2003/2003102316085.html](http://earthobservatory.nasa.gov/Newsroom/NasaNews/2003/2003102316085.html)

Recently observed change in Arctic temperatures and sea ice cover may be a harbinger of global climate changes to come, according to a recent NASA study. Satellite data — the unique view from space — are allowing researchers to more clearly see Arctic changes and develop an improved understanding of the possible effect on climate worldwide.

The Arctic warming study, appearing in the November 1 issue of the American Meteorological Society's *Journal of Climate*, shows that compared to the 1980s, most of the Arctic warmed significantly over the last decade, with the biggest temperature increases occurring over North America.

"The new study is unique in that, previously, similar studies made use of data from very few points scattered in various parts of the Arctic region," said the study's author, Dr. Josefino C. Comiso, senior research scientist at NASA's Goddard Space Flight Center, Greenbelt, Md. "These results show the large spatial variability in the trends that only satellite data can provide." Comiso used surface temperatures taken from satellites between 1981 and 2001 in his study.

The result has direct connections to NASA-funded studies conducted last

year that found perennial, or year-round, sea ice in the Arctic is declining at a rate of nine percent per decade and that in 2002 summer sea ice was at record low levels. Early results indicate this persisted in 2003.

Researchers have suspected loss of Arctic sea ice may be caused by changing atmospheric pressure patterns over the Arctic that move sea ice around, and by warming Arctic temperatures that result from greenhouse gas buildup in the atmosphere.

Warming trends like those found in these studies could greatly affect ocean processes, which, in turn, impact Arctic and global climate, said Michael Steele, senior oceanographer at the University of Washington, Seattle. Liquid water absorbs the Sun's energy rather than reflecting it into the atmosphere the way ice does. As the oceans warm and ice thins, more solar energy is absorbed by the water, creating positive feedbacks that lead to further melting. Such dynamics can change the temperature of ocean layers, impact ocean circulation and salinity, change marine habitats, and widen shipping lanes, Steele said.

In related NASA-funded research that observes perennial sea-ice trends, Mark C. Serreze, a scientist at the University of Colorado, Boulder, found that in

2002 the extent of Arctic summer sea ice reached the lowest level in the satellite record, suggesting this is part of a trend. "It appears that the summer 2003 — if it does not set a new record — will be very close to the levels of last year," Serreze said. "In other words, we have not seen a recovery; we really see we are reinforcing that general downward trend." A paper on this topic is forthcoming.

According to Comiso's study, when compared to longer term ground-based surface temperature data, the rate of warming in the Arctic over the last 20 years is eight times the rate of warming over the last 100 years.

Comiso's study also finds temperature trends vary by region and season. While warming is prevalent over most of the Arctic, some areas, such as Greenland, appear to be cooling. Springtimes arrived earlier and were warmer, and warmer autumns lasted longer, the study found. Most importantly, temperatures increased on average by 1.22 degrees Celsius per decade over sea ice during Arctic summer. The summer warming and lengthened melt season appears to be affecting the volume and extent of permanent sea ice. Annual trends, which were not quite as strong, ranged from a warming of 1.06 degrees Celsius over North America

to a cooling of .09 degrees Celsius in Greenland.

If the high latitudes warm, and sea ice extent declines, thawing Arctic soils may release significant amounts of carbon dioxide and methane now trapped in permafrost, and slightly warmer ocean water could release frozen natural gases in the sea floor, all of which act as greenhouse gases in the atmosphere, said David Rind, a senior researcher at NASA's Goddard

Institute of Space Studies, New York. "These feedbacks are complex and we are working to understand them," he added.

The surface temperature records covering from 1981 to 2001 were obtained through thermal infrared data from National Oceanic and Atmospheric Administration satellites. The studies were funded by NASA's Earth Science Enterprise, which is dedicated to understanding the Earth as an integrated

system and applying Earth System Science to improve prediction of climate, weather and natural hazards using the unique vantage point of space.

