

# EARTH SYSTEM MONITOR

## Polar Pathfinder Data

*New NSIDC product aids in closing the gap on credible climate projections*

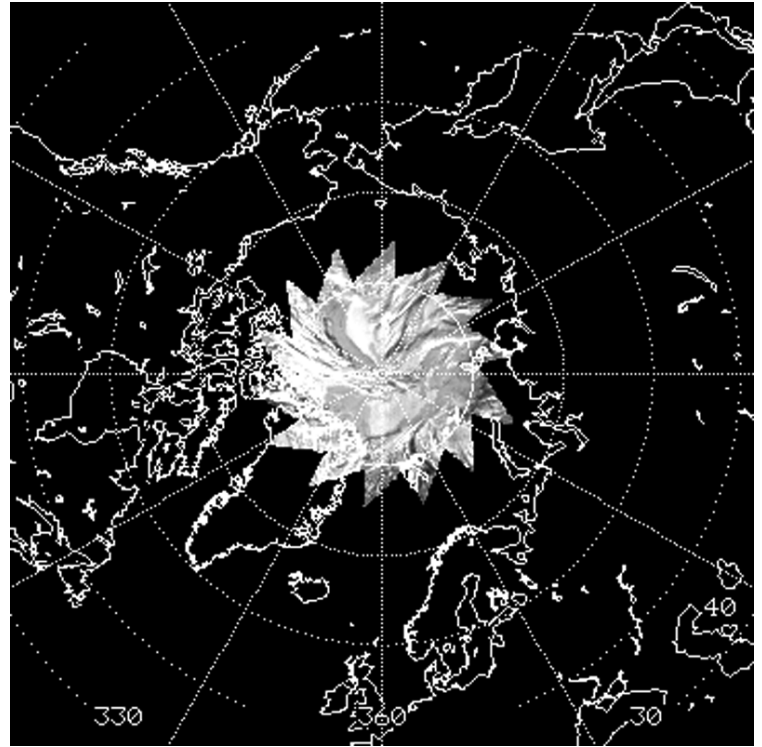
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National Snow and Ice Data Center  
NOAA

As governments and industries continue to debate the costs of implementing emissions-limiting measures, such as those called for in the Kyoto Protocol, the importance of accurate climate modeling is cast into severe relief. Decision makers, initiating conservative legislation designed to modify entrenched yet potentially climate-altering consumer behaviors, rely on credible scientific projections to leverage voter support and, ultimately, to educate societies toward making what are sometimes painful changes.

Global warming predictions run the gamut from melting polar caps, rising sea levels, increases in tropical diseases, damage to forests and coral reefs, to species extinction and regional famine—the outlook appears grim. Yet a concurrent reality is that it's hard to convert believers, and harder still to inspire spending, when as at present the ability of climate models to portray surface processes remains somewhat crude.

"For instance, it's uncertain how well the Arctic system is reflected in climate models," says Greg Flato, a research scientist at the Canadian Centre for Climate Modeling and Analysis. "If you look at results of general circulation models that project future temperature changes, the Arctic is anticipated to experience the largest warming." Given this potential sensitivity to climate change, he says, "it's important to understand how accurate those projections are and what they mean."

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▲ Figure 1. A 25-km image (reduced resolution from 5-km satellite images) of the Arctic is provided for September 8, 1997 showing surface albedo brightness temperatures and surface temperatures. Future versions of the P-Cube data set will use averages of the 5-km AVHRR product.

Yet research is typically impeded by gaps in observations of remote areas and by technical difficulties inherent in manipulating data from different sources, such as grappling with data provided on a variety of grids or data locked into wildly diverging formats. Before numerical process descriptions can be reached, available data must be reduced to common terms.

With the needs of the climate modeling community in mind, an elite group of cold region researchers—NOAA/NASA Pathfinder investigators working with polar data—have teamed with the National Snow and Ice Data Center (NSIDC) to produce a suite of complementary products designed to improve current representations of what is happening in the cryosphere.

In January 1999, NSIDC will release an advance CD-ROM containing samples of Polar Pathfinders created from the output of four sensors, the Advanced Very High Resolution Radiometer (AVHRR), the Special Sensor Microwave

– continued on page 2

A guide to  
NOAA's data and  
information  
services

### INSIDE

3

News briefs

5

Monitoring global  
surface temperature

8

Exploring with the  
NOAA Central Library

11

Data products  
and services



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and Atmospheric  
Administration

**Polar data, from page 1**

Imager (SSM/I), and two instruments (high-resolution infrared radiation sounder (HIRS) and the microwave sounding unit (MSU)) on the TIROS Operational Vertical Sounder (TOVS), in a unique data package called the P-Cube that allows the different data sets to be integrated.

The NOAA/NASA Pathfinder program was begun in 1991 to produce long time-series from existing satellite data sets that could be used for global change research prior to the availability of EOS data. Because the polar regions hold special significance in the climate system, Pathfinder teams working with cryospheric data sets formed a consortium to develop data products that could address technical difficulties and the science needs of both the polar research and the broader climate change modeling communities.

In addition to providing a standardized 15-plus year record for climate research, the Polar Pathfinder principal investigators worked together to develop consistent approaches to data formatting, and gridding. All Polar Pathfinder data have been projected to the NSIDC Equal-Area Scalable Earth-Grid (EASE-Grid, see "The NSIDC EASE-Grid" *ESM* 7(4):6-7,14). The data have synchronized file formats and naming conventions. In addition, the three instruments selected for demonstration on the new CD-ROM provide different and complementary information, Flato points out.

"AVHRR provides high resolution thermal and visible surface imagery and gives quantitative information on ice types, but suffers because it can't see through clouds," says Flato. "SSM/I is coarse, low-resolution data that doesn't have as many channels as AVHRR, so it gives less surface information. However, SSM/I sees through clouds, giving us ice concentrations, large-scale surface temperatures and ice motion information everywhere. TOVS main purpose is to take measurements of the atmospheric column above the ice."

The NSIDC data sampler carries AVHRR visualizations and time series at two resolutions, 1.25 and 5 km (Figure 1). At a resolution that rivals the scale of *in situ* data, 1.25 km AVHRR data offer insights into detailed surface conditions and processes such as sea ice formation,

sea ice motion and ice sheet mass balance. For the January release, three sites were selected from 1997 Northern Hemisphere AVHRR composites to correspond to areas of active field programs.

These areas, the Surface Heat Budget of the Arctic Ocean (SHEBA) study region in the Beaufort Sea, the ETH/CU Camp in western Greenland, and Point Barrow, Alaska, cover the main polar surface types: sea ice cover, ice sheets, and polar lands. Products include daily sea-ice motion vector fields and twice-daily composited images of albedo, surface temperature, and the calibrated and geolocated AVHRR channel data used to generate them.

Compared to visible-spectrum sensors, passive microwave remote sensing penetrates non-precipitating clouds and seasonal polar darkness, distinguishing between different kinds of sea ice, ocean, and snow cover. With the completion of processing in early 1999, the Polar Pathfinder passive microwave record will include the Scanning Multichannel Microwave Radiometer (SMMR), thereby extending the data history to more than 20 years.

