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EARTH SYSTEM MONITOR

Searching for NOAA Data

Empowering users and streamlining information access

A guide to NOAA's data and information services

INSIDE

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The National Oceanic and Atmospheric Administration's (NOAA's) National Data Centers have pioneered many new innovative methods that enrich data and information delivery on the Web. We are currently implementing new spatial searching techniques that empower users with the ability to access data and metadata through GIS-enabled Web servers. However, an important element of information delivery is the awareness of your users' requirements: who are your users; how do they find you; what are they seeking; and, how can you serve them more effectively? In response to these questions, we have explored data mining tools to provide improved understandings of these needs.

Knowledge of your users

The Web depersonalized our knowledge of our users. Where once we had frequent telephone conversations with customers, now they surf our Web pages. It is difficult to determine whether users are finding the information they desire and are leaving our Web site satisfied. Can one effectively operate an information service without maintaining an awareness of customer needs? — probably not well. How do we design Web pages that are effectively viewed; how do we streamline information access; how do we understand our users' basic needs? System access logs can play an important role in designing your service. Most Web servers create formatted access logs. The logs provide information on who is visiting your Web site that is helpful in better designing your site and determining what new HTML capabilities to incorporate into Web pages.

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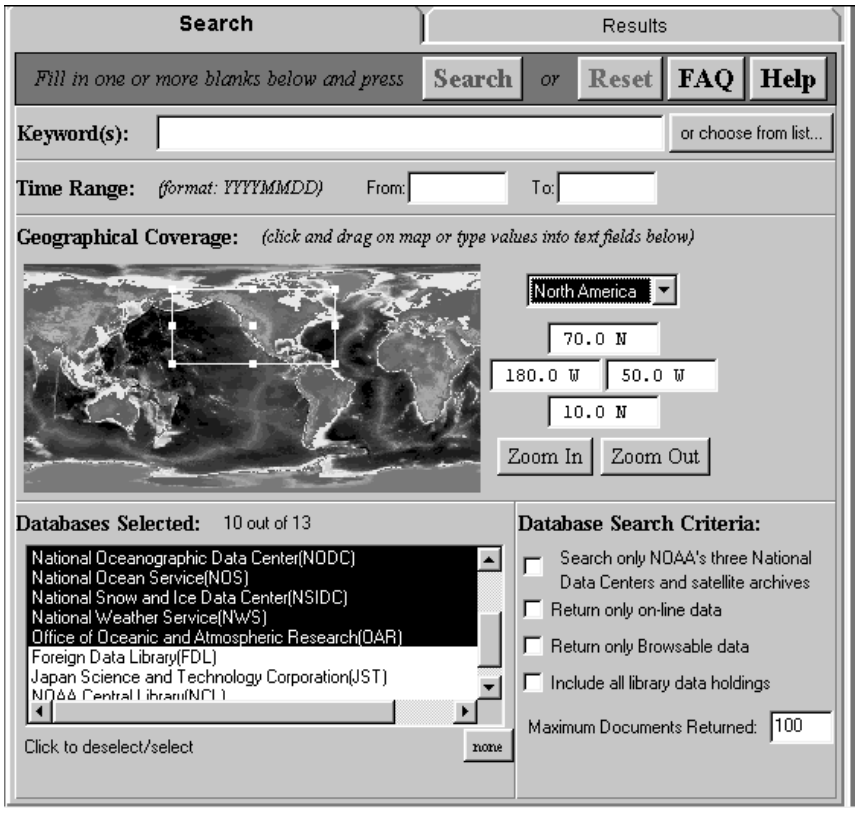
How are users searching for NOAA Data?

Anyone looking for information on the Web is aware of the tremendous growth in sources of information. According to a recent survey (*http://www.netcraft.com/survey*), servers on the Web have exploded from 1.7 million in 1997 to over 13 million by January 2000. How does that affect those of us in data delivery?

One portal to NOAA data is through the NOAAServer. NOAAServer searches collections of metadata (information about data) and provides access to the metadata as well as browse imagery and data on- or off-line. To improve access, the server operates redundantly at four regional sites in the United States (referred to in Table 1, as

— continued on page 2



▲ **Figure 1**. The NOAAServer enables the user to search for data in a variety of ways.

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NOAA Data, *from page 1*

western, central, northeastern and southeastern).

Its popular user interface helps users define inquiries with respect to topics, geographic space, and time. Users can select data from any or all of NOAA's 10 data sources, using special criteria that enables the user to customize search results to: only on-line data, only browsable data, or include all library data holdings.

In Table 1, popular search strategies from logs associated with the NOAAServer were reviewed. This summary covers more than 250,000 user accesses during a three-and-a-half year period (June 1996 to January 2000).

Of the top 10 discipline-oriented search words hitting NOAAServer, three are standouts (consistently requested an order of magnitude more frequently than any others). These are precipita-

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Table 1. Popular search strategies by geographic region

Western Server 51,325

DISCIPLINE: (90%)
Precipitation, Temperature, Rainfall
Tide, Bathymetry, El Nino, Wind, Satellite, COADS Climate, Sea Surface Temperature

GEOGRAPHIC: (51%)
Key Words:
California, Alaska, Washington, Hawaii, Oregon, Seattle

Spatial (Words; lat/lon):
North America, North Pacific, Tropical Pacific, Vancouver, Santa Barbara, Los Angeles, Point Delagada (CA), Newport, Seattle

TEMPORAL: (36%)
1997, 1998, 1996; 1990-1998 1900-1997, 1950-1998.

Central Server 40,856

DISCIPLINE: (89%)
Precipitation, Temperature, Rainfall
Tornado, Climate, AVHRR, Wind, Evaporation, Snow Fall, Humidity, Satellite

GEOGRAPHIC: (49%)
Key Words:.
Texas, Colorado, Chicago,

Spatial (Words; lat/lon):
North America, Europe, Entire Globe, South America , San Antonio, Austin, Dallas, South Pole, Houston

TEMPORAL: (38%)
1998, 1997, 1996; 1990-1998, 1995

Northeastern Server 64,489

DISCIPLINE: (91%)
Temperature, Precipitation, Rainfall
Air Pressure, Climate, AVHRR, Wind, Snowfall, Bathymetry, Hurricane, Tide, Satellite

GEOGRAPHIC: (47%)
Key Words:
Pennsylvania, Maryland, Massachusetts, Chesapeake Bay, Boston

Spatial (Words; lat/lon):
North America, North Atlantic, Europe, Entire Globe, Boston, Washington DC, Harrisburg, Albany

TEMPORAL: (37%)
1998, 1997, 1996; 1990-1997, 1992-1996, 1990-1998, 1995

Southeastern Server 98,957

DISCIPLINE: (90%)
Rainfall,Precipitation, Temperature
Hurricanes, Tornado, Bathymetry, Wind, Tides, Buoy, Lightening, Barometric Pressure

GEOGRAPHIC: (55%)
Key Words:
Florida, Puerto Rico, North Carolina, Gulf of Mexico, Ohio, Atlanta

Spatial (Words; lat/lon):
North America, South Atlantic, Europe, St. Augustine, Daytona Beach, Miami, Asheville, Gaya (India), Columbus

TEMPORAL: (42%)
1998, 1997, 1996; 1990-1998, 1995-1998, 1996-1998

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NESDIS/NWS collaborate on digital reporting capability

Representatives from the National Weather Service's Office of Meteorology, including field personnel, visited the National Climatic Data Center in April. The focus of this meeting was a collaborative joint project to transform the use of handwritten station history paper forms to a web-based electronic system; robust upfront rule-based quality control software are to be built into the process.

Reports documenting changes to a station will be generated using web-based software and transmitted with electronic signatures from the originating Weather Forecast Office (WFO), in the field, to the NWS Regional Office, and then directly to the NCDC and the NWS databases.

Accurate and timely information changes are critical to many users of the data to include climate change research, the insurance industry, the weather derivatives industry, as well as the data quality control monthly processes performed at NCDC. The first version of the new digital reporting capability is scheduled for release in January 2001.

Normals development discussions

Plans are being discussed, at the the National Climatic Data Center, for the development of 1971-2000 Normals and the Climate Means and Summaries web page with EPRI (formerly the Electric Power Research Institute), a research institute funded by the utility industry which is active in the areas of alternative power sources, conventional and nuclear power generation improvements, climate change and related health issues.

