



Earth System MONITOR



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A Guide to NOAA's Data and Information Services

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Data and Information Management in NOAA, the Earth System Agency

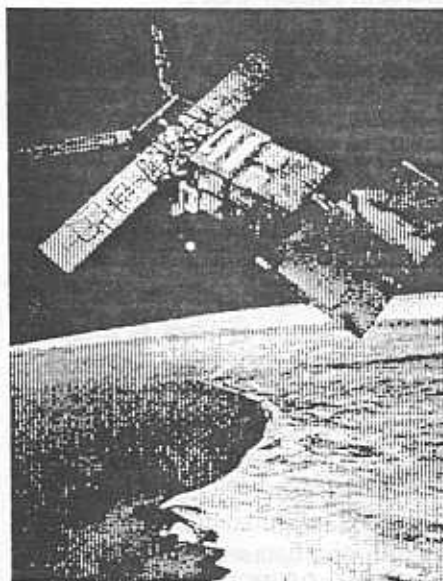
Integrated NOAA Data Management Effort

Vernon Derr
Director-Designee
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Data and information management is moving rapidly to a higher level in the consciousness of the scientific community and government officials, spurred by expanding widespread or global research efforts. Within NOAA these efforts are exemplified by the National Weather Service (NWS) Modernization Program, the Climate and Global Change Program, and the Coastal Oceans Program. In other U.S. agencies, in the private community, in the international societies, and in foreign countries, expanded research efforts to understand, monitor, and predict the processes of our earth's system, both natural and impacted by man, clearly announce major increases in the quality, quantity, and spatial extent of data being gathered. Further, as we come to understand the interactions of the earth's system, we recognize that interdisciplinary research is required.

Because of this explosion of data sources and information needs and the wide range of disciplines, the NOAA administration has asked me to join the Office of the Chief Scientist with the goal of coordinating NOAA's expanding role in data and information management across the agency. This oversight role is to aid all the line organizations of NOAA to move efficiently toward the future gath-

-continued on page 2



ERS-1 Planned for Late 1990 Launch
(see page 2)

NESDIS Working to Improve Data Access

Thomas N. Pyke, Jr.
Assistant Administrator for Satellite
and Information Services

The United States' ability to prosper and remain economically competitive in a changing world will become increasingly dependent in the 1990's on our understanding the Earth System and human influences on that system. A fundamental underpinning of NOAA's role as the Nation's Earth System Agency is our ability to provide quality environmental information for decision making. Whether these decisions concern acid rain, global change, coastal oceans, or weather, it will be paramount that accurate and timely global environmental data and information be available for use in describing the environment, leading to scientific understanding and prediction.

The role of NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) is to observe, acquire, process, validate, describe, and distribute information about the Earth System consistent with NOAA's national responsibilities. This requires both the management of satellite and *in situ* data for near real-time operational applications, such as weather forecasting, and the production and maintenance of research quality data bases and information, which accurately describe the environment over time. These long-term, high-quality data sets are crucial to programs such as Climate and Global Change.

-continued on page 2

INSIDE

ERS-1 Data	2
Data Availability at NCDC	3
NOAA Data Directory	4
CEOS Working Group	4
Paleoclimate Data	5
NOAA Network	6

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NOAA To Receive ERS-1 Data

(First of Two Articles)

NESDIS and the European Space Agency (ESA) have been discussing plans for cooperation in ocean sensing satellites since 1982. In return for useful Low-Bit-Rate (LBR) ocean data from ESA's Earth Resources Satellite (ERS-1), planned for launch in late 1990, NOAA has considered providing joint calibration and validation support.

NOAA/NWS operates moored buoys that, with some upgrading, would

be well suited to this purpose. The process of upgrading these buoys during their normal refurbishment has begun and is expected to be completed in time for the ERS-1 launch.

NESDIS is also planning to participate, through the Joint Ice Center, in an ERS-1 Synthetic Aperture Radar (SAR) operational demonstration project. The SAR data is being made available by NASA through its memorandum of understanding with ESA to receive ERS-1 SAR at the Alaska SAR Facility (ASF).

