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EARTH SYSTEM MONITOR

A guide to NOAA's data and information services

INSIDE

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

NOAA establishes new Center for Coastal Ecosystem Health

CCEH to coordinate coastal science and management

Curt Mason, Center for Coastal Ecosystem Health
NOAA/NOS
Roz Cohen, National Oceanographic Data Center
NOAA/NESDIS

Using new funding appropriated by Congress in 1994, the National Oceanic and Atmospheric Administration is establishing the NOAA Center for Coastal Ecosystem Health in Charleston, South Carolina. The main goal of the Center is to contribute to the development of improved management strategies for achieving coastal ecological, cultural, and economic sustainability. The Center provides an opportunity for NOAA to address several of its responsibilities in coastal environmental sciences and management by developing innovative partnerships with Federal, state, local, and private institutions. The Center will accomplish its mission through cooperative efforts with the science and management communities to provide the technologies, methodologies, and information necessary to assess, predict, and improve the health of the Nation's regional coastal ecosystems and their living marine resources. It will serve as a focal point for addressing national coastal environmental quality problems, such as nonpoint source pollution, nutrient overenrichment, and habitat loss and degradation.

NOAA established a management committee of senior staff to provide advice on the Center's programs and operations. Teams of NOAA and regional experts developed work plans for the initial Center efforts. These plans defined the preliminary facility, staffing, and other resource requirements associated with the Center start-up. Ultimately, Center staffing will include employees with expertise in scientific, engineering, coastal resource management, and data and information management fields. Start-up activities began during the summer of 1994, in temporary facilities located at the Charleston Naval Base (Figure 1). Renovations of the buildings designated for permanent Center quarters will begin in the fall of 1994, and are planned to be completed late in 1995.

The Center will be organized into three program areas: Coastal Management Services, Environmental Monitoring and Technology, and Data and Information System. Each of these major program areas will focus on specific aspects of coastal research and resource management:

■ *Coastal Management Services.* This element will develop and provide users with syntheses of environmental, legal, regulatory, and management practices information. Synthesis development will be based on Center data and information, and expertise

– *continued on page 2*

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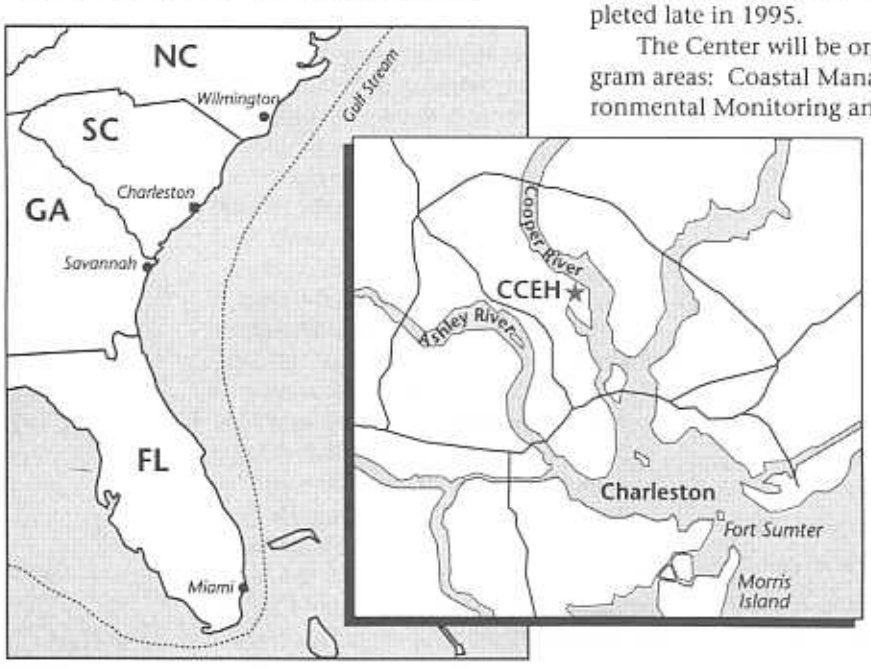

▲ **Figure 1.** The Charleston Naval Base on the west bank of the Cooper River in Charleston, S.C. is the site of the new NOAA Center for Coastal Ecosystem Health.