For more information and images on the Internet, visit:

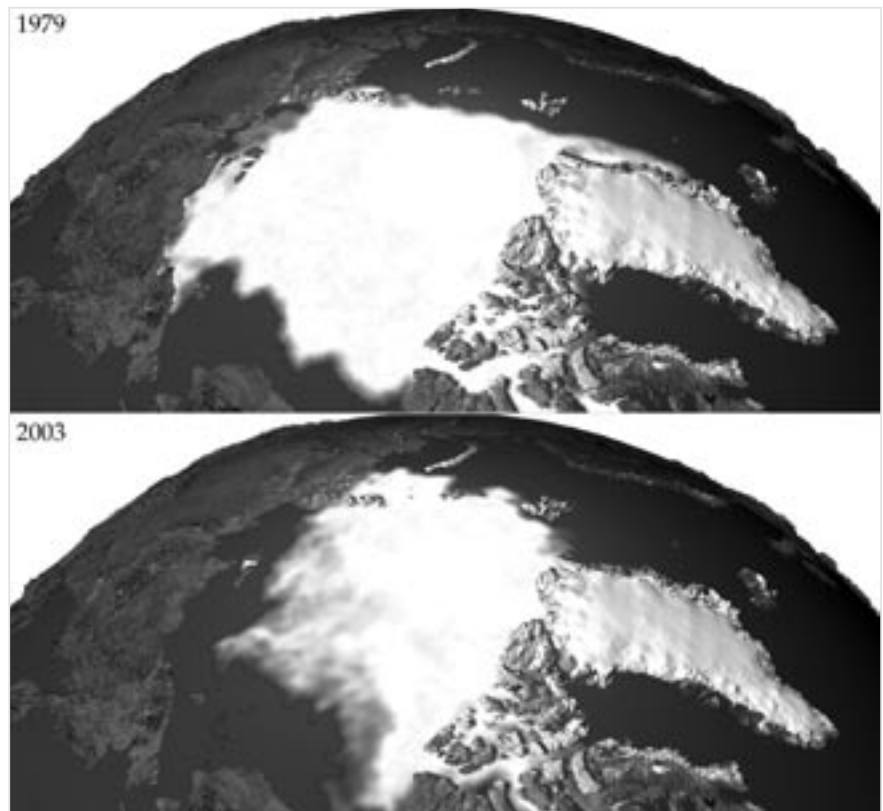
[www.gsfc.nasa.gov/topstory/2003/1023esuice.html](http://www.gsfc.nasa.gov/topstory/2003/1023esuice.html) and [earth.nasa.gov](http://earth.nasa.gov)



According to a new NASA study, Arctic perennial sea ice has been decreasing at a rate of 9% per decade since the 1970s. The changes in Arctic ice may be a harbinger of global climate change, says Josefino Comiso, researcher at NASA Goddard Space Flight Center, in Greenbelt, Maryland. In a recent *Journal of Climate* paper, Comiso notes that most of the recent global warming occurred over the last decade, with the largest temperature increase occurring over North America. Researchers suspect the loss of Arctic sea ice may be caused by changing atmospheric pressure patterns over the Arctic that move sea ice around, and by warming Arctic temperatures that result from the buildup of greenhouse gases in the atmosphere.

The image here shows a comparison of composites over the Arctic Circle, acquired in 1979 (top) and 2003 (bottom) by the Defense Meteorological Satellite Program (DMSP) Special Sensor Microwave Imager (SSM/I). The first image shows the minimum sea ice concentration for the year 1979, and the second image shows the minimum sea ice concentration in 2003.

Image courtesy Scientific Visualizations Studio, NASA GSFC.





## Earth Science Education Update

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### The NASA SCI Files™ Wins Emmy Number 4

The NASA Science Files™ (SCI Files) won its 4<sup>th</sup> Emmy Award, Saturday, September 13, 2003, in Philadelphia, competing in the 2003 Mid-Atlantic Regional Emmy Competition sponsored by the National Academy of Television Arts and Sciences (NATAS), in the category of “best production design.” The Mid-Atlantic region includes New York, New Jersey, Delaware, Pennsylvania, West Virginia, Virginia, and Maryland.

Other nominees included QVC, the New Jersey Network, and entries from two national broadcast networks — Eagle Network and Comcast. The NASA SCI Files™ also won regional Emmys, upping NASA Langley’s Emmy total to lucky number 13 for distance learning programs. For more information, visit [scifiles.larc.nasa.gov](http://scifiles.larc.nasa.gov).

### NASA Portal Articles Highlight Earth System Science Courses for Teachers

The NASA portal has three new articles highlighting the Earth System Science Education Alliance (ESSEA), a national professional development program sponsored by the NASA Earth Science Enterprise (ESE). ESSEA supports colleges, universities, and science organizations offering online, Earth system science courses for K-12 teachers. Visit the NASA portal at [www.nasa.gov](http://www.nasa.gov).

For more information on ESSEA, see [www.cet.edu/essea](http://www.cet.edu/essea).

