



Earth System MONITOR



Vol. 1, No. 4

A Guide to NOAA's Data and Information Services

April 1991

NOAA Workshop Asks: How Do We Ensure the Quality of the Environ- mental Data Record?

As they search available data looking for apparent trends and anomalies, climate and global change researchers must often stop and ask: Is this a real phenomenon or an artifact of changing instruments or calibration procedures? One of the thorniest problems facing earth scientists remains how to ensure the long-term quality and continuity of the environmental data record.

A workshop to address this issue was held at NOAA's Silver Spring Metro Center complex on April 11-12. Over 40 individuals participated, representing each of the Line Offices and major programs, an eclectic mix of NOAA scientists, covering the range from Center Directors to data analysts and data users. Dr. Vernon Derr, Director-designee of the Earth System Data and Information Management Project Office, presided.

The workshop was convened in response to the growing recognition that

-continued on page 6

INSIDE

The National Climatic Data Center Library 3

Improving Catalog Interoperability for Trackline Data Systems 5

The Ocean Pollution Data and Information Network 7

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

Pathfinder Program Launches AVHRR Data Transcription

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

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

Pathfinder Data Sets have become a major collaborative activity between NOAA's Climate and Global Change and NASA's Early-EOSDIS Version 0 programs. The principal objective of the Pathfinder effort is to focus resources of NOAA, NASA, and academia on the problem of accessing and retrieving very large data sets for climate applications.

The Pathfinder program currently includes AVHRR, TOVS, and GOES operational satellite sensor data*, with current data volumes of 4 TB (terabytes), 0.4 TB, and 125 TB, respectively. A first step in the Pathfinder program will be the transcription of these data from magnetic tape to more accessible storage media.

Since the Pathfinder agreement was signed by NOAA and NASA on October 15, 1990, considerable progress has been made with the AVHRR Pathfinder Data Set. NOAA and NASA have begun the

*AVHRR - Advanced Very High Resolution Radiometer
TOVS - TIROS Operational Vertical Sounder
GOES - Geostationary Operational Environmental Satellite

NOAA/NESDIS E/SP
Federal Building 4
Suitland, MD 20233

tasks of organizing technical and science working groups, modifying and testing transcription software, organizing and initiating a massive magnetic tape shipment process, and configuring hardware systems for the actual transcription operation.

The AVHRR 4 km resolution data will be transcribed from magnetic tape to 12-inch optical WORM (write once, read-many) disks. This medium is currently being used for satellite data applications at the National Oceanographic Data Center (NODC), the NASA Goddard Space Flight Center (GSFC) EOSDIS Distributed Active Archive Center (DAAC), and the universities of Rhode Island and Miami. The optical disks will be used as working storage media to facilitate access to the 13-year record of Level 1 AVHRR data.

The problem of access and retrievability can best be shown by comparing optical and magnetic media. Afternoon satellites (northbound Equator crossing time at about 1420 LST) with 5-channel AVHRR sensors dating back to 1981 are of particular interest to scientists studying global sea-surface temperature and vegetation index. This data set currently resides on about 17,000 magnetic tapes, in both computer compatible tape (CCT or "round") and cartridge ("square") formats. After transcription, the data will reside on 340 optical disks, where each disk will hold approximately 6.5 GB of data, or 10 ten days worth of orbital data from one spacecraft. Each optical system

-continued on page 2

Earth
Observing
System
Data and
Information
System

Pathfinder Program, from page 1

at the Pathfinder program sites currently uses a 50-disk robotic jukebox capable of storing well over a year of 4 km AVHRR data online.

The data transcription operation is scheduled to begin about June 1, 1991, starting with the 17,000 AVHRR afternoon data tapes. This planned start date depends, however, on completion by NOAA and NASA software analysts of final changes to the applications software. The transcription software will: 1) drive a read/write spooling operation from magnetic tape to magnetic disk storage, 2) update a relational data base (DEC RDB) that contains inventory information, and 3) drive a read/write operation from magnetic disk to optical disk.