CCEH, from page 1

in regulatory and non-regulatory approaches to coastal management problems. The methodology for production of these syntheses will be described as well. This activity will provide a unique national capability to develop, validate, and transfer regional management strategies for sustainable development that promote conservation of desirable aesthetic qualities and the functional ecology of natural coastal ecosystems.

One of the Center's primary areas of emphasis will be providing expertise in habitat restoration to foster rehabilitation of coastal habitats and improved management of coastal resources. Another area will focus on management needs in addressing the problem of nonpoint source pollution. The coastal management community will be provided with fundamental information, new technologies, and assistance in the application of restoration science to rehabilitate degraded coastal habitats. Education, training, and outreach activities will also be an important component of this element.

■ *Environmental Monitoring and Technology*. This element has three components. The Interdisciplinary Monitoring and Prediction component will demonstrate, evaluate, and provide to users new techniques and strategies for improved coastal ecosystem health monitoring through: 1) a long-term monitoring demonstration to measure anthropogenic impacts on coastal ecosystem health within the context of natural variability in a southeast ecosystem; 2) new protocols and methods for characterizing ecosystem health, which will improve the design and comparability of national and international monitoring programs; and 3) improved regional inter-disciplinary model capabilities, using a real-time test bed of ground/water-based and satellite sensors to calibrate and verify model capabilities.

An Instrument/Technology Development component will develop and validate new environmental measurement and monitoring technologies by identifying promising tools and technologies in the Research and Development community; developing operational prototypes of high-priority instruments; demonstrating and testing them in a well-instrumented test bed; ensuring the utility and quality of the data produced; and transferring them to commercial production and operational implementation.

A Remote Sensing component will integrate data from a variety of satellite and aircraft sensors to provide near real-time and retrospective products for application to coastal land and water resource issues. Two initial activities are planned: 1) an operational coastal change analysis program (C-CAP) to create a data base of coastal emergent and submergent wetland and land cover change for all U.S. coastlines. The C-CAP facility will establish an operational system for the classification of coastal habitats; and 2) a regional ocean color operational capability to acquire near real-time high resolution data from ocean color satellites and generate high resolution coastal products for U.S. coastal areas.

■ *Data and Information System*. This element will be responsible for Center data and information management ac-

– *continued on page 5*

Center for Coastal Ecosystem Health

Planned program areas

CENTER DIRECTOR
- Program coordination
- Program support

COASTAL MANAGEMENT SERVICES
- Syntheses and applications
- Education, outreach, and training

ENVIRONMENTAL MONITORING AND TECHNOLOGY
- Monitoring strategies and demonstrations
- Instrument/technology development
- Remote sensing

DATA AND INFORMATION SYSTEM
- Data and information clearinghouse and publications
- Integration and development
- Analysis and characterization

EARTH SYSTEM MONITOR

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U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary
National Oceanic and Atmospheric Administration
D. James Baker,
Under Secretary and Administrator

Curators of marine geological samples meet at NGDC

On June 11, 1994, the National Geophysical Data Center (NGDC) hosted a meeting of the Curators of Marine Geological Samples group. This was the first truly international meeting of the group, and included representatives from the Research Center for Marine Geosciences and the Alfred Wegener Institute in Germany, the Institute of Oceanographic Sciences in the United Kingdom, the Ocean Drilling Program, and the National Science Foundation. During the meetings, NGDC's David Anderson described the NGDC Paleoclimatology Program. He discussed ways in which curators could interact more closely with the global change and paleoclimate community scientists, in order to assure continued funding and adequate curation of deep sea sediment samples.

To promote continued communication among group members, the NGDC has established an online communications forum (listserver) for the curators group. It is one of the steps that NGDC is taking to respond to resolution IODE-XIV.2 of the International Oceanographic Commission's (IOC) Committee on International Oceanographic Data & Information Exchange (IODE). The resolution "Encourages Member States to locate and catalog marine sediment cores available for sampling and analysis, and contribute information (metadata) about these cores to the Index to Marine Geological Samples database maintained by WDC-A-MGG [World Data Center A for Marine Geology and Geophysics]."