### Redesigned Web Site Offers New Services to Minority University Community

In September 2003, the NASA Minority University-SPace Interdisciplinary Network (MU-SPIN) Project launched an enhanced version of its web site at [muspin.gsfc.nasa.gov](http://muspin.gsfc.nasa.gov). The site features the following new on-line services to its community:

- MU-SPIN Forum ([muspin.gsfc.nasa.gov/forum](http://muspin.gsfc.nasa.gov/forum)) offering on-line discussion groups on various topics including education & research, MU-SPIN events, NASA Enterprise & other themes, and general MU-SPIN-related topics.
- MU-SPIN Listserve ([muspin.gsfc.nasa.gov/listserv](http://muspin.gsfc.nasa.gov/listserv)), comprises 3 mailing lists: “Announce” (general announcements), “Education” (for students and educators) and “Research” (research opportunities).
- MU-SPIN Search ([muspin.gsfc.nasa.gov/search](http://muspin.gsfc.nasa.gov/search)) a new and improved search engine software with boolean search support and sorting options.
- MU-SPIN RESUME Databank ([muspin.gsfc.nasa.gov/resumedb](http://muspin.gsfc.nasa.gov/resumedb)) a resumé repository for minority students and educators working

at minority institutions who are seeking research opportunities at NASA, to be used by NASA mentors who can offer minority students and educators research opportunities at NASA centers nationwide or at partner institutions.

For more information, email [askmuspin@muspin.gsfc.nasa.gov](mailto:askmuspin@muspin.gsfc.nasa.gov), or visit [muspin.gsfc.nasa.gov/contact/index.php](http://muspin.gsfc.nasa.gov/contact/index.php).

### NASA Explorer Schools Recruitment Program Takes Flight

*Application deadline: January 30, 2004*

NASA has launched the application season for its NASA Explorer Schools (NES) Program. Schools from across the country are eligible to apply online for an opportunity to partner with NASA in a program designed to bring mathematics, science, and technology learning to educators, students, and families.

The NES Program establishes a three-year partnership between NASA and 50 NASA Explorer Schools teams consisting of teachers and education administrators from diverse communities nationwide. NASA will invite teams “back to school” at NASA Centers each summer in an effort to spark innovative science and mathematics instruction aimed at students in Grades 4 through 9.

NES schools receive grants of up to \$10,000 for technology tools that sup-

port science and mathematics curricula in the classroom. The deadline for submission of applications for the NES Program is January 30, 2004. For access to NES applications and information, and to view the list of 50 Explorer Schools, visit [explorerschools.nasa.gov](http://explorerschools.nasa.gov).

#### **New NASA Student Involvement Program (NSIP) Resources Available**

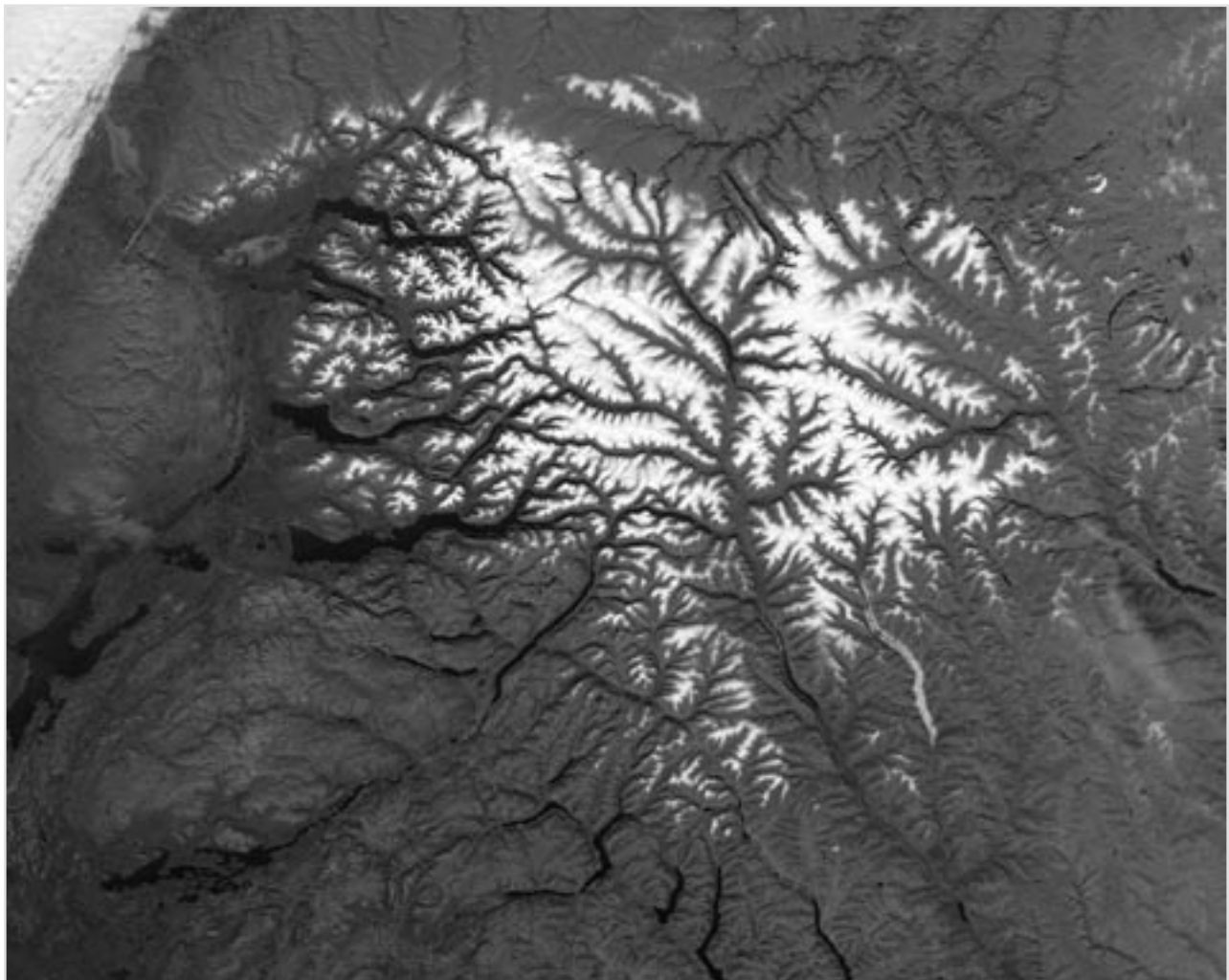
NSIP resource guides, posters, and entry packets for the 2003-2004 competitions are now available at [education.nasa.gov/nsip](http://education.nasa.gov/nsip). K-12 students can get a head start creating research