For now, samples of NSIDC's EASE-Grid Brightness Temperature series based on SSM/I passive microwave data are included on the new release (Figure 2). The brightness temperatures provide information on polar oceans that has become essential to tracking ice edges, for estimating sea ice concentrations, and for classifying sea ice types.

Interest in the potential of passive microwave data for polar researchers has engendered creation of a number of valuable spin-offs, such as the Northern Hemisphere EASE-Grid Weekly Snow Cover and Sea Ice Extent, and the Near Real-Time Ice and Snow Extent (NISE) Product, designed to provide NASA EOS instrument calibration teams (CERES, MISR and TRMM) with near real-time, daily, global snow cover and sea ice concentration data. Imagery for each of these product sets are included on the new CD; sample Northern Hemisphere monthly snow depth climatologies derived from SSM/I EASE-Grid Brightness Temperatures demonstrate product applications.

TOVS atmospheric soundings, vital for weather forecasting, capture detailed  
—continued on page 4

**EARTH SYSTEM MONITOR**

The *Earth System Monitor* (ISSN 1068-2678) is published quarterly by the NOAA Environmental Information Services office.

Questions, comments, or suggestions for articles, as well as requests for subscriptions and changes of address, should be directed to the Editor, Sheri A. Phillips.

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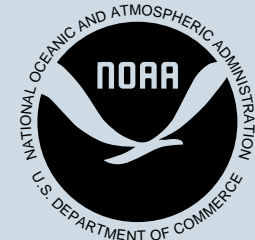
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### Proposal funded to investigate North Atlantic climate variability

NGDC Paleoclimatologist David Anderson was awarded funding from the National Science Foundation for a cruise to the North Atlantic (together with University of Colorado scientists J. Andrews, A. Jennings, J. Syvitski, and J. Hardardottir). Six nations will participate in the cruise scheduled for August 1999, aboard the French research ship the *Marionne Dufrenne*, the only ship in the world equipped to collect long (50m) cores from the seafloor. The sediments will be used to study the climate variability of the North Atlantic over the past centuries to thousands of years using paleoclimate proxies, and will yield insights into past variations in the North Atlantic thermohaline circulation, North Atlantic Oscillation, and the frequency of events such as the great salinity anomaly.

### Drier conditions expected in southern United States

If La Niña conditions strengthen in the tropical Pacific Ocean, they will impact precipitation and temperature patterns in the next three to six months, according to a scientist with the National Oceanic and Atmospheric Administration. Speaking at special La Niña briefings, Dr. Gerry Bell, research meteorologist at the National Weather Service Climate Prediction Center, said strengthening La Niña conditions would mean, "The southern United States can expect a drier, warmer and less stormy winter due to the effects of La Niña through the spring." This dryness might intensify already existing drought conditions in the deep South.

According to Bell, "Texas, New Mexico and Oklahoma will likely be drier and warmer." "Georgia and Florida will also likely be drier and warmer. Louisiana, Mississippi and Alabama will likely be warmer, but near normal precipitation is expected during the months of January, February and March 1999 and Tennessee will likely be wetter and warmer," Bell said.

La Niña reflects cooler than normal sea surface temperatures across the eastern half of the tropical Pacific, whereas during El Niño, the ocean waters in that region are warmer than normal. The last strong La Niña occurred in the winter of 1988-89. Armed with graphic reviews of conditions in the tropical Pacific Ocean, Bell explained how the National Weather

## News briefs

Service Climate Prediction Center conducts its state-of-the-art research.

According to Bell, the center monitors La Niña and El Niño with a network of buoys and satellites operated by the National Oceanic and Atmospheric Administration. He also explained how La Niña impacts the weather throughout the world. "These temperature changes affect global wind and air pressure patterns and our world's climate, as well as the location of marine life," Bell said. "El Niño and La Niña have always been a naturally occurring part of our global climate system. Thanks to widespread research efforts throughout the world and recent advances in technology, our observing and forecasting capabilities have significantly improved in the past few years."

The current La Niña began developing in the eastern half of the tropical Pacific in late May and June 1998, with ocean temperatures dropping up to 10 degrees Fahrenheit in that period, signaling the end of the 1997-98 El Niño cycle. According to an advisory issued by the Climate Prediction Center on September 10, 1998, moderate La Niña conditions are expected to develop and persist for the remainder of 1998 and continue into the spring. This outlook is consistent with forecast models being run by other research institutions around the world.

### NGDC hosts international space agencies for CEOS group meeting

On behalf of NOAA, NGDC hosted the subgroups and task teams of the Committee on Earth Observation Satellites (CEOS) Working Group on Information Systems and Services, September 21-25 in Boulder. About 60 scientists, primarily from North America, Europe and Japan, reviewed progress in data, networks, and access. David Clark led the local organizing committee, David Hastings reported on the final review and assembly of the Global Land One-km Base Elevation elevation model and on the Web-based Virtual Workshop on Environmental Data Issues, Ian Sprod presented the Web Image Spreadsheet, and other NOAA personnel were active in the meeting. Other highlights included increased collaboration with the International Geosphere-Biosphere Programme and the International

Society of Photogrammetry and Remote Sensing.

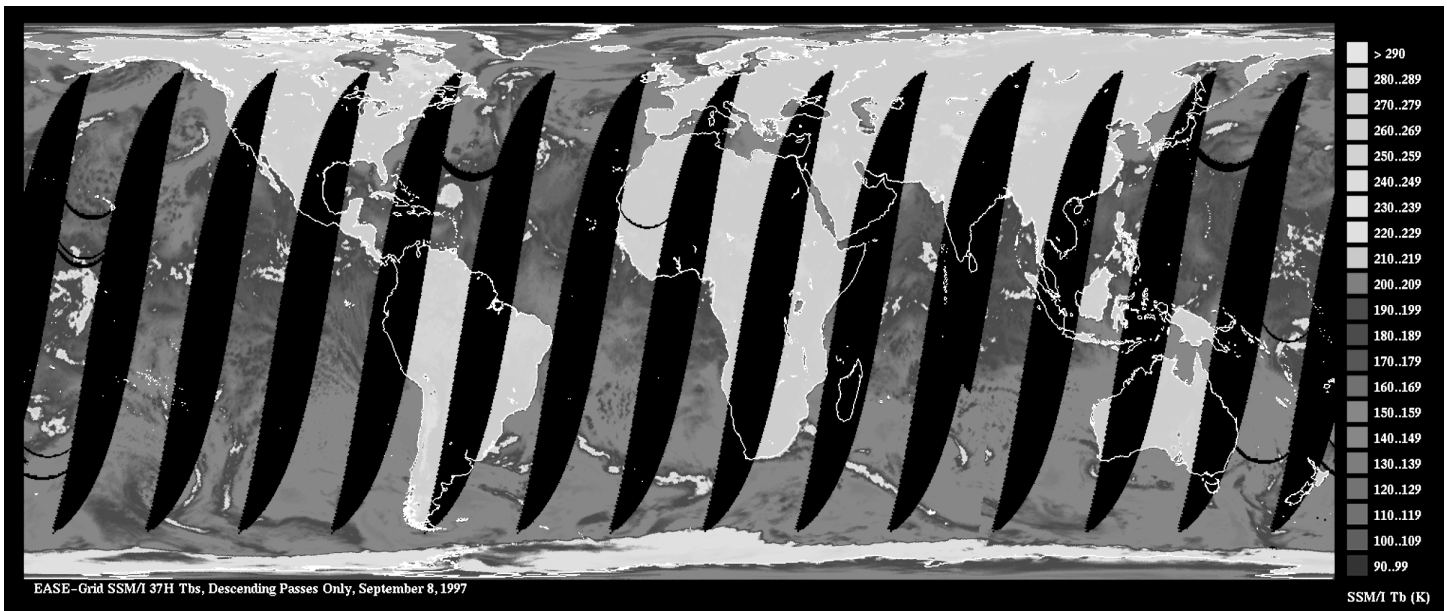
### U.S.-Russia agree to participate in collaborative projects