Editorial in *Paleoceanography* supports new AGU data policy

Robert Webb, David Anderson, and Jonathan Overpeck of the National Geophysical Data Center co-authored an invited editorial in the June issue of the American Geophysical Union (AGU) journal, *Paleoceanography*, entitled "Archiving Data at the World Data Center-A for Paleoclimatology". The editorial focussed on the need to archive all published data in a digital format, how to retrieve and contribute data, and provided a brief description of paleoclimate data activities at the National Geophysical Data Center (NGDC). The two-page *Paleoceanography* editorial followed an editorial by the chief editor of the journal, Ken Miller, which introduced the new AGU policy that all data cited or published in an AGU journal should be permanently archived at a data center accessible to scientists worldwide.

News briefs

NODC support for marine data center in Indonesia

Two trainees from Indonesia will arrive at the National Oceanographic Data Center (NODC) in early September to begin a three-month period of training in oceanographic data processing and data management. Mr. Fajar Suryono, a geologist specializing in geographic information systems, and Mr. Bhimantoro Yudho, an electronic engineer involved in hydrographic data collection, are members of the Directorate of Technology for Natural Resources Inventory within the Indonesian Agency for the Assessment and Applications of Technology.

Partially funded by the U.S. Department of State, this visit is the first phase of a program of technical assistance through which the U.S. NODC will assist the Indonesian Government in developing a National Marine Data and Information Center. Emphasis will be placed on data management initiatives intended to support long-term objectives of the Indonesian National Commission on Oceanography. The terms of the project are detailed in a memorandum of understanding between NOAA and the Department of State's Bureau of Oceans and International Environmental and Scientific Affairs.

Development of an Indonesian national marine data and information center with U.S. assistance is expected to enhance data exchange relations between the two countries. The existence of a cooperating data center in such a large area of the world ocean could result in increases in the data available to climate and global change researchers worldwide.

National Climatic Data Center move scheduled

The new building in Asheville, N.C. that will house the NOAA National Climatic Data Center is now essentially complete. Telephone lines and cabling for NCDC's local area network are scheduled to be installed in mid-September. NCDC employees are expected to move to the new facility in late October, and a formal dedication is planned for late November.

NARA authorizes use of CD-ROM as an archival medium

On July 20, 1994, the National Archives and Records Administration (NARA) issued a policy authorizing the use of CD-ROM by Federal agencies to transfer records to the National Archives of the United States. Previously, NARA accepted electronic records on standard one-half inch magnetic tape and 3480-class tape cartridges. The new policy is presented in NARA Bulletin 94-4.

Among other requirements, Bulletin 94-4 states that CD-ROMs containing fielded data or text files scheduled to be preserved in the National Archives must conform to the ISO 9660 standard, be in ASCII format (and not depend on control characters or codes not defined in the ASCII character set), and be individually addressable. Files may not be compressed unless decompression software is provided

NARA Bulletin 94-4 is in effect until July 31, 1996. NARA will continue to evaluate criteria for accessioning permanent records on CD-ROM to determine how the criteria may be expanded or otherwise revised. Questions concerning this bulletin may be directed to: The National Archives and Records Administration, Center for Electronic Records (NSX), 8601 Adelphi Road, College Park, MD 20740-6001, Telephone: 301-713-6630.

NOAA data centers host visiting scientists

Dr. Don Jensen, Utah State Climatologist, completed a visit at NCDC. His work at NCDC included: research on historic severe storms in the western United States, development of documentation for long-term climate stations in existence in 1896 (for use in the Utah centennial recognition program), comparing NCDC quality control programs with those at the Utah Climate Center, and comparing CD-ROM mastering techniques. Coordination has begun to jointly produce a national climate atlas publication and CD-ROM.