Discussions included what new products might be beneficial to EPRI such as population-weighted degree days at the countly level, for Metropolitan Statistical Areas and even a 2-km gridded data set instead of the current practice of using divisional data. Computation of degree days to a base of 68 degrees Fahrenheit was suggested because it corresponds to 20 degrees Centigrade, a temperature scale and level used in some EPRI epidemiological research. While EPRI agreed in principle that computations based on a finer areal coverage than climate divisions would be beneficial, specific requirements for new products have not been developed.

News briefs

EPRI will be in contact with NCDC in the future if questions, concerns, or requirements for new normals procedures or products arise. There was no concern expressed about the use of the H.C.S. Thom rational conversion model to compute degree days data.

NGDC discusses geophysical hazards with Japanese scientists

The National Geophysical Data Center was visited by two prominent Japanese scientists on March 24. Dr. Haruo Hayashi, from the Research Center for Disaster Reduction Systems (Kyoto, Japan), and Dr. Norio Make, from the Earthquake Disaster Center (Hyogo, Japan), are working on disaster mitigation in their country. Among topics discussed, with NGDC's Solid Earth Geophysics Division staff, were potential volcanism on Hokkaido Island and the possibility of a tsunamigenic earthquake or volcanic eruption in the southerly Volcano Islands region of Japan.

On March 27, Mt. Usu on Hokkaido Island became active with over 1000 earthquakes occurring the next day. The local evacuation of more than 11,000 residents was followed by a strong eruption on March 31. This was the tenth strong volcanic (VEI>=2) eruption during March 2000, making March the most volcanically active month in the historical volcanic catalog maintained by NGDC. The previous record was held by January 1973 and February 1974 with eight eruptions each. Another event on March 27 was an Mw 7.7 earthquake occurring in the Volcano Islands region.

Also, NGDC recently hosted two Japanese earthquake mitigation experts, Professor Hayashi and Dr. Maki of the Earthquake Disaster Mitigation Research Center in Miki, Japan. They have been using Defense Meteorological Satellite Program (DMSP) nighttime imagery to determine the socio-economic effects of earthquakes in near real-time. The nighttime lights show where fires may be burning, electricity may be out, and where the local populace has decided to leave their residences and offices. They feel that they can also use the DMSP imagery to track the recovery process in Venezuela following the heavy rains and mudslides there.

New paleoclimatologist at NGDC

Dr. Connie Woodhouse's position with the National Geophysical Data Center's Paleoclimatology Program has changed from visiting scientist to physical scientist (paleoclimatologist). Dr. Woodhouse is an expert in extracting climate information from tree rings, and was recently elected the chairperson of the International Tree-Ring Data Base.

NGDC's Paleoclimatology Program regularly provides input on climate variability, including drought, global warming, and El Niño, as seen in the past over long time scales in the paleoclimate record from tree rings, ice cores, and other sources. The program has provided input for television, public radio, newspapers, and magazines, and also provides information for journalists via the web at: *http://www.ngdc.noaa.gov/paleo*.

Ice charting working group

National Geophysical Data Center's affiliated National Snow and Ice Data Center recently created web pages for the International Ice Charting Working Group (IICWG), at *http://www.nsidc.colorado.edu /NOAA/IICWG/index.html.*

The group was formed in October 1999 to promote cooperation between the world's ice centers on all matters concerning sea ice and icebergs. Agencies from ten nations participated in the first meeting, which was organized by the U.S. Navy/NOAA/Coast Guard National Ice Center and the Danish Meteorological Institute.

EIS chief visits NGDC

Ms. Ida Hakkarinen, Chief of the NESDIS Environmental Information Services Office, visited the National Geophysical Data Center on May 15. She was given a tour of the Center, with a focus on the Earth System Data and Information Management (ESDIM)-supported Great Lakes and Coastal Data Access and the Hydrographic Data Quality Improvement projects. The Center's Great Lakes posters for Michigan, Erie, and Ontario were shown as a very tangible product of ESDIM funding and research. Discussions centered on the importance of both ESDIM research to maintain and improve the quality of the data the Center serves to the public and ESDIM support to the health of the Center.

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tion, temperature and rainfall. The remaining top 10 search words are: wind, tide, bathymetry, climate, satellite, hurricane and tornado. Regional access points (Table 1) tend to have their own favorites. For example, the Central region server, hosted in landlocked Colorado, has fewer searches for bathymetry and tides. The Western region server, located on the Pacific coast, has less interest in hurricanes and tornadoes. Table 1 illustrates a primary preference by users for topical interests or disciplines searches (~90%), followed by a strong geographic preference (~51%), and finally, a frequent interest in period or temporal searches (~38%). Knowing how users search for data and which words are most frequently used help us improve our textual descriptions of data sets.

Information on user search habits, such as shown in Table 1, can help effectiveness in our user services. An example might be found with respect to the frequent spatial search associated with "my neighborhood." According to statistics from NOAAServer, many users search for data in their state or city. This is probably not an effective search strategy, since few scientific databases are coded by state and city names. Clients will only find data in "their state" if the metadata is coded with the state name. However, since users frequently ask this question, we can upgrade our services to identify data by multiple means, including discipline, geographic location, and geographic name.

We can also improve our Web site by making choices easier for viewers. For example, knowing that users often request similar summaries (such as, my state, an annual period, or popular weather discipline words), information providers can design Web pages that clearly provide this information. Industry has made effective use of keywords when registering domain names. This is something government sites are just beginning to do. An example of this is NOAA's URL for weather data *(http://weather.gov/)* where you can get the latest weather information.

Modeling user behaviors

Information providers observe users on a daily basis and find that they usually go through a 3-phase process: data discovery, browse and retrieval. Indeed, the NOAAServer described above follows this model. The data discovery phase empowers users with discipline, spatial and temporal search tools; they are rewarded with a (sometime lengthy) list of data set summaries. The system's second phase lets users browse this list in a "Boolean" fashion to determine which data sets to explore further. Persistent browsers are frequently furnished with more detailed summaries that often contain summary images (and occasionally these images are sufficient to satisfy the inquirer's needs).

In Figures 2 and 3, two satellite-based browse images are illustrated: nighttime lights of Europe (from the Defense Meteorological Satellite) and a Web-Image Spreadsheet Tool (WIST) illustrating four different images from NOAA's Geostationary Observing Environmental Satellite.

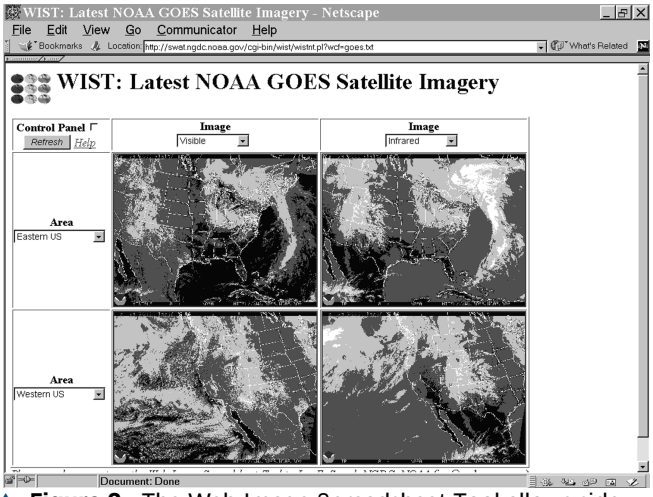
The third phase is actual retrieval of detail data (either by ordering online a product which is mailed or downloading data directly from the Web). As an example, if someone searched for terms "ocean and crust and age," they would:
1) discover a "Crustal Ages of the Ocean Floor Poster,"
2) be presented with a summary image of the poster with an opportunity to link to the online store, and
3) be able to order the standard or custom product using their credit card.

However, few users follow the NOAAServer path. The more popular paths remain (at about an equal proportion): commercial search engines (i.e., "Infoseek"), referral links from companion sites, and direct links (from some news release or bookmark page).

