



Earth System MONITOR



Vol. 1, No. 2

A Guide to NOAA's Data and Information Services

September 1990

NOAA Ocean Data Policy Issued

In recent hearings before the Senate, NOAA Administrator Dr. John Knauss testified about the large volumes and diverse types of data collected by NOAA. Senator Albert Gore (D-Tenn.) supported the goal of making these data available to scientists studying the Earth's climate. That goal, which has been expressed many times, is a major driving force behind a new NOAA policy on ocean data. After an extensive review process in NOAA, Dr. Knauss signed the new policy (NOAA Administrative Order 216-101) on June 20.

The NOAA policy is based on an earlier Federal Ocean Data Policy, which was coordinated by the National Science Foundation. Beginning in 1987, several Federal agencies, including NOAA, participated in outlining the essential elements of an ocean data policy. The group's goal was to promote sharing of ocean data collected by Federally sponsored programs. The purpose of the Federal

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U.S. DEPARTMENT OF COMMERCE
National Oceanic
and
Atmospheric Administration

At NGDC 25th Anniversary Symposium

High Priority Set for Data and Information Management

Gray Castle, Deputy Under Secretary of Commerce for Oceans and Atmosphere

This article is a slightly edited version of opening remarks presented at a symposium in honor of the 25th anniversary of the NOAA National Geophysical Data Center, Boulder, Colo. (see page 6).

Data and information management is the key to gaining improved understanding of what is happening to the environment—both as a result of natural change and of manmade variability. We need to understand these changes, and we need to calibrate how quickly they are taking place.

That's why the theme of this symposium—*Old Data-New Science*—is so significant. Today, in an era that may come to be known as the Age of the Environment, we have a responsibility to know more about the earth system, not only to understand its dynamics but also to make sound policy decisions about how to assure its long-term well-being.

The Administration and NOAA are stepping forward to the challenge of understanding what we know—and what we do *not* know—about the planet we inhabit. Because we are now working in a political climate that appreciates the value of environmental data, the National Geophysical Data Center is clearly celebrating a milestone anniversary at a critical time.

Furthermore, data is what NOAA has always been about. And although

that fact has not always been apparent, it is now. When John Knauss, Jennifer Joy Wilson, and I came to NOAA about a year ago, we set four priorities: weather service modernization, global change research, an expanded marine science program, and data management.

I don't need to tell this audience that it is not possible to do the first three of those substantive priorities without insuring that we have the best architecture in place for gathering, archiving, and accessing that data.



Because of the importance that we attach to data management, we have formed a NOAA-wide, cross-cutting working group, under the leadership of Vernon Derr, to examine and present

an analysis of our present capabilities and needs in data management. We have also asked him to formulate a plan for proceeding into the next five years and beyond well equipped for the challenges we face.

As an indication of our seriousness, we now have the hard evidence of a much larger budget than we've had in years, and I am irrevocably committed to fighting to keep every penny that we have allocated for data management from the pruning shears of the Office of Management and Budget and the Congress.

There are some even more visible signs of our commitment as well—the new building in Asheville, N.C. and the plans for the new building here in Boulder. And we've even been able to get you

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Data Management, from page 1

some assistance in putting out attractive publications like the programs and services brochure in circulation today.

So I recognize that many of you have felt that environmental data management has been treated as a step-child in the past. Well, my friends, the step-child has become a Cinderella. If, at one time, data resources were undervalued, they no longer are.

For in the current climate of public concern the leadership in the Administration understands full well the importance of acquiring good data, preserving it carefully, and making it easily accessible to both scientific and lay audiences.

I am optimistic that the tough times you have gone through are behind you. The time has now come to make sure that the resources we have in NOAA and throughout the scientific community are coordinated in a way that makes high quality data available quickly and efficiently. Under John Knauss' guidance, we have begun a three-pronged effort to give data management the priority it deserves:

- **First, money:** We are seeking resources to operate our data centers more effectively. The first part of this request is targeted for data management and specifically directed toward improvements in our management of global change data.
- **Second, innovation:** We are encouraging the use of new technology as it becomes available.
- **And third, manpower:** Hiring good staff and working with key people in other agencies and other countries to assure the productive flow of dependable information.