Dr. Robert Dunbar, a geology professor at Rice University, has joined the NOAA-NGDC Paleoclimatology Program for a seven-month tenure as a visiting scientist. Dr. Dunbar will work with NGDC staff to develop paleoceanographic data sets for archiving and on collaborative research efforts. His expertise includes stable isotope geochemistry, paleoclimate reconstructions from corals, and the role of Southern Ocean sea ice in climate change.

An introduction to the Spatial Data Transfer Standard

New Federal standard mandated for exchange of geo-referenced, spatial data

Lt. Cdr. Charles Gross
Environmental Information Services
NOAA/NESDIS

The National Oceanic and Atmospheric Administration (NOAA) collects, processes, and archives almost two thousand data types ranging from Absolute Gravity to Zooplankton. The majority of these data sets are referenced to the Earth's surface and could be classified as "geospatial" including NOAA's hydrographic, geodetic, environmental, climatological, oceanographic, and remotely sensed data.

With the advent of the National Information Infrastructure (NII) the demand for NOAA data will increase, and users will be able to locate, browse, and retrieve vast amounts of data via the Internet. Unfortunately, most of these data are stored and distributed in a bewildering array of unique formats and exchange standards that require additional documentation or decoding software. Answering a request like, "What is the relationship between population growth, temperature change, and wetland loss in South Florida since 1980?" becomes a monumental—and costly—task. The Spatial Data Transfer Standard (SDTS) was developed over a ten-year period to fulfill the need for a mechanism to allow spatial data to be moved from one computer system to another, independent of make or operating system.

The Spatial Data Transfer Standard became mandatory for Federal agencies on February 15, 1994.

Improvements in computer system hardware and software have dramatically increased the demand for digital spatial data. The absence of data exchange standards, however, limits the exchange of data between producers and users. The lack of standards results in duplication of effort and data sets that are incompatible and difficult to integrate. As much as 80% of the cost of developing a Geographic Information System is the development of the database. Conversion of data into each specific system format, the switchboard approach, is costly. The SDTS approach is to define an intermediate structure so that data must only be translated once. Figure 1 depicts these two approaches.

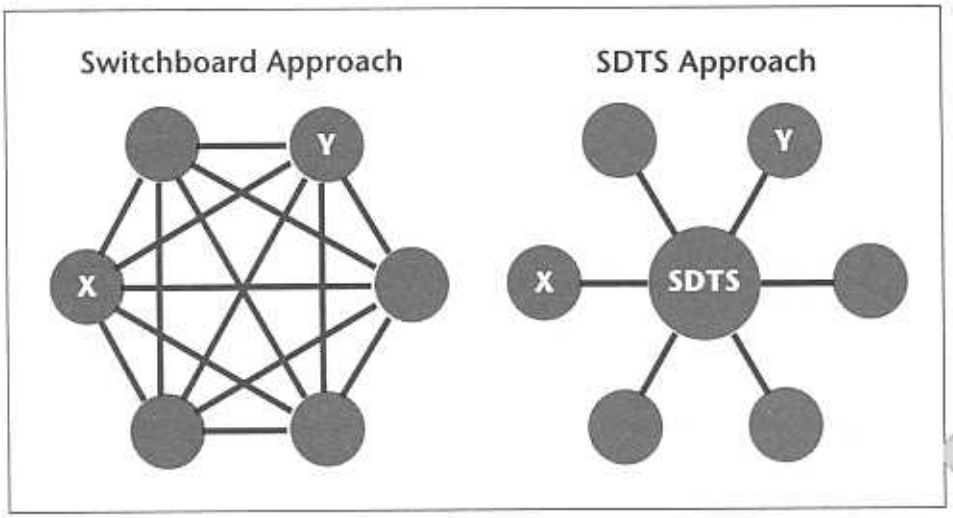
The SDTS as a Federal standard

Although the Spatial Data Transfer Standard became mandatory for Federal agencies on February 15, 1994, it is not applicable to all situations. The standard was designed for the transfer of geo-referenced, spatial data between *dissimilar* computer systems. Data exchange that is specific to a particular application program, class of computer platform, or distribution media is excluded. An example would be dedicated systems such as the Advanced Weather Interactive Processing System (AWIPS), that sends and receives spatial data in specific formats such as GRIB and BUFR between similar computers. However, any digital spatial data products that NOAA produces for external use must be made available in SDTS.