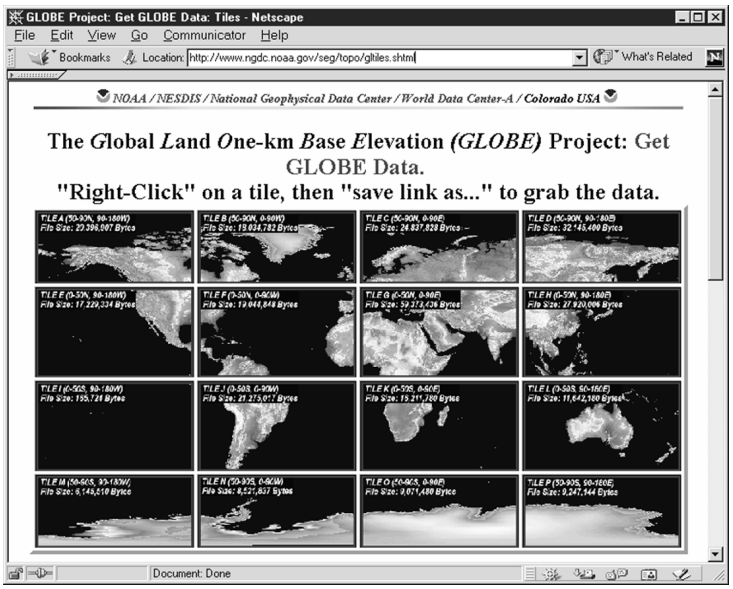
Modernizing Web delivery with spatial techniques

Often we present data to users in standard geographical tiles. Relief data, shown in Figure 4, provide important boundary conditions for weather and climate modelers. If "my neighborhood" of interest is North America, users must download four separate tiles. This is inconvenient for users, as they must stitch the tiles back together for a North American data tile. To solve this problem numerous sites (including ours) also empower users to define their own geographical area-of-interest using

▲ **Figure 2.** Nighttime lights browse imagery from the DMSP available online.



▲ **Figure 3.** The Web Image Spreadsheet Tool allows side-by-side comparison of images.



▲ **Figure 4.** The GLOBE topography database, accessed by predefined tiles or user-defined rectangles.

user controlled coordinates. Visit our Web site at *http://www.ngdc.noaa.gov/seg/topo/*.

More advanced systems are using Gazetteer search strategies in which users define words with geographic significance. These are decomposed into a bounding rectangle or polygon that in turn is used to query the appropriate databases for available information. Those interested in this technology may wish to tap into the Internet at the University of California at Santa Barbara's Alexandria Digital Library Gazetteer (*http://www.alexandria.ucsb.edu/gazetteer*).

Effect of new technologies on the Information Paradigm

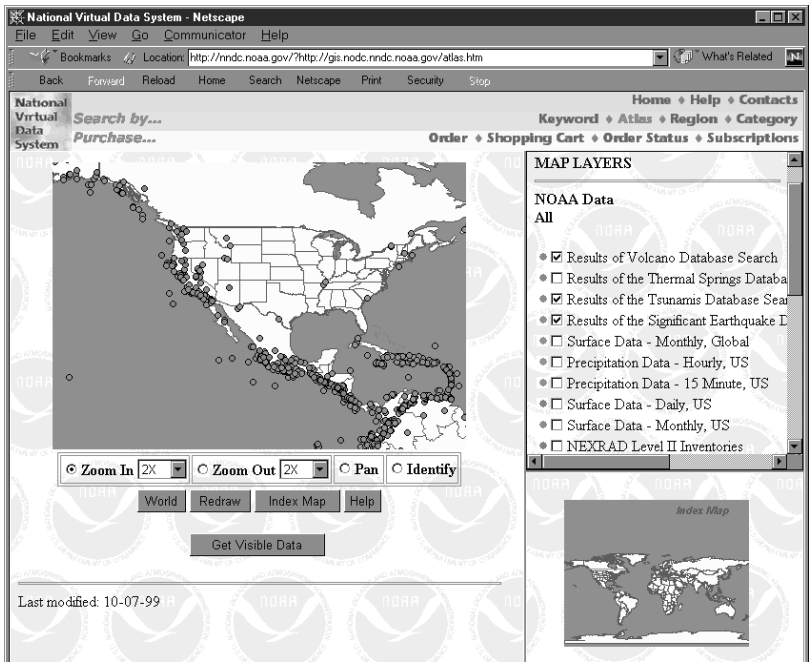
GIS technologies were originally used by cartographers and scientists to analyze relationships between different data layers. Now GIS has come to the forefront of information technology, enabling end-users to use advanced display features as part of the browsing function of information discovery. In Figure 5, users can interact over the Web and view data layers as an interactive Atlas. Numerous agencies, such as NOAA, USGS, EPA, FEMA and others have embraced this technology and are "spatially enabling" scientific data sets. In the image at left, NOAA's Virtual Data System enables users to select from a variety of NOAA data contain in databases and display them in a GIS environment. This tool will become increasingly powerful as more data and metadata are moved into the GIS enabled databases.

Where once we satisfied the needs of scientists, students and the public, soon we will be also servicing the needs of decision-makers. Formerly, users were satisfied with simple browse images; we will soon need to support complex queries from GIS-enabled relational databases. A sample question which may be soon asked, and answered, by GIS enabled databases on the Web is: "*Show the location and inundation zone for tsunami impacting the U.S. coast within 50 miles of cities with a population over 1 million*". The technology exists to answer such questions. The underlying databases must be populated with quality data that support multiple query methods.

Conclusion

With the explosion of the World Wide Web, data providers are increasingly isolated from data clients. However, one can "mine" very useful information about clients from logs maintained by Web-servers. Knowledge of your users, especially their search strategies and browser limitations, can help you better design your Web interfaces and inventory systems. This ultimately improves the level of services you provide.

Emerging Web technologies, such as GIS-enabled relational databases allow data providers to begin serving data online in digital atlas format. This capability will greatly empower the user, allowing much more powerful, and intuitive, search and retrieval of data. The technology exists to support complex queries online, but many of the underlying data needed to support the queries are poorly described or formatted. The challenge of the modern data and information provider is to establish relationships with the many Web visitors, gain some insight into their needs and limitations, and populate the web with quality data in relational database format. As the bandwidth increases and more users migrate to newer and more powerful browsers, the potential for serving data "your way" will become an everyday expectation. ■



▲ **Figure 5.** Web data delivery through GIS enabled databases empower users.

Distributing paleoclimate data

New WDC mirror site in Nairobi, Kenya

Connie A. Woodhouse, Wendy S. Gross, John Keltner, and Edward P. Gille
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The World Data Center for Paleoclimatology (WDC-Paleo), at the National Geophysical Data Center (NGDC) in Boulder, Colorado, has actively sought worldwide partnerships to establish mirrors (i.e. copies) of its Web and FTP sites, which contain a full archive of paleoclimatic and paleoenvironmental data. To date, mirror sites exist in Toulouse (France), Johannesburg (South Africa), and most recently, Nairobi (Kenya); see Figure 1.

Mirror sites, which are established through partnerships between regional hosts and the WDC-Paleo, serve a vital role in the exchange of data between scientists worldwide. Although worldwide Internet access is improving, timely and reliable connections from distant locations to the WDC-Paleo in Boulder can be very difficult. By placing mirror sites in other areas of the world, a bi-directional flow of data is stimulated. Mirror sites reduce the isolation between scientists that has too often led to limited participation in regional and international activities. WDC-Paleo mirror sites are also of great benefit to teachers, students, and the general public who are seeking information on paleoclimatology.

The WDC-Paleo mirror sites, updated weekly, store a complete copy of the WDC-Paleo's paleoclimatic holdings, providing fast and convenient access to paleoclimate data and information. The sites include records of past climate conditions from tree rings, ice cores, ocean and lake sediments, corals, climate models, and other sources from around the world. The volume of these data is now approximately three gigabytes.

▲ **Figure 1.** World Data Center for Paleoclimatology mirror sites.

New mirror site in Kenya

The latest mirror site in Nairobi, Kenya, is a cooperative effort between the Pan-African START Secretariat (PASS) of IGBP-PAGES, the International Council of Scientific Union's World Data Center Panel, and the NOAA Paleoclimatology Program, which supports the WDC-Paleo. Dr. Eric Odada, Director of PASS, and Dr. Daniel Olago, Programme Officer, sponsors of the project, provide the scientific oversight and local support for the system. The WDC-Paleo and the NOAA Paleoclimatology Program provide the funding for the server hardware and its maintence.

The selection of Nairobi as a mirror site was made because of the considerable effort PASS has made to mobilize and enhance regional scientific capacity in global change research within

▲ **Figure 2.** PASS personnel, clockwise from the upper left: Eric Odada (director), Daniel Olago (program officer), Evans Miriti (computer system/network administrator), and Roselyn Mwendwa (administrative assistant).