Many of the software changes were necessary to improve overall quality control and to include additional inventory information in the data base. With disk transcription and eventual usage planned at multiple sites, a NOAA/NASA technical working group is developing a quality assurance plan to make sure the optical disks are 100% compatible among all sites.

Two optical systems, one at the NODC and the other at the GSFC DAAC, will be used in the initial AVHRR transcription operation. Throughput rates have been estimated and verified by prototype transcription operations at GSFC. With both systems operating 24 hours per day, 5 days per week, the transcription operation for the entire Level 1 data record for the afternoon AVHRR data is projected to take 12 months. A compatible optical system is currently being procured by NESDIS and will be used to help reduce the archive backlog.

AVHRR tapes to feed these optical systems will come from NOAA archive tapes previously purchased by GSFC, and copies of archive tapes from the National Climatic Data Center (NCDC)

and its Satellite Data Services Division (SDSD). If data from the morning polar orbiters are included in the Pathfinder Data Set, the total number of AVHRR tapes that will be migrated to the optical systems will exceed 31,000—presenting a formidable job at NCDC in tape handling, shipping and inventory control.

All of the above activities are in preparation for the generation of higher-level (Level 2) research quality, climate reference products. As algorithms or calibration techniques are improved over time, the product generation operations will also include reprocessing of the data to

allow for re-evaluation or improvement of climate products.

To help define this phase of the Pathfinder program, NOAA and NASA have formed Pathfinder Science Working Groups (SWGs). The SWGs will review the AVHRR data set and recommend community-consensus algorithms, as well as product generation and browse requirements. Three inter-

agency and extramural SWGs have been formed for the AVHRR Pathfinder data—*Oceanic*, chaired by Dr. Peter Cornillon of the University of Rhode Island; *Land*, chaired by Dr. John Townshend of the University of Maryland; and *Atmospheric*, chaired by Dr. Jim Coakley of Oregon State University.

Each group has met once and status reports are being prepared that will provide recommendations to NOAA and NASA for generating Pathfinder products. Already, an important result of SWG deliberations has been the formation of an AVHRR Calibration Working Group to assist in characterizing the accuracy of derived climate products. Chaired by Dr. Mike Weinreb of NESDIS, this group will establish a consistent calibration record of AVHRR visible and infrared channels for the AVHRR Pathfinder Data Set (1981 to present).

In the near term, activities of the

“If data from the morning polar orbiters are included in the Pathfinder Data Set, the total number of AVHRR tapes that will be migrated to the optical systems will exceed 31,000 . . .”

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 Richard Abram at FTS-673-5561 or 202-673-5561 or write:

NOAA/Data and Information Management Program Office
Office of the Chief Scientist
Universal Building, Room 517
1825 Connecticut Avenue, NW
Washington, DC 20235

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, Under Secretary

AVHRR Pathfinder program are expected to include transcription operations at GSFC and NODC, additional SWG meetings, and planning for initial product generation. Eventually the Pathfinder program will also expand with the addition of GOES and TOVS science working groups. ■

THE NATIONAL CLIMATIC DATA CENTER LIBRARY

A treasure trove for data archaeologists

Linda D. Preston

Librarian

Peter Steurer

Chief, Data Base Management Branch,

National Climatic Data Center

NOAA/NESDIS

The data archaeologist of the 1990s is working to recover and make more accessible existing information that may unlock many of the secrets of global climatic change. A major information resource that has long been servicing data archaeological needs and requests is the library of the National Climatic Data Center (NCDC), Asheville, N.C. Although by most standards the NCDC library is not large, it is a treasure trove of information and data. Its resources and services support many aspects of global change research.

Making Data More Accessible

With the library's move to a new location in 1981, NCDC made a commitment to provide better response to data archaeological requests. The first objective was to improve the organization of our holdings. Most books had labels with UDC (Universal Decimal Classification) numbers. The rest of the collection—including observation manuals, historical collections, microformats, articles, and periodicals—was uncataloged. To allow easier and more efficient access, all publications were placed in Library of Congress (LC) Classification number order (with some aspects of the LC classification system modified after coordinating with the Library of Congress.)

