

# EARTH SYSTEM MONITOR

## Enhancing NOAA's image

### *Imagery in print, on walls, and on the World Wide Web*

A guide to  
NOAA's data and  
information  
services

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at NODC

Peter W. Sloss  
Marine Geology and Geophysics Division  
National Geophysical Data Center  
NOAA/NESDIS

The National Geophysical Data Center (NGDC) is using imagery to heighten public awareness of earth science data and to create new products for scientific and educational uses. Examples of NGDC graphics described below demonstrate the diversity of our data holdings and the importance of those data to science, education, and commercial interests.

Images produced for NGDC are popping up in many places, some because we put them on our World Wide Web (WWW) site, and some

because someone liked what they saw elsewhere. Solicited graphics have appeared, with appropriate credit lines, in U.S. and international publications, including *National Geographic*, *Scientific American*, *Geo*, *Newsweek*, and *Encyclo- paedia Britannica*.

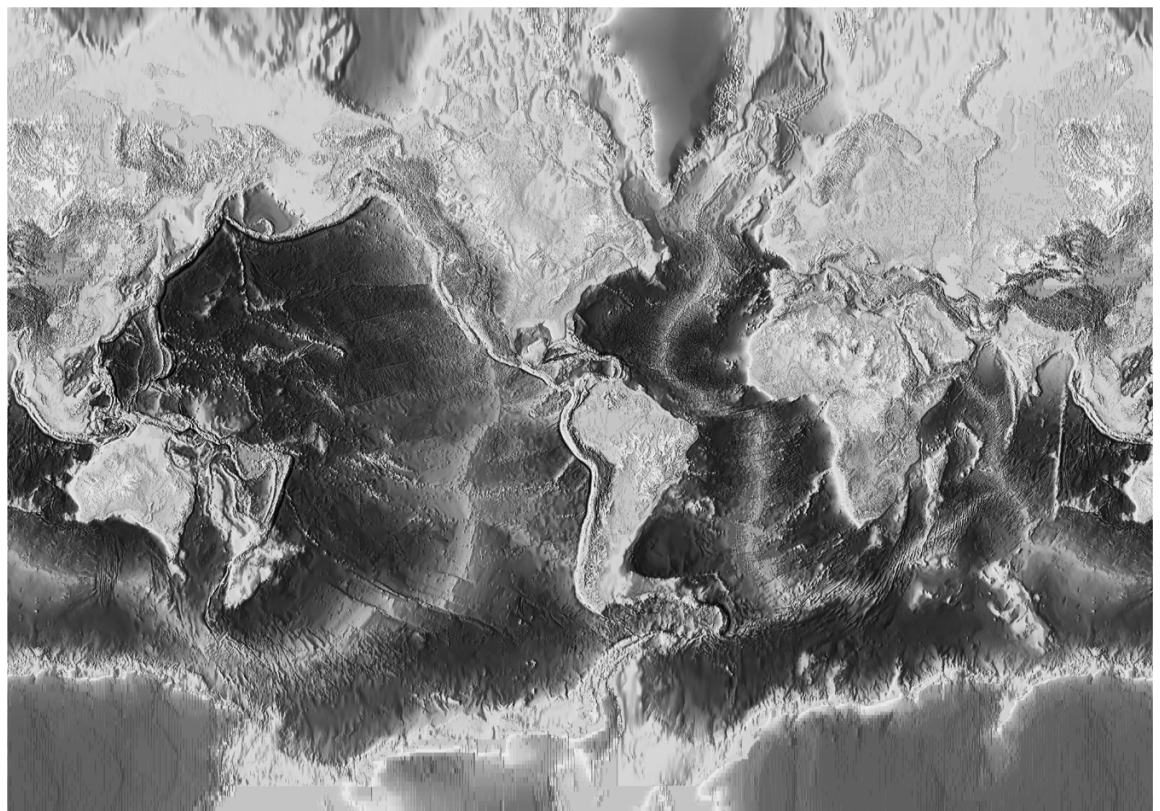
On computer media, credited illustrations were supplied for the award-winning *Small Blue Planet* CD-ROM by NowWhat Software and for Microsoft's *Oceans* CD-ROM. The Weather Channel used a NGDC relief image on the back cover of their 1994 calendar. The PBS television series *Newton's Apple* needed relief images for a segment on late-Cretaceous species extinctions. As examples of more exotic locations for NGDC imagery, relief globes have appeared on the cover of an internal report on the Secretary of Energy's travels, seen fleetingly on the evening TV news, on the cover of an Italian refrigeration-equipment catalog, and in a syndicated comic strip. Icons made from NGDC globe images appear on

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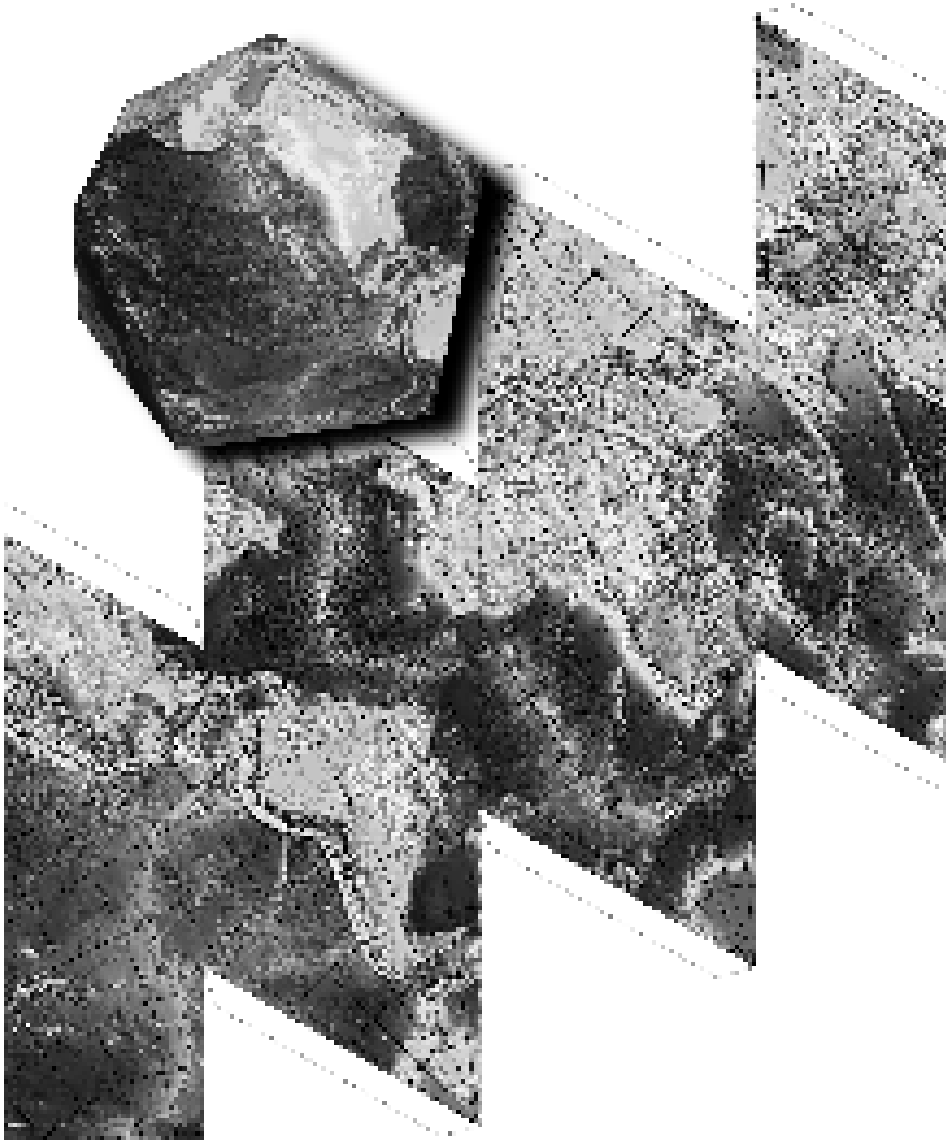
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U.S. DEPARTMENT  
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National Oceanic  
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Administration



▲ Figure 1. Mercator-projection shaded relief image of global topography. Modeled illumination is from the west, with shading based on a logarithmic function of slope to emphasize smaller features. Data resolution is 5 minutes of latitude and longitude (about 8 km at the equator).



▲ Figure 2. The Icosahedron Globe as it would appear when assembled.

#### NOAA's image, from page 1

diverse Web pages to indicate world-wide coverage. The Swiss shareware program *Home Planet* uses a NGDC relief map as a background for its world-time display.

Without the resources of a specialized graphic arts department or Hollywood-style multiprocessor graphics workstations, there are still many reasonably-priced choices of powerful software for desktop personal computers that can manipulate images, turn data into 3D graphics, and compose everything into film-ready color separation files or digital images for the Web. Topographic data are one of the most "imagable" types and form the basis for the graphics presented here. The following are a few basic image types that work well with topographic data.

#### Planar color-shade relief maps

These products started with digital raster elevation data from ETOPO5<sup>1</sup> that were processed into color-shaded relief imagery. Homegrown software was written to compute color according to a predetermined algorithm representing elevation as hues and slope as brightness on a specified geometric projection. A nonlinear brightness function allowed smaller slopes to remain visible without overemphasizing the high relief areas. Products made using this technique were *Surface of the Earth*<sup>2</sup> (Report MGG-5) poster (Figure 1) and the *Surface of the Earth Icosahedron Globe*<sup>3</sup> (Figure 2). The Icosahedron has proven very popular with educational users, and the first printing of 7500 copies was used up in just a few months; 3000 copies of the

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## 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 should be directed to the Editor, Sheri A. Phillips. Requests for subscriptions and changes of address should be directed to the Associate Editor, Nancy O'Donnell.

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U.S. DEPARTMENT OF COMMERCE  
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### OAI Science Management Office newsletter call for articles

The Ocean Atmosphere Ice Interaction Science Management Office (OAI) located in the Center for Coastal Physical Oceanography at Old Dominion University, Norfolk, Va., requests articles, photographs and figures for their annual newsletter, *ARCSS-OAI*. Submissions to *Arctic System Science-AOII*, if appropriate, may also be posted to the OAI Home Page. For further information about length, style or format, contact [anne@ccpo.odu.edu](mailto:anne@ccpo.odu.edu), [lou@ccpo.odu.edu](mailto:lou@ccpo.odu.edu) or write Anne S. West-Valle, CCPO, Old Dominion University, Crittenton Hall, Norfolk, VA 23529.

### NCDC participates in South American climate data meeting

Ken Davidson, director of the National Climatic Data Center, chaired a World Meteorological Organization meeting held in Buenos Aires, Argentina in April 1996. The meeting looked at the monitoring of climate messages and products transmitted over the Global Telecommunication System. For the past year, NCDC has studied the transmissions from South America and has dramatically increased the flow of data through intensive training and request efforts in cooperation with Argentina.