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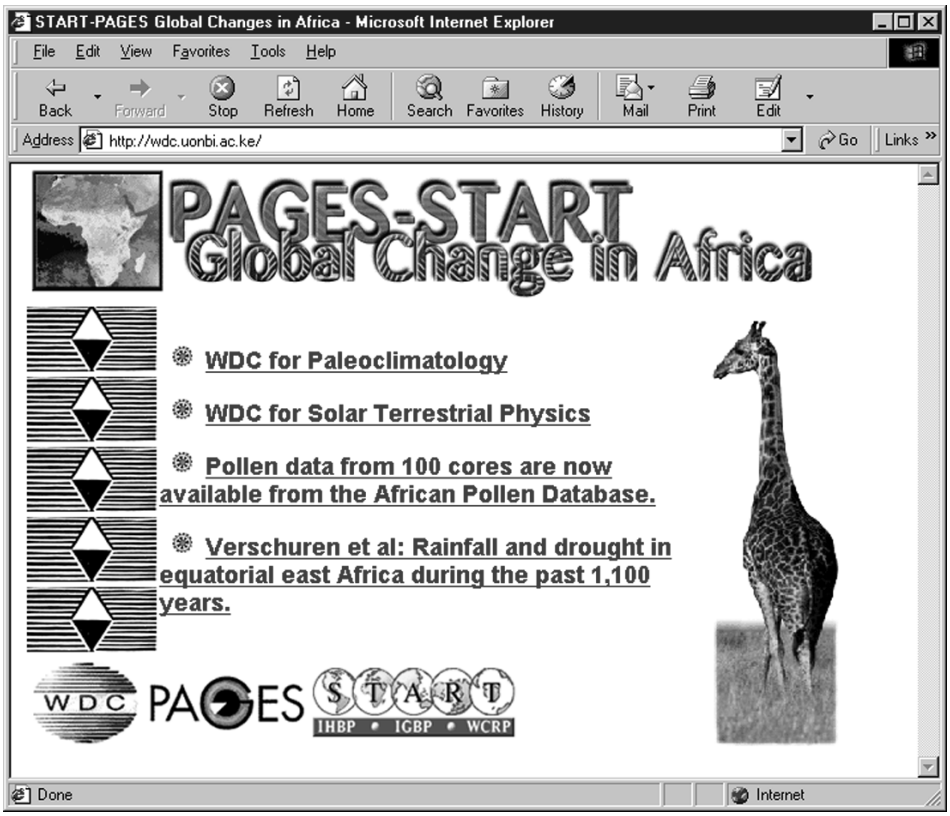

▲ **Figure 3.** The Nairobi home page has an African focus.

Africa, including the establishment of a training center in the PASS offices at the University of Nairobi. This training center, equipped with the latest computer technology and Internet access, will enhance the ability of local and regional researchers to take advantage of technological change as they study and report on the impacts of global change in Africa.

Because of rapid rises in population, extensive changes in land-use, and considerable inter-annual climatic variability, Sub-Saharan Africa is one of the most sensitive regions of the world, with respect to global climate and environmental changes. The new WDC mirror server strongly supports the mission of PASS by providing a means for data sharing as well as instant access to the latest paleoclimatic and other data from around the globe.

In December 1999, Wendy Gross and John Keltner of the NOAA Paleoclimatology Program traveled to Nairobi to set up this latest WDC-Paleo server. Airline baggage handlers notwithstanding (see Figure 4), the server arrived safely and was quickly set up in the PASS offices. The next challenge was Internet access. Working with administrators at the University of Nairobi's Institute for Computer Science and with technical support from Météo-France, the cabling was completed, an IP address was attained and registered, and the WDC-Paleo server was on the Net! Connectivity to the server remains less than ideal, due to the limited but expensive bandwidth available from the local Internet Service Provider (ISP), and to problems with the local telephone service. Happily, this situation should soon improve as the University, through the leadership of the ICS, becomes its own ISP with a direct Internet connection. This will greatly enhance the accessibility to the WDC-Paleo server.

The long-term goal of the WDC regional Internet site in Nairobi is to focus on Africa-specific data for all disciplines of data archived at NGDC. Currently the Paleoclimatology Program's Web and FTP sites are completely mirrored. Also mirrored are portions of the Solar Terrestrial Physics website that present fires and nighttime lights for Africa. Visit the Nairobi mirror site at: *http://wdc.uonbi.ac.ke*, or link to it from: *http://www.ngdc.noaa.gov/paleo/mirror.html*.

Future Mirror Sites

The WDC-Paleo plans to expand its network of mirror sites in the future. We hope build on the experience gained in Nairobi to extend the benefits of WDC-Paleo mirror sites to other under-served areas of the world. Funding is now being sought to bring an additional site on-line in South America by the end of 2000. In addition, potential sites are currently being investigated to establish a site southeast Asia by 2001. Stay tuned!

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▲ **Figure 4.** Photo of damaged box.

Aquariums, zoos and science museums to explore new ways to increase understanding of the oceans

A report on The Ocean Project and its recent national poll

Bill Mott, The Ocean Project
Paul Boyle, Wildlife Conservation Society/ New York Aquarium
SeaWeb Aquaculture Clearinghouse

As populations expand, society continues to urbanize and technology hurtles forward in quantum leaps, real contact with nature, including the oceans, is disappearing for most people at an alarming rate. While research shows that people have positive emotional connections to oceans and sense the importance of healthy oceans as integral to the balance of life on this blue planet, for the most part people have a dwindling comprehension of the simple principles that govern how our ocean planet works and the threats to this vast yet vulnerable watery habitat. Further, most people fail to see the harm that they do individually to oceans as well as the responsibilities and opportunities each of us has to ensure that the oceans remain healthy and productive for the future.

The poor state of the oceans today is less the result of the relatively naïve understanding of the complexity of ocean ecosystems than it is a sad testimonial to the very low importance the ocean has among the people of the world. The general population has a perception of the ocean akin to its understanding of rainforests 30 years ago; the issues seem of little importance to those not involved directly and oceans have been relegated to secondary status behind terrestrial regions when it comes to people's belief of where conservation is needed.

Yet today, while most people may not understand the technical details related to rainforests, the overwhelming majority now do know that they are important and that rainforests have relevance to them personally as well as ramifications for future generations. Many think of rainforests as the 'lungs of the planet' even though photosynthesis in the oceans of the world contribute more oxygen to our atmosphere than all terrestrial plants and ecosystems combined. Over the past few decades, people have assimilated a visceral belief that rainforests must be saved, which has resulted in greater conservation action on a widespread local basis. The challenge we face is to achieve a similar public perception and awareness of the ocean and aquatic resources in much less time.

A collaborative, multi-year approach is required to cultivate substantive change in the way people understand, relate to and use the ocean. A deep scientific and technical understanding is not needed by most people any more than it was in building the belief that rainforests are important. Instead, mechanisms are needed through which people can relate personally to the importance and value of the ocean. This connection is essential if people are to care about the profound changes the world ocean is undergoing today.

Aquariums, zoos, and museums have a unique opportunity to educate the public about the importance of the ocean. One in three Americans has visited at least one of these institutions in the last twelve months and polls show that people trust these educational institutions as a credible source of information on ocean protection.

Creation of The Ocean Project

Recognizing the advantage that these institutions possess, a new initiative, called The Ocean Project, formed recently to work with and through aquariums, zoos and science, technology, and natural history museums in order to develop a concerted and coordinated effort to reach people at a fundamental level regarding the importance of oceans and our connections to them. The Ocean Project believes that the single greatest impediment to healthy and productive marine and coastal areas is the public's low level of ocean awareness and see our mission as creating in people a lasting, measurable, top-of-mind awareness of the importance, value, and sensitivity of the oceans.

The Wildlife Conservation Society (WCS), through its New York Aquarium, supported the early work of The Ocean Project and established a steering committee of nine to lead the new initiative. Currently, it is comprised of: Paul Boyle, deputy director of WCS's New York Aquarium; Vikki Spruill, executive director of SeaWeb; Diane Sena, managing director of the Monterey Bay Aquarium; Kathy Sher, deputy executive director at the National Aquarium in Baltimore; James Hekkers, executive director of Colorado's Ocean Journey; Greg Stone, director of conservation programs at the New England Aquarium; John Nightingale, executive director of the Vancouver Public Aquarium; Michael Hutchins, director of conservation science at the American Zoo and Aquarium Association; and Bert Vescolani, vice president of education and programs at the John G. Shedd Aquarium.