Our atlases and maps are classified with the same call numbers as our books, that is, primarily by subject, not by geographic area. Where possible, publications are arranged by beginning date of data. This makes it easier for users to

move back through time from title to title to search out data overlaps and voids. Also, all of our holdings, regardless of media or formats, are filed together. For a topic such as drought, for example, all books, videos, periodicals, bibliographies, articles, microformats, CD-ROMs, software diskettes, etc., are filed together rather than separately by media categories as is the usual case.

Linking Data Sets

We also link our data to other NCDC data holdings, as well as to data held by other organizations. This linkage allows users to take logical steps to find related information more efficiently. For example, on our first volume of *Local Climatological Data*, we have a label referring users to related NCDC manuscript collections. On the same volume we have another label advising users that microfiche sets are also available in station order, not date order. For those interested in only one station for the entire period, they will probably be more interested in a data station sort. Our storm section shows another linkage because it has labels referring users to the Central NOAA Library and the National Technical Information Service for early storm and typhoon data. In addition, other referrals are made to various in-house experts.

Another method of linkage can be found in the additional notes in our cataloging entries. Titles and Superintendent of Documents classification numbers change over time so we link them for outside users and for our own historical understanding. This is particularly important as our cataloging is input for the

heavily used international data base, OCLC (Online Computer Library Center, Inc.).

Finding Special Data Collections

It is unusual for NCDC's projects to need data that we do not already have. In one such instance, however, our library contacted the Pennsylvania Hospital's Medical Library in Philadelphia to borrow microfilm of the hospital's daily weather data, 1825-1871. A copy of

this microfilm is now in the NCDC library with the rest of the Pennsylvania data as well as in the NCDC film archive for all to use.

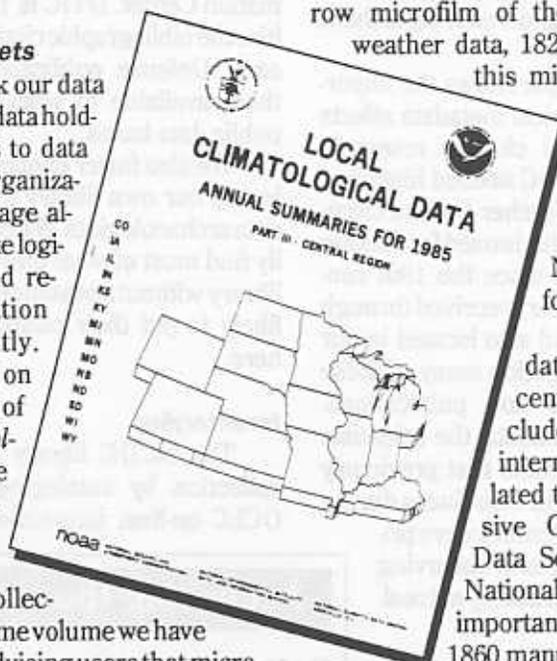
Other existing data that have recently been located include both national and international projects related to the Comprehensive Ocean-Atmosphere Data Set (COADS). The National Archives holds an important collection of pre-1860 manuscript marine log-

books known as the Maury Collection. NCDC has acquired a microfilm copy of this collection for our library and plans to digitize it. Also, contacts have been made with archives in other countries such as Japan and Germany to fill gaps in the marine record. Within NCDC's own archives, we have located valuable data for the World War I and II years that are missing in the marine record. When digitized, these newly discovered log-books will add tremendously to COADS and thus to a better understanding of past climate.

Locating Metadata

Not only do we assist our users as they search for data sets, we also help as they search for explanations for the dif-

—continued on page 4



National Climatic Data Center
NOAA/NESDIS E/CC
Federal Building
Asheville, NC 28801

NCDC Library, from page 3

ferences in how basic observations were recorded and reported over time. These metadata, or data about data, are important in determining potential biases that may have affected the climatological record. Data archaeologists often must trace back changes through various manuals, instruction sheets, and forms. Although the NCDC library has a good collection, for some acquisitions we refer to the Central NOAA Library, the World Meteorological Organization (WMO), and other offices and agencies who are now recording, using, or referring to these data.