*- Brent Smith/Rob Masters
NOAA/NESDIS International
and Interagency Affairs Office ■*

Derr, from page 1

ering, archiving, and usage of data and information products. Special attention will be given to developing accurate, trustworthy information needed by scientists and policy makers

At this time, a NOAA data policy and mission statement defining NOAA's role and responsibilities is under development. This document, when reviewed and approved, will clarify and unify the various laws, regulations, and budget statements under which NOAA operates in this area.

The Office of the Chief Scientist and NESDIS are also assembling teams to develop the NOAA-wide FY 92 budget submission for data and information management and to develop proposals and implementation plans for the rapidly expanding activities in FY 91 under the Climate and Global Change Program.

Some activities in NOAA are being managed under program offices and these will play a very important role in the future organization of data and information services. For uniformity and efficiency, some oversight is needed. An example is the working group being formed under Fred Long of the National Ocean Service to define the technological organization of NOAA's Data and Information Services. The purpose is to adhere as closely as possible to national standards that will provide uniformity and functional capability within NOAA and across the scientific community. ■

Pyke, from page 1

In its function of supporting NOAA's Earth System programs, NESDIS has one main goal: to put the highest quality data into the hands of users as soon as possible. NESDIS is taking action to improve access to needed data and information as follows. Plans have been made and pilot projects have been started to build and maintain a NOAA Earth System Data and Information Directory that will identify what data sets exist and where they are located. NESDIS has paved the way for an environmental data and information communications network backbone for NOAA and is investigating standards that will be required for a data management capability to be realized in NOAA. New technologies will be used to migrate to new media valuable data in jeopardy of being lost and make them more accessible. New data sources will be added, and basic science quality data sets will be produced and updated periodically. NESDIS is also actively seeking out, restoring, evaluating, correcting, and interpreting past data needed to accurately describe the Earth System over time, a process called "Data Archeology."

I welcome the attention Dr. Vernon Derr will give to coordinating data management activities throughout NOAA and developing a strategy to modernize the management of NOAA's Earth System data and information. The need for accessible, high-quality data and information, combined with the unprecedented

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Climate Services: Satellite Services:
FTS 672-0682 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)
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U.S. DEPARTMENT OF COMMERCE

Robert A. Mosbacher, Secretary

National Oceanic and Atmospheric Administration

John A. Knauss, Administrator

quantities expected from observation systems to be deployed in the near future, provides great opportunities and NOAA must be prepared to accept the challenge. Data and information management technology has increased dramatically in recent years and major improvements are being accomplished throughout government, industry, and academia. NESDIS is prepared to take advantage of this revolution. As a result of a decade of planning, evaluating, and applying existing technology, new capital investments can show remarkable improvements in productivity with a small increase in resources. ■

Data Availability at the National Climatic Data Center

Kenneth D. Hadeen, Director
Rex Snodgrass, Chief, Systems
Development Staff
NOAA/National Climatic Data Center

Long term, high quality, homogeneous data sets are required by the scientific community for input to research programs and to evaluate the credibility of research results of programs dealing with the Earth's changing environment. The Global Climate Laboratory housed in the National Climatic Data Center located in Asheville, N. C., is actively developing high quality data sets and information from the massive data bases held by the Center. Documenting these data sets and making them readily available to the research community are high priority tasks.

The Center receives global meteorological records that are taken daily from a vast network of stations. The types of data held in the active data bases include *in situ* measurements of temperature, pressure, precipitation, wind, and sunshine, as well as satellite measurements in multispectral bands of the visible, infrared, and ultraviolet. The data are processed, sorted, reformatted, extensively quality controlled, and made available to users in a variety of formats and media including magnetic tapes, floppy disks, microforms, and paper. Some data are also available on CD-ROM. Customers preferring direct facsimile service may obtain data in that mode.