The NGDC is a key component in NOAA's global change initiative, and the entire U.S. Global Change Research Program is depending on the data you have amassed. In an era when stewardship is a key theme, you have been a first-class steward of not only U.S. data, but also international environmental data.

Some of that data is being distributed through the CD-ROM products you have developed. You have published 10 CD-ROMs—more than any other federal agency. You've been the leader in devising software for the display and manipulation of data on discs that allow users to work on their own personal computer systems. You've gotten rave reviews from a fan club that includes both the scientific

“...environmental data management has been treated as a step-child in the past. Well, my friends, the step-child has become a Cinderella.”

community and the private sector. You've brought much closer the day when researchers can have a complete data library at their fingertips.

While some might think that these are not exactly bread-and-butter issues, those of us here today know better. There is no better example of that fact than what happens when we send up a satellite at great expense to the American taxpayer or to a private corporation only to have its useful life cut short by solar activity. Your work has greatly reduced the severity of the impact of solar radiation and particles on that expensive and critical hardware. The sharing of data through the NGDC has greatly improved our ability to cope with those effects.

I noted another example of how NGDC's focus for data and research is getting the attention it deserves. *The Washington Post* carried an article several days ago on paleoclimatology, a field where your data has hastened our understanding of how interactions within the earth's system in the past shed light on our ability to predict our planet's future. Because the NGDC is the repository for that data, you are playing an important role in finding answers to questions with broad economic and social implications.

Earth System MONITOR

is published by the NOAA Data and Information Management Program Office. If you have any questions, comments, or recommended articles, or if you would like to be placed on the mailing list, please call Andrew Horvitz at FTS 763-8402 or 301-763-8402 or write:

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Office of the Chief Scientist
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HELPLINE:

National Climatic Data Center (NCDC)

Climate Services: FTS 672-0682
Satellite Services: FTS 763-8399
704-259-0682 301-763-8399

National Geophysical Data Center (NGDC)

FTS 320-6958
303-497-6958

National Oceanographic Data Center (NODC)

FTS 673-5549
202-673-5549

NOAA Earth System Data Directory

FTS 673-5548 (Gerald Barton)
202-673-5548

FTS 673-5636 (Douglas Hamilton)

202-673-5636

NOAA Central Library

Reference Services:
FTS 443-8330
301-443-8330

U.S. DEPARTMENT OF COMMERCE

Robert A. Mosbacher, Secretary

National Oceanic and
Atmospheric Administration
John A. Knauss, Administrator

We in NOAA will continue to encourage you in every way we can. We applaud the efforts of NGDC and the entire NOAA data management community to create a NOAA Earth System Data Directory and to communicate frequently and effectively with users through the new regular publication *Earth System Monitor*. We recognize that your role as ex-aminer and teacher will continue to bring credit to NOAA as a whole. ■

Interagency Working Group on Data Management for Global Change

Gerald Barton, Office of the Director
National Oceanographic Data Center
NOAA/NESDIS

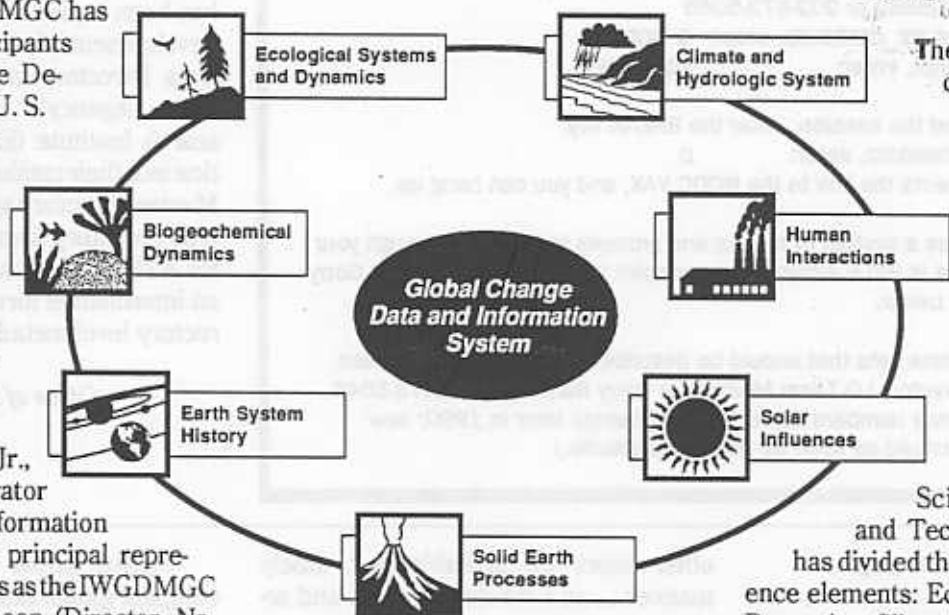
The Interagency Working Group on Data Management for Global Change (IWGDMGC) was organized to coordinate development and implementation of a data and information system to support global change research. The Group has been meeting since June 1987. Initial participants were NOAA, NASA, the National Science Foundation, and the U.S. Geological Survey. Since then, interest in the IWGDMGC has expanded, and participants now also include the Department of Energy, U.S. Department of Agriculture, Environmental Protection Agency, Department of State, U.S. Navy, National Archives and Records Administration, and Bureau of Reclamation.