At the Environmental Working Group VIII Data Exchange Coordinators Meeting, Dr. R.G. Barry, National Snow and Ice Data Center (NSIDC) Director, participated in the joint U.S.-Russia discussions held at the National Center for Atmospheric Research, Boulder, September 14-18. He reported on collaborative projects related to data on snow water equivalent with the Institute of Geography, Russian Academy of Sciences (RAS), Moscow, soil temperature with the Soils Institute, RAS, Pushchino, and fresh water ice with the State Hydrological Institute, St. Petersburg. The projects are supported by ESDIM, the National Science Foundation, and the Cooperative Institute for Research in the Environmental Sciences/NSIDC. Plans were developed for activities in 1999, subject to funding availability.

### Joint Coordination Panel for Data and Information Cooperation

The Sixth Meeting of the Joint Coordination Panel for Data and Information Cooperation took place in Tianjin, China, September 14-18, 1998. U.S. participants were Dr. Henry Frey, Director NODC; Dr. Michael Loughridge, Director NGDC, Dr. Bruce Parker (co-rapporteur), Chief, Coast Survey Development Lab, NOS; Dr. Wayne Wilmot, NODC; and Joe Elms, NODC. Discussions were held on progress achieved during the past intercessional period and a cooperation plan was established for the next period. Further discussions were held between NODC staff and Joe Elms to establish details of the keying format and schedule of the project.

Two new items were added to the list for cooperative research and data exchange: Coral Reefs and Harmful Algal Blooms. A Workshop on Coastal Ocean Management was also held. Joe Elms presented an update on the status of global surface marine collections and the current US-PRC Implementation plan. A summary report signed by the head of the two delegations, Dr. Frey and Professor Hou Wenfeng, Director, National Marine Data and Information Service of China, is available for more detailed information.



▲ Figure 2. SMMR and SSM/I EASE-Grid brightness temperatures provide users with information on the polar oceans and have become essential to the tracking of ice edges, for estimating sea ice concentrations, and for classifying sea ice types. Shown here are global brightness temperatures from September 8, 1997.

#### **Polar data, from page 2**

information about the atmospheric profile from the Earth's surface to the stratosphere. The TOVS-derived yield includes temperatures of each layer, percent precipitable water, effective cloud fraction, cloud top temperature and pressure, turning angle between geostrophic wind and surface stress over ice, microwave emissivity, boundary layer stratification and geostrophic drag coefficient (Figure 3).

In polar research communities, the TOVS high quality atmospheric data is especially valued because it provides measurements for regions where *in situ* data are difficult to acquire. The new CD features animations showing warm air and other features being transported over the Arctic.

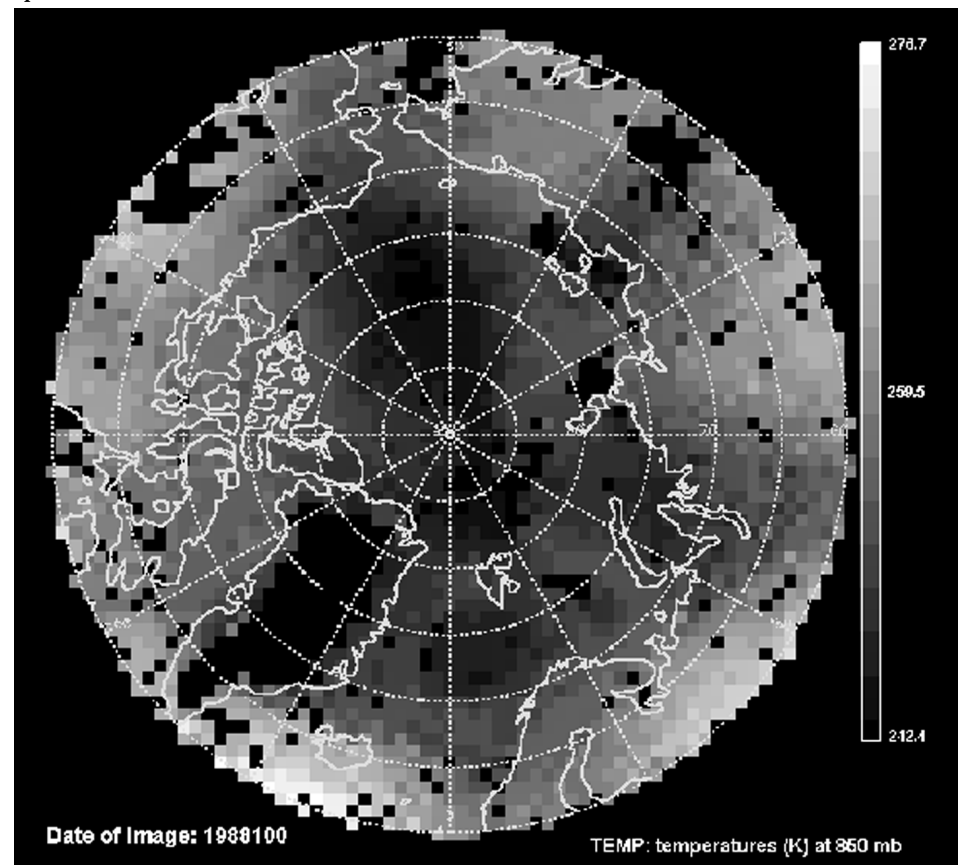
In addition to demonstrating the richness and utility of the surface and atmospheric Polar Pathfinder data collections now available or soon to be released as extended time-series, Path-

finder investigators have developed a unique analysis package called the P-Cube that combines products. The goal, according to Flato, is to allow unprecedented understanding of interactions between arctic ice, ocean, and atmosphere.

"These data are attractive because they're all mapped to the same grid. They're all in the same convenient format," he says. "Usually, data are scattered. To use them you have to scout

—continued on page 12

▲ Figure 3. Atmospheric temperatures from the P-Cube data set show temperature variation in the Arctic at 850 mb on February 18, 1998. Warmer temperatures can be seen in the Chuckchi Sea near Alaska, while much cooler air temperatures are observed closer to the north pole. Missing data are indicated by the black pixels.