### NODC exhibits at TOS scientific meeting in Amsterdam

Oceanographers Don Collins and Mary Hollinger represented the National Oceanographic Data Center at the Sixth Scientific Meeting of the Oceanography Society in Amsterdam, The Netherlands on July 8-11, 1996.

Demonstrations were provided using two notebook PCs: one displayed a slide show simulation of the NODC Website, the other displayed a slide show presentation "NODC: 35 Years of Ocean Data Service."

The keynote speaker for the conference was NOAA Administrator Dr. D. James Baker, who spoke on "Our World and the Sea: Global Change and Global Security."

### Conference on environmental degradation scheduled

The Skies Above Foundation and co-sponsoring partners will hold an interdisciplinary conference on Vancouver Island in British Columbia, Canada, April 30-May 3, 1997. The conference will focus on envi-

## News briefs

ronmental degradation: ozone layer depletion, increased ultraviolet radiation, climate change, water and air pollution.

For more information, please contact Conference Chair, Bruce Torrie, Skies Above Foundation, 2701 Seaview Road, Victoria, British Columbia, Canada, V8N 1K7, (604) 477-0555, e-mail: [skies@islandnet.com](mailto:skies@islandnet.com).

### NOAA hosts WebShop '96

NESDIS was well represented at WebShop '96 held in Silver Spring, Md., June 26-28. Peter Sloss, of the National Geophysical Data Center, presented a paper "Browser Bruising—Things that Go Bump in the Net," that addressed the problems in making a Web Page "look good on several different computer systems." Ethan Davis and Eric Kihn presented two papers: "Space Physics Interactive Data Resource (SPIDR)" and "Data Visualization on the Web Using an IDL Server." Other papers presented were "NOAA, the Web, and Education" by Ted Habermann; "Pictures and Words on the Web: Comprehensive Image and Caption Presentation System" by Kevin Frender, Ted Habermann, R. Fozzard and K. Tanaka; and "Exploring Personal Web Sites as the Next Step in NOAA Web Development" by Ted Habermann and Rich Fozzard.

In addition, Chris Haggerty, National Snow and Ice Data Center, presented NSIDC's work on Eurasian glacier inventory in a session on database access. NSIDVC plans to adopt some of the technologies presented by other NOAA facilities. These would include online data visualization and possibly a Java interface to the glacier inventory.

### NCDC assists Virginia middle school science curriculum

The National Climatic Data Center was contacted by the Summer Productions Company in Virginia for help in the development of a national middle school science curriculum entitled *Assignment Discovery*. The company takes past episodes of Discovery Channel programs and transforms them into interactive classroom study material. The NCDC's role will be to update climatological data previously presented in the programming. Data from

NCDC Storm Data publications and Research Service Group Technical Reports were provided.

### NESDIS prepares for Eco-Informa '96 Conference on global networks

The NESDIS national data centers and Satellite Archive will be presenting papers and demonstrating interactive online sessions at the Eco-Informa '96 Conference: Global Networks for Environmental Information at Lake Buena Vista, Florida, November 4-7, 1996.

Included in the presentations will be web sites, home pages, *in situ* and remote data and information on NODC CD-ROM products. In addition, the NOAA Library will give a special demonstration of Internet search strategies distributing reports and brochures.

For more information, see the Eco-Informa WWW site at : <http://www.erim.org/CONF/ECOINF/ECO.html>.

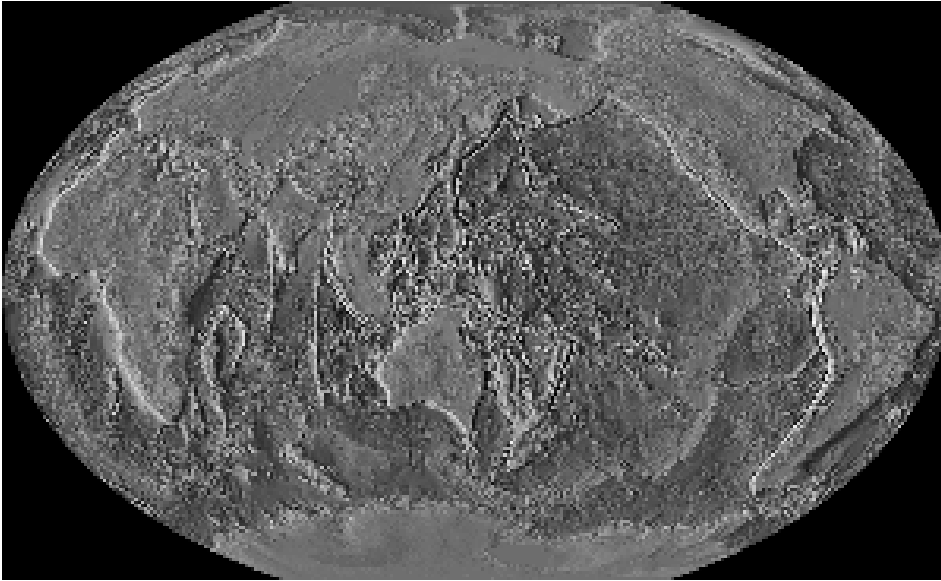
### Nature museum features NGDC earthquake CD-ROM

The National Geophysical Data Center's two-volume earthquake CD-ROM collection is being featured by *Nature* magazine in an exhibit at the museum in their London, England headquarters. The exhibit shows various earthquake displays created using the GeoVu software. The public is attending in records numbers, up 78% compared to last year according to museum staff.

NGDC personnel worked with editors and graphic artists at *Nature* in preparation for this exhibit which began July 1 and continues throughout the summer.

### Mariners Weather Log continues publication

The Spring 1996 issue of the *Mariners Weather Log* resumed publication of this highly-acclaimed NOAA publication. NOAA's National Weather Service has taken the lead for production of the *Log* with support from the NOAA National Environmental Satellite, Data, and Information Service and the U.S. Navy. Founded in 1957, the *Log* is a quarterly publication providing information for mariners, shipboard weather observers, and others whose lives and livelihoods depend on knowledge of the sea. Subscriptions are \$12/yr. For information, contact the Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.



▲ Figure 3. Winkel-Tripel projection shaded relief map for a *National Geographic* article on global tectonics.

#### **NOAA's image, from page 2**

larger Mercator poster have been distributed since its introduction in 1994.

Both publications used the same shading algorithm, but the map projections used were Mercator for the poster and gnomonic for the Icosahedron (with a different projection reference pole for each of the 20 triangular facets). All of these projects went from concept to final files on a desktop Macintosh computer. The *Earth's Fractured Surface* map (Figure 3) published as a folded insert in *National Geographic* (April 1995) used the same shading algorithm as the images in Figures 1 and 2, but the color palette was specified by National Geographic Society cartographers to correspond to their standards. Annotations and identifiers were added to the base image file at the *National Geographic* computer compositing system.

#### **Textured surfaces**

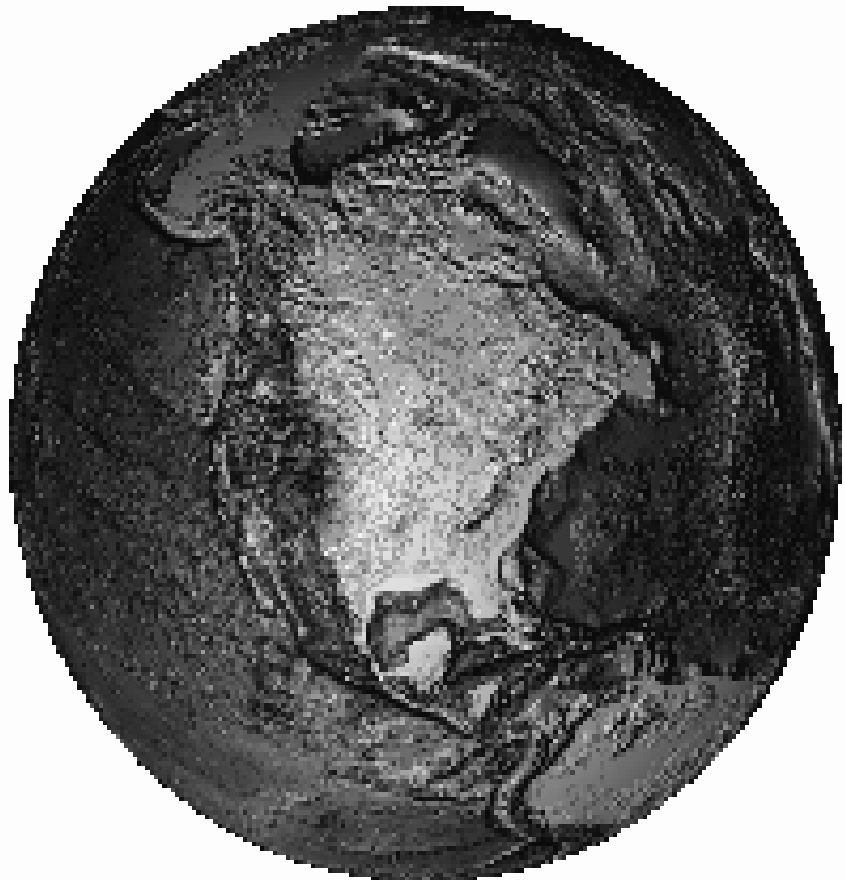
Desktop PC software can render global views using texture mapping to simulate the lighting of topography and to apply a specific coloration to the simulated landscape. While these programs can produce a stereoscopic pair of images from any 3D modeled object, the mapped texture is revealed to be painted on a smooth surface. The computational rationale for this is obvious — there are far fewer surface polygons to be computed on a smooth sphere than there would be if the surface

model actually represented the true shape of the topographic relief. The shading algorithms that give the appearance of relief shading operate on only a few hundreds of polygons to represent the sphere, rather than the

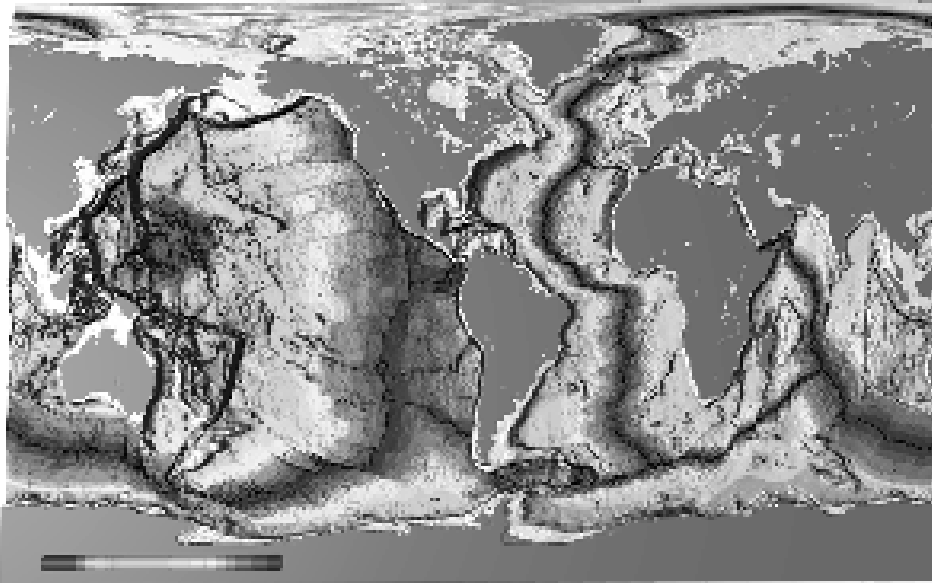
millions necessary to model the actual physical surface. On the simplistic smooth sphere, only the colors are changed to represent lighting, although the modeled effects can include reflective surfaces, transparency, and multiple light sources. Figure 4 shows one of the 14 global topographic images from *Views of the Globe*<sup>4</sup> (Report MGG-10). A sun-glint area is visible near the center because the modeled surface was given some specular reflectivity.