Most of NCDC's 280 data sets are continually updated. Many of these sets represent global coverage and are suitable for climate change studies. In addition, the center has over 210 million paper records and 1 million microfiche. Total available archives contain about 100 terabytes (10^{12} bytes) of data, increasing in the early 1990s at a rate of 14 terabytes/yr. The digital data from the newest satellites represent the fastest growing portion of the Center's holdings, although new surface based observational systems such as Next Generation Radar (NEXRAD) will also generate significant volumes of useful data in this time frame.

NOAA's National Data Centers First in a series of articles

The Center also issues about 1 million copies per year of various publications which provide summaries and analyses of the data in the data base. Examples of serial publications available by subscription include Local Climatological Data (published by city), Climatological Data (by state), and Hourly Precipitation Data (by state).

The NCDC has been quick to adopt PC-based technology. Recently, in cooperation with the WMO, NCDC developed a PC-based climatological data processing system, called CLICOM, to provide developing countries the capability to digitize, quality control, manage

and analyze climatic data. There are over 74 installations in other countries and 61 installations in the U.S. The number of installations using the CLICOM format and quality assurance features have been useful in standardizing the organization, digitization, and exchange of various historical data sets. Data are available on both 5.25- and 3.5-inch diskettes.

Desktop computers operating on a PC-LAN within the Center have brought data sets formerly available only on a mainframe within reach of individual analysts and quality control specialists.

The CD-ROM, or compact disc, has become an attractive media for data storage and distribution. Compact discs can hold 700 megabytes of digital information on one side and allow random access to any of the data. For several years, NCDC has been working with the private sector and a university to make available NCDC data sets on CD-ROM. Some of the principal NCDC data sets available on CD-ROM are listed in the adjacent table.

In the next few years, the Center will emphasize creation of baseline data sets of research quality that will provide documented, "artifact-free" data for global climate monitoring, and will expand on-line catalogues and inventories to make data and information more quickly available. A major effort will be expended for effective planning and liaison for new observing systems (e.g., Profiler, NEXRAD, ASOS, GOES-Next) to ensure climatological continuity of data, and the establishment of data exchange standards and formats. Also, a major effort is required to upgrade our technological infrastructure to manage the 400 terabytes of data expected by the turn of the century; to integrate data obtained from different platforms—satellite, *in situ*, sub-surface; and to provide information sorted to meet user specifications, in addition to providing single-station data.

We are entering a challenging and exciting period for researchers and data managers alike. By working together, we can realize our mutual goals. ■

NCDC Data on CD-ROM

1. **Climate Data** - Hourly and 15-minute precipitation from 1900-1989.
2. **Climate Data - Summary of the Day.** This set represents the Cooperative Observer Network of station summaries and histories and observations of temperature, precipitation, and snowfall.
3. **World Weather Disc** contains 17 meteorological data sets describing the climate of the Earth.
4. **AFOS Data Disc** contains surface and upper air data for the 2nd half of 1987 for North America.
5. **AVHRR Data Set** is image data and vegetation index completed during the 1988 growing season.
6. **Climatology of the U.S. No. 20** (by city) includes normals, means, extremes, and probabilities for daily/monthly temperatures, precipitation, etc. (1895-1980).

For details, contact NCDC
- See page 2

The NOAA Earth System Data Directory

Many of us use the library to search for some good reading, or to find a particular reference on a subject of interest. When we do that, we sometimes simply wander about the shelves, but often go first to the card catalog to speed our search.

The NOAA Earth System Data Directory (NESDD) serves the same function for NOAA scientists, managers, and other employees who are inquiring about one of the many earth-describing data files held by NOAA. One difference between the local library and NOAA, however, is that NOAA files are scattered at locations throughout the United States, making it even more difficult to find data on a specific topic. The Directory contains over 300 file descriptions, and additional entries are being made each week. The types of earth measurements reflected in these files are extremely varied, and browsing through the Directory

is a journey through NOAA data resources. You may search by scientific discipline, measured parameters, time period, geographic location, project and other criteria.