# Monitoring global surface temperature

## *NOAA climatic researchers assist in U.S. policy decisions related to global warming*

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### Introduction

Beginning in mid-1997, the surface temperature of the globe, both land and sea, began to exhibit unprecedented warmth. To assist with U.S. policy decisions relating to global warming, NESDIS developed a series of global metrics that could place ongoing anomalies in century-scale perspective. To do this in a timely way, a blend of satellite data (AVHRR and SSM/I), and

*in situ* climatic and real-time data sets data are employed (Basist *et al.*, 1998; Quayle *et al.*, 1998) to create both time series and maps. For the global sea surface, long-term ship data climatologies are combined with a blend of ship, buoy, and satellite data to provide the greatest possible coverage (Reynolds and Smith, 1994). The results are: (A) global surface maps (minus snow covered areas) of temperature anomalies with respect to a 1992-1998 averaging period, available a few days after the end of the month (Figure 1); and (B) global century-scale time series of a surface temperature index that closely parallels other widely published global surface temperature measurements and can be updated monthly a week or two after the end of a data month (Figure 2).

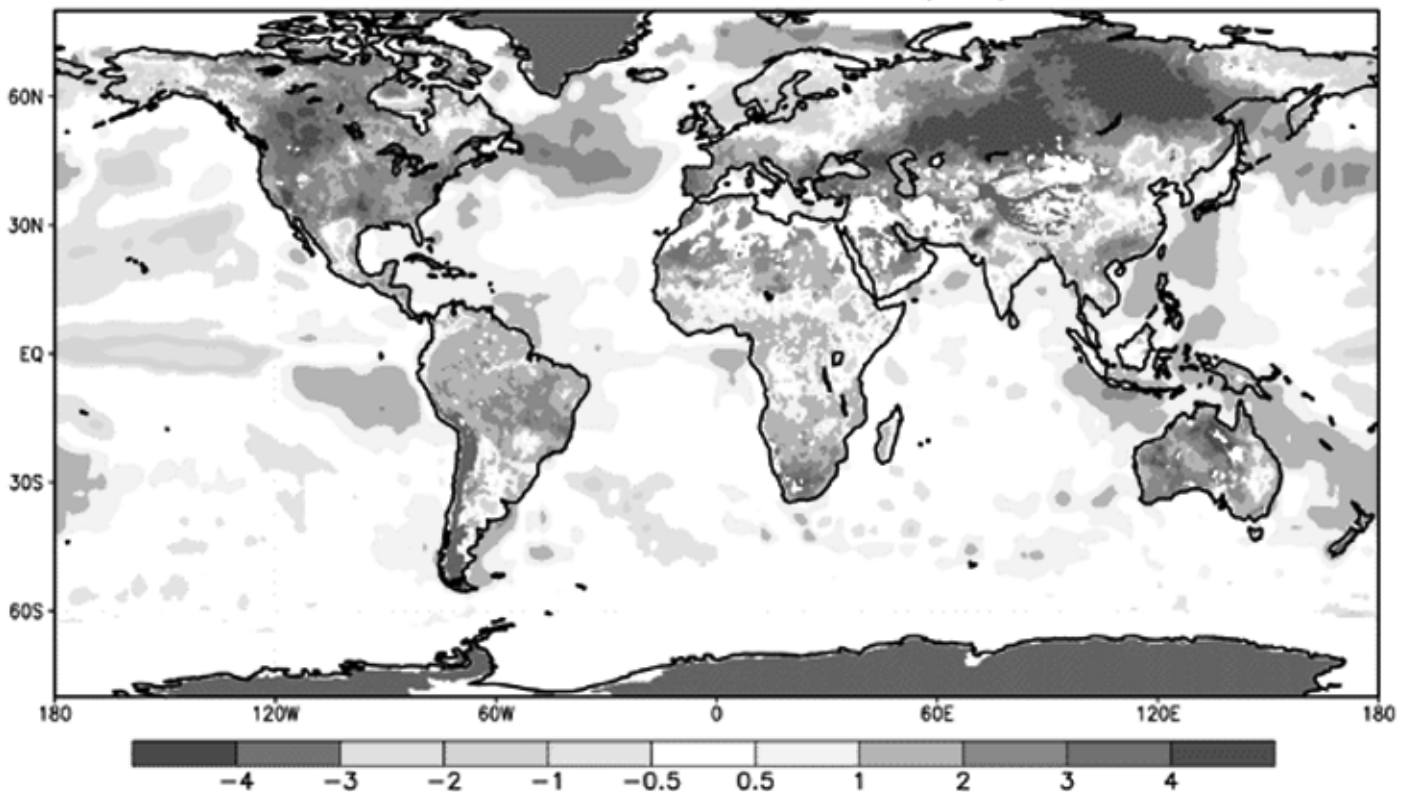
Surface land temperatures: station data for time series

Surface land air temperature climatology (at instrument shelter height) is derived from the Global Historical Climatology Network version 2 data set (GHCN, Peterson and Vose, 1997). GHCN v.2 includes previously unavailable Colonial Era data that fill in data sparse times and places (Peterson and Griffiths, 1997). All data are processed via the Climate Analysis System (CAS) developed at NCDC. The update system subjects the most recent data to a rigorous quality control (Peterson *et al.* 1998a). Its unique duplicate preservation scheme preserves the integrity of the input data streams (Peterson and Vose, 1997). The First-Difference area averaging technique thrives on these

—continued on page 6



MONTHLY MEAN TEMPERATURE ANOMALY IN CELSIUS AUG. 1998  
SSMI DERIVED SNOW COVER SURFACES ARE IN GREY  
CLIMATOLOGICAL BASE PERIOD IS 1992 - 1998  
SST DATA COURTESY OF R. REYNOLDS NCEP/NWS/NOAA



▲ Figure 1. August 1998 global surface land and sea temperature anomalies from 1992-1998 means. From: <http://www.ncdc.noaa.gov/ol/climate/research/1998/aug/>.

### Surface temperature, from page 6

duplicates and maximizes the global data available for analysis (Peterson *et al.*, 1998b). Homogeneity adjustment procedures developed over several years assures objective, reproducible homogeneous time series (Peterson and Easterling, 1994, Easterling and Peterson, 1995, Peterson *et al.*, 1998c).

Data volume varies from several hundred stations per year to several thousand (Peterson and Vose, 1997). For 1997, over 14,000 individual station monthly records are used in the analysis to produce 5x5 degree grid box data that are summarized into hemispheric and global averages.