projects about Earth or planetary missions, flight-focused videotapes or print articles, or experiments for NASA launch. Competitions support National Standards for science, math, geography, and technology and are easily adapted to local curricula. All participants receive NSIP certificates. Awards include plaques, medals, NASA ceremonies at schools, Space Camp scholarships, and trips for high school students and their teachers to the National Symposium and/or Student Flight Weeks. Entries are due in January 2004.



A fresh blanket of snow traces out the highlands on Russia's Putorana Plateau, signaling the onset of autumn. This image of the plateau, situated in Northwestern Siberia about 600 km (373 miles) south and slightly east of the Kara Sea, was acquired on September 25, 2003, by the Moderate Resolution Imaging Spectroradiometer (MODIS) aboard NASA's Aqua satellite. The bright white highlighting provides a striking contrast to the deep hues of the ancient volcanic plateau. A number of lakes—including the eastern tip of the Khantayskoye (left edge), the Ozera (left center), and the Keta and Lama (moving northward from the Ozera)—appear dark gray in this scene.

Image courtesy Jeff Schmaltz, MODIS Land Rapid Response Team at NASA GSFC.



## Antarctic Penguins Thrive in Ocean "Oases"

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NASA satellite data was used for the first time to analyze the biology of hot spots along the coast of Antarctica. The biological oases are open waters, called polynyas, where blooming plankton support the local food chain.

The research found a strong association between the well being of Adelie Penguin populations in the Antarctic and the productivity of plankton in the polynyas. Polynyas are areas of open water or reduced ice cover, where one might expect sea ice. They are usually created by strong winds that blow ice away from the coast leaving open areas, or by gaps appearing on the ocean's surface, when flowing ice gets blocked by an impediment, like an ice shelf.

The Antarctic waters are rich in nutrients. The lack of ice, combined with shallow coastal waters, provides the top layers of the ocean with added sunlight, so polynyas offer ideal conditions for phytoplankton blooms. Because the ice around polynyas is thin in the early spring when the long Austral day begins, they are the first areas to get strong sunlight. The open waters retain more heat, further thinning ice cover and leading to early, intense, and short-lived plankton blooms. These blooms feed krill, a tiny, shrimp-like animal, which in turn are eaten by Adelie Penguins, seabirds, seals, whales, and other animals.

Although relatively small in area, coastal polynyas play a disproportionately important role in many physical and

biological processes in Polar Regions. In eastern Antarctica, more than 90 percent of all Adelie Penguin colonies live next to coastal polynyas. Polynya productivity explains, to a great extent, the increase and decrease in penguin population.