During the formation of The Ocean Project, SeaWeb joined with WCS to create a team approach to forwarding this important ocean conservation movement. SeaWeb and WCS now jointly manage The Ocean Project and hired Bill Mott to serve as director of its operations. Institutional partners (Table 1) currently include more than 75 aquariums, zoos and museums across the United States and Canada.

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Table 1
Partners of The Ocean Project (as of June 2000)

Alaska SeaLife Center, Seward, AK
*American Zoo and Aquarium Association, Silver Spring, MD
Aquarium of the Americas, New Orleans, LA
Belle Isle Aquarium, Royal Oak, MI
Bermuda Aquarium, Museum & Zoo, Flatts, Bermuda
Birch Aquarium at Scripps, La Jolla, CA
Bronx Zoo/Wildlife Conservation Park, Bronx, NY
Central Park Wildlife Center, Manhattan, NY
Chaffee Zoological Gardens, Fresno, CA
Coastal Encounters Nature Center, St. Simons Island, GA
*Colorado's Ocean Journey, Denver, CO
Columbus Zoo and Aquarium, Powell, OH
Coral World, St. Thomas, VI
Dallas Aquarium at Fair Park, Dallas, TX
Dolphin Quest French Polynesia, Moorea, and Bermuda
Dolphin Quest San Diego, Hawaii and Oahu
El Paso Zoo, El Paso, TX
Erie Zoological Society, Erie, PA
Florida Aquarium, Tampa, FL
IGFA Fishing Hall of Fame and Museum, Dania Beach, FL
Indianapolis Zoo, Indianapolis, IN
International Fly Fishing Center, Livingston, MT
Lee Richardson Zoo, Garden City, KS
Long Beach Aquarium of the Pacific, Long Beach, CA
Memphis Zoological Garden and Aquarium, Memphis, TN
*Monterey Bay Aquarium, Monterey, CA
Moody Gardens, Inc., Galveston, TX
Mote Marine Laboratory and Aquarium, Sarasota, FL
Museum of Science, Boston, MA
Mystic Aquarium, Mystic, CT
*National Aquarium in Baltimore, Baltimore, MD
*New England Aquarium, Boston, MA
New Jersey State Aquarium, Camden, NJ
Newport Aquarium, Newport, KY
*New York Aquarium, Brooklyn, NY
New York Hall of Science, Queens, NY
North Carolina Aquarium at Fort Fisher, NC
North Carolina Aquarium at Pine Knoll Shores, NC
North Carolina Aquarium on Roanoke Island, NC
North Carolina Zoological Park, Asheboro, NC
Oceanarium Bar Harbor, Bar Harbor, ME
Oceanarium Southwest Harbor, SW Harbor, ME
Ocean Park, Aberdeen, Hong Kong
Oglebay Zoo, Wheeling, WV
Omaha's Henry Doorly Zoo, Omaha, NE
Oregon State University, Hatfield Marine Science Center, Newport, OR
Pittsburgh Zoo and Aquarium, Pittsburgh, PA
Point Defiance Zoo & Aquarium, Tacoma, WA
Poulsbo Marine Science Center, Poulsbo, WA
Prospect Park Wildlife Center, Brooklyn, NY
Pueblo Zoo, Pueblo, CO
Queens Wildlife Center, Queens, NY
St. Louis Children's Aquarium, Brentwood, MO
San Antonio Zoological Gardens & Aquarium, San Antonio, TX
Santa Barbara Zoo, Santa Barbara, CA
Science Museum of Long Island, Manhasset, NY
Sea Life Park Hawaii, Waimanalo, HI
The Seattle Aquarium, Seattle, WA
*SeaWeb, Washington, DC
SeaWorld Cleveland, OH
SeaWorld Orlando, FL
SeaWorld San Antonio, TX
SeaWorld San Diego, CA
Shark Reef at Mandalay Bay, Las Vegas, NV
*John G. Shedd Aquarium, Chicago, IL
Six Flags Marine World, Vallejo, CA
Sonoran Sea Aquarium, Tucson, AZ
South Carolina Aquarium, Charleston, SC
Steinhart Aquarium, San Francisco, CA
Tennessee Aquarium, Chattanooga, TN
Texas State Aquarium, Corpus Christi, TX
The Toledo Zoo, Toledo, OH
Tulsa Zoo, Tulsa, OK
UnderWater World Guam USA, Tumon, Guam
*Vancouver Aquarium Marine Science Center, BC
Waikiki Aquarium, Honolulu, HI
Walt Disney World's Animal Kingdom, Lake Buena Vista, FL
Walt Disney World's Living Seas, Lake Buena Vista, FL
*Wildlife Conservation Society, Bronx, NY

Note: The above list represents TOP's network of institutional partners (aquariums, zoos, and museums) with and through whom we will do most of our work. Those with * are on the steering committee.

The Ocean Project, *from page 8*

The Project will focus initially in North America but will expand in the coming years to include institutions from around the world. In addition to creating an unprecedented collaborative effort among these educational institutions, that together serve more than 100 million visitors a year, The Ocean Project is building a diverse and broad network of nongovernmental and governmental partners with whom to develop synergies and complementary conservation activities.

Of great importance, The Ocean Project will not duplicate or compete with the many conservation groups already working to save the oceans; instead, The Project aims to significantly increase the overall success of ocean conservation by collaborating in various capacities with local and national nonprofit conservation and environmental organizations, government agencies, universities and schools, dive clubs and others interested in networking to protect the oceans and help create a truly sustainable water planet. In addition to the 75 partner aquariums, zoos and museums, nearly 100 organizations, agencies and clubs have expressed interest in partnering with The Project.

The major task of The Ocean Project and its network of educational institutions will be to increase the saliency of the ocean and ocean issues in order to build public commitment to protecting the health of the oceans. To understand best how to proceed on such a major initiative and what to communicate to the public, The Ocean Project needed to explore the present status of the public's connections, values, attitudes, and knowledge relating to the oceans.

Public opinion research conducted

To lay a solid foundation upon which to build this far-reaching public awareness campaign, The Ocean Project last year commissioned two major research firms to undertake a comprehensive national public opinion survey in order to understand how and why people think about the oceans the way they do, what people know, and the gaps in public awareness about the oceans and related conservation issues.

The Project worked with the primary firm of Belden, Russonello & Stewart, assisted by American Viewpoint. Together six focus groups were conducted in the spring of 1999, as well as a national telephone survey between July 24 and August 8, 1999. A total of 1,500 adults, living in the continental United States, were sampled. The margin of sampling error for the study is plus or minus 2.5 percentage points at the 95% level of confidence.

This public opinion research represents the first time that aquariums, zoos and museums have collaborated in undertaking a comprehensive national effort to measure the public's knowledge and attitudes about oceans and adds significantly to a growing body of public perception research on the oceans, an area long ignored in environmental polling.

Research findings

Major findings from the research show reasons for both pessimism and optimism in terms of protecting the oceans. Essentially, while Americans have little basic knowledge of ocean functions, there is broad awareness of the oceans' vulnerability. However, people do not generally perceive the oceans to be in immediate danger.

A large majority of the public feels a strong personal and positive connection to the ocean, regardless of where they live. During focus groups, participants viewed oceans as powerful; vast; relaxing; and fun. The survey shows that people tend to value the oceans for their recreational and emotional aspects, and most understand that the oceans are neither a 'bottomless sink' nor indestructible.

People do know that human activities damage the oceans. Eight in ten reject the idea that "the oceans are so large, it is unlikely that humans will cause lasting damage to them." A similar percentage reject the idea that "we do not need to worry about the health of the oceans because we will develop new technologies to keep them clean." Importantly, even though they do not know why or how, the public understands that oceans are critical to maintaining the balance of life on the planet. Fully 92 percent of Americans consider the oceans essential for human survival, with 75 percent strongly agreeing.

At the moment, however, Americans remain largely unaware of the threats to ocean health and they greatly underestimate their own role in damaging the oceans. Understanding of why we need the oceans is superficial. When asked about the health of the open, deep oceans, close to half of the public report that they do not know enough about these oceans to give an opinion and slightly over a quarter say so for coastal waters. Most Americans are unable to correctly answer a majority of simple questions related to ocean functions. For example, only 21 percent of Americans know that oceans produce more of the earth's oxygen than forests.