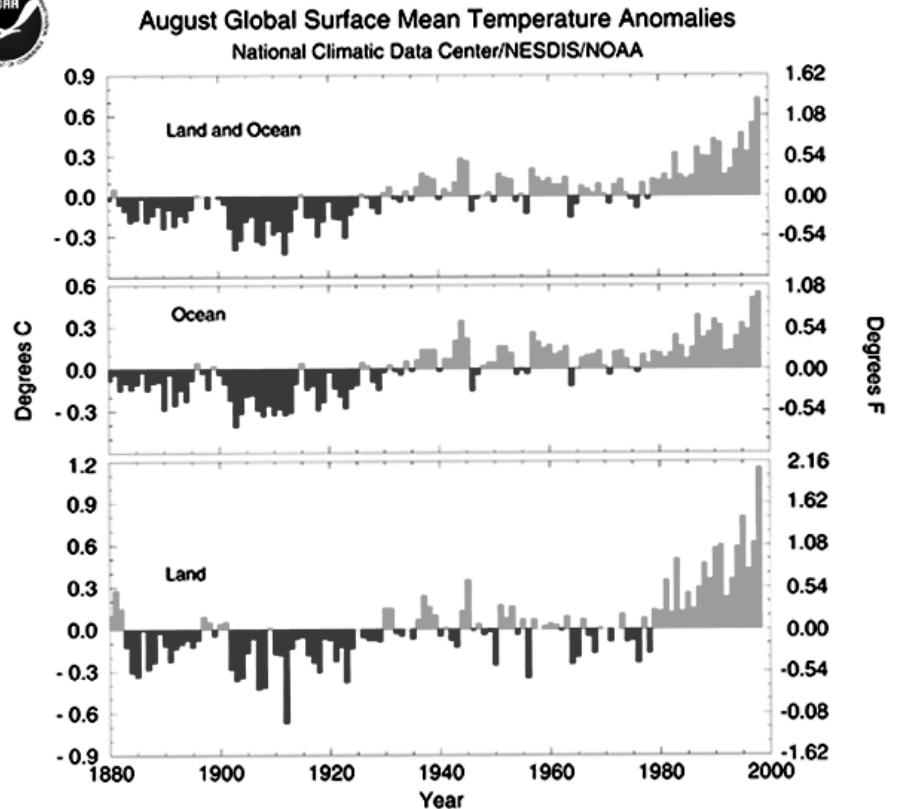
### Surface land temperatures: satellite data for maps

The global land surface map product (still experimental, Basist *et al.*, 1998) is derived from the Special Sensor Microwave Imager (SSM/I), a polar orbiting satellite with global coverage, and station data derived from the GTS. The data are available in near real-time by the fifth day of the following month. Anomalies are derived from the 1992-1997 or 1998 base period. The spatial resolution is 10, and it is not available when snow cover is observed over a grid box during a portion of the month, or if the climatology places snow cover in a grid during 3 months of the base period.

To measure temperature, numerous surface types were identified and adjustments made for variations in emissivity. Training data sets were used to define the relationship between the seven SSM/I channels and the near surface temperature. Surface types (e.g., water, snow, ice, and deserts) as well as precipitation were identified, and numerous adjustments and/or filters were developed. The global and U.S. networks of first order and cooperative

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▲ Figure 2. Global century-scale time series of a surface temperature index that closely parallels other widely published global surface temperature measurements and can be updated monthly within two weeks after the end of a data month.

stations, quality controlled by NCDC, serve as validation.

### Sea surface temperatures: satellite *in situ* blend for maps and time series

The Global Ocean Surface Temperature Atlas (GOSTA, Bottomley *et al.*, 1990), provides a century+ global record of 5x5 degree grid box *in situ* Sea Surface Temperature (SST) means by year through 1996. For this study, we use the UKMO HSST in the form of anomalies with respect to a 1961-90 averaging period (Folland *et al.*, 1993). For near real-time updates, the most timely and geographically complete data available are the National Centers for Environmental Prediction-Optimum Interpolation (NCEP OI) blended satellite, ship and buoy SST data set (Reynolds and Smith, 1994), also in monthly 5x5 degree grid box format, available for all years since 1982. Global averages and the accompanying anomaly series were produced from both data sets.

To fuse the two time series, a simple linear regression is performed

for global monthly (and annual) mean anomalies for the years 1982-1997, using NCEP OI SST with respect to 1982-1997 as the dependent variable and UKMO HSST with respect to 1961-90 as the independent variable. The fit was very good ( $r = 0.93$ ) considering the areas covered are somewhat different, with ship data available primarily along shipping lanes, and blended NCEP OI data being virtually global.

Using the monthly equations, UKMO HSST data are converted to modeled NCEP OI SST anomalies (from 1961-90 means) for each month from 1880 thru 1981. The NCEP OI SST data are appended to this record, and are updated shortly after the end of each data month. For plotting purposes, the data are then adjusted to anomalies from an 1880-1997 averaging period.

On a globally averaged basis, the NCEP OI data are somewhat cooler than the UKMO HSST data, but the reasons are not yet fully known. Possibly, (1) the use of modeled SST data in the vicinity of the ice edge by UKMO HSST creates a warmer strip of water in

polar areas; and (2) the use of satellite AVHRR Multi-Channel SSTs, uncorrected by ship and buoy data in some extremely data-sparse areas, creates a modest cooling (because of skin temperature effects).

#### The global blend

NCDC now has readily updatable global surface land-air temperature and global SST anomalies (time series and maps) through the latest month, two to 10 days after the end of a data month. The land data set is essentially independent from the ocean data, and are summarized independently of each other. To combine these data into a simple blend, the land temperature is weighted with a coefficient of 0.3 (since about 30% of the surface of the Earth is land) and the sea temperature with 0.7 (as the globe is about 70% ocean).

When the time series blend is compared to similar data developed at the NASA Goddard Institute for Space Studies ([www.giss.nasa.gov](http://www.giss.nasa.gov), documented in Hansen and Lebedeff, 1987; Reynolds and Smith, 1994; Smith *et al.*, 1996), the match is very good ( $r=0.95$ ) for the period for which Hansen has a land-ocean product (1950 to the present, also using NCEP OI SST). The match ( $r=0.87$ ) with the current global bench-

mark surface data set for the period 1880-1996 is also relatively good, particularly for a near-real time product.

In summary, we believe we have combined several of the best data sets in the world for their respective specialties: For time series: UKMO HSST for long-term SST; NCEP OI SST (via MCSST and *in situ*) for recent decades; and the GHCN and for global land surface temperatures. For maps: SSM/I, and NCEP OI SST. The techniques are robust and the results compare favorably with other widely used analyses.

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—continued on page 12

## 1998: A "mean" season for Atlantic hurricanes

The 1998 hurricane season brought an above-average number of hurricanes and tropical storms—including the devastating Hurricane Mitch—making it the deadliest Atlantic region season in more than 200 years in terms of storm-related fatalities, reported scientists at the Commerce Department's National Oceanic and Atmospheric Administration. A contributing factor to the increased activity—50 percent more hurricanes and 30 percent more tropical storms than normal—was a climate phenomenon called La Niña, cooler-than-average sea-surface temperatures in the central tropical Pacific.

In a joint August 4 outlook, forecasters at NOAA's Climate Prediction Center, National Hurricane Center and Hurricane Research Division correctly predicted above normal tropical storms and hurricanes in the Atlantic between August and October. The Atlantic sea-

son, which runs June 1 to November 30, spawned 14 tropical cyclones (average is 10) with ten becoming hurricanes (the average is six). Almost all of these storms and hurricanes occurred subsequent to the forecasts. There were \$3.2 billion in insured damages and 21 deaths in the United States.