A recent search for data files containing information on biology, for example, turned up 23 references, most having to do with the marine biology and fisheries. Another search showed that NOAA holds over 70 files of atmospheric science data. Did you know that you can obtain data on earthquake events in the U.S. over the past 150 years from the National Geophysical Data Center? Or that some data sets are available on diskettes and/or CD-ROMs?

Most entries at this time describe data held by NOAA's three National Data Centers, but the Directory will become even more comprehensive as other Line Offices add their data files. Plans are to continue expanding NESDD to support NOAA data management plans and activities, and to explore providing direct links from the Directory to other NOAA online catalogs and inventories.

The NOAA Directory uses software that was developed by NASA for the NASA Master Directory. The Directory is installed on the National Oceanographic Data Center (NODC) VAX 11/785 computer. The system uses specially written software and the ORACLE Data Base Management System.

NESDD is indirectly linked to other directory systems through the Directory Interchange Format (DIF), which is the format used by NOAA, NASA, and USGS for exchange of directory-level information about data sets among information systems. The DIF is described in the *Directory Interchange Format Manual* (Version 2.0, July 9, 1989) published by the NASA National Space Science Data Center.

Remote access to NESDD is available through direct dial-in to the NODC VAX, or through the NASA SPAN network.

—Douglas Hamilton/Gerald Barton
NOAA/National Oceanographic
Data Center ■

CEOS Working Group on Data (CEOS/WGD)

The Committee on Earth Observing Satellites/Working Group on Data, established at the initial meeting of CEOS in 1984, defines areas for increased coordination and standardization of spaceborne Earth observations data management for the benefit of members and the international user community.

NOAA chairs CEOS/WGD, as well as the Catalog Subgroup. WGD also established several sensor-specific subgroups (Synthetic Aperture Radar, Scatterometer, Altimeter, and Passive Microwave) to coordinate standardization of user product formats. WGD and its subgroups meet every four to six months.

The CEOS/WGD Catalog Subgroup has made considerable progress in developing and promoting an approach for achieving an interoperable, international catalog system by which a user can determine which data of interest exist and how

they can be obtained, as well as acquire other supporting information.

The user product formats subgroups generate sensor formats that conform to a CEOS-recommended standard. Format standardization will facilitate the ability to generate and read data products that are supplied by different agencies from the same sensor or from similar sensors on different satellites. A number of such formats have been developed and accepted by CEOS/WGD, and member countries have agreed to incorporate them into ongoing data management planning. To further such coordination, NOAA maintains a library of accepted product formats on behalf of CEOS/WGD.

Other coordination activities of CEOS/WGD include:

- Common lexicon and data dictionary
- Networks
- Storage and distribution media
- Data management strategies

Other groups (EO-ICWG and IPOMS)* have chosen to direct their technical coordination requirements for data management and calibration/validation to the CEOS Working Groups, rather than to establish their own separate working groups. The CEOS Working Group on Data has been directed to undertake technical discussions regarding implementation of the Japanese proposal for a "Worldwide Network for Global Environmental Monitoring from Space."

—Betty Howard,
NOAA/NESDIS International
and Interagency Affairs Office ■

- *EO-ICWG - Earth Observation-International
Coordination Working Group
IPOMS - International Polar Orbiting Meteorological Satellite Group

This first issue of
Earth System MONITOR
was prepared at the
National Oceanographic Data Center

THE SEARCH FOR PALEOCLIMATE DATA

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Center

Global Climate Models (GCM's) have great potential to predict climate change, but for their validation they require information on the past history of climate variability, that is, global paleoclimate data. Such information must span a time period sufficient to encompass the time scale of the climate variations being studied. Past climate changes have been grouped into three time scales based on the suspected natural causes of the climate change: *tectonic* time scales (hundreds of thousands to millions of years); *orbital* time scales (a few thousand to hundreds of thousands of years; and *oceanic* time scales (up to a few thousand years.)

Because directly observable instrumental climate data are available from only the last 150 years or so, the study of paleoclimate relies mainly on historical climate records and a variety of climate "proxies" from the geological and biological record. These data come from many sources including historical records (temperature, rainfall, streamflow, agricultural harvests), tree rings (ring width, wood density), ice cores (isotope measurements, atmospheric chemistry), and fresh water and offshore sediments (pollen, fossil remains, sediment chemistry).