Thomas N. Pyke, Jr., Assistant Administrator for Satellite and Information Services, is NOAA's principal representative and functions as the IWGDMGC Chair. Kenneth Hadeen (Director, National Climatic Data Center), Gregory Withee (Director, National Oceanographic Data Center) and Gerald Barton (National Oceanographic Data Center), work on the Contacts level of the Working Group.

The Working Group's charge is to make it as easy as possible for scientists and others to locate and obtain data needed for studies of global change. The Group's goal is to develop by 1995 a national global change data and information system that is consistent across agencies and involves and supports the university and other user communities.

The Working Group is approaching data management problems via a number of activities such as:

- improving interconnectivity and interoperability among existing agency data systems,
- assembling data and information requirements and developing standards for quality control and confidence limits,
- defining requirements for data providers such as documentation standards, and
- fostering international data exchange.
- *U.S. Strategy for Global Change Data and Information Management*, A Report by the Committee on Geophysical Data of the National Research Council (planned for late 1990 publication),
- input to the Data Management sections of the FY 90 and FY 91 Global Change Research Plans prepared by the Committee on Earth and Environmental Sciences, and
- recommendations for the U.S. Data Management Policy.



Completed and ongoing projects of the IWGDMGC include:

- the Global Change Master Directory, an on-line computer system for finding global change data sets,
- the Arctic Data Interactive, a CD-ROM that holds a directory of Arctic data, as well as selected Arctic data sets, publications, bibliographies, and images (in preparation),
- the Forum on Data Management for Global Change, a workshop held in Baltimore in 1988 that focused on data management requirements, issues, and problems,

The IWGDMGC works closely with the Committee on Earth and Environmental Sciences (CEES), which is responsible for the U.S. Global Change Research Program (GCRP). The CEES is a committee on the President's Federal Coordinating Council for

Science, Engineering, and Technology. The CEES has divided the GCRP into seven science elements: Ecological Systems and Dynamics, Climate and Hydrologic System, Human Interactions, Solar Influences, Solid Earth Processes, Earth System History, and Biogeochemical Dynamics. The IWGDMGC is concerned with data management for these science elements because the data provide the foundation for global change research. The Working Group believes that data management practices instituted now will benefit global change research far into the next century.

For more information on the IWGDMGC contact Gerry Barton, National Oceanographic Data Center, 1825 Connecticut Avenue NW, Washington, DC 20235; 202-673-5548; G.BARTON (OMNET); GBARTON (NESDIS Tele-mail); NODC::BARTON (SPAN). ■

The NOAA Earth System Data Directory

HOW TO FIND NOAA DATA

The NOAA Directory is your tool to locate NOAA data sets. You can use your PC to access the Directory.

Terminal settings:

FULL DUPLEX, 8 BITS, NO PARITY, ONE STOP BIT, 1200 BAUD
Terminal type: VT-100 (preferred)

Via SPAN:

At the \$ prompt, enter: **SET HOST NODC**
At the \$ prompt, enter: **NOAADIR**

Via direct dial (1200 baud):

Dial 202-673-5662 or 202-673-5666
At the prompt **XT_COMMAND**, enter: **C NODC**
At the \$ prompt, enter: **NOAADIR**

When you end the session, enter the BREAK key.
At the **XT_COMMAND**, enter: **D**
This disconnects the link to the NODC VAX, and you can hang up.