"The season started a little late with Tropical Storm Alex on July 27, but made up for lost time," said Jerry Jarrell, director of the National Weather Service's National Hurricane Center. "In a remarkable span of 35 days between August 19 and September 23, ten named tropical storms formed. That's nearly a whole year's worth of activity crammed into little more than a month."

The year tallied seven landfalling storms in the continental United States, including Hurricanes Bonnie, Earl, Georges, Frances and Mitch (the last

two were downgraded to a tropical storm on landfall) and Tropical Storms Charley and Hermine.

The 1998 Atlantic season was the deadliest in more than 200 years. Not since the hurricane of 1780 that struck Martinique, St. Eustatius and Barbados (October 10-16, 1780), killing between 20,000 and 22,000, has the Atlantic hurricane basin seen storm-related fatalities like those of Hurricane Mitch (October 21-November 5). Wire services attribute some 11,000 deaths to Mitch, with thousands more missing.

In this "mean" season, Mitch, a Category 5 monster, registered average sustained winds near 180 mph (October 25) with gusts well over 200 mph. Mitch was the fourth most intense hurricane ever observed in the Atlantic basin this century based on barometric pressure, and the strongest ever ob-

—continued on page 12

# Exploring with the NOAA Central Library

*Utilizing the power of the Internet to aid users researching the oceans and atmosphere*

Albert E. Theberge  
NOAA Central Library  
NOAA/NESDIS

One of my pleasant memories of childhood was the Saturday trip to the local library. Besides the usual stories and poems, the children's section had books on far-away lands, maps and atlases, many history books, and books for exploring nature. There was also a box of old stereo photos that could be placed in a viewer for scenes of adventure to pop out in 3-D. Unfortunately, I was never quite able to see in 3-D; yet it was fun to spend hours perusing the old photos in a flat 2-D world.

Because of the computer revolution and today's Internet, there have been voices decrying the loss of contact with the treasures and the homey safe atmosphere of the venerable town library. But have the computer and the Internet really caused a loss of the old-style library? Or has it instead made library treasures, both old and new, accessible to hundreds if not thousands more patrons than ever before?

In the case of the NOAA Central Library and the affiliated NOAA libraries, the answer to the first question is a resounding "No!" In the case of the second question, the answer is an equally resounding "Yes!" Suddenly, because of computer technology, and in particular the Internet, the resources and treasures of the NOAA Central Library and the other NOAA libraries are becoming increasingly accessible to a larger segment of the citizens of the United States and of other lands.

## The NOAA Central Library Home Page

By accessing the NOAA Central Library Home Page at <http://www.lib.noaa.gov/>, the Internet user can enter the adventure and wonder of the National Oceanic and Atmospheric Administration. As with the traditional library of

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NOAA Central Library  
NOAA/NESDIS  
SSMC3, 2nd Floor E/OC4  
1315 East-West Highway  
Silver Spring, MD 20910  
E-mail: [reference@nodc.noaa.gov](mailto:reference@nodc.noaa.gov)



▲ Figure 1. NOAA ship *Surveyor* in pack ice, Bering Sea, Alaska, 1977. Photo courtesy of the NOAA Office of NOAA Corps Operations.

old, there is a catalog that provides access to over 150,000 titles dealing with the oceans, the atmosphere, fisheries science, marine biology, and all of the peripheral subject matter that bears on NOAA's mission.

Through the NOAA History Page, stories of the adventures and accomplishments of NOAA's ancestors can be found. Under collections, the photo collection contains thousands of digitized photographs detailing the work of NOAA and its ancestor agencies, while a special treat awaits those who wish to peruse the old maps and charts of the NOAA historical map and chart collection. But, because of the Internet, many new functions and services have been added for those who access the NOAA Central Library.

WINDandSEA, the Library Internet guide, opens the power of the Internet for those wishing to explore our fisheries, our oceans, and our atmosphere. Time spent in the NOAA Browser will help the user find his/her way into the many nooks and crannies of NOAA. And a look at the NOAA Library and Information Network will help guide a user to the specialized or regional NOAA Library that will meet his/her needs. Although the NOAA Central Library Home Page has many addi-

tional sources of information, the following discussion only touches on the aforementioned sub-sites and functions. The discussion follows the organization of the Library Home Page.

## The NOAA Library Catalog

The NOAA Library Catalog is basically a digital card catalog that allows access to over 150,000 titles in the NOAA Library system. It is a joint effort of the NOAA Central Library and other NOAA libraries throughout the country. The digital catalog includes most titles acquired after 1975 and a small percentage of the pre-1975 NOAA Library holdings. The primary means of searching the catalog includes words and phrases, title, and author. The catalog provides the user with the document call number, the NOAA library or libraries at which the document resides, and the document status (in stacks, reference only, rare-book, etc.) among other parameters. The catalog also allows access to over 300 full-text digital documents.

The pre-1975 holdings in the NOAA Library system approach 1 million documents and include many rare works available only within the NOAA Library system. In fact, because of widespread destruction during World War



II, the NOAA Central Library has one of the largest pre-World War II collections of European meteorological and geodetic works in existence. The pre-1975 documents are found through manual card catalogs and are being added to the digital catalog as time and resource permit.

#### WINDandSEA

WINDandSEA is the NOAA Central Library Internet Locator for the oceanic and atmospheric sciences. It was designed initially to help the Library reference staff respond to questions coming from NOAA personnel, other Government entities, academia, commercial organizations, and the general public. Today this resource is available to all. The site contains four major parts: 1) a current interest page; 2) a "Teachers' and Students' Corner; 3) the main index; and 4) the annotated links that lead to both NOAA and outside sites.

Today, WINDandSEA provides links to over 1,000 sites organized into 42 major headings and approximately 150 sub-headings. For best results with WINDandSEA it is advisable to study the index prior to using. For educators and students, the "Teachers' and Students' Corner" provides access to over 100 NOAA education pages as well as access to many other Government science agency education sites, academic education sites including full courses in oceanography and meteorology, and over 100 NOAA photo sites (Figures 1-3).

#### The NOAA Browser

The NOAA Browser is basically a WINDandSEA type of vehicle that only links to NOAA Internet sites. The Browser was devised to help navigate within NOAA. This is not a trivial exercise, as NOAA is an agency with hundreds of functions, field installations in virtually all states and territories, and operations all over the Earth.

Presently there are over 500 links in the Browser. In general, the site is organized hierarchically with links following NOAA's structure. Within the Browser, one can find: NOAA ship, aircraft, diving, and satellite operations; environmental science studies extending from the center of the Earth to the surface of the Sun; information on

charting our seaways and airways; information related to managing the American fisheries including statistics, habitat management, protected species, and marine mammals; links to Weather Service sites including the National Centers for Environmental Prediction, local weather forecast and river forecast offices, and many headquarters functions; links to the NOAA data centers including oceanographic, geophysical, and meteorological data; and NOAA management information.