"It's the first time anyone has ever looked comprehensively at the biology of the polynyas," said Kevin Arrigo, assistant professor of Geophysics at Stanford University, Stanford, Calif. "No one had any idea how tightly coupled the penguin populations would be to the productivity of these polynyas. Any changes in production within these polynyas are likely to lead to dramatic changes in the populations of penguins and other large organisms," Arrigo said.

The study, which appeared in a recent issue of the *Journal of Geophysical Research*, used satellite-based estimates to look at interannual changes in polynya locations and sizes; abundance of



The well being of Adelie Penguin populations in the Antarctic depends on the productivity of plankton in polynyas, areas of open water or reduced ice cover. For the first time, NASA satellite data has been used to analyze the activity of the plankton in these areas. Image credit: NOAA Corps Collection.

microscopic free-floating marine plants called phytoplankton, which are the base of the polar ocean food chain; and the rate at which phytoplankton populations thrive. Covering five annual cycles from 1997 to 2002, 37 coastal polynya systems were studied.

The largest polynya studied was located in the Ross Sea (396,500 square kilometers or 153,100 square miles; almost the size of California). The smallest was located in the West Lazarev Sea (1,040 square kilometers or 401.5 square miles). Most polynyas, at their maximum area in February, were less than 20,000 square kilometers (7,722 square miles).

Data from NASA's Sea-viewing Wide Field-of-view Sensor (SeaWiFS) and NOAA's Advanced Very High Resolution Radiometer (AVHRR) provided weekly measurements of chlorophyll and temperature that were used in a computer model to estimate phytoplankton productivity. The research-

ers found, taken together, the Ross Sea, Ronne Ice Shelf, Prydz Bay, and Amundsen Sea polynyas were responsible for more than 75 percent of total plankton production.

The researchers were surprised to find how closely connected the Adelie Penguins were to the productivity of their local polynyas. The more productive polynyas supported larger penguin populations. The more abundant krill fed more penguins, and the birds had shorter distances to go to forage, which reduced exposure to predators and other dangers.

The NASA Oceanography Program, the National Science Foundation, and the U.S. Department of Energy funded this research. NASA's Earth Science Enterprise is dedicated to understanding the Earth as an integrated system and applying Earth System Science to improve prediction of climate, weather, and natural hazards using the unique vantage point of space.

For information about the research and images on the Internet, visit [www.gsfc.nasa.gov/topstory/2003/0930penguins.html](http://www.gsfc.nasa.gov/topstory/2003/0930penguins.html)

For information about Adelie Penguins, on the Internet, visit [www.aad.gov.au/default.asp?casid=1654](http://www.aad.gov.au/default.asp?casid=1654)



Rookeries, like the one below, are used by penguins to raise and protect their young. Image credit: NOAA, NESDIS, ORA.





**NASA's Earth Science Update Explores Global Effects of Arctic Sea Ice**, Oct. 23, *Associated Press, Australian Broadcasting Corp., CNN*; The worldwide impact of a simultaneous reduction in Arctic sea-ice and considerable warming of the Arctic over the past 20 years was discussed by **Josefino Comiso** (NASA GSFC); **Waleed Abdalati** (NASA HQ); **Mark Serreze** (NSIDC); **Michael Steele** (Univ. of Washington); and **David Rind** (NASA GISS).

**South American Glaciers Melting Faster, Changing Sea Level**, Oct. 16, *CNN*; According to **Eric Rignot's** (NASA JPL) research on the Patagonia Icefields of Chile and Argentina, the largest non-Antarctic ice masses in the Southern Hemisphere, they are thinning at an accelerating pace and now account for nearly 10 percent of global sea-level change from mountain glaciers.

**Remote Sensing in Vineyards**, Oct. 16, *San Francisco Chronicle*; **Lee Johnson** (NASA ARC) was interviewed about his work with remote sensing of vineyards, specifically about soil moisture and a new ground-penetrating radar being employed by the University of California, Berkeley in a Napa area vineyard.

**Antarctic Penguins Thrive in Ocean "Oases,"** Oct. 7, *LA Times, Reuters, Sydney Morning Herald, Washington Post: Weather Channel*; **Kevin Arrigo** and **Gert van Dijken** (both of Stanford Univ.) used NASA satellite data for the first time to analyze the biology of hot spots along the coast of Antarctica.