The NOAA Directory has a system of menus and prompts to lead you through your search session. There is HELP available at any point in your session, or call Gerry Barton at the number below.

If you know of NOAA data sets that should be described in the Directory, please contact your NOAA Directory LO Team Member or Gerry Barton at 202-673-5548. (NOTE: NODC telephone numbers listed here will change later in 1990; new numbers will be announced as soon as they are available.)

CEOS/WGD Subgroup Promotes Catalog System

The Committee on Earth Observing Satellites/Working Group on Data implemented a Directory Interchange Format (DIF) for structuring directory level data descriptions. All members have agreed to structure their directory references in this format. To date, NASA and NOAA directory descriptions are converting to this format and NOAA directory level files in DIF form have been copied to the NASA Master Directory system.

The NASA Master Directory system has been copied to NOAA to be used for development of a NOAA Earth Systems Data Directory and to the European Space Agency's European Space Research Institute (ESRIN) for incorporation into their catalog system. The NASA Master Directory system will be a prototype inventory level interchange format for AVHRR data as a step in developing an interchange format similar to the Directory level metadata DIF structure.

- William Callicott
Office of Systems Development
NOAA/NESDIS ■

Ocean Data Policy, from page 1

policy is "...to assure timely submission of appropriate real-time and archival quality *in situ* oceanographic data to national centers, while recognizing needs of principal investigators to protect their intellectual investment and encouraging their continued efforts to collect useful oceanographic data."

Both the National Science Foundation and the Navy's Office of Naval Research adopted the Federal policy essentially in its original wording. NOAA, being a diverse organization with unique needs, chose to rewrite the policy to meet NOAA needs while maintaining the spirit of the Federal policy. Under the policy, managers of NOAA programs that conduct ocean data collection activities "...are responsible for assuring that data and related information with high utility for

other users are available in a timely manner ... and are documented and archived in designated national data management centers."

Four NOAA national data management centers are named in the policy as archives for various types of ocean data. They are the National Oceanographic Data Center (NODC), National Climatic Data Center (NCDC), National Geophysical Data Center (NGDC), and National Snow & Ice Data Center (NSIDC). Guidelines in the policy spell out which types of data are to be sent to each center. Data on the ocean's physical, chemical, and biological features are to be sent to the NODC. Surface and upper-air meteorological data collected over the ocean are to be sent to the NCDC. The NGDC accepts marine geophysical and geological data, while sea ice and other glaciological data are to be sent to the NSIDC.

NOAA ocean data derive from a complex global network of satellite and ocean based observation systems. This network is a composite of operational and research measurement systems operated by different NOAA programs and organizations. Data from this network help NOAA personnel to understand and forecast the structure and variability of both the oceans and the atmosphere. The NOAA Ocean Data Acquisition Policy is a step toward increasing the efficient use of ocean data produced by NOAA. The policy will help NOAA accomplish its various missions, as well as increase the availability and usefulness of these data to researchers outside NOAA.

- Douglas Hamilt
National Oceanographic Data Cen
NOAA/NESDIS

NOAA Begins Early EOSDIS Activities

Arthur Booth
Program Manager, Office of Satellite
Data Processing and Distribution
NOAA/NESDIS

**First in a series of articles on
NOAA's evolving role in EOSDIS**

NOAA participation in EOSDIS—Earth Observing System (EOS) Data and Information System—started with the signing in July 1989 of a Memorandum of Understanding (MOU) between NOAA and NASA that provides the framework from which the two agencies will build a cooperative program in Earth system science data management. A major objective of the MOU is to provide rapid data access between each agency's Earth observation programs—principally NASA's EOS mission (and possibly others) and NOAA's operational satellite and *in situ* data collection systems. For NOAA this will involve the definition, development, and implementation of: catalog, directory, and inventory information (metadata) for NOAA data sets; near real-time access to selected EOS instrument data; an operational active archive for NOAA satellite data; and long-term active archive responsibilities for selected oceanic and atmospheric EOS data sets.