#### **True perspective**

The most intensive rendering computations are involved in perspective views of a polygon-modeled surface. NGDC has a new poster in preparation that uses 2.9 million polygons to represent the age of crustal material on the ocean floor draped over world topographic relief<sup>5</sup> (Figure 5). As with the globe view shown in Figure 4, this image incorporates some reflectivity to give the appearance of a physical material such as a vacuum-formed plastic relief map. The same 3D rendering software can be used to create close-up



▲ Figure 4. Shaded-relief globe with surface texture mapping on a smooth sphere. ETOPO5 elevation data resampled to about 10-minute resolution.



▲ **Figure 5.** True-perspective view of relief colored with ocean crustal age bands. Note that the apparent tilt of topographic features depends on their distance from the view's center. To be published as a 24"x36" NGDC poster.

views of the ocean floor, for example, a 1-degree-square area of the Gulf of Mexico being investigated for methane seepage (Figure 6).

#### Images on the Web and on request

Previews of many of these printed graphical products are available on NGDC's Web Site at <http://www.ngdc.noaa.gov/mgg/image/images.html>. Also included here are experimental items such as an animated fly-over of the Great Lakes and rotating global images. Computer image formats are chosen for multi-platform compatibility so that no user is excluded from access by computer type (PC, Mac, UNIX) or Web browser (Netscape, Mosaic, America On-Line, MS Internet Explorer). Please see other NGDC Web pages for more graphics. For example, visit the Defense Meteorological Satellite Program image archive in our Solar-Terrestrial Physics Division site at <http://www.ngdc.noaa.gov/dmsp/>.

Printed materials range in size from 24"x24" for the *Views of the Globe* poster to 32"x43" for the *Surface of the Earth* poster. Special requests have included a wall-size blowup of the latter (printed in three 8-foot strips on a commercial ink-jet plotter), and film transparencies of many images for classroom or publication use. The Intergovernmental Oceanographic Commission (IOC) has been supplied with full-size CMYK color separation films for the cover of the Pacific

volume of their ocean atlas series. Increasingly, outside and NOAA-based publishers have been requesting computer files rather than film or hard copy for reproduction.

#### Other projects

Cooperative projects with organizations such as the National Geographic Society, the Scripps Institution of Oceanography, and various consortia will continue to present opportunities for new and colorful displays of just how much data and expertise we have

in NOAA, NESDIS, and NGDC. Watch our Web site and printed circulars for announcements. For further information and special requests, contact the author at NGDC:

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#### Notes

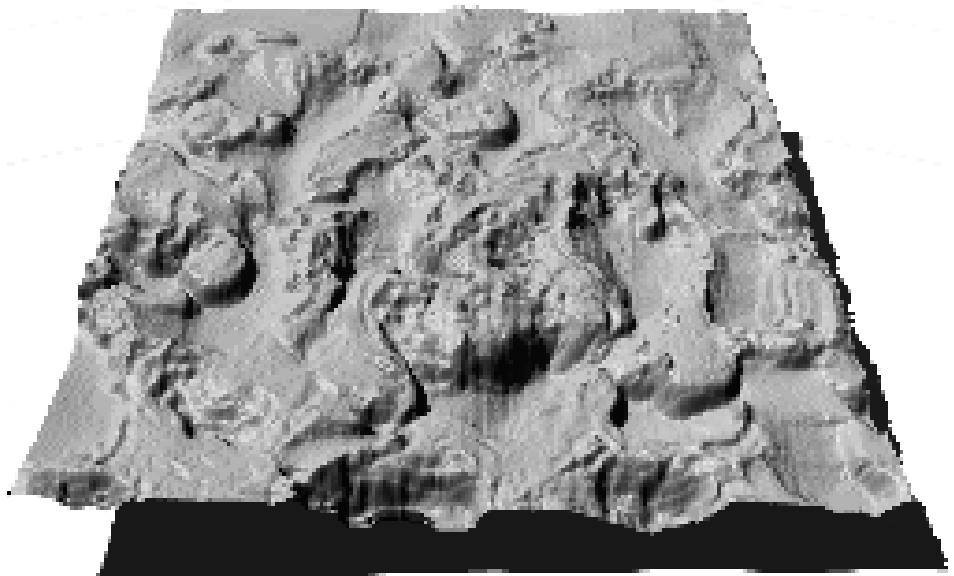
<sup>1</sup> 5-minute gridded global topographic data from US Naval Oceanographic Office, Defense Mapping Agency, and others. See details on the Web at: <http://www.ngdc.noaa.gov/mgg/global/seltopo.html>

<sup>2</sup> See [http://www.ngdc.noaa.gov/mgg/announcements/announce\\_surface.html](http://www.ngdc.noaa.gov/mgg/announcements/announce_surface.html)

<sup>3</sup> See [http://www.ngdc.noaa.gov/mgg/announcements/announce\\_icosahedron.html](http://www.ngdc.noaa.gov/mgg/announcements/announce_icosahedron.html)

<sup>4</sup> See [http://www.ngdc.noaa.gov/mgg/announcements/announce\\_map10.html](http://www.ngdc.noaa.gov/mgg/announcements/announce_map10.html)

<sup>5</sup> See <http://www.ngdc.noaa.gov/mgg/global/crustage.HTML> ■



▲ **Figure 6.** Oblique view of Gulf of Mexico floor, generated from NOS gridded multi-beam soundings. Data resolution was 250m. Images on the WWW and on request.

# Coastal environmental quality

## *NOAA's NS&T Program presents results from the Mussel Watch Project*

A. Y. Cantillo, T. P. O'Connor,  
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*Coastal Monitoring Branch  
Office of Ocean Resources Conservation  
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NOAA/NOS*

In response to the need for information on effects of human activities on environmental quality in coastal and estuarine areas, and the need to develop management strategies to deal with these conditions, NOAA initiated, in 1984, the National Status and Trends (NS&T) Program for Marine Environmental Quality. The purpose of this program is to determine the status and detect changes in the environmental quality of our Nation's estuarine and coastal waters. The NS&T Quality Assurance Project is one of the seven components of the Program and applies to the two monitoring projects: the National Benthic Surveillance Project (NBSP) and the Mussel Watch Project (MWP).

The NBSP collected and analyzed benthic fish and sediments from sites around the coastal and estuarine United States, including Alaska. This effort was performed primarily by NOAA's National Marine Fisheries Service. The MWP collects and analyzes bivalve mollusks and associated sediments from around the United States, including the Great Lakes, Alaska, Hawaii, and Puerto Rico. This effort is administered by NOAA, with collection and analyses being performed under contract.

From 1986 through 1994, the Geochemical and Environmental Research Group, Texas A&M University, College Station, Tx., collected and analyzed samples from the Gulf Coast. During this time, Battelle Memorial Institute, Duxbury, Mass., and Sequim,

Wash., collected and analyzed samples from the U.S. East and West Coasts, including sites in the Hawaiian Islands and Alaska. During 1986-1989, samples from along the California and Hawaiian coasts were collected and analyzed by Science Applications International Corporation, Inc. The analytes include 24 polycyclic aromatic hydrocarbons, 20 polychlorinated biphenyl congeners, DDT and its metabolites, nine other chlorinated pesticides, organotins, five major elements, and twelve trace elements. Sampling sites and analytical protocols are described in several NOS/ORCA publications.

The elements are all potential contaminants in the sense that their concentrations in the environment have been altered by human activities. The organic groups include chlorinated pesticides, polychlorinated biphenyls, and tributyltin, all of which are totally synthetic products of human invention. Another group of organic compounds, the polycyclic aromatic hydrocarbons, are like metals in the sense that they occur naturally, but their environmental concentrations have been enhanced by human activity. All of these chemicals can, at sufficiently high concentration, pose a hazard to wildlife and to humans. In recent years the list of chemicals has been expanded to include contemporary pesticides with sufficiently high tendencies to accumulate in the mollusks.

### Quality assurance

Long-term monitoring studies, whether local, regional, or global, require that data of known quality be generated by all participants. These data must be comparable to one another, be traceable to a common reference point, and meet data quality parameters needed to substantiate the conclusions of the monitoring program. The quality of the analytical data generated by the NS&T Program is overseen by the performance-based Quality Assurance Project. This Project has been in operation since 1985 and is designed to document sampling protocols, analytical procedures and laboratory per-

formance, and to reduce intralaboratory and interlaboratory variation. In addition, the QA Project facilitates comparisons among different monitoring programs with QA activities and thus extend the temporal and spatial scale of such programs.

To document laboratory expertise, the QA Project requires that all NS&T laboratories participate in a continuing series of intercomparison exercises utilizing a variety of materials. The organic analytical intercomparison exercises are coordinated by the National Institute of Standards and Technology and the inorganic exercises by the National Research Council of Canada.