**ICESat's Lasers Measure Ice, Clouds and Land Elevations**; Oct. 6, *Aboutweather.Com, Der Wissenschaft (Germany) Global Warming Today, Spaceflightnow*; **Waleed Abdalati** (NASA HQ); **Jay Zwally**, (NASA GSFC) and **Bob Schutz** (Univ. of Texas at Austin) were quoted in this story on the ICESat satellite's measurements of Earth's polar ice sheets, clouds, mountains, and forests.

**Scientists Use Satellite to "Pond-er" Melted Arctic Ice**, Oct. 2, *Washington Times, UPI*; **Donald Cavalieri** (NASA GSFC) and other scientists used a satellite combined with aircraft video to create a new technique for detecting ponds of water on top of Arctic sea ice.

**Huge Antarctic Iceberg Makes a Big Splash on Sea Life**; Oct. 1, *BBC News, Canadian Broadcasting Corp., Washington Post*; **Kevin Arrigo** and **Gert van Dijken** (both of Stanford Univ.) used NASA satellites to observe the effects of C-19, one of the largest icebergs ever

recorded, as it splashed into the Ross Sea, and virtually eliminated a valuable food source for marine life.

**NASA catalyst being used to help reduce pollutants**, Oct., *Associated Press, Newport News Daily Press, Virginian-Pilot, Aerotechnews.com, SpaceDaily.com*; **Jeff Jordon** (NASA LaRC) discusses how Low-Temperature Oxidation Catalysts (LTOC) technology is expected to reduce formaldehyde and carbon monoxide concentrations in smokestack emissions by approximately 85 to 95%.

**2003 Ozone 'Hole' Approaches, But Falls Short Of Record**; Sept. 25, 160 television stations throughout the U.S.; *Reuters, Bloomberg News, UPI, USA Today*; This year's Antarctic ozone hole is the second largest ever observed, according to **Paul Newman** and **Rich McPeters** (both NASA GSFC) and other scientists from the National Oceanic and Atmospheric Administration (NOAA), and the Naval Research Laboratory.

**Scientists Discuss Climate-Human Interactions**, Sept. 23, *Voice of America Radio*; **Garik Gutman** (NASA HQ), **Anatoly Gitelson** (U.Nebraska), and **Pavel Groisman** (NOAA NCDC) were on a panel, broadcast to Eastern Europe and the former Soviet Union, discussing NASA's tools for observing climate change, climate impact on humans, and environmental effects produced by humans, and answering questions on the open lines from the listeners.

**Ocean Plant Life Slows Down and Absorbs Less Carbon**; Sept. 16, *Environment News Service, New Scientist, San Francisco Chronicle, UPI*, and more; **Watson Gregg's** (NASA GSFC) research concluded that plant life in the world's oceans has become less pro-

ductive since the early 1980s, absorbing less carbon, which may in turn impact Earth's carbon cycle, according to a study that combines NASA satellite data with NOAA surface observations of marine plants.

**Earthquake Research**, Sept. 16, *Der Spiegel*; Josef Csallos requested photos of lightning preceding earthquakes. The requestor mentioned **Friedemann Freund** (NASA ARC) and his earthquake research.

**Salt Ponds**, Sept. 15; *Estuary Newsletter*; Martha Larson interviewed with the NASA ARC team that is assisting in the monitoring of salt ponds which are being reclaimed near NASA Ames Research Center, along San Francisco Bay.

**NASA Satellites Extract Ingredients in Hurricane Recipe to Improve Forecasts**, Sept. 10, multiple television stations across the U.S.; The Atlantic Ocean becomes a meteorological mixing bowl from June 1 to November 30, with all needed ingredients for a hurricane recipe. NASA GSFC's **Marshall Shepherd** and **Jeff Halverson** provided live television interviews about the information offered by NASA's cadre of satellites.

**NASA Langley, HU Scientists Lend Hand to Promising Study of Ozone Layer**, Sept. 8; *Newport News Daily Press*; A team of scientists, including **Mike Newchurch** (University of Alabama), **James Russell** (Hampton University) and **Joe Zawodny** (NASA LaRC), announced that ozone depletion was decreasing in the upper stratosphere.

**Ames Students Study Mosquitoes**; Sept. 5, *Mountain View Voice* (CA) newspaper; *Spacenews*; *KPIX-TV CH 5 CBS*

*San Francisco*; *KOIN-TV, CH 46, Salinas*; Students at NASA ARC created a map of Monterey County, California, that shows West Nile virus risk areas. **Jay Skiles** (NASA ARC) was interviewed by KPIX-TV.