A recent example shows the importance of how historical metadata affects climate and global change research. Researchers at NCDC needed historical manuals and old Weather Bureau circulars describing methods used for making cloud observations since the 19th century. The NCDC library received through interlibrary loan and also located in our own microfilm collection many of these historical manuals and publications. Based on these metadata, the scientists were able to determine that previously reported increases in cloudiness during the first half of this century were primarily due to changes in observing practices and were probably not real.

Salvaging Data Sets

Although most data are physically very accessible, some data are deteriorating. We need to reprocess and rescue them in some other formats or media before they disintegrate. A project currently underway at NCDC involves digitizing monthly temperature and precipitation data for the Signal Corps fort stations published in the early 19th century. For cost effectiveness, NCDC also works with individual state climatologists to preserve valuable data sets. For example, NCDC provided the monthly weather reports and reviews for Utah, 1891 to 1897, to the Utah State University for microfilming. In exchange, we received two copies of the resultant microfilm. These publications are

examples of the wealth of historical climate data available in the NCDC library that are deteriorating rapidly. Once these data are digitized and stored on other media, they will benefit many researchers and ultimately increase our knowledge of climate.

Improving Communication and Cooperation

One way the NCDC library convinces others to share data is by setting a good example. We have donated 83 of our publications to the Defense Technical Information Center. DTIC is planning to digitize the bibliographic citations from these early Defense publications and make them available to world scientists via public data bases.

We also foster cooperation by opening up our own library to scientists and data archaeologists. When they can readily find most of what they need from the library without assistance, they are more likely to put their publications or data here.

Inventorizing

The NCDC library inventories its collection by cataloging through the OCLC on-line, international data base.

This is a long-standing (since 1967) and heavily used data base used by many national and international libraries. A major effort is now underway at NCDC to provide catalog entries for all publications in our library. This is not a simple task since many publications are non-standard entries such as observation manuals, historical collection materials, microformats, etc. However, on-line cataloging is an essential aid in accessing information at distant sites.

Future Projects

Because of the steps taken over the last decade, we think the NCDC library is probably the world's most convenient and accessible library for working with United States national, regional, and state weather data. We probably do not have the most data nor the most complete catalog, but we believe we have the most convenient arrangement for data archaeologists.

A new project is on the horizon. Due to great interest in global climate change, NCDC's separate but extensive foreign data collection is becoming increasingly important. There are proposals to reorganize and merge several collections containing international climate publications from several buildings following a pattern similar to our own NCDC library. We will be automating these bibliographic records and other bibliographic records for data at different locations such as the Library of Congress. The NCDC/World Data Center A for Meteorology and the NOAA Central Library and others are studying and arranging these systems so the data archaeologists of the world will have convenient access to these data sets as soon as possible.

Examples of what is to come for our foreign collection are the application of optical disk technology, more in-depth analyzing for keywords, and greater access to outside users via on-line bibliographic data. Although this is a large task, it will provide many benefits to the data archaeologist researching global climate change. ■

Accessing the NCDC Library

The National Climatic Data Center Library is open M - F from 7:30 am to 5:30 pm eastern time. The Librarian is on duty from 9:00 am to 5:30 pm.

For reference services, contact:

Linda Preston, Librarian

Telephone: 704-259-0677
FTS 672-0677

FAX: 704-259-0246
FTS 672-0246

Omnet: T.KARL (Attn: L. Preston)

Telemail: CLIMATE.NCDC (Attn: L. Preston)

Research customers needing assistance in obtaining and using climate data should contact:

Tom Ross, Meteorologist

Telephone: 704-259-0308
FTS 672-0308

Improving Catalog Interoperability for Trackline Data Systems

Allen M. Hittelman, Dan Metzger,
and Ron Buhmann
National Geophysical Data Center
NOAA/NESDIS

Trackline data represent a class of data collected along survey paths. Survey platforms typically include oceanographic ships, airplanes, and surface vehicles. Trackline data are also collected, however, by satellites or passive platforms such as weather balloons or floating ice islands. The common attribute is a spatial series of observations, with position, time, and elevation parameters frequently relevant.