### Sampling sites and methods

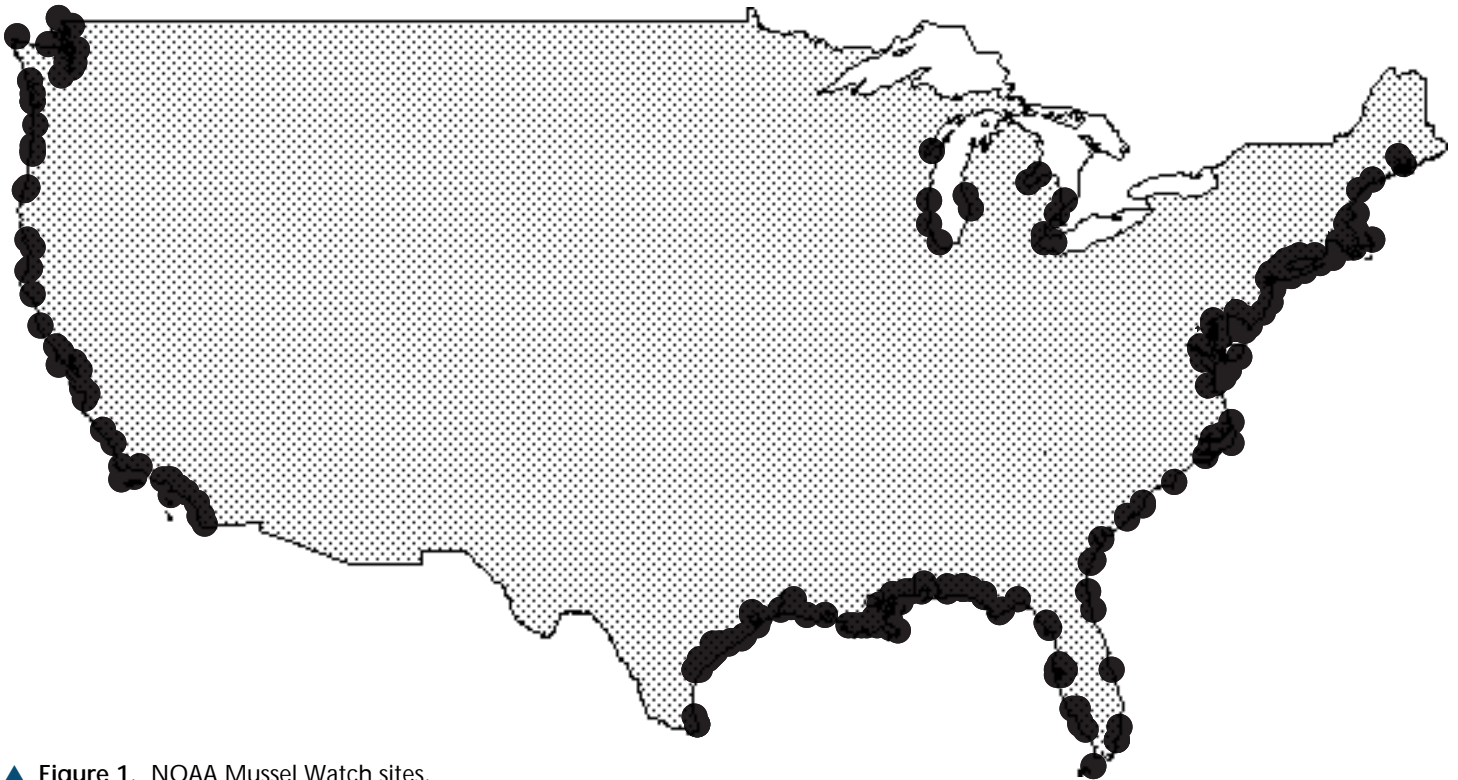
The NS&T Mussel Watch Project is designed to represent chemical distributions over national and regional scales. Therefore, it is important for sampling sites to be representative of rather large areas rather than the small-scale patches of contamination commonly referred to as "hot spots." To this end, no sites were knowingly selected near waste discharge points. Furthermore, since the Mussel Watch Project is based on analyzing indigenous mussels and oysters, a site must support a sufficient population of these mollusks to provide annual samples.

There are 300 sites currently sampled as part of the NS&T Mussel Watch Project (Figure 1). At each site, bivalves and sediments are collected from three stations at each site (a station is generally within 100 m of a site center). The bivalves are dredged or picked in intertidal to shallow subtidal zones, brushed clean, packed in dry ice, and shipped to the analytical laboratory. Once in the laboratory, tissue and sediment samples are composited from each site before being analyzed. Each mussel composite contains 30 individuals and each oyster composite contains 20 individuals, while each sediment composite is made from three samples.

The composites are analyzed for concentrations of organic and metal contaminants. Nationwide, data are collected for several species of bivalves:

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▲ Figure 1. NOAA Mussel Watch sites.

blue mussels (*Mytilus edulis*) from the U.S. North Atlantic, blue mussels (*Mytilus sp.*) and California mussels (*M. californianus*) from the Pacific coast, eastern oysters (*Crassostrea virginica*) from the South Atlantic and the Gulf of Mexico, smooth-edge jewelbox (*Chama sinuosa*) from the Florida Keys, Caribbean oyster (*C. rhizophorae*) from Puerto Rico, tropical oysters (*Ostrea sandvicensis*) from Hawaii, and zebra mussels (*Dreissena polymorpha*) from the Great Lakes.

#### Data availability

There are currently nine years of NS&T data and trends in the concentrations of analytes can be determined. The first eight years of data from collection and analysis of mussels displayed clear evidence, on a national scale, of decreases in concentrations of: chlorinated hydrocarbons, whose use has been banned; tributyltin, whose use as an antifoulant on recreational boats has been banned; cadmium and arsenic, whose uses have been severely curtailed; and copper, whose use has not decreased but whose discharges apparently have diminished. For other chemicals there was no evidence for decreasing or increasing trends in concentration.

Sediment data describe the status, or spatial distribution, of contamination on a national scale. The molluscan data, on the other hand, are used primarily to describe and follow temporal trends in contaminant concentrations. Published results indicate that high levels of chemical contamination are generally limited to relatively small areas near urban centers, that concentrations are decreasing for chemicals whose use has been banned or severely curtailed, and that no measured chemicals exhibit increasing trends.

#### Correlations between concentrations and population

The overall concentration distributions for each chemical in sediment are approximately log normal, and "high" concentrations were defined as those exceeding the mean plus one standard deviation of the log normal distribution. Those "high" concentrations are useful for comparisons within the NS&T data set and with other reports on sediment contamination. The "high" concentrations in units of microgram/gram (ug/g) of dry fine-grained sediment for each contaminant are (in parentheses): Ag (1.2), As (24), Cd (1.2), Cr (230), Cu (84), Hg (0.49), Pb (89), Sn (8.5), Zn (270), total PAHs

(3.9), DDT and metabolites (0.037), and total PCBs (0.20).

There is a correlation between concentrations of most of these chemicals and numbers of people (1990 data from the U. S. Census Bureau) living within 20 km of each site. This simply means that, in general; human activity accounts for most of the high concentrations. There are a few exceptional trace elements (e.g., As, Cr, and Ni) where the high concentrations are not associated with human activities.

#### Temporal trends

Chemical concentrations in mussels and oysters are determined by the extent to which the organisms accumulate chemicals from the food they filter from their surrounding water and from the water itself. When chemical concentrations increase or decrease in their surroundings, the organisms are capable of increasing or decreasing the corresponding concentrations in their tissues. This, and the fact that they are immobile, make them ideal for monitoring temporal trends, i.e. correlation between concentration and time.

The trends sought in the Mussel Watch data were correlations between concentrations and year for the years of

– continued on page 14

# National Climatic Data Center's very eventful year

## *A new complex and a line of new online products, CD-ROMs, and publications*

Neal Lott

Climate Services Division

National Climatic Data Center

NOAA/NESDIS

The past fiscal year has been a busy and eventful one at the National Climatic Data Center in Asheville, NC. After moving into our new facility in the spring of 1995, we became very comfortable and accustomed to our new surroundings. Despite the disruption, there were many advances and additions in our products, and we hope our customer and research communities have benefited from what we've accomplished. This article provides a brief review of NCDC online products and services, CD-ROM, articles and reports published, and satellite data services.

### CD-ROM products

Recently added or updated: NCDC CD-ROM products include the following:

- International Station Meteorological Climate Summary (ISMCS) Version 4.0: this CD-ROM now provides detailed climatological summaries for 2600 locations worldwide. These locations include National Weather Service stations, domestic and overseas Navy/Air Force sites, and numerous foreign stations. Limited summaries are also given for approximately 5000 other worldwide sites.

Tabular and statistical data can be exported to a printer or spreadsheet and some of the tables can be bargraphed. Version 4.0 (released in Sep 96) adds 400 new foreign stations, precipitation tables for 1100 foreign stations, and updated U.S. station summaries through 1995.

- Global Upper Air Statistics: this CD-ROM uses 16-year (1980-1995) 2.5-degree gridded upper air summaries derived from the European Centre

for Medium-Range Weather Forecasts (ECMWF) model analyses. The CD presents upper air statistics for 15 different vertical levels in the Northern and Southern Hemisphere for dry bulb and dewpoint temperature, geopotential height, air density, and vector and scalar wind speed.

The previously completed 'atlas' CD (Global Upper Air Climate Atlas—'GUACA') provided access/display software, contouring capability for user-defined areas, and vertical profiles for 1980-1991. This new CD simply provides the ASCII data (no graphic interface) for users desiring quick/easy access to the data files, and adds the 1992-95 period.

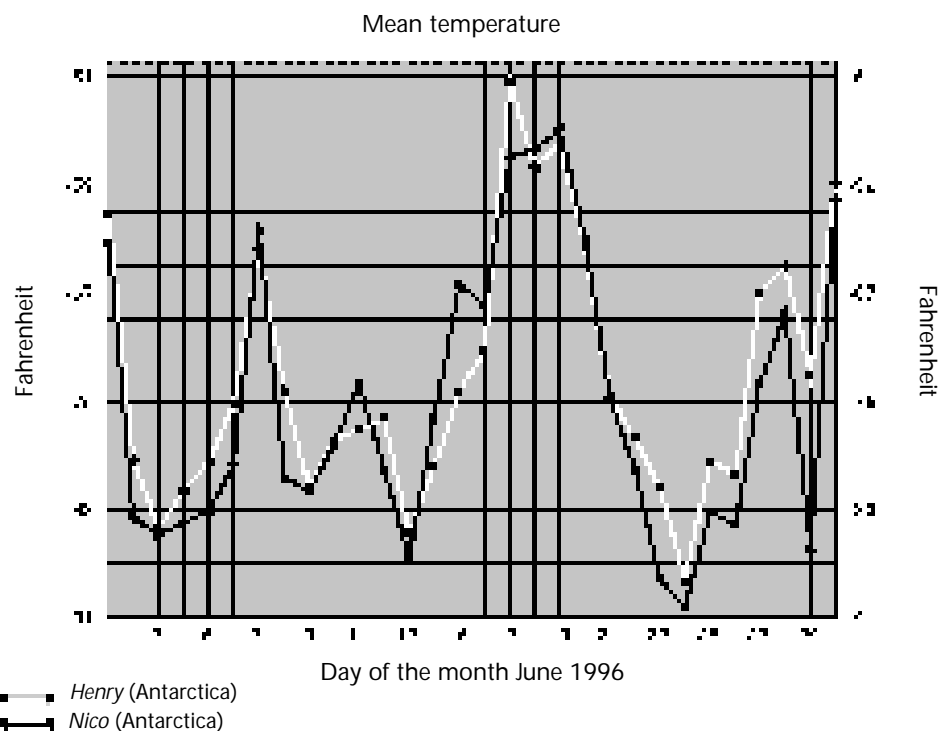
- Global Tropical and Extratropical Cyclone Climatic Atlas (GTECCA) Version 2.0: this CD-ROM (released in September 1996), as its predecessor, contains global tropical storm track data from as early as the 1870's through 1995 for the five tropical storm basins, along with northern hemispheric extratropical storm track data for 1965-1995. The new version has

updated global track data through 1995 along with several added functions, such as plot capability by Saffir-Simpson category. Also, narratives for tropical storms from the 1950s to present, narratives for extratropical storms since 1980, and basin-wide climatology graphics have been added.