**NASA Helping to Understand Water Flow in the West**, Sept. 4, *ABC World News, Environment News Service*; **Kristi Arsenault** (NASA GSFC) and **Dave Matthews** (U.S. Bureau of Reclamation) were quoted in this story about NASA and partnering agencies that are going to provide the United States Bureau of Reclamation water resource managers with high resolution satellite data, allowing them to analyze up-to-date water-related information over large areas all at once.

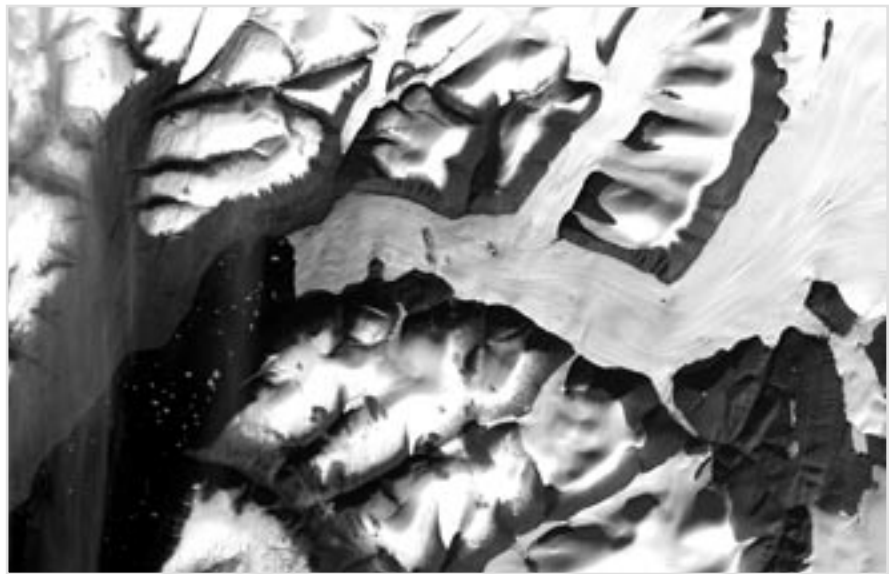
**Ocean May Sponge Up Some Warmth Over Next 50 Years**, Sept. 3, *Australian Broadcasting Corp., Sciencedaily, Weather Channel*; **Jim Hansen** and **Shan Sun** (both NASA GISS) explained their improved global climate computer

model, which simulates and projects how Earth's climate may change. The model indicates that the oceans have been absorbing heat since 1951 and will continue to absorb more heat from the atmosphere over the next 50 years.

**Fierce Thunderstorms Kill Three**, Aug. 27, *LA Daily News*; **Bill Patzert** (NASA JPL) was interviewed for this front page article.

**A Better Understanding of Earth by Observing From Space**, Aug. 21, **Bill Patzert** (NASA JPL) gave this lecture for the 2003 NSF-sponsored Chautauqua Short Course for College Teachers, held at JPL.

**Hot and Humid California**, Aug. 20, *KNX (AM1070) Radio*; Host Dick Helton interviewed **Bill Patzert** (NASA/JPL) about the hot and humid weather in Southern California for the past two months and the outlook for the remaining summer and fall.



The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) instrument aboard NASA's Terra satellite captured the image above of the northeastern corner of Ellesmere Island. The island forms the most northerly extent of Canada. This region has been set aside as the Ellesmere Island National Park Reserve, as such, it is the most northerly park on Earth. Image courtesy ASTER Science Team.

**EOS Science Calendar**

**November 10 - 14**

30th International Symposium on Remote Sensing of Environment, Honolulu, HI. Email: [isrse@email.arizona.edu](mailto:isrse@email.arizona.edu), URL: [www.symposia.org](http://www.symposia.org).

**November 19-20**

CALIPSO Science Team Meeting, sponsored by NASA Langley Research Center, Woodlands Hotel & Suites, Williamsburg, VA. Contact: K. R. Armistead, [kiesha.r.armistead@nasa.gov](mailto:kiesha.r.armistead@nasa.gov).

**December 4-6**

SORCE Science Meeting, Sonoma, CA. URL: [lasp.colorado.edu/sorce/Dec03ScienceMeeting.html](http://lasp.colorado.edu/sorce/Dec03ScienceMeeting.html). Contact: Vanessa George, [vanessa.george@lasp.colorado.edu](mailto:vanessa.george@lasp.colorado.edu).

**Global Change Calendar**

**2003**

**December 9-12**

American Geophysical Union (AGU) San Francisco. E-mail: [meetinginfo@agu.org](mailto:meetinginfo@agu.org) URL: [www.agu.org/meetings/fm03/](http://www.agu.org/meetings/fm03/)

**2004**

**January 11-15**

American Meteorological Society Annual Meeting, Seattle, WA. URL: [www.ametsoc.org](http://www.ametsoc.org).