On July 29, 1992 the standard was approved as Federal Information Processing Standard 173 (FIPS 173). FIPS are primarily implemented through the procurement process, and all acquisition and development of government applications are covered. Waivers from the standard must be in writing, authorized by agency heads, and approved by the National Institute of Standards and Technology (NIST). A recent Executive Order also mandates the use of SDTS for all Federal agencies as well as a separate metadata standard. SDTS is currently being considered by the American National Standards Institute (ANSI) as a national standard and eventually it will be submitted to the International Standards Organization (ISO) as an internationally recognized standard.

NIST has designated the U.S. Geological Survey (USGS) as the SDTS maintenance authority. A full-time staff is responsible for periodic updates, program coordination and development of specific subsets or profiles. SDTS was designed to be a workable standard, both technically and politically. This requires the support of Federal agencies, the user community, and private vendors.

SDTS is based on a conceptual model of spatial data that can accommodate any other user-defined spatial data model. The SDTS model has three



▲ **Figure 1.** The Spatial Data Transfer Standard simplifies the exhange of digital spatial data among disparate users and systems.

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elements: a model of spatial phenomena, spatial objects, and spatial features. Spatial phenomena include real-world entities, their attributes, and the attribute values. A bridge is a real-world entity. The length of the bridge is one of its attributes and the actual measurement, the attribute value. Spatial objects are used to digitally represent real-world entities. The SDTS defines 13 zero-, one-, and two-dimensional objects that are used to define real-world entities. Objects include points, lines, strings, rings, pixels, and so on. Almost any complex entity can be represented by combining these simple objects.

Implementing the SDTS

The SDTS is a broad standard. In order to support specific types of data, a number of subsets or profiles have been developed. The intent of a profile is to limit the potential options while sharing common characteristics. A vector profile has been formally approved and a raster profile is in the final stages of development. If required by users, additional profiles can be developed to accommodate diverse data types.

FIPS 173 is composed of three parts. Part 1 consists of five sections: an introduction, conformance criteria, the conceptual model of spatial data, spatial data quality report and detailed instructions for logical record and field-level encoding. Part 2 contains definitions for a large number of spatial features including 200 defined entity types (e.g., ice_field, wind_indicator, shoreline), entity attributes (e.g., sea_ice_present, direction, boundary_marker) and terms. Part 3 defines how the SDTS must be implemented using an existing, low level exchange standard called ISO 8211. Part 3 describes how logical constructs such as modules, fields and subfields are mapped into ISO 8211 constructs. For the average user, the actual encoding/decoding of data into ISO 8211 will be transparent and performed by commercial application programs.

Implementation of a complex standard such as the SDTS by a diverse organization such as NOAA will not be simple. The first step in the process is the recognition that although adoption of SDTS might be painful in the short-term, it offers significant long-term benefits. From the point of view of our customers, including internal customers, all of NOAA's vast spatial data holdings will be available in a single, logical format. Maintenance of NOAA's hundreds of existing formats and the software needed to process them is extremely labor intensive. A long-term goal of reducing this number would create significant savings. Data is the lifeblood of NOAA and existing legacy formats that have been used and developed over time are not going away overnight. A strategy to implement SDTS must accommodate not only the requirements of the law, but also existing national and international agreements. The SDTS offers the hope of data interoperability not only for NOAA, but the entire country. ■

FURTHER INFORMATION ABOUT SDTS

For additional information about the Spatial Data Transfer Standard, FIPS 173, or how to participate in related development activities, contact:

U.S. Geological Survey
SDTS Task Force
526 National Center
Reston, VA 22092
Fax: 703-648-5542
E-mail: *sdts@usgs.gov*

Paper copies of FIPS 173 are available from:

National Technical Information Service (NTIS)
Computer Products Office
5285 Port Royal Road
Springfield, VA 22161
Telephone: 703-487-4600

FIPS 173 and related documentation are available in electronic form via anonymous FTP on the Internet:

Internet address:
sdts.er.usgs.gov
(130.11.52.170)
User name: *anonymous*
After connecting, change to the appropriate directory: *cd sdts*
File README contains information about FIPS 173.