EOS is planned as a series of six large low-altitude polar orbiting platforms with EOS-A scheduled for launch in 1998. NASA's goal is to build an integrated data and information system that will place unprecedented focus on end-to-end information flow and data management of remotely sensed Earth observations. The EOS mission is being designed to observe and study the Earth as a complete system with concurrent observations from as many as 16 instruments. EOSDIS will include spacecraft command and control, data processing, archival, user services, and distribution functions.

A major goal of EOSDIS is to provide a user friendly system that will facilitate and encourage multidisciplinary and interdisciplinary research. To achieve this, the EOSDIS architecture

will be highly-distributed to take advantage of existing institutional science expertise and data systems facilities. NASA has called these facilities DAACs—Distributed Active Archive Centers, of which there are presently seven—Goddard Space Flight Center, Langley Research Center, Marshall Space Flight Center, EROS Data Center, Alaska SAR Facility, National Snow and Ice Data Center, and Jet Propulsion Laboratory.

Although the launch of EOS-A is eight years away, NASA is busy moving forward with the development of EOSDIS. Two parallel Phase B studies (detailed design concepts) were completed this past April and a Request-For-Procurement for Phase C/D (final design and deployment) is scheduled for release to industry in early 1991.

**“Pathfinder data sets
have large data volumes
and long time-series,
and are critical to
global change science.”**

Teams are currently being formed to provide definition and implementation planning for Early-EOSDIS program development. Early-EOSDIS will be a series of phases that will feature bottom-up, “build-a-little, test-a-little,” development and prototyping that are expected to be transitioned to, and carried forward by, the Phase C/D contractor who should be onboard by mid-1992. An important date in all this phasing is 1994. At that time, NASA expects to have a working prototype system that will demonstrate initial EOSDIS functionality—at all their DAACs.

Early-EOSDIS development has provided an excellent starting point for defining the work needed to develop NOAA-NASA data systems interoperability. NOAA is participating in NASA working groups that are focusing on the 1994 milestone. The major activities that

NOAA will participate in are intra-DAAC networking, catalog interoperability, standards, and experimental browse.

Plans are being formulated whereby NOAA facilities, principally its national data centers and selected operational centers, will be participating, as affiliated DAACs in the 1994 phase of Early-EOSDIS. Indeed, NOAA has already been active in many of the Early-EOSDIS activities, especially standards and catalogs, as reported in the first issue of *Earth System Monitor* (June 1990).

Another area of EOSDIS participation by NOAA has become known as Pathfinder data sets. Pathfinder data sets have large data volumes and long time-series, and are critical to global change science. They are also critical to NASA's EOSDIS program development. To date, only NOAA operational satellite data have been identified as Pathfinder data. NOAA *in situ* data will eventually be added to this effort. NASA and NOAA are nearing completion of an agreement in which Pathfinder data will go through a two-step process: First, the data will be migrated to new working storage media (perhaps optical) which will facilitate easy access and encourage global change investigations; second, NOAA/NASA science working groups will decide on algorithms and product generation, with the goal of producing research-quality, climate-related data sets, such as global sea-surface temperature, vegetation index, Earth radiation budget, cloudiness, atmospheric temperature, water vapor, winds, and aerosols.

The ocean and atmospheric instruments planned for EOS-A will generate in a day what one current NOAA polar orbiting satellite produces in 50 days. Yet the success of EOSDIS will not be measured by the billions of information bytes that flow, but by the productivity of the researchers using the system, which is why NOAA's participation in Early-EOSDIS embodies two necessary requirements for global change science—efficient access to the data, and the production of quality data. ■

NOAA to Receive ERS-1 Data

(Second of two articles)

The ERS-1 satellite bus is based on the French SPOT satellite, having a 3-axis stabilized, yaw steering, nadir pointing design. The satellite is to have a total mass of 2400 kg. Communications will be via an S-band TT&C (tracking, telemetry, & command) link and two X-band links for direct readout and downlink of on-board tape recorded Low-bit-rate (LBR) data. The LBR data contains data from all instruments other than the Synthetic Aperture Radar (SAR) in image mode.

The ERS-1 instruments include the Active Microwave Instrument (AMI), a

Radar Altimeter, a Scanning Radiometer, and ranging satellite position equipment. The AMI in SAR image mode is to acquire wide swath images over the oceans, polar ice caps and land areas. The AMI SAR wave mode will yield 5 x 5 km images at regular intervals along track for the derivation of wavelength and direction of ocean waves. The wind scatterometer mode of the AMI will use three separate antennae to measure sea-surface wind speed and direction. The ERS-1 Altimeter is designed to provide accurate measurement of sea-surface elevation, significant wave heights, wind speeds, and various ice parameters.