NOAA's National Geophysical Data Center (NGDC) maintains two large collections of trackline data that are valuable as key global Earth systems reference data bases—Underway Marine Geophysical Data and Aeromagnetic Data. The Underway Marine Geophysical Data include 3,100 surveys which sailed over 11.5 million nautical miles (3.8 gigabytes); the Aeromagnetic Data encompass over 1,500 surveys flown over 4.5 million nautical miles (4 gigabytes). Both contain measurements of the magnetic field of Earth, but underway ship-collected data also include bathymetry (ocean depth) and gravity measurements.

For almost a decade, online graphic inventory capabilities have existed for many of these data. Users query metadata inventory files on a computer and produce trackline plots and tabular listings that summarize holdings that meet certain menu-searchable criteria. Upon identification of useful data, data extraction utilities search the databases producing data sets that are sent to users (via mailed magnetic tapes or via network transmissions). The most common search criterion is a spatial window (defined by latitude-longitude polygons). Other common selections include institution, project,

parameters surveyed, or time period.

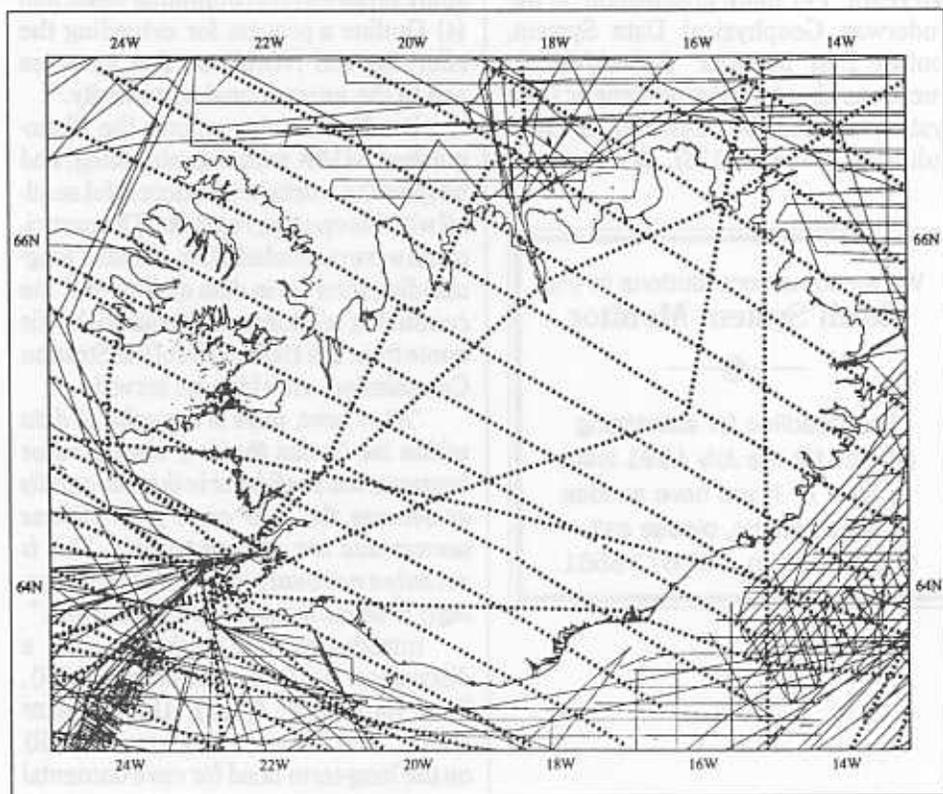
To improve access to these data and inventory systems, the NGDC has begun an effort to make them available on compact disc (CD-ROM). Prior to pressing the compact disc, inventory metafiles for each survey are created. These files contain documentation as well as summary trackline information. Also along the way, validation checks are performed on each data field and summaries of the range of values within key fields are saved. Each survey is documented in a header file describing the data format, survey characteristics, instrumentation, and some data processing techniques. Geographical indices within the header support geographic searches.

Upon completion of these compact disc compilations, end users will be able to have on their desktops the entire data collection, with access software that

supports data downloads and graphic browse of the data. As an example, a researcher may view profiles along survey tracks to determine offsets between different surveys. These offsets may represent reference datum or leveling problems within the database or global changes in Earth's magnetic field.