If one wishes to explore NOAA or comprehend the structure and scope of its operations, the Browser is a good place to start.

#### NOAA history

NOAA is descended from the oldest physical science and conservation agencies in the United States. These agencies were instrumental in forming the American science community and in helping establish the American Association for the Advancement of Science, the National Academy of Sciences, the American Geophysical Union, and the American Meteorological Society. As an aside, the NOAA Library is descended from the Coast Survey Library, the Weather Bureau Library, and the Fish Commission Library.

The Coast Survey Library was the oldest physical science library in the United States and probably the Western Hemisphere. The initial collection of

3,000 books was brought to America by Ferdinand Hassler, the first Superintendent of the Coast Survey in 1805. This personal collection served as the nucleus of the Coast Survey Library after the formation of that organization. Because of these early library collections, the NOAA Library is in a unique position to help record NOAA's rich heritage and the history of science in the Nineteenth Century United States.

The NOAA History site was built to help celebrate that heritage and includes stories of adventure and pioneering science work with the Coast and Geodetic Survey, the Weather Bureau dating back to its Signal Service days, and the Bureau of Commercial Fisheries. NOAA History includes: 1) "Profiles in Time," over 300 biographical sketches of those who served in NOAA's ancestor agencies; 2) "Stories and Tales" recounting the rough and tumble work of the Coast and Geodetic Survey, the early weathermen, and the early fisheries scientists; 3) "Art and Poetry" painted, sketched, and written by some of those who served; 4) the NOAA Historical Photo Collection which is a subset of the larger NOAA Photo Library; and 5) the NOAA Historical Map and Chart Collection.

NOAA History provides a glimpse at the way it was in NOAA's ancestor agencies and may perhaps provide

—continued on page 10



▲ Figure 2. Surf pounds the beach in spite of clearing weather after a storm at Pegotty Beach, Scituate, MA, February 9, 1978. Photo courtesy of AP Laserphoto.

**Surface temperature, from page 9**

some inspiration and guidance for the future.

**NOAA Library and Information Network**

The NOAA Library and Information Network provides descriptions, contacts, mail addresses, E-mail addresses and phone numbers for more than 30 libraries in the NOAA system. These libraries include the regional libraries, numerous fisheries libraries, weather service libraries, and many specialty libraries.

These specialty libraries include the National Hurricane Center Library, the National Marine Mammal Laboratory Library, the Great Lakes Environmental Research Laboratory Library, the Coastal Services Center Library, the Geophysical Fluid Dynamics Laboratory Library, and the National Severe Storms Laboratory Library. The combined collections and services of these libraries are a wonderful resource for NOAA and the Nation.

**The NOAA Photo Library**

The NOAA Photo Library is the counterpart of the collection of stereo photos found in many of the old-style libraries. But instead of one or two individuals sharing the wonder of these images at one time, thousands of viewers all over the world can access these images daily. Presently there are approximately 6,000 images online.

The Photo Library today is made up of: the National Severe Storms Laboratory collection; the National Undersea Research Program collection; historical collections of the Coast and Geodetic Survey, the National Weather Service, and the National Marine Fisheries Service; and a general collection that encompasses much of NOAA's realm. With the exception of the general collection, most images have captions including date, location, names of personnel where known, and access to a high-resolution .jpeg image for downloading if desired.

Future planned modules for the NOAA Photo Library include among others: Coastlines, a pictorial tour of America's coast and other coasts that NOAA personnel visit and work upon; "NOAA at the Ends of the Earth", a photo collection of NOAA and its ancestor agencies working from the Arctic

to the Antarctic with many out of the way stops in between; a site that will detail NOAA ship, aircraft, and diving operations; NOAA Space Operations featuring meteorological satellites and oceanographic satellites; a disaster site detailing the ravages of all manner of natural disasters; and a number of fisheries and living marine resource sites. These sites will become available over the next two years.

**The challenge for the future**

The NOAA Central Library System has been confronted with many challenges as a result of the Internet revolution. No longer can a responsive library system be content with merely cataloging its products and waiting for those who are in geographic proximity to walk in at their leisure. Today's user needs and expects desk-top access to information. The Internet helps provide that access. But with the Internet comes a plethora of new opportunities and new problems.

Foremost among these is developing a means to discover and then make accessible via the Library catalog the blizzard of digital publications that an agency such as NOAA produces through its many offices and programs. Without cataloging these works and devising a means to assure their long-term storage and accessibility, both the producing organization and the American public are shortchanged. The digitization of the existing agency works is another major issue as many of the older works such as the Nineteenth Century Reports of the Superintendent of the Coast Survey, the Chief of the Weather Bureau, and the Commissioner of Fisheries are deteriorating. These documents are important historical records but more importantly contain much information that is still scientifically useful. Digitization of pre-digital Twentieth Century reports and documents is also an issue as speed of access for needed information is becoming increasingly critical.

Another issue is the capture of existing photographic imagery as the NOAA Library contains thousands of photographs in its photographic collection as well as additional thousands in government documents that should be accessible to the American public. These photographs are of natural phe-



▲ Figure 3. Dolphin playing in the bow wave of the NOAA ship *Peirce*, Atlantic coast, 1985. (Photo courtesy of the personnel of the NOAA ship *Peirce*.)

nomena, disasters, living resources, engineering works, and scientific projects. Many of these images don't exist anywhere else.

As we move towards the new millennium, the NOAA Library System is moving towards new services, new products, and expansion of the traditional role of the Library. Look for an increasingly larger catalog, expansion of the digital photo library, an increasing number of online documents, and continuation and improvement of the linking sites such as WINDandSEA and the NOAA Browser.

For NOAA personnel, universal access to indexing and bibliographic services and online professional periodicals is a major goal. Already, this is becoming reality at numerous NOAA sites around the country. The new millennium will be an exciting time. The NOAA Library System will be there to help NOAA and other Government organizations, academia, commercial organizations, and the general public move forward and have the necessary information to make informed decisions regarding our environment and its living resources. ■

### National Geographic publishes "Nighttime Lights of the World"

The National Geophysical Data Center's (NGDC) image "Nighttime Lights of the World" was published as part of a map supplement in the October issue of National Geographic. The nighttime lights of the world image was produced by compositing the lights detected in cloud-free portions of Defense Meteorological Satellite Program Operational Linescan System data acquired during the dark half of the lunar cycle between October 1, 1994 and March 31, 1995. It took the NGDC team almost four years to develop the algorithms and generate the product.

Contact: NGDC

### NGDC web pages for the General Bathymetric Chart of the Oceans

NGDC has just made public the official Web pages for the Intergovernmental Oceanographic Commission (IOC) and the International Hydrographic Office (IHO) sponsored General Bathymetric Chart of the Oceans (GEBCO) project. NGDC has been working with Sir Anthony Loughton, Chairman of GEBCO, and Mr. Brian Harper, permanent Secretary of GEBCO, on page design and contents of the GEBCO website since June. The site <http://www.ngdc.noaa.gov/mgg/gebco/>, hosted by NGDC, will provide a focal point for dissemination of information about GEBCO and contain the GEBCO list servers.