The ERS-1 Along-Track Scanning Radiometer and Microwave sounder (ATSR-M) combine infrared and microwave sensors for the measurement of

sea-surface temperature, cloud top temperature and cloud cover and atmospheric water vapor. The Precise Range and Range-Rate Equipment (PRARE) will be used to for satellite position and orbit characteristics and for geodetic "fixing" of ground stations. The Laser Retro-Reflector (LRR) will enable measurement of the satellite position and orbit using laser ranging stations on the ground.

ERS-1 is currently manifested on the Ariane V44, Flight 4-40 scheduled for April 1991.

- Rob Masters

Office of International and
Interagency Affairs
NOAA/NESDIS ■

Product Advisory Teams Being Formed

As part of its Climate and Global Change Program, NOAA/NESDIS is organizing satellite product advisory teams. The purpose of these teams is to advise NOAA on the development of climate products from operational environmental satellites. The teams will consist of producers and users of satellite data, from the academic and government scientific communities, and will formulate development plans for the following operational satellite product suites: oceanic variables; land surface variables; clouds/radiation budget/aerosols; soundings (temperature, moisture, winds); and stratospheric constituents.

The plans will include priorities, output products, algorithms, validation, operational implementation, storage/distribution/access, and science evaluation and applications studies. After completion of these plans, the advisory teams will disband. The plans will be implemented over the next few years, with extramural participation being funded on the basis of an Announcement of Opportunity.

The teams met in a workshop atmosphere August 14-17, 1990 at the

World Weather Building, Camp Springs, Md. Drs. George Ohring and Arnold Gruber, of the Satellite Research Laboratory, NESDIS, organizers of the teams, believe this to be an excellent opportunity for research, development and implementation of new operational climate products from the nation's operational environmental satellite system.

- Arnold Gruber

Office of Research and Applications
NOAA/NESDIS ■

NGDC Celebrates 25th Anniversary

NOAA's products are data and information, and the management of data and information has a very high priority in the current NOAA Administration. These points were made in an address by Gray Castle, Deputy Under Secretary of Commerce for Oceans and Atmosphere, in Boulder, Colorado, on August 9, 1990 (see page 1).

Mr. Castle's address opened a symposium on the theme "Old Data - New Science" that formed part of the 25th Anniversary celebration of NOAA's National Geophysical Data Center (NGDC). Other speakers were Juan Roederer (Uni-

versity of Alaska), Dr. James Baker (Joint Oceanographic Institutions), Ichtaque Rasool (NASA), Margaret Leinen (University of Rhode Island), J. Tuzo Wilson (University of Toronto), Vernon Derr (Office of Chief Scientist, NOAA), William Hay (University of Colorado) and John Eddy (University Corporation for Atmospheric Research). The symposium drew about 150 attendees from Boulder and many parts of the U.S.

A banquet was held in the evening. Speakers included Alan Shapley (former Director of NGDC) and Thomas N. Pyke, Jr. (NOAA Assistant Administrator for Satellite and Information Services). The highlight of the evening was a lecture by Thomas Cech (Distinguished Professor of Biochemistry at the University of Colorado), winner of the 1989 Nobel Prize in Chemistry for his work on RNA catalysis in biological reactions.

On August 10, NGDC held an open house for symposium attendees and the general public. Several hundred people enjoyed refreshments while viewing the many new poster displays and demonstrations of CD-ROMs and GIS systems.

- Michael A. Chinnery, Director
National Geophysical Data Center
NOAA/NESDIS ■

NODC: ACCESS TO THE HISTORICAL OCEAN DATA RECORD

Gregory W. Withee, Director
Richard J. Abram, User Services Branch
National Oceanographic Data Center
NOAA/NESDIS

**NOAA's
National Data Centers**
Second in a series of articles

The National Oceanographic Data Center (NODC) located in Washington, D.C. maintains the nation's historical ocean data base and makes these data resources available to users. The historical ocean data record, however, reflects the fact that oceanography is a young science. A plot of ocean temperature profiles by year from NODC's major archive files (Figure 1) shows the rapid increase in available ocean data after the late 1940s. Although ocean data remain strongly concentrated in the northern hemisphere, the NODC in recent years has put special emphasis on acquiring data from the southern oceans.