How do research scientists learn of the existence of these data and inventory systems? One way is through linkages to online data directories via the Catalog Interoperability (CI) Project. This interagency/international program, sponsored in part by the Interagency Working Group on Data Management and Global Change (IWGDMGC), is developing central directories and inventory/data linkages to remote data systems. For these trackline data systems, linkages can easily be established with NOAA; however, since the entire data-

—continued on page 6



Inventory plot of NGDC trackline geophysical data in the vicinity of Iceland. The solid lines show tracks of shipborne underway marine geophysical data; the bold dotted lines show tracks of aeromagnetic data collected by aircraft.

National Geophysical Data Center
NOAA/NESDIS E/GC
325 Broadway
Boulder, CO 80303

Trackline Data Systems, from page 5 base/inventory system is "portable" on compact disc, it can also be replicated at numerous research sites.

The data/inventory system will operate within a network environment or in a stand-alone mode. Those who are unaware of the data may learn about the databases through a centralized directory (such as those available at NOAA and NASA) and then "link" to the data system at a convenient site via a network. Those who frequently use the data will have them at their individual workstations. Many prefer information on-desk as opposed to online. A more interactive system with greater flexibility is possible in a desktop environment. For example, system response is much faster, hardcopy output is easier, and down-time is less frequent.

Prototype releases of these trackline data systems and their linkages to central directories are expected in late 1991. Additional capabilities (such as improved software and expanded data sets) will be released periodically throughout the next two years. For more information on the Underway Geophysical Data System, contact Dan Metzger (303-497-6542). Questions about the Aeromagnetic Data System should be directed to Ron Buhmann (303-497-6128). ■

We welcome contributions to the
Earth System Monitor

The deadline for submitting articles for the July 1991 issue is June 7. If you have an idea for an article, please call Richard Abram, 202-673-5561.

NOAA Workshop, from page 1 today's environmental problems are placing new demands on the measurement of parameters describing the earth's system, and that NOAA has an obligation to assure the quality of the data record, including accuracy, precision, and representativeness. In order to assess whether parameters such as temperature exhibit trends, it is necessary to maintain the continuity of calibration as instruments are changed and platforms replaced. In response to a request from Under Secretary John Knauss, a small planning meeting was held in Boulder last June to assess the current situation within NOAA. The preliminary findings suggested the need to conduct a formal workshop to address the issue.

The workshop objectives were to:

- (1) Identify those parameters which require special attention of NOAA management with respect to data continuity,
- (2) Prepare a draft policy statement for data continuity to be submitted to the NOAA Administrator for approval,
- (3) Specify a mechanism to identify and address issues on a continuing basis, and
- (4) Outline a process for extending the effort beyond NOAA to other agencies and to the international community.

Dr. Knauss was among the distinguished NOAA scientists attending, and he gave the workshop a successful send-off with his opening remarks. The participants were reminded of Dr. Knauss' long-standing interest in data quality—and the continuing relevance of this issue—by his quote from the 1969 report of the Stratton Commission, on which he served:

"At present, there is a wealth of data within the Nation that is of limited value because of low confidence in the data quality or because the data came from diverse sources and are not comparable. This is not only a national problem, but it increasingly is becoming an international one."

Introducing the workshop was a discussion by Jerry Mahlman (OAR), Tom Kaneshige (OAR), Dana Kester (NOS), and Maurice Blackmon (OAR) on the long-term need for environmental monitoring. The first day was devoted largely to presentations identifying problems in a number of broad categories.

These included: surface measurements for climate by Tom Karl (NESDIS) and Chester Ropelewski (NWS); upper air measurements by Barry Schwartz (OAR), Bram Oort (OAR), and Roy Jenne (NCAR); ocean measurements by Syd Levitus (NESDIS) and Bruce Douglas (NOS); satellite measurements and calibrations by George Ohring (NESDIS), Walt Planet (NESDIS), Mike Weinreb (NESDIS), John DeLuisi (OAR), and Levin Lauritson (NESDIS); atmospheric chemistry by Pieter Tans (OAR) and Fred Fehsenfeld (OAR); fisheries data sets by Jim Sargent (NMFS) and Glenn Flittner (NMFS); and geophysical measurements by Joe Allen (NESDIS).