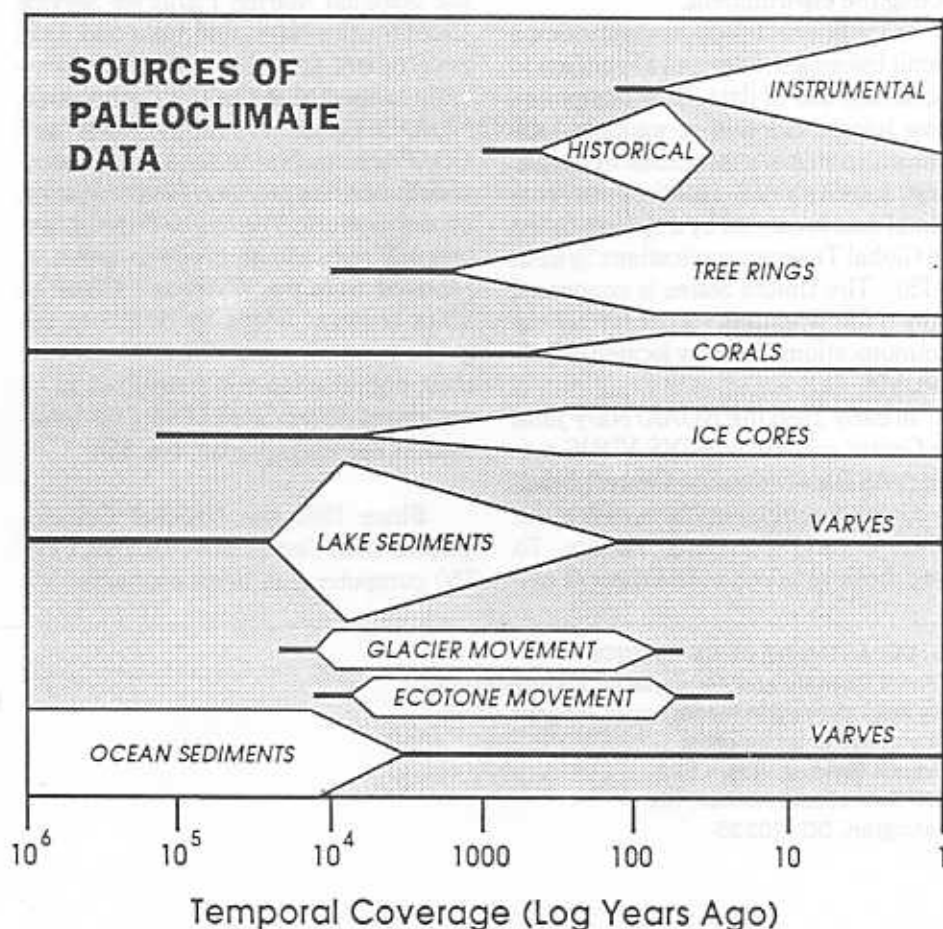
Geologists have long uncovered evidence and speculated on causes of climate change at tectonic time scales. More recently, the discovery that deep-sea marine sediments hold an unbroken record of climate change at orbital time scales has fueled an exciting era of global studies (CLIMAP, SPECMAP)* which has revolutionized the study of quaternary geology and elevated paleoclimatology to the status of a scientific discipline. Even so, studies at tectonic and orbital time scales have largely been topics of academic interest because the rates of

climate change do not impose immediate consequences to mankind.

Climate changes in the annual-to-century (oceanic) time scale are the least studied and least understood, yet these are the climate changes of immediate concern to man because they can be large, occur rapidly, and have severe impact. For these reasons, the study of paleoclimatology has moved to center stage as concern over the consequences of short term climate change due to the greenhouse effect and other man-induced and natural causes have become national and global issues.