Unlike meteorological data, which are collected by a global synoptic network, *in situ* ocean data still derive largely from individual research cruises and ship-of-opportunity programs. Delayed-mode ocean data collected to support ocean

research or operational programs are submitted to NODC after they have served their primary purpose. The NODC typically receives such data months to years after their collection.

Near-real-time ocean data collected as part of ocean monitoring and prediction programs arrive at the NODC a few days to a month or so after collection. Temperature and salinity (T-S) data from the Integrated Global Ocean Services System (IGOSS), for example, are telecommunicated to the NOAA National Meteorological Center and the U.S. Navy Fleet Numerical Oceanography Center, which collect them and transmit them to the NODC monthly.

The NODC provides physical, chemical, and biological ocean data. Temperature-depth and salinity-depth profiles are available worldwide along with associ-

ated measurements of oxygen, nutrients such as nitrate, phosphate, and silicate, and other parameters. Other important physical data include current measurements from moored current meters and drifting buoys, marine meteorological and wave spectra data from NOAA buoys, and sea level data from tide stations. NODC also holds global wind/wave data derived from altimeter data collected by the U.S. Navy GEOSAT, which operated from March 1985 to January 1990.

Marine biological and marine pollution data are available primarily for the U.S. coastal zone and outer continental shelf. These data include the distribution and characteristics of phytoplankton, zooplankton, fish and shellfish, and marine birds and mammals, as well as concentrations of hydrocarbons, pesticides, heavy metals, and other toxic substances and pollutants.

NODC's data holdings presently total nearly 30 gigabytes. This year NODC will respond to about 7,000 data and information requests and provide researchers with over 70 gigabytes of data.

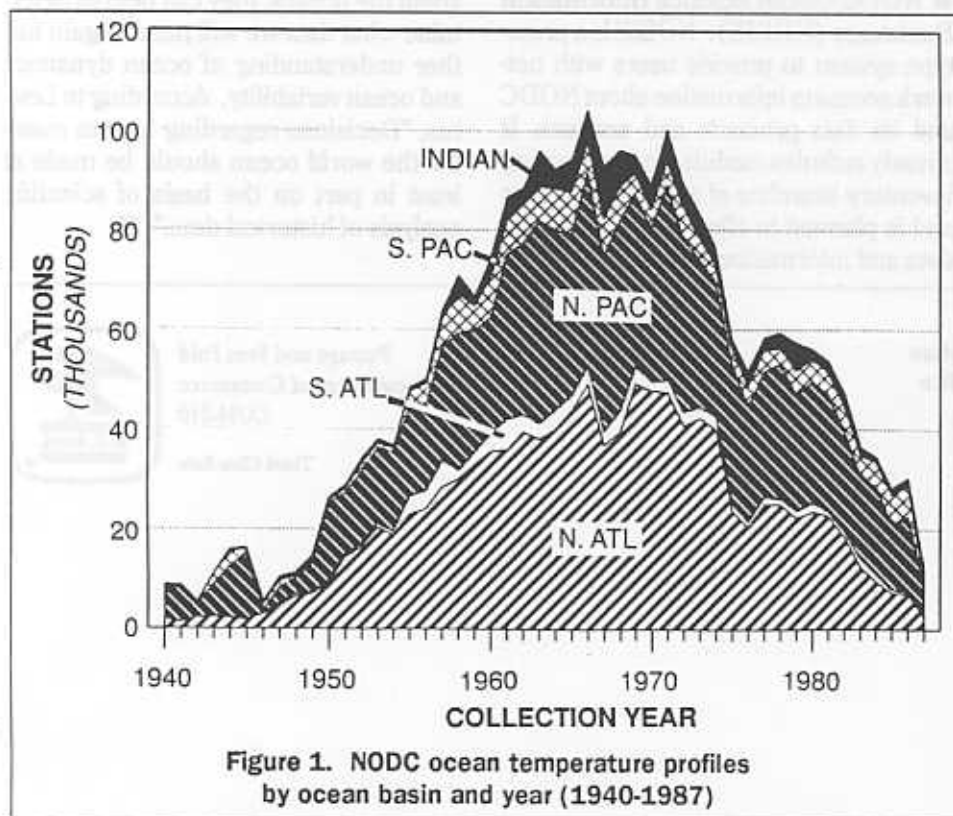
The NODC is involved in many programs and projects to improve the quantity and quality of available ocean data and to make those data more accessible. Among the most important of these are:

- **Joint Centers with Academia.** The NODC and university researchers have established three such centers to date:

Joint Environmental Data Analysis (JEDA) Center, with the Scripps Institution of Oceanography, University of California at San Diego, which is managing subsurface thermal data for the Tropical Ocean-Global Atmosphere (TOGA) program. As of May 1990 NODC's TOGA data base for the Pacific Ocean contained 109,000 bathythermograph temperature profiles.

Joint Archive for Sea Level (JASL) with the University of Hawaii, which coordinates the acquisition, processing, archiving, and distribution of data from the Pacific Sea Level Network. The initial ar-

-continued on page 8



NODC, from page 7

archive of sea level data at the NODC contains data from 80 Pacific coastal and island stations going back to the early and mid-1970s.

Joint Center for the Management of Ocean Data (JCRMOD), with the College of Marine Studies of the University of Delaware, which conducts research on methods, systems, and technology for coping with and effectively using the enormous volume of data that will flow from new observing systems and ocean-sensing satellites.

● **Project POSEIDON.** Using a dedicated data base processor (Sharebase 700 with 1.2 gigabyte hard disk) linked via Ethernet to its VAX 11/750 computer, the NODC is testing a system for providing users with on-line access to its ocean data. The goal of this project is a continuously updated ocean data base that captures data and associated data documentation entering the NODC and makes it immediately available to users. Because it is format-independent, this system will also easily accommodate new data parameters or data from new instruments.

● **Global Temperature Salinity Pilot Project (GTSP).** GTSP is a cooperative, international project to increase the number and quality of near-real-time and delayed mode temperature and salinity observations available from IGOSS and other sources. The NODC is working with organizations in Australia, Canada,

France, and the USSR, as well as with relevant international groups, to promote data submissions, improve data exchange, upgrade quality control systems and procedures, and create a timely and complete T-S data base in support of the World Climate Research Program and of national requirements.

● **NOAA Coastal Ocean Program.** This program will be the source of several important new data sets to be disseminated by NODC, including satellite imagery from the NOAA CoastWatch program and data on bio-effects of contaminants in coastal waters from the National Status and Trends Program

● **Ocean Data on CD-ROM.** In 1989 NODC released its first ocean data CD-ROM. It contains over 1.6 million T-S profiles for the Pacific Ocean for the period 1900-1988 and is accompanied by data selection/display software. A companion CD-ROM containing T-S data for the Atlantic, Indian, and Arctic Ocean basins is in preparation and expected to be ready by the end of 1990.

● **NODC Ocean Science Information Exchange (NOSIE).** NOSIE is a prototype system to provide users with network access to information about NODC and its data products and services. It already includes modules for conducting inventory searches of some NODC files and is planned to allow users to submit data and information requests.

"Data Archaeology" is a term coined to describe the process of augmenting the historical environmental data record by "unearthing" data sets that languish undigitized in forgotten file drawers or on digital media that have never been submitted to the appropriate National data center. The NODC plans to seek additional resources to recover these data. Resources devoted to this effort will pay dividends to all global change research.

The historical ocean data record is already shedding light on how the oceans change over time. NODC oceanographer Sydney Levitus, for example, in research conducted while he was at the NOAA Geophysical Fluid Dynamics Laboratory, used NODC data to study water masses in the North Atlantic Ocean. He showed that at intermediate depths (500-1300 m) waters in the subtropical gyre and eastern portion of the subarctic gyre were colder and fresher during 1970-74 compared to 1955-59, while the western portion of the subarctic gyre was warmer and saltier.

These old data can still teach us new lessons. Besides providing information about the oceans, they can help us determine what data we will need to gain further understanding of ocean dynamics and ocean variability. According to Levitus, "Decisions regarding how to monitor the world ocean should be made at least in part on the basis of scientific analysis of historical data." ■

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