Following the formal presentations, Greg Withee (NESDIS) led a lively discussion. This unstructured working session allowed all participants to present their ideas openly. While the development of a policy statement is in its early stages at this time, two recommendations were made at the conclusion of the workshop:

- A standing committee of scientists from a broad spectrum of backgrounds and organizations should be constituted with the mandate to address issues of data quality and continuity.
- Recognizing that requirements for maintaining data continuity and quality will come largely from in-house research with those data, encourage an expanded effort of studies with environmental data, drawing on researchers within NOAA with appropriate scientific credentials.

The proceedings from the workshop will be published by the Office of the Chief Scientist, and a draft policy statement on the data continuity issue will be forwarded to Under Secretary Knauss. The next step will be to expand the effort collaboratively with other agencies and the international community of scientists.

— Robert W. Reeves

Office of the Chief Scientist
NOAA/CS

1825 Connecticut Avenue, NW
Washington, DC 20235 ■

OPDIN, from page 7

requestors with lists of references that may be accessed directly from OPDIN or through the NOAA Library. Weekly searches of Current Contents on Diskette are conducted to add references to the data base, and the Library will provide annual search updates.

OPDIN also plans to cooperate with the Library in the development of a standardized automated system for tracking marine and Great Lakes pollution "grey" literature. This system will facilitate access to the growing number of unpublished, often inaccessible, reports containing valuable data and information.

OPDIN Directory

The *Directory* will list Federal marine and Great Lakes pollution scientists and managers. Among other applications, it will aid those involved in selecting proposal evaluation committees, peer reviewers for journal articles, and members of technical working groups. The *Directory* data base structure has been developed, and the first edition will be published in 1991.

Marine Pollution Data Files

This project involves reviewing NODC's pollution data holdings in order to identify problems and improve data quality. Data inventories, relevant data sets, and special data synthesis and display products will be developed, and then accessed through the automated system in response to user requests.



**OPDIN is dedicated to serving
all users who need ocean pollution
data or information.**

Customer Service Reporting System

A major function of OPDIN is to provide high quality, timely responses to customers who request marine and Great Lakes pollution data and information. The Customer Service Reporting System (CSRS) was designed in 1984 to provide a means of recording staff activities in this area; maintain a record of user statistics to assist staff in focussing their outreach activities; and generate statistics for reports. The CSRS is out of date and a new system is under development. This new data base will be incorporated into the automated system.

In addition to these automated resources, OPDIN maintains special topics files and a scientific reprint collection (linked to the Pollution Literature data

base) on a number of high interest marine and Great Lakes pollution topics. These resource files are used to respond to customer requests for data or information. In general, requests for data held by the National Oceanographic Data Center are referred to the NODC User Services Branch. Information retrieved from the OPDIN automated and hardcopy files is provided to customers free of charge. Referrals are also made to other Federal systems and services that may be able to provide additional material. To defray the cost of providing data and information on diskette, customers are asked to provide the required number of blank diskettes.

OPDIN recently began publishing the quarterly *OPDIN Update*. This brief report is designed to facilitate exchange of information among the agencies that are members of the interagency National Ocean Pollution Policy Board, which is chaired by NOAA.

To obtain OPDIN products and services, contact:

OPDIN/CCRO
National Oceanographic Data Center
NOAA/NESDIS E/OC24
1825 Connecticut Avenue, NW
Washington, DC 20235
Telephone: 202-673-5539
FTS 673-5539
E-mail: NODC.POLLUTION.INFO
on Omnet/SCIENCENet ■

U.S. DEPARTMENT OF COMMERCE

National Oceanic and Atmospheric Administration
Data and Information Management Program Office
Office of the Chief Scientist
Universal Building, Room 522
1825 Connecticut Avenue, NW
Washington, DC 20235

Postage and Fees Paid
U.S. Department of Commerce
COM-210
Third Class Rate