As before, the tropical track data includes time, position, and storm stage (maximum wind, central pressure when available). The user is even able to select storm tracks passing within a user-defined radius of any point.

- Coastal-Marine Automated Network (C-MAN) Station and Buoy Reports and Summarized Elements (SeaBreeze): A new 2-volume CD-ROM set containing climatic summaries and archived observations measured by National Data Buoy Center (NDBC) moored buoys and C-MAN stations for 197 sites. The period of record generally covers a 3- to 20-year period depending on the station and ends with December 1993.

The CD-ROM set consists of archived observations and climatic summary tables. All measurements are



▲ Figure 1. Gray scale rendition of Antarctic station data plotted utilizing NCDC's popular CLIMVIS (Climate Visualization) System.

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included except for spectral wave data and subsurface measurements. A map shows the station locations, and data inventories show measurements and time periods for each station.

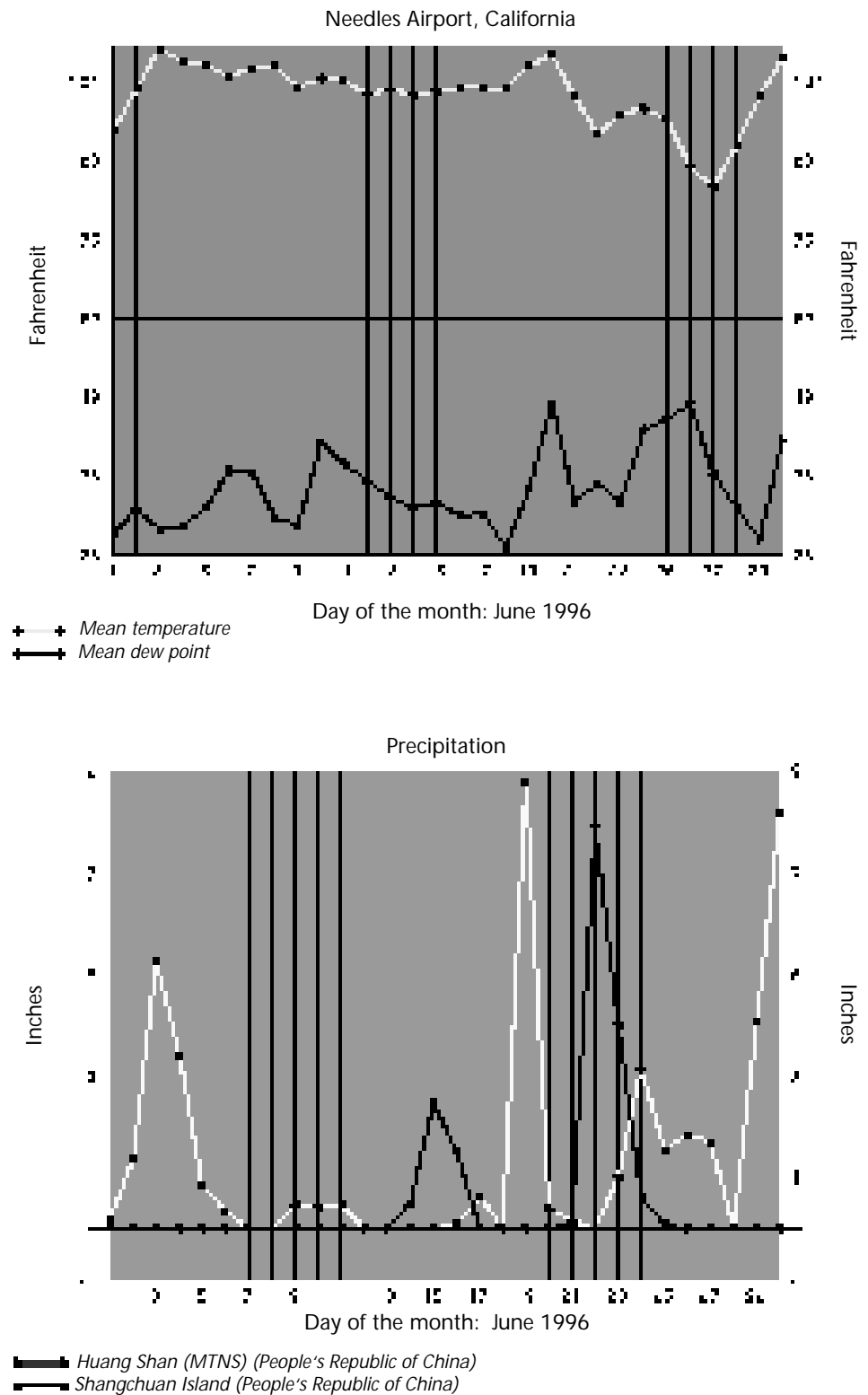
The following elements are summarized into monthly frequency distributions: Wind speed, wind gust, sea level pressure, air and sea temperature, air-sea temperature difference, dew point (where available), significant wave height, and the average and dominant wave period. Additional tables include: Wind speed versus direction, significant wave height versus dominant and average wave periods, and significant wave height versus wind speed. We've also included the individual monthly means and extremes for all measurements.

• NOAA Weather Charts Via CD-ROM Subscription: A new series available as a subscription (one year basis only) or as individual copies and containing numerous types of weather charts. They are archived as PCX files on a monthly basis and serve as a continuation of NCDC's microfilm archive. The series includes monthly CD editions of: Surface and Upper Air Weather Charts; Initial Analysis and Forecast Charts; and Tropical Strip/Precipitation and Observed Weather Charts. They're available approximately eight weeks after the close of the data month. Subscription orders begin with the February 1996 charts, and the period since October 1994 will also be added.

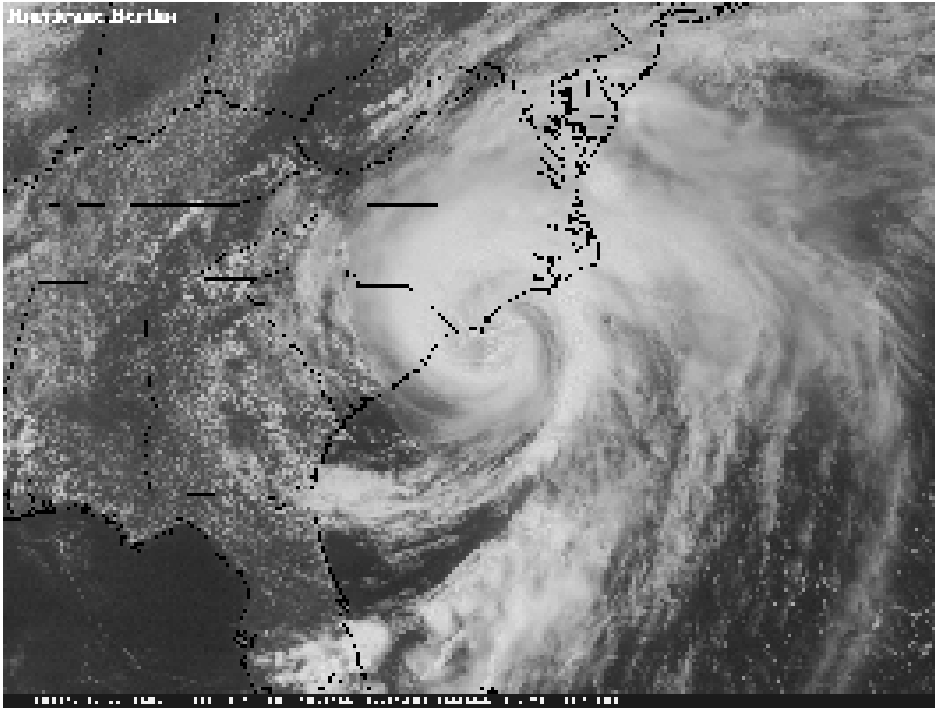
It is important to note that NCDC CD-ROM products were initially produced to be used in a DOS PC environment and will usually not work in a Macintosh environment. However, they will usually work in a Windows environment if the user goes to the DOS prompt to access the CD. Also, NCDC has help sheets for users, including those now using Windows-95. A CD-ROM help desk has been established (704-271-4702) for answering users' questions after they've ordered and received a CD. The basic cost of the CD-ROMs is \$120 per CD (+ \$5 service charge) although discounts are provided for larger volume orders.

**Online products and services**

The following are several products and services that were added (or had - continued on page 10



▲ **Figure 2.** Sample renditions of climatic data graphics demonstrating different parameters that may be color plotted with CLIMVIS. The upper plot was generated from data collected at Needles Airport, Calif; the lower plot was generated from precipitation data collected in China. NCDC's interactive CLIMVIS system may be accessed through the WWW at URL: <http://www.ncdc.noaa.gov/>.



▲ Figure 3. GOES satellite image of Hurricane Bertha.

#### NCDC's year, from page 8

significant updates) during the past fiscal year. Our WWW address is <http://www.ncdc.noaa.gov>, and all of the following items can be accessed there either through the On Line Data Access icon or through the Products, Publications, and Services icon. Data under On Line Data Access have been re-organized for easier user-recognition of what's available.

- CLIMVIS: This has quickly become our most popular new system. Climate Visualization (CLIMVIS) provides various graphic capabilities for U.S. divisional monthly data and U.S./Global surface daily data (over 8000 stations, available about 4 weeks after end of the data month). It generates bar/line graphs (Figures 1-2) along with contour/vector maps from the data. Then, the user can download the actual data values used in generating the plot. Climatic data not only from U.S. cities but from as far away as Antarctica, Siberia, Indonesia, and any other country can be explored with this system.

- NCDC Products and Services Guide: This has been updated with more information on available datasets, products, and publications.