Studies that provide information on past climates are being conducted in many different disciplines, and the resulting

data are widely dispersed. Each discipline has a research community and program management structure which is distinct from the others. There has been no centralized attempt to gather the various pieces of data together. Consequently, the NOAA/NGDC Program in Paleoclimatology has as its objectives to (1) establish and build a global paleoclimate data base, and (2) carry on a research program to use the developing data base for the study of global climate change. A specific long-term objective is to develop climate reconstructions, using the combined global array of paleoclimate data, for testing and improvement of GCM's. Work has already begun on the first objective. ■



From Overpeck (1988), modified after Bembo (1978)

- *CLIMAP - Climate Mapping for Long Range Prediction
SPECMAP - Spectral Mapping (A project to study climatic time series of the past 400,000 years from ocean sediment cores.)

NOAA's NETWORK SYSTEM

Fred Long
Acting Chief, Ocean Products Division
NOAA/National Ocean Service

Primarily through operations of its National Weather Service (NWS), NOAA has a long history of extensive use of telecommunications. For many years teletype circuits were used to communicate meteorological data: temperature, pressure, winds, and humidity. Today, telecommunicated data include these basic meteorological parameters as well as observations of the subsurface ocean. In addition, satellites serve as platforms for new observational instruments and as links in communications circuits that support observing, monitoring, and predicting the environment.

In traditional telecommunications, a circuit linked a sender and a recipient to coordinate use of data. Now computers allow interconnection of multiple locations with minimal intervention by people. Most international, real-time environmental data is carried by a system called the Global Telecommunications System (GTS). The United States is connected to the GTS computers via the NWS Telecommunications Gateway located in Suitland, Md.

In early 1986 the NOAA/Navy Joint Ice Center and the NESDIS VDOC system (VAS Data Utilization Center) developed joint requirements for access to the NOAA Central Computer Facility. To meet these requirements Ethernet net-

works were installed at their facilities in Federal Building 4 (FB4) in Suitland and the World Weather Building (WWB) in nearby Camp Springs, Md., and the interconnecting microwave communications link was upgraded. The protocol chosen for this system was TCP/IP (Transmission Control Protocol/Internet Protocol), which is used by the Internet system that connects most major U.S. networks.

At the World Weather Building, the National Ocean Service is implementing a network called NOCN (National Ocean Communications Network) to interconnect facilities involved primarily with oceanographic data. These facilities include the Center for Ocean Analysis and Prediction (COAP) in Monterey, Calif., the National Marine Fisheries Service (NMFS), the Navy, and state and local government agencies. NOCN is presently connected to the TCP/IP network. NOAA's Ocean Products Center and COAP are combining ocean and atmospheric data into products for distribution on the network. The larger Federal centers will redistribute products and data received from the WWB and COAP to other centers. Plans by NMFS to upgrade network capabilities throughout their organization are formalized in a document abbreviated IT-95 (for Information Technology Plan, No. 95).

Since 1984 the National Oceanographic Data Center's (NODC) VAX 11/750 computer has been connected via

9.6-kilobit lines to the NOAA computing facility in Suitland and to the National Climate Data Center's Unisys mainframe system in Asheville, N.C. This allows NODC users to connect via terminals and PCs to modems and the VAX. A hook-up to NASA's international DECnet network called SPAN provides a path for mail and data transmission between the NODC and a large part of the international scientific community. In 1987 NODC launched an accelerated program to upgrade its communications capabilities. With cooperation of NESDIS headquarters, a plan was drawn up to convert the NODC Local Area Network to a 10-megabit Ethernet. A router with a 56-kilobit connection to the NOAA backbone network in the World Weather Building was added. A distribution processing environment is now provided in-house, improving the ability of the Center to acquire and distribute data quickly.

In the coming years NOAA's widespread use of networks will allow easy access to the research quality data sets being developed by the data management initiative. The archive data bases of the National Oceanographic Data Center, the National Climatic Data Center, and others will support new scientific investigations in the Climate and Global Change and the Coastal Oceans programs. Additional benefits will accrue from the increased interaction between NOAA scientists and researchers in other scientific agencies. ■

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