**February 24-27, 2004**

8th Specialist Meeting on Microwave Radiometry and Remote Sensing Applications, Rome, Italy. URL: [www.microrad04.org](http://www.microrad04.org)

**March 22-23**

Seventeenth Annual Towson University GIS Conference, Towson University, Baltimore, MD. Contact: Jay Morgan, Email: [jmorgan@towson.edu](mailto:jmorgan@towson.edu), URL: [cgis.towson.edu/tugis2004](http://cgis.towson.edu/tugis2004)

**May 23-28**

ASPRS Annual Conference, Denver, CO. URL: [www.asprs.org/denver2004](http://www.asprs.org/denver2004)

**July 12-23**

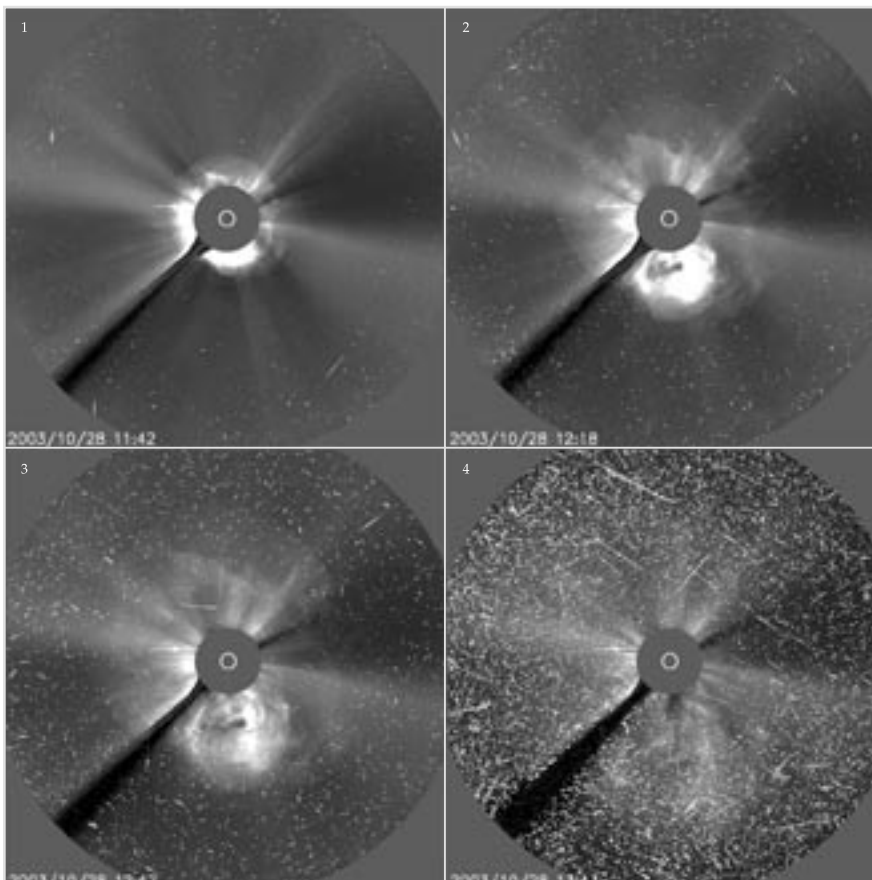
International Society for Photogrammetry and Remote Sensing (ISPRS), Istanbul, Turkey. URL: [www.isprs2004-istanbul.com](http://www.isprs2004-istanbul.com)

**July 18-25**

35th COSPAR Scientific Assembly, Paris, France. Abstracts due February 15, 2004. URL: [www.copernicus.org/COSPAR/COSPAR.html](http://www.copernicus.org/COSPAR/COSPAR.html)

**September 20-24**

International Geoscience and Remote Sensing Symposium (IGARSS), Anchorage, Alaska. URL: [www.ewh.ieee.org/soc/grss/igarss.html](http://www.ewh.ieee.org/soc/grss/igarss.html)



A time-series capture of the solar flare eruption that occurred at 9:51 UTC on October 28, 2003. This series was captured by NASA's Solar and Heliospheric Observatory (SOHO) satellite.

People in the Southern Hemisphere saw aurorae at much lower latitudes than usual on October 29, when the coronal mass ejection reached Earth. In May 1998 the commercial Galaxy IV satellite was damaged by a solar storm, knocking out its ability to support telecommunications.

Images courtesy SOHO

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