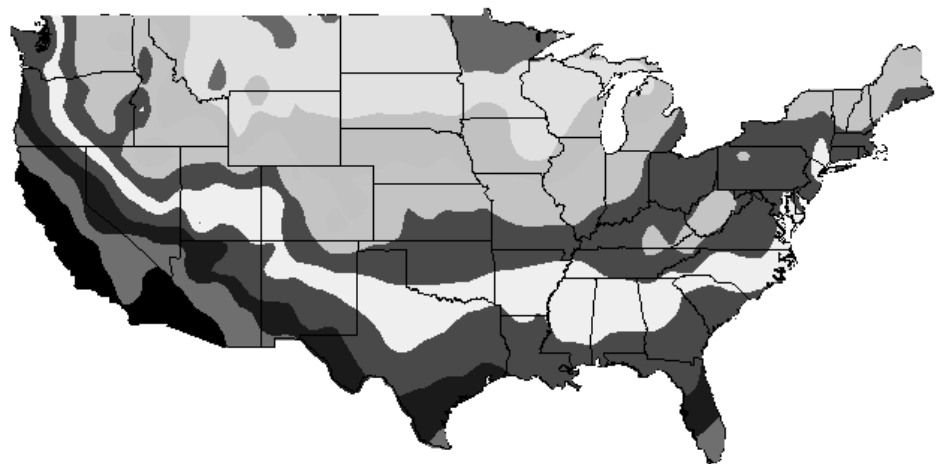
- New technical reports are now available on various topics (Table 1, Figures 5-6) including : reports on 1995 flood-

ing in California, Hurricane Opal, the 1995 hurricane season, the winter of 1995-1996, the probabilities for a white Christmas, and billion-dollar weather disasters of 1980-1996.

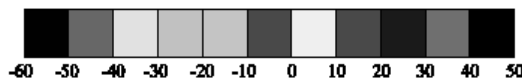
- Online images: This new system provides easy access to over 200 images, (Figure 3) with the main emphasis on satellite images. Hurricanes from as early as 1970, and all 1995-1996 tropical storms and hurricanes are included.

We also have historical storms such as Gilbert, Hugo, and Andrew.

- Inventories: A new system for accessing online inventories for datasets such as global upper air data, global surface data, and NEXRAD data.
- NEXRAD Page: A new page devoted to NEXRAD products, including inventories of available data by station, software for using the data, and links to near real-time radar images.
- Global Surface Summary of Day Data: Numerous new files and capabilities were added, including special weather event files, interactive graphics (Figures 1-2), and station-selection capability as described above (CLIMVIS).
- Global and U.S. Historical Climate Network Data: New web pages for these long-term monthly datasets. Datasets contain monthly climatological data for over 10,000 U.S./global stations with periods of record of over 100 years for some of the locations.
- Special Sensor Microwave Imager/DMSP Data: New page linking to SSM/I products from the DMSP archives, such as satellite-derived snow cover/sea ice, cloud cover, cloud liquid water content, precipitable water, precipitation amount, and ocean surface wind speed.
- Upper Air Browse/Inventory System: New system to browse and obtain inventories for NCDC's new upper air sounding database—the Comprehensive Aerological Reference Data Set (CARDS).



Temperature (degrees Fahrenheit)



▲ Figure 4. Contour plot of lowest temperatures recorded (degrees Fahrenheit) from February 1-5, 1996.

**Table 1.** Selected articles and reports, 1995-96

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- Guttman, N.B. and R.G. Quayle, 1995: A Historical Perspective of U.S. Climate Divisions. *Bulletin of the American Meteorological Society* 77, 293-303.
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- Guttman, N.B., 1996: Statistical Characteristics of U.S. Historical Climatology Network Temperature Distributions. *Inter-Research* 6, 33-43.
- Guttman, N.B. and C.B. Baker, 1996: Exploratory Analysis of the Difference Between Temperature Observations Recorded by ASOS and Conventional Methods. *Bulletin of American Meteorological Society*, in press.
- Karl, T.R., R.W. Knight, D.R. Easterling, and R.G. Quayle, 1996: Indices of Climate Change for the United States. *Bulletin of the American Meteorological Society* 77, 279-292.
- Lott, N.I and T. Ross: *NCDC Products and Services Guide*. [Asheville, N.C.]: National Climatic Data Center, Research Customer Service Group, 1996.
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- Lott, N., T. Ross, and M. Sittel: *White Christmas?* Technical Report 95-03. [Asheville, N.C.]: National Climatic Data Center, Research Customer Service Group, 1995.
- Lott, N., A. Graumann, J. Kobar, D. Ross, K. Ross, T. Ross, and M. Sittel: *Hurricane Opal*. Technical Report 95-02. [Asheville, N.C.]: National Climatic Data Center, Research Customer Service Group, 1995.
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- Steurer, P.M., 1996: Comparison of Probability Distributions Used in Estimating the 100-Year Return Period of the Air-Freezing Index. *Journal of Cold Regions Engineering* 10(1): 25-35.
- Viront-Lazar, A. and P.M. Steurer, 1996: Metadata for Climate Data. *Proceedings of the 1st IEEE Metadata Conference*, Silver Spring, Md.
- Zhai, Panmao and R.E. Eskridge, 1996: Analyses of Inhomogeneities in Radiosonde Temperature and Humidity Time Series. *Journal of Climate* 9, 884-894.

### Satellite Data Services

On July 10, 1995, NCDC began servicing retrospective satellite data requests from its main office in Asheville, N.C. With the advent of the Internet, NCDC realized that it would be more efficient and cost effective to service the requests from its home base. In anticipation of the transition, thousands of magnetic tapes were shipped from the over-crowded archive at the Satellite Data Services Division in Suitland, Md., to a brand new, environmentally controlled site in Asheville. NCDC archives the original and processed data from NOAA's Polar Orbiting Environmental Satellites (POES) and from selected instruments on the Defense Meteorological Satellite Program (DMSP) satellites.

Recently, NCDC has begun archiving the Geostationary Operational Environmental Satellite (GOES) Day-One Products, while the Space Science Engineering Center (SSEC) at the University of Wisconsin continues to archive the GOES data. Requests for GOES data are routinely submitted via e-mail from NCDC to SSEC, where the data are processed and then submitted to a dedicated file server for FTP.

Therefore, orders for any of the above data types can be submitted to NCDC, and we'll handle the request. NCDC has

many (too numerous to mention here) types of satellite products, digital data, and printed images available. For further information or requests:

E-mail: [satorder@ncdc.noaa.gov](mailto:satorder@ncdc.noaa.gov)

Phone: 704-271-4850

Fax: 704-271-4876

The Satellite Active Archive (SAA) is even more automated, allowing users with Internet access to view inventories of POES AVHRR and TOVS Level 1b data, to browse them, and to order selected datasets for further processing and analyses without any human intervention. Furthermore, the data can be retrieved via FTP within a matter of hours at no charge. The SAA is accessible via NCDC's homepage at URL: <http://www.ncdc.noaa.gov>.

### Conclusion

We hope this has provided a good overview of NCDC's recent additions to its products and services, and thereby given readers some insight into how we can be of service. Please contact:

National Climatic Data Center  
NOAA/NESDIS

151 Patton Avenue

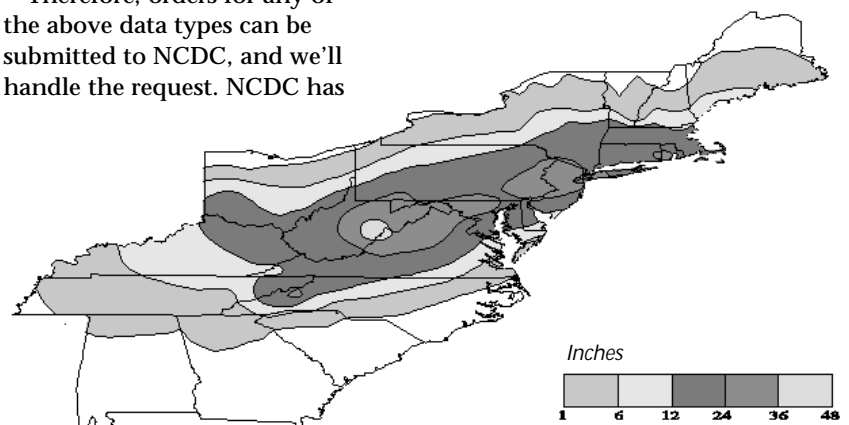
Asheville, NC 28801-5001

Attn: Climate Services Branch

Telephone: 704-271-4800

Fax: 704-271-4876

Internet: [orders@ncdc.noaa.gov](mailto:orders@ncdc.noaa.gov) ■



▲ **Figure 5.** A gray scale version of a color plot, "Blizzard of '96" snowfall totals, January 6-8, 1996.

# Unique and innovative descriptions of the environment released by NGDC

## *Visually exciting data products and collections offered in a wide range of media*

*Kathy Martin and John Kinsfather  
Information Services Division  
National Geophysical Data Center  
NOAA/NESDIS*

NOAA continues to provide new information about the environment and makes this information available on various media to businesses, educators, scientists and the general public. The following new environmental data products were developed during 1996 and are now available from the National Environmental Satellite Data and Information Service's (NESDIS) National Geophysical Data Center (NGDC):

- *1995 Atlantic Hurricanes Poster from DMSP Satellites.* The 1995 Atlantic hurricane season was one of the most active and destructive seasons on record. Eleven tropical cyclones reached hurricane strength when sustained winds exceeded 64 knots (73 mph). More than twice the 1885-1994 average of 4.9 hurricanes per year were recorded, and this is second only to 1933 when thirteen hurricanes were reported.

The eleven hurricanes were captured in numerous images recorded by two Defense Meteorological Satellite Program (DMSP) satellites. The 1995 Hurricanes and Typhoons Slide Sets are a group of 22 slides showing the 1995 season hurricanes and a set of 23 slides showing the typhoons from 1995. The DMSP satellites' unique points of view allow studies of the structure, magnitude and location of storms. Each slide displays a storm in either visible or infrared wavelengths. The name of the storm and the time of image are printed on the slide. Captions, in an attached information booklet, describe the magnitude and path of each storm.