Contact: NGDC

### China flooding summary

The National Climatic Data Center (NCDC) placed a web page on line describing China's severe summer flooding, with a brief narrative, satellite images of the river flooding, and daily/monthly climatic data. During the June-July 1998 period, nine stations reported more than 40 inches of rainfall, with a maximum of 68.28 at Qinzhou in southeastern China. The daily and monthly data were produced from a sophisticated system of programs which decode and quality control the synoptic data into a global hourly/synoptic data set, and then into daily and monthly summaries. China has officially reported over 3000 deaths and over \$20 billion (U.S. dollars) in damages. The web page is accessible via <http://www.ncdc.noaa.gov/ol/reports/weather-events.html>.

Contact: NCDC

## Data products and services

### Urban heat-island publication

A paper titled "Satellite-based adjustments for the urban heat-island temperature bias" by K. Gallo (ORA) and T. Owen (NCDC) has been accepted for publication by the *Journal of Applied Meteorology*. The paper includes the development of monthly and seasonal relationships between urban-rural differences in temperatures measured at surface-based observation stations, and satellite-derived (AVHRR) estimates of a normalized difference vegetation index (NDVI) and surface radiant temperature (Tsfc). A comparison of the satellite-based estimates of the urban heat-island (UHI) bias with population-based estimates of the UHI bias indicated similar levels of error. The use of satellite-derived data may contribute to a globally consistent method for analysis of the urban heat-island bias.

Contact: NCDC

#### CONTACT POINTS

National Climatic Data Center (NCDC)  
704-271-4800  
Fax: 704-271-4876  
E-mail: *Climate Services - orders@ncdc.noaa.gov*  
*Satellite Services - satorder@ncdc.noaa.gov*  
WWW: <http://www.ncdc.noaa.gov/>

National Geophysical Data Center (NGDC)  
303-497-6419  
Fax: 303-497-6513  
E-mail: [info@ngdc.noaa.gov](mailto: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](mailto:services@nodc.noaa.gov)  
WWW: [http://www.nodc.noaa.gov](http://www.nodc.noaa.gov/)

NOAA Environmental Services Data Directory  
301-713-0572  
(Gerry Barton)  
Fax: 301-713-1249  
E-mail: [barton@esdim.noaa.gov](mailto:barton@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](mailto:reference@nodc.noaa.gov)  
WWW: <http://www.lib.noaa.gov/>

### GEBCO grids for coastal regions

The National Geophysical Data Center (NGDC) provided the U.S. Naval Oceanographic Office with a preliminary version of the U.S. West Coast Coastal Relief Model. The data will be used in the beginning versions of the General Bathymetric Chart of the Oceans (GEBCO) grids for coastal regions of the world. GEBCO has long produced bathymetric contours of the world's oceans, but generally has not provided details for the continental shelves. Due to the increased importance of these regions, in terms of climate, commerce, and resources, GEBCO is undertaking the generation of gridded relief models.

Initial grid size will be two arc-minutes of latitude and longitude. NGDC is generating a much more detailed three arc-second Coastal Relief Model for the coastal United States. Therefore, the preliminary grids of the West Coast were the ideal starting point for GEBCO gridding in that region.

Contact: NGDC

### Storm Database online

The National Climatic Data Center has developed a Storm Events Database and placed it online. The National Weather Service (NWS) paradox database is used. Users can select by state, begin time, type of storm, then further refine the search to Fugita scale tornadoes, hail size, wind speed, dollar amount of damage, etc. Query results give city or county, date, time, type, magnitude, deaths, injuries, amount of property damage, and amount of crop damage. The events data base was in response to requests received at a NEXRAD users workshop and currently resides in the NCDC Spotlight and the NCDC Radar Resources page.

Contact: NCDC

### Ohio earthquake coverage

NGDC was contacted by more than 20 media representatives regarding the magnitude 5.4 earthquake in Ohio on September 25. Several interviews were conducted with television and radio stations in the Cleveland and Detroit areas. Many people were interested in the effects of the earthquake and the possibility of aftershocks. This was the largest earthquake ever recorded in the United States between the Great Plains and the Appalachian Mountains north of Tennessee.

Contact: NGDC

**Polar data, from page 4**

around and do a lot of pre-processing to get them all in a useful form. The benefit of these Polar Pathfinder data and the P-Cube is that that step has been accomplished."

"Also, Polar Pathfinder data address areas not so intensely observed as other parts of the globe," Flato continues. "The Arctic has been largely overlooked. There are very little data on the three-dimensional state of the Arctic—by that I mean the ice cover and the atmosphere above it. So it's hard to assess the way clouds behave, or the way clouds and radiation interact in the Arctic, which may be quite different from the way they do in the tropics. These are rich data sets that are going to see a lot of use."

It's clear that investigators dealing with large-scale atmospheric changes, surface heat and mass balance studies, and sea ice modeling, will welcome the

Polar Pathfinder data. The Polar Pathfinder Sampler will be distributed (free) at the January 1998 meeting of the American Meteorological Society. To order a copy, please contact:

NSIDC User Services  
nsidc@kryos.colorado.edu  
Campus Box 449  
University of Colorado  
Boulder, CO 80309-0449 USA  
Telephone: +1 303-492-6199  
Fax: +1 303-492-2468 ■

**Surface temperature, from page 9**

Method: Maximizing Station Density for the Calculation of Long-term Global Temperature Change. *J. Geophys. Res. (Atm.)*, in press.

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Smith, T.M., R.W. Reynolds, R.E. Livezey, and D.C. Stokes, 1996: Reconstruction of historical sea surface temperature using empirical orthogonal functions. *J. Climate*, 9, 1403-1420. ■

**1998 hurricanes, from page 9**

served in the month of October.

During the 1998 season, NOAA scientists, working with NASA and University collaborators, conducted the most complete and sophisticated campaign of observations in hurricanes ever, noted Hugh Willoughby, director of NOAA's Hurricane Research Division. "In Bonnie, Danielle and Georges, we had six or seven aircraft observing the same hurricane simultaneously," Willoughby said. "Advanced observational instrumentation and remote sensing technology aboard NOAA's Gulfstream-IV high altitude jet and WP-3D airplanes make each of these platforms an airborne laboratory, vastly more capable than those flying just a couple of decades ago. We can study and under-

stand hurricanes on all scales, from a single raindrop to hemisphere-wide winds that control the storm's motion."

For more information on hurricanes and the season summary, consult the NHC home page at <http://www.nhc.noaa.gov>. For current "El Niño/La Niña Forecasts and Outlooks" and "Special Climate Summaries" that include this year's hurricane activity, check <http://nic.fb4.noaa.gov>.

For background on Hurricane Mitch, consult NOAA's National Climatic Data Center Web site (Mitch: The Deadliest Atlantic Hurricane Since 1780) at <http://www.ncdc.noaa.gov/ol/reports/mitch/mitch.html>. For more information about hurricane research, visit the following Web page: <http://www.aoml.noaa.gov/hrd/HFP98/index.html>. ■

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