While the poll found that people believe the oceans are threatened with serious and lasting damage caused by human activities, most people do not understand the role that each of us plays in the health of the oceans. For example, a majority of poll participants blame industry as the leading cause of ocean pollution and are much less aware of other threats to the oceans' health such as those cumulative effects, like runoff, caused largely by individuals. When asked to choose the main source of ocean pollution among three sources, only 14 percent of Americans select the correct answer— "runoff from yards, pavement, and farms." Nearly half of the respondents agree with the statement: "what I do in my life doesn't impact ocean health much at all."

Presently, there is little acceptance that each us of has a major responsibility (and opportunity) for protecting the health of the oceans and our planet. Part of the problem seems to stem from the fact that, at the moment, people do not perceive the oceans to be in immediate danger, and the need for action to protect the oceans is not readily apparent to people.

The survey shows that telling people how and why the oceans are important to human survival is not enough to inspire the public to indi-

vidual responsibility and action. Indeed, the survey reveals that people's existing concern for the oceans has little to do with specific knowledge of the major role oceans play in producing the oxygen we breathe, regulating the world's climate and providing habitat for countless forms of life. The study identified the great importance of connecting people to the oceans through their values and aesthetic appreciation before attempting to get them to focus on ocean problems.

Significantly, the poll demonstrates that there is tremendous opportunity for aquariums, zoos and museums to reach the public with new educational efforts that emphasize both science and the inspirational and ecological value of healthy oceans. Although The Ocean Project's network of partners will need to surmount significant challenges, overall, the survey results portend good news for oceans and clarified the tremendous opportunities that exist for aquariums, zoos and museums to significantly increase ocean awareness. These institutions are in a unique position to channel the public's love for the oceans into duty and action.

Need for a paradigm shift

A major role for The Ocean Project to play will be to create a paradigm shift both in the way that people relate to the oceans and in the way institutions approach connecting people to ocean conservation. The Project intends to develop and promote people's natural affinity for the oceans and conservation through the creation of messages, communication tools, exhibits, events and projects that effectively mesh science education and conservation values with memorable experiences about the oceans. The Ocean Project's over-arching policy will be to use positive messages that connect the ocean to our lives and make the oceans relevant to all. Starting in North America and then expanding around the world, we will collaborate as an extensive network of aquariums, zoos, museums and others to capture people's interest in the oceans, intrigue them, and inspire wonder. We will identify and encourage people to take more active roles in protecting oceans locally, nationally and internationally.

Over time, we hope to stimulate a lasting sense of respect for the oceans that permeates people's lives and transcends geographical boundaries. Through a variety of activities The Ocean Project and our partner institutions hope to instill in people not only a recognition of the interconnectedness of all things and belief that the oceans are an integral part of our lives, but also an empowering recognition that each individual plays a significant and influential role in the future of our ocean planet.

About the authors

Bill Mott serves as director of The Ocean Project. He has 12 years of experience actively involved in effecting positive change through local and national nonprofit conservation organizations. Most of his work has focused on federal policy issues, public education and coalition building.

For the last two years, Bill has also served as director of the SeaWeb Aquac ulture Clearinghouse, a relatively new project at SeaWeb formed to address the growing issues related to marine fish farming around the world. Previous work includes several years as director of the Marine Fish Conservation Network, a coalition of 100 organizations

— continued on page 12

Table 2

The analysis of the survey data identifies key points about public attitudes toward the oceans that will inform how aquariums, zoos, science museums and others can strengthen commitment to ocean protection.

1. Oceans are viewed as powerful, vast, relaxing, and fun.
2. The public possesses little awareness of ocean health, especially of the oceans beyond the beach.
3. Protecting the oceans is not an urgent issue.

4. The public possesses only superficial knowledge of the oceans, their functions, and their connection to humans' well-being.
5. Oceans are viewed as vulnerable to lasting damage, but the public does not generally see individual actions as having a great impact.

6. Currently low levels of personal importance placed on protecting oceans.
7. Facts alone will not increase concern for oceans' health.
8. Values framework: Balance of nature.

9. Effective messages: recreation, responsibility, and future.
10. Most salient threat: pollution.
11. Americans may sacrifice to protect the oceans.

The Ocean Project, *from page 11*

that successfully helped reform federal fisheries policy through significant changes in the Magnuson-Stevens Act. He also worked for several years at the Center for Marine Conservation on development of marine protected areas; among other things, he helped create the Coral Reef Coalition, which was instrumental in establishment of the Florida Keys National Marine Sanctuary.

Bill received an M.E.S. from the Yale University School of Forestry and Environmental Studies and a B.Sc. in Natural Resources from Cornell University. He was born in Washington, DC and currently lives in Providence, Rhode Island. He may be reached at:
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Dr. Paul Boyle has been involved in aquatic conservation and environmental research programs for over twenty-five years. His graduate work at Harvard University's Division of Applied Sciences solidified a long-term commitment to conservation where he earned a masters degree in Environmental Microbiology and a Ph.D. in Applied Environmental Sciences. Dr. Boyle spent twelve years at the New England Aquarium where he served as Chief Scientist of the Edgerton Research Laboratory before being promoted to General Curator, Director of Programs & Exhibits and, finally, Director of Program Planning to coordinate the creation of a new mission and a plan for a $70 million expansion.

In 1994, Dr. Boyle moved to the Wildlife Conservation Society's New York Aquarium as Deputy Director of the Aquarium and Director of WCS's Osborn Laboratories of Marine Sciences which now focuses entirely on aquatic conservation research. He has published extensively on microorganisms in the aquatic environment, marine wood boring organisms, and his current research focuses on aquatic diseases and, so-called, non-culturable aquatic microorganisms.

He conceived WATERWALK, a series of exhibits to increase understanding of aquatic wildlife in locales where people are actively using the aquatic environment. Dr. Boyle directed the creation of numerous additional public exhibits on aquatic themes, and his Fish That Go ZAP! exhibit at the New York Aquarium received a national award for excellence. Presently he is leading the creation of ALIEN STINGERS, a unique exhibit that will utilize the mesmerizing nature of ocean jellies and their relatives to allow people to understand more about science as a process of inquiry with a web component allowing people to conduct simple experiments on-line using their own observations and a live "jelly-cam." Dr. Boyle may be contacted at:

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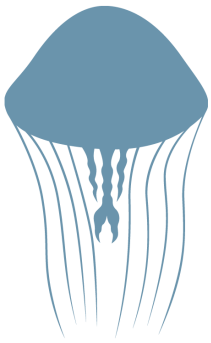

NOAA Central Library selected Federal Library of Year

NOAA's Central Library in Silver Spring, Md., received the 1999 Library of the Year award at the Library of Congress, the Commerce Department announced in March.

"This award recognizes the NOAA Central Library for its initiative and dedication in creating a distinctive combination of products and services," said D. James Baker, NOAA administrator. "It also recognizes the library for excellence in meeting the needs of its user groups."

The award was presented by Librarian of Congress James Billington on behalf of the Federal Library and Information Center Committee at the 17th annual committee forum on federal information policies. The award recognizes the many innovative ways that the library, librarians and technicians fulfill the information demands of government, business, the academic community, and the American public.

NOAA's Central Library maintains a collection of more than one million books, journals, technical reports, and other sources that support research in disciplines such as the atmospheric sciences, fisheries, space sciences, marine biology, meteorology, oceanography and related disciplines of interest to NOAA. Access to the library's catalog and the collections of 27 other NOAA libraries is available online at: *http://www.lib.noaa.gov*.

The library has a unique collection of rare books dating from 1485 that were assembled by scholars of the original U.S. Weather Bureau. In addition to writings on meteorology and climatology, the Rare Book Room also includes treasures from the original Survey of the Coast (1807) and from the original U.S. Commission on Fish and Fisheries (1871). This unparalleled collection is preserved in a climate-controlled environment for use by NOAA staff and the public.

The library is a tremendous resource for NOAA staff, and is open to the public Monday through Friday from 9:00 a.m. to 4:00 p.m. People outside of NOAA may obtain materials through their local interlibrary loan services.