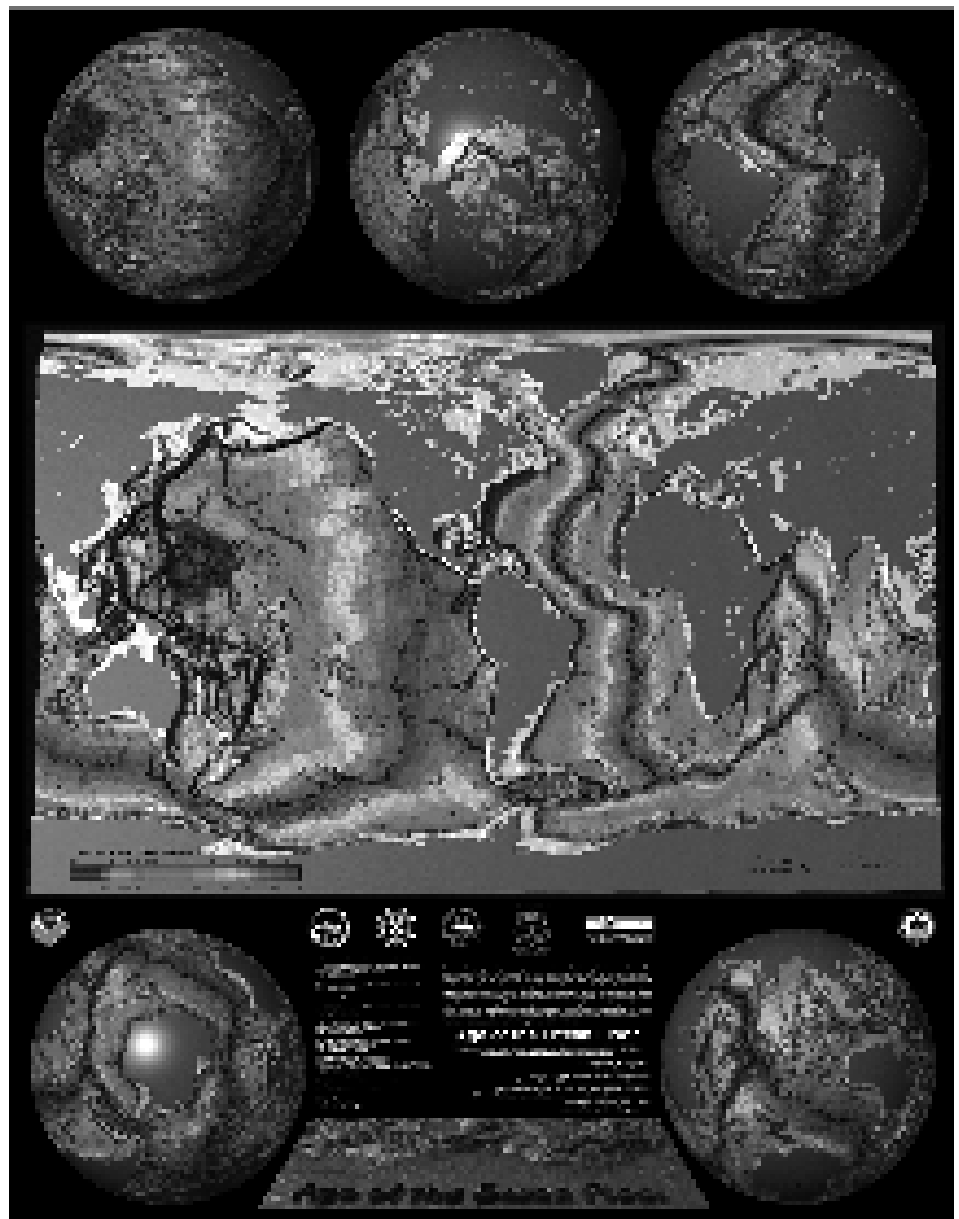
- *Age of the Ocean Floor.* (Figure 1) is a full-color poster showing plate bound-

aries, tectonic patterns, and crustal age of the seafloor draped over relief data. Ages for ocean floor between the oldest identified magnetic anomalies and continental crust were interpolated by scientists by estimating the ages of passive continental margin segments from geological data and published plate models.

- *The Bathymetry of Lake Michigan* includes a full-color poster and digital data on CD-ROM. The poster depicts the bathymetric contours of Lake

Michigan in 10 meter contours, and includes color diffracting glasses for viewing in 3D. The CD contains 5-meter bathymetric contours, 9 arc second grid with a 9 arc second interval, a graphic image showing sounding locations, and a file to plot the poster.

- *Earthquake Strong Motion CD-ROM Collection,* a 3 volume collection contains NGDC's entire strong motion archive - over 15,000 digitized and processed accelerograph records from 1933



▲ Figure 1. Gray scale rendition of NGDC's "Age of the Ocean Floor" full-color poster.

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NOAA/NESDIS  
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Boulder, CO 80303  
E-mail: kmartin@ngdc.noaa.gov*

to 1994. The data represent a broad range of structural and geologic recording environments. Records were contributed to the archive from various worldwide industrial, academic and governmental sources.

- *The Ionospheric Digital Database of Worldwide Vertical Incidence Parameters* is available on two compact discs with custom-designed access and display software. The CDs contain 40,000 station months (1.3 gigabytes) of digitized vertical incidence parameters from 130 sites worldwide for the period from 1957 through 1990. These data have been contributed through a major effort among the World Data Centers and ionosonde network organizations.

- *Marine Trackline Geophysics, Version 3.2*, a CD-ROM set, contains marine geophysical trackline data including new data which have been acquired and assimilated by NGDC through 1995. The total amount of new data covers 854,000 kilometers of bathymetry, magnetics and gravity from 169 surveys, and includes over 2.4 million additional digital records. The GEODAS software developed by NGDC allows customized searches and produces trackline plots on both PC and UNIX systems. The companion WWW GEODAS system provides post-release updates until the next CD is released.

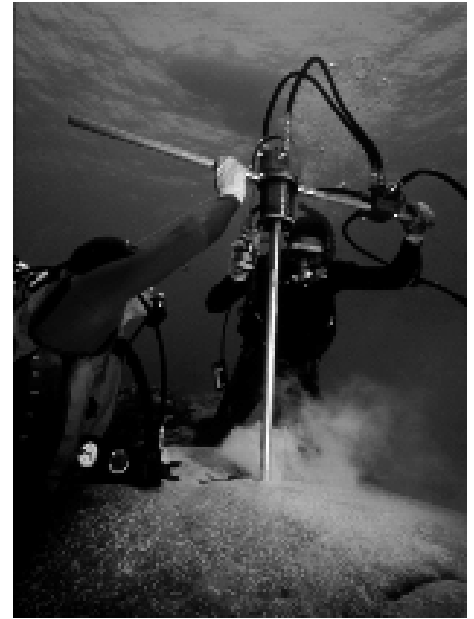
- *Nighttime Lights of the USA from DMSP Satellites*. The DMSP Operational Linescan System (OLS) has a unique capability to detect low levels of visible-

near infrared radiance at night. With the OLS VIS banked data it is possible to detect clouds illuminated by moonlight, plus lights from cities, industrial sites, gas flares, and ephemeral events such as fires and lightning illuminated clouds. The poster (Figure 2) was derived from cloud-free portions of 231 orbits of DMSP OLS data. The majority of the detected features are lights from urban areas.

- *NOS Hydrographic Survey Data - U.S. Coastal Waters*. This new CD-ROM set features the complete National Ocean Service (NOS) Hydrographic Survey Digital Database which includes over 44 million soundings from 4,961 surveys providing 1.7 gigabytes of data. The database consists of depths and navigation features digitized from the plots of hydrographic surveys completed between 1930 and 1965, and survey data acquired digitally in the field since 1965.

The NOS Survey Data provides the most extensive digital bathymetric data available for the coastal waters of the continental U.S., Alaska, Hawaii, and Puerto Rico/Virgin Islands. The dense inshore and shallow-water data are well suited for computer generation of grids to be used in hydrodynamic models of estuaries and other coastal systems. GEODAS access software is included for data access and display.

- *Coral sampling for climate reconstruction*. The Paleoclimatology Educational Slide Project includes vivid photo-



▲ Figure 3. Coral sampling for climate reconstruction studies.

graphs of field research (Figure 3), high-quality graphics of important datasets, and descriptive diagrams. Included in each set is a narrative to accompany the slides, a bibliography and, in most cases, a vocabulary list. The Coral Paleoclimatology (Natural Recorders of Interannual Climatic Variability in the Tropical Oceans and Seas) set furnishes 20 slides; the Low-Latitude Ice Cores (High Resolution Records of Climatic Change and Variability in the Tropics and Subtropics) has 20 slides; the Polar Ice Cores (Records of Climatic Change and Variability from the Ends of the Earth) totals 37 slides; and the Rock Varnish (Microlaminations as a Paleoclimatic Indicator in Drylands) set has 22 slides.

- *The Seismicity Catalog CD-ROM Collection*. A compilation of seismicity catalogs from NGDC and the U.S. Geological Survey's National Earthquake Information Center. This 2-volume set includes data from more than 4 million earthquakes dating from 2100 B.C. to 1995 A.D. The data include information on epicentral time of origin, location, magnitudes, depth, and other earthquake-related parameters.

For more information on these and other new products contact the NGDC Information Services Group at [info@ngdc.noaa.gov](mailto:info@ngdc.noaa.gov) or (303) 497-6826 or see the NGDC WWW site at <http://www.ngdc.noaa.gov/>. ■



▲ Figure 2. Nighttime lights of the USA from DMSP satellites, a poster released from NGDC in 1996.

**Environmental quality**, from page 7 site-by-site and chemical-by-chemical correlations, correlations were calculated for 14 chemicals at the 154 sites with 6 or more years of data. Correlations were also sought for the annual geometric mean concentrations for each chemical.

The most common result was a lack of trends. Among the 2373 combinations of 14 chemicals at 154 sites, there are only 41 increases and 217 decreases at the 95% level of confidence. Given a 5% probability of random data showing trends, there could be 59 increases and 59 decreases that are not real trends. Conceivably, none of the 41 increases are real.

The important point, however, is that decreases greatly outnumber increases. Decreases exceed increases by a factor of three or more for all the chlorinated hydrocarbons, tributyltin, arsenic, cadmium, copper, and selenium. Because of species differences, concentrations in mussels have been separated from those in oysters for Cu, Pb, and Zn prior to calculating annual geometric means. Decreasing geometric means were found for As, Cd, Cu (in mussels), all the chlorinated organics and total butyltins (Figure 2). Except for selenium, this list highlights the same decreasing trends found by counting trends site-by-site.

Decreasing trends are not unexpected. All the monitored chlorinated hydrocarbons have been banned for use in the United States and tributyltin has been banned as a biocide on recreational boats. There have also been decreases in the uses of cadmium and arsenic.

#### Exceedances of public health limits

For the most part, chemical concentrations in mussels and oysters are used to identify temporal trends in contamination. In that context, it is the changes in concentration rather than the concentrations themselves that are of interest. However, the concentrations are examined for instances where public health guidelines are exceeded. There are U.S. Federal Drug Administration standards for chlorinated hydrocarbons and for mercury, such that fish and shellfish with higher concentrations are prohibited from interstate commerce.

None of the standards were exceeded for: Hg; DDT and metabolites; dieldrin, endrin and aldrin; or the cyclopentadiene pesticides at any site in any year. The 10,000 ng/g (dry weight) standard for total PCBs was exceeded in 1989 at one site in Buzzards Bay, MA, but not in any other year.