CCEH, from page 2

tivities, including acquisition, quality control, processing, archiving, and dissemination. It will provide data and information for environmental planning, conservation, and sustainable development activities in the coastal zone, derived from state-of-the-art scientific data bases, using modern analytical tools and presentation techniques. Start-up activities will establish a national geographic database capability (beginning with the southeast region) consisting of base layer data in Geographic Information System (GIS) structure; provide network or active archive access to program-related coastal zone data bases; and build integrated cross-scale, GIS-related data bases focussed on specific problems, and linked with suitable models or model outputs. Also, a modern electronic library, serving Center staff and outside users, will be established by this element.

Strong ties will be built between external communities and the Center to ensure that data, information, and science-based strategies developed at the Center are effectively shared with users. Coastal zone managers and scientists will be encouraged to work at the Center and participate in the full suite of activities: evaluating and validating new strategies and technologies; proposing new target problem areas; and providing continuous feedback as to the utility and quality of Center products and services. In addition, the Center will work with the National Sea Grant Program, other Federal agencies and programs, and state and local governments to translate and deliver these products to appropriate users and to the public. Center staff will assist local planners and administrators in coastal states to assess the trade-offs between economic development and environmental concerns to foster sustainability of coastal natural resources and ecosystems.

Inquiries regarding the NOAA Center for Coastal Ecosystem Health should be referred to: Curt Mason, NOAA/CCEH, Building FBM61, Room 250, 2000 Bainbridge Avenue, Charleston Naval Base, Charleston, SC 29408. Telephone: 803-974-6201. Fax: 803-974-6224. E-mail: curt=mason%cceh%n@vines.erl.gov ■

NODDS: the new Navy/NOAA Oceanographic Data Distribution System

Online system provides users with access to synoptic environmental data

William G. Schramm
Ocean Applications Branch
NOAA/NOS

On 16 June 1994 RADM G. L. Chesbrough, the Oceanographer of the Navy, and Diana Josephson, the Deputy Under Secretary of Commerce for Oceans and Atmosphere, signed an annex to the Navy-NOAA Umbrella Memorandum of Agreement. This signing was noteworthy because it signified formal approval for NOAA to use the Navy's new NODDS data distribution system. The introduction of NOAA NODDS is significant because NODDS will provide direct access to synoptic environmental information to a large number of people around the country in a way that was never possible before.

For the first time NOAA will be able to provide resource managers, researchers, educators, and others with direct access to near real-time synoptic data that can be used with their desktop computers in the office or laboratory or even on ships at sea. With its new capabilities and flexibility, NOAA NODDS is a major improvement over older systems such as the CNODDS system that it replaces and that provided users with vector graphic representations of preprocessed contoured products.

NODDS was developed by the Navy's Fleet Numerical Meteorology and Oceanography Center (FNMOC) in Monterey, California to meet a need to provide Department of Defense users throughout the world with direct access to environmental information in a digital form. John Garthner and Ralph Loveless, the principal developers of NODDS, decided that they needed a system that would work with the most common computer (the 286 PC) and use ordinary telephone lines for communications. Since there was no money to support this development, John and Ralph used as much off-the-shelf software as possible and filled in the rest themselves. The result was a program that was a success from the day it was introduced. There are now close to 1000 DOD NODDS users around the world. It has been used from ships at sea and from the Antarctic as well as from Saudi Arabia during Operation Desert Storm.

NODDS is a client/server type of system. The client gets to define areas of interest anywhere in the world and then pick products of interest from a menu. The products include synoptic observations, satellite images, warnings, such as high seas or tropical cyclone warnings, and analyses and forecasts produced by numerical models and available as gridded fields. Once the user has defined the area of interest and products desired, the system automatically dials the appropriate telephone