The NOAA Central Library shares the Library of the Year award with the Los Alamos National Laboratory Research Library. ■

Three new icebergs in Antarctica

The National Ice Center, in Suitland, Maryland, reports that three massive icebergs have calved from the Ronne Ice Shelf in the Weddell Sea. The dimensions and center point locations of the icebergs are as follows:

- A-43A: 107x21 Statute Miles (168x33KM) centered at: 7510S 05858W
- A-43B: 53x23 Statute Miles (84x35KM) centered at: 7657S 05513W
- A-44: 41x20 Statute Miles (60x32KM) centered at: 7624S 05326W

Iceberg A-43 was detected using the Defense Meteorological Satellite Program's Optical Linescan Sensor (DMSP OLS) infrared imagery on May 5, 2000. It is known to have calved from the Ronne Ice Shelf sometime during the afternoon or evening of May 4th 2000, as satellite imagery indicates that the ice shelf was still intact on the morning of May 4th. Iceberg A-44 calved in the afternoon or evening of May 6th, at or near the time that A-43 broke in half.

The National Ice Center is a tri-agencyoperational activity with representation from the U.S. Navy, NOAA, and the U.S. Coast Guard. Its mission is to provide worldwide operational sea ice analyses and forecasts tailored to meet the requirements of U.S. national interests. The Center tracks icebergs using remotely sensed data provided in-part by satellites operated by the National Oceanic and Atmospheric Administration (NOAA) and the Department of Defense.

Iceberg names are derived from the Antarctic quadrant in which they were originally sighted. The quadrants are divided counter-clockwise in the following manner:

A = 0 to 90 degrees West longitude
(Bellinghausen/Weddell Sea)

B = 90 West to 180
(Amundsen/Eastern Ross Sea)

C = 180 to 90 East
(Western Ross Sea/Wilkesland)

D = 90 East to 0
(Amery/Eastern Weddell Sea)

When an iceberg is first sighted, the National Ice Center documents its point of origin. The letter of the quadrant, along with a sequential number, is assigned to the iceberg. For example, A-44 is the 44th iceberg the ice center has found in the Antarctica in Quadrant A.

—Selina Naumann
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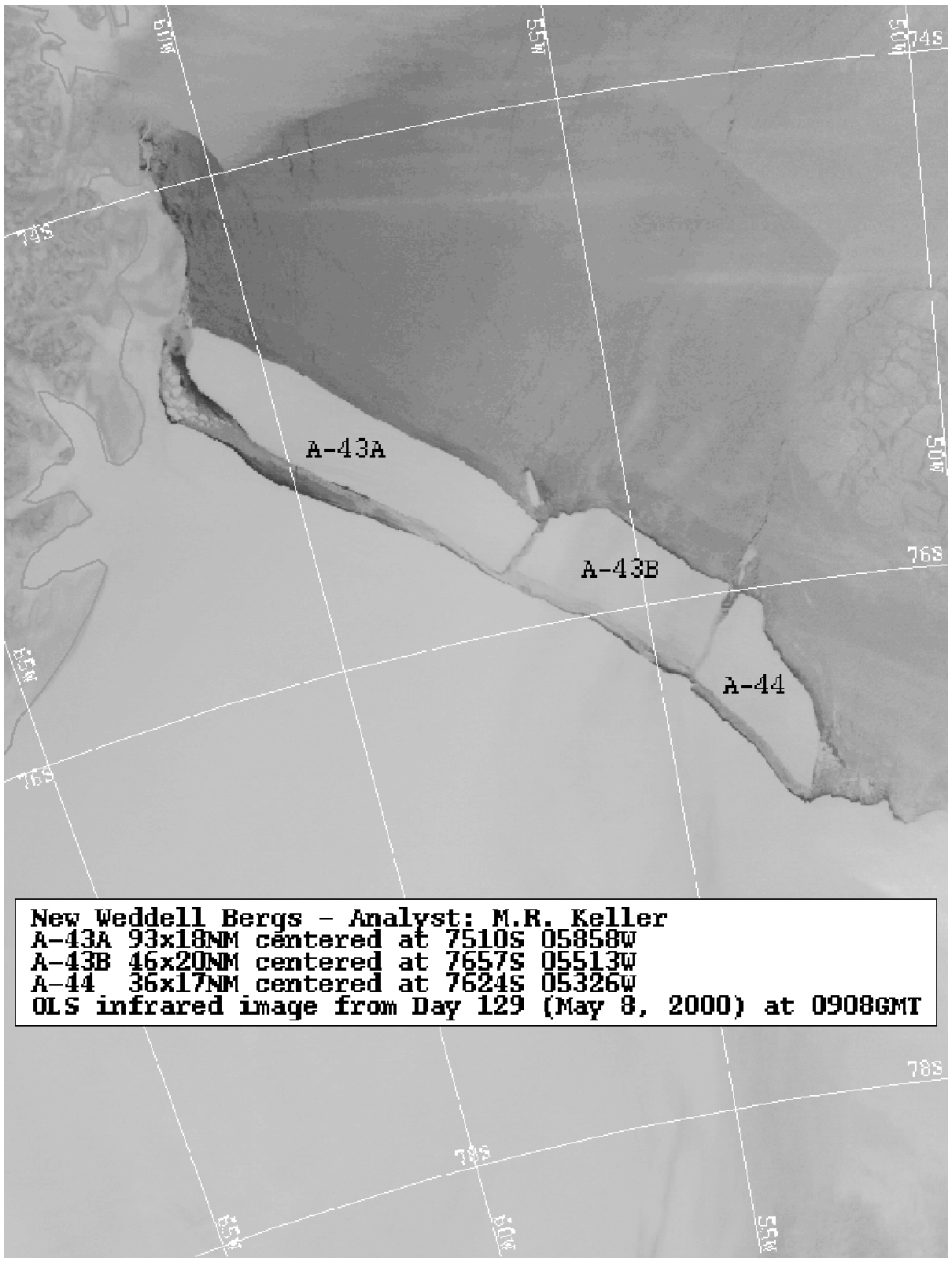

▲ **Figure 1.** The three newly-formed icebergs.

MODIS data expected to yield improved snow and ice maps

Lack of global, high resolution cryospheric data cited

Greg Scharfen and Annette Varani
National Snow and Ice Data Center

Currently, there are no global, daily snow cover and sea ice maps produced at 500-meter resolution (or better). For instance, satellite-derived snow cover data sets detailed by Hall *et al.* (in press) include National Operational Hydrologic Remote Sensing Center (NOHRSC) tabulations of percent of snow cover by hydrologic basin and elevation zone from the Geostationary Operational Environmental Satellite (GOES) used in forecasts by the National Weather Service; International Geosphere-Biosphere Project (IGBP) land-cover maps of North America developed from 1-km Advanced Very High Resolution Radiometer (AVHRR); hemispheric-scale maps such as the Northern Hemisphere weekly snow-cover maps produced by the National Oceanic and Atmospheric Administration (NOAA) National Environmental Satellite, Data and Information Service (NESDIS); and various maps derived from passive-microwave data from SSM/I, available at 12.5- and 25-km resolution.

Since annual runoff from mountain snowpack contributes to streamflow and recharges groundwater over wide areas of the mid-latitudes, and is estimated to supply water reserves for over a billion people worldwide, high resolution snow maps are needed by water resource managers and planners. In the long-term, consistent global records of snow and sea ice extent are necessary for any accurate assessment of climate change.

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The lack of global, high resolution cryospheric data may soon be remedied by the availability of snow and ice products from the Moderate Resolution Imaging Spectroradiometer (MODIS). With the successful launch of the NASA EOS Program Terra satellite in December 1999, MODIS was set into a sun-synchronous near-polar orbit with a 10:30 a.m. equatorial crossing time. MODIS views the entire Earth surface every one to two days, gathering high-quality data in 36 channels, covering visible, shortwave and longwave infrared bands from 0.4-14 µm. It is anticipated that this spectral coverage and the high spatial resolution will allow production of the most accurate daily global snow maps ever produced.

The MODIS Instrument Science Team has developed a suite of snow cover and sea ice extent products which will soon be available from the National Snow and Ice Data Center at the University of Colorado at Boulder. NSIDC is affiliated with the NOAA/NESDIS National Geophysical Data Center.