In 1993 the FDA issued human consumption guidelines for concentrations of five trace elements in molluscan and crustacean shellfish that vary with the age of consumer and rate of consumption. For three of those elements (arsenic, chromium, and nickel), there are no cases where mussels or oysters collected in the Mussel Watch Program exceeded even the most stringent guideline. In 1991, the only year it was successfully sampled, the site in Lake Pontchartrain near New Orleans yielded oysters whose cadmium concentrations exceeded the lowest guideline. The lowest guideline for Pb has been exceeded in some years at several sites in urban areas. Children should not eat mussels or oysters from these locations. However, these are generally areas where shellfishing is already prohibited due to bacterial contamination.

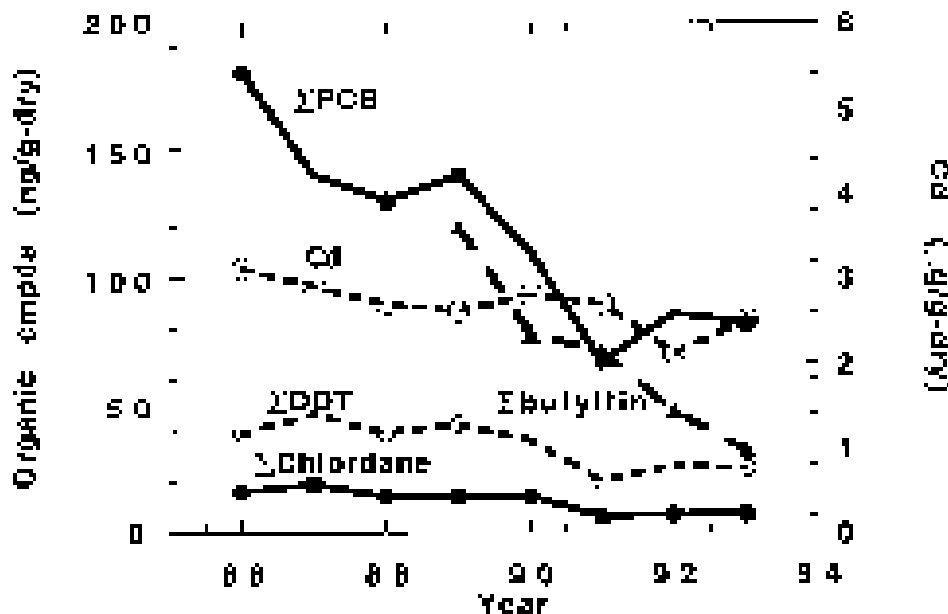
#### Conclusions

For the most part, the high levels of chemical contamination are found in proximity to centers of human popu-

lation. In terms of temporal trends, there were many more decreases than increases in chemical concentrations between 1986 and 1993. The chemicals for which most of these trends exist are: chlorinated hydrocarbons whose use has been banned; tributyltin, whose use as an antifoulant on recreational boats has been banned; cadmium and arsenic, whose uses have been severely curtailed; and copper, whose use has not decreased but whose discharges apparently have diminished. Lead is the only chemical showing concentrations in excess of public health guidelines at several sites.

#### Further reading

Over 500 publications, reports, presentations, and technical memoranda have been derived from NS&T data already. Many of these reports are available from the NS&T Program upon request (a list of publications is available). NS&T data can be obtained in printed or electronic form from the Program office (301-713-3028 x 147, e-mail: [ACantillo@rdc.noaa.gov](mailto:ACantillo@rdc.noaa.gov)) or can be downloaded from the NS&T Home Page on the World Wide Web at: <http://www-orca.nos.noaa.gov/projects/nsandt/nsandt.html> (NS&T raw data). ■



▲ Figure 2. Decreasing annual mean concentrations of chlorinated organics and total butyltins demonstrated from mussel tissues.

### NGDC announces first release of ionospheric digital database

The National Climatic Data Center (NCDC) has released the Ionospheric Digital Database of Worldwide Vertical Incidence Parameters on two CD-ROMs, with custom designed access and display software. The CDs contain 40,000 station months (1.3 gigabytes) of digitized vertical incidence parameters from 130 sites worldwide for the period from 1957 through 1990. These data have been contributed through a major effort among the World Data Centers and ionosonde network organizations.

Contact: NGDC

### NGDC announces first release of geomatic data

The National Geophysical Data Center (NGDC) is pleased to announce the availability of the complete Project Magnet data collection on CD-ROM. From 1951 through 1994, the U.S. Navy, under its Project Magnet Program, continuously collected vector aeromagnetic survey data to support the U.S. Defense Mapping Agency's world magnetic modeling and charting program.

The CD-ROM is expected to simplify the work of scientists performing regional and global geophysical studies. NGDC's multi-platform browse and retrieval software, GeoVu, is included with the CD-ROM.

Contact: NGDC

### NCDC completes production of marine station CD-ROM

The National Climatic Data Center (NCDC) is offering a 2-disc CD-ROM set, C-MAN/Buoy Reports and Summarized Elements. These joint NCDC/NWS CD-ROMs contain data and summaries for 197 marine stations. The data include hourly buoy and C-MAN station elements (excluding spectral wave data) through 1993. Summaries include frequency of occurrence tables (elements); bivariate distributions of wind speed and direction; wave period and height by month and season; and year-month time series means and extremes.

Contact: NCDC

### NGDC acquires images depicting seismic creep

The National Geophysical Data Center (NGDC) recently acquired images depicting fault creep from Dr. Susan

## Data products and services

Hirschfeld, Department of Geological Sciences, California State University in Hayward, CA. These images are in addition to 50 images of fault creep primarily in Hollister, Calif, were acquired from Joe Dellinger, Amoco, Tulsa, OK, earlier this year. Twenty images have been selected from the above collection to include in a soon-to-be published set of slides entitled Seismic Creep.

Contact: NGDC

### Hurricane Bertha images online courtesy of GOES-8

The National Climatic Data Center's (NCDC) Satellite Services Group has placed a dozen GOES-8 satellite images and four movie loops of Hurricane Bertha on its World Wide Web Home Page. Bertha can be found under the heading "Online Data Access" link on the NODC Home Page.

The Web Page includes a brief storm narrative, numerous satellite images (visible and infrared) of the storm, and a NEXRAD reflectivity image of the hurricane near landfall. One movie loop contains 40 images acquired at five-minute intervals showing the hurricane regaining strength and re-forming an eye while approaching the North Carolina Outer Banks on July 12, 1996. The images and movie loops are unique in that they created data while GOES-8 was in a rapid scan mode.

Satellite and other images have proven to be among the most popular features of NCDC's web site, with more than 15,000 images downloaded in June (over 2.5 gigabytes) from a separate WWW page devoted entirely to them. Included along with the Bertha images are ones of hurricanes and other storms going back to 1970. Super Typhoon Herb images are the most recent ones linked to this page. These images are available at URL: <http://www.ncdc.noaa.gov/pub/data/images/olimages.html>.

Contact: NCDC

### New NGDC Seismicity Catalog CD-ROM popular around the country

The National Geophysical Data Center's new Seismicity Catalog CD-ROM collection is being used in demos and exhibits in the U.S. and around the world. Institutions featured described below contacted NGDC for information about the collection.

Dorothy Tao of the National Center for Earthquake Engineering Research including the CDs in the agenda for a secondary school teachers workshop on earthquakes and earthquake engineering held at the University of Buffalo, New York, August 14, 1996.

The Cleveland Museum of Natural History has also obtained the CD Collection. They are currently designing 10 new galleries and 189 exhibits that will open in 1997. They plan to use the Seismicity Catalog CDs in one of their interactive displays.

The Seismicity Catalog CD and the new Strong Motion CD collections were both demonstrated at the Hazards Research and Application Workshop held in Denver, Colo, July 7-10, 1996. Over 300 people from all over the world attended the workshop.

Contact: NGDC

#### CONTACT POINTS

National Climatic Data Center (NCDC)  
704-271-4800  
Fax: 704-271-4876  
E-mail: [Climate\\_Services - orders@ncdc.noaa.gov](mailto:Climate_Services_orders@ncdc.noaa.gov)  
[Satellite\\_Services - satorder@ncdc.noaa.gov](mailto: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/>

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/>

## New Director Named at NODC

Dr. Henry R. Frey, an oceanographer, diver, author, and former academician has been named director of the National Oceanographic Data Center. Dr. Frey's professional experience is broad in scope—including private industry, nonprofit research institutions, domestic and foreign consulting, and the federal government.

A physical oceanographer by training, Dr. Frey joined NOAA/NESDIS after serving as Deputy Director, Office of Oceanic Research Programs, in NOAA's Office of Oceanic and Atmospheric Research. His activities there included management of the National Sea Grant College Program and the National Undersea Research Program.

Prior to joining NOAA/OAR, Dr. Frey served as Chief, Coastal and Estuarine Oceanography Branch, National Ocean Service (NOS). At NOS, he managed applied and mission-oriented research in oceanography, field measurements, data analysis, and computer modeling of circulation and water levels in the nation's estuaries, bays, and coastal seas. He placed a special focus on data quality assurance.

For this leadership and participation in a major oceanographic project relating to the National Strategic Petroleum Reserve Program, he was given the Department of Commerce Silver Medal Award. He won a second DOC Silver Medal Award for his scientific, engineering, and managerial leadership that resulted in the nation's first fully integrated, physical oceanographic real-time system (PORTS) in Tampa Bay. This system has proved to be invaluable for the safety of life, property, and the environment, and is currently being replicated in other ports.

He was recognized nationally by the Cooperative Education (Charles F. Kettering Award) and given the NOAA Administrator's Award for Equal Employment Opportunity in recognition for his painstaking work to develop a unique, barrier-free environment for deaf and hard-of-hearing workers at NOS.

After receiving a B.S. in physics from Queen College, CUNY, he began his career in underwater acoustics and undersea technology at Uniroyal's Corporate Research Center, he became



▲ In July 1996 Dr. Henry Frey became the National Oceanographic Data Center's seventh director.

Chairman of the corporate-wide Uniroyal Ocean Engineering Group and a member of the USN SEALAB II Project Team. He then returned to academia, received a Ph.D. in Oceanography from New York University, and rose to Director of Ocean Engineering at New York University and then later at the Polytechnic University, where he advanced to Associate Professor of Oceanography. He supervised graduate students, taught at the undergraduate and graduate levels, and performed research. During this period, he was the principal investigator on grants from NSF, Sea Grant, and the ARCA Foundation.

His diving experience includes both commercial and science project diving. He served as divemaster and diver on NYU's R/V *Kyma* and on NOAA, Coast Guard and Jamaican research ships. His total number of logged dives exceeds 3,000 hours under water.

As NODC Director, Dr. Frey plans to place special focus on data quality assurance, scientifically excellent data and analysis products, intra-NOAA and interagency cooperation and collaboration, relationships with the academic research community, and customer-focused management strategies.

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