Global snow cover extent, including snow-covered ice on large, inland water bodies, is mapped daily over the Earth's land surfaces at 500-meter resolution. The SNOMAP algorithm (Hall *et al.*, 1998) based on the Normalized Difference Snow Index (NDSI) and other criteria tests, is used to process the data collected by the MODIS instru-

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Table 1. MODIS snow and ice products at the NSIDC DAAC. Name is the shorthand notation for the archived product. Grid projections are: IS= Intergerized Sinusoidal, LAMAZ= Lambert Azimuthal, CMG= Climate Modeling Grid. The time column gives the temporal coverage or averaging period for each data file.

Name	Parameters	Type	Resolution	Time
MOD10_12	Snow Cover Extent	Swath	500 m	5 min
MOD29	Sea Ice Extent	Swath	1 km	5 min
MOD10A1	Snow Cover Extent	IS	500 m	1 day
MOD29PIN	Sea Ice Extent - Night mode	LAMAZ	1 km	1 day
MOD29P1D	Sea Ice Extent - Day and Night modes	LAMAZ	1 km	1 day
MOD10A2	Snow Cover Extent	IS	500 m	8 days
MOD10C1	Snow Cover Extent	CMG	28 km	1 day
MOD10C2	Snow Cover Extent	CMG	28 km	8 days
MOD29C2	Sea Ice Extent	CMG	28 km	8 days

New NGDC color poster of world topography

The National Geophysical Data Center has produced a new, high-resolution image of global topography and bathymetry. The image was computer-generated from Global Land One-kilometer Base Elevation (GLOBE) project digital databases of land elevations, combined with Smith and Sandwell (1997) measured and estimated sea floor topography, on a 2-minute latitude/longitude grid (1 minute of latitude = 1 nautical mile, or 1.853 km). This poster supersedes the 1994 poster that was based on nearly 20-year old, 5-minute data. The new image has both a higher resolution and a much more complete and accurate portrayal of the Earth's surface and sea floor. The data base improvement results from accumulated data and pioneering, satellite-based work of Smith and Sandwell. The image is a Mercator projection, 390 degrees of longitude wide (270 degrees west to 120 degrees east) by 160 degrees of latitude tall (80 degrees south to 80 degrees north). More complete information is available at: *http://www.ngdc.noaa.gov/mgg/fliers/00mgg05.html*.
Contact: NGDC

Hourly precipitation CD-ROM product available

The National Climatic Data Center (NCDC) and the Forecast System Laboratory (FSL) have developed a new CD-ROM that contains precipitation observations from the Hourly Precipitation Dataset (HPD) archived at the NCDC. The data files contain hourly precipitation amounts for more than 2500 active stations and close to 7000 total stations.

The HPD observations are available for the period 1948 through June 1998, though some stations have data back to 1900. Access software is provided to extract the data from the CD-ROM archive and then can be used to summarize the data into daily or monthly precipitation quantities. Display software, which requires a Java-enabled web browser, will generate a zoomable map and time series graphics. This effort was funded by the Earth System Data and Information Management (ESDIM) program to provide improved access to historical hydrologic data.
Contact: NCDC

Data products and services

ASCII files available for Unedited Local Climatological Data

A much-requested online store module has been added to the Unedited Local Climatological Data product that allows downloading of ASCII comma-delimited files for all stations per month. This feature is available for our Unedited Local Climatological Data, unlimited subscription customers and all current free domain customers.

The customer may now download an archive monthly file that contains five separate ASCII comma-delimited files: daily, daily average, hourly, hourly precipitation data, and station listing. The URL for accessing these files is: *http://www5.ncdc.noaa.gov/ulcd*.
This is a feature that has been requested by many customers including the weather derivatives industry.
Contact: NCDC

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Fax: 303-497-6513
E-mail: *info@ngdc.noaa.gov*
WWW: *http://www.ngdc.noaa.gov/*

National Oceanographic Data Center (NODC)
301-713-3277
Fax: 301-713-3302
E-mail: *services@nodc.noaa.gov*
WWW: *http://www.nodc.noaa.gov/*

NOAA Environmental Services Data Directory
301-713-0575
Fax: 301-713-0819
E-mail: help@esdim.noaa.gov
WWW: *http://www.esdim.noaa.gov/#data-products*

NOAA Central Library
Reference Services:
301-713-2600
Fax: 301-713-4599
E-mail: *reference@nodc.noaa.gov*
WWW: *http://www.lib.noaa.gov/*

Additional Global Positioning System (GPS) data acquired

The National Geophysical Data Center has acquired additional "Continuously Operated Reference Station (CORS)" data, collected by NOAA's National Geodetic Survey. These data contain approximately 100 gigabytes of GPS satellite data stored on 152 compact disks. The entire GPS collection at NGDC currently includes 526 compact disks and spans the period from April 1995 to January 2000.
Contact: NGDC

Climate Reference Network

The National Climatic Data Center has prepared a public web page describing the Climate Reference Network (CRN). The CRN is a new nationwide network of climate monitoring stations being developed under the leadership of NCDC. CRN data will be used to put current climate change anomalies into historical perspective and to detect long-term climate change. The web page describes the background, motivation, and organizational structure behind the CRN as well as the technical specifications and system requirements. Future plans for the web page include information on site locations and digital photographs of new sites and their surroundings. The web page address is *http://www.ncdc.noaa.gov/crn.html*.
Contact: NCDC

State of the Cryosphere

The National Snow and Ice Data Center's (NSIDC) new State of the Cryosphere web pages (*http://wwwnsidc.colorado.edu/NASA/SOTC/*) answer the need for a succinct information product for the general public interested in the cryosphere and climate change. The pages present a summary of cryospheric and related indicators of global climate trends including global temperature change over the past century, trends in hemispheric snow extent, trends in sea ice extent, changes in glacier mass balance, and changes in sea level. A snapshot of permafrost conditions is also included on their site. NSIDC's Richard Armstrong leads this project, with contributions from other cryospheric specialists at the Cooperative Institute for Research in Environmental Sciences and from NSIDC's sister organization, the Institute of Arctic and Alpine Research.
Contact: NSIDC

MODIS, *from page 14*

ment. NDSI is the normalized difference between surface reflectance in a visible band and a shortwave-infrared band. The MODIS cloud mask product is used to distinguish clouds from snow.

Global sea ice extent and sea ice surface temperature are mapped daily at 1-km resolution. The ICEMAP algorithm (Riggs *et al.,* 1999), also based on the NDSI and other criteria tests, is used to map sea ice extent by reflectance. NDSI was designed for the detection of snow, but is also useful for the detection of sea ice. In addition to sea ice mapping based on shortwave, or reflected solar radiation, sea ice is also determined using longwave, or emitted thermal radiation. Sea ice surface temperature (IST) is calculated using a split-window technique based on a method developed with AVHRR data (Key *et al.*,1997). The day-mode gridded sea ice extent product, MOD29P1D contains sea ice maps using both techniques. The night-mode gridded sea ice extent product, MOD29P1N contains only the IST-based sea ice map. The MODIS cloud mask product is used to distinguish clouds from snow and sea ice.

The MODIS snow and ice products will be available in three versions: level 2 (ungridded, geolocated orbital swath), and level 3 (gridded) daily and eight-day composites. The snow cover products are in a sinusoidal equatorial grid, while the sea ice products are in the Lambert Azimuthal Equal-Area north and south polar grids. In addition, snow cover and sea ice products will be available in 1/4 x 1/4 degree spatial resolution Climate Modeling Grids (CMGs) several months from now.

The MODIS snow and ice products are archived in Hierarchical Data Format EOS version (HDF-EOS) and will include extensive metadata. Documentation is available. NSIDC expects to release the snow products late 2000, subject to change. Contact NSIDC User Services, *nsidc@kryos.colorado.edu* or see the MODIS web pages at NSIDC, *http://nsidc.org/NASA/MODIS/*, for most current information.

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Hall, D.K., A.B. Tait, G.A. Riggs and V.V. Salomonson. 1998. Algorithm theoretical basis document (ATBD) for the MODIS snow-, lake ice- and sea ice-mapping algo rithms (in press). See *http://snowmelt.gsfc.nasa.gov/MODIS_Snow/atbd1.html.*

Key, J., J.B. Collins, C. Fowler and R.S. Stone. 1997. High-latitude surface temperature estimates from thermal satellite data. *Rem. Sens. of Environ.* 61:302-309.

Riggs, G.A., D. K. Hall and S.A. Ackerman. 1999. Sea ice extent and classification with the Moderate Resolution Imaging Spectroradiometer Airborne Simulator (MAS). *Rem. Sens. of Environ.* 68(2):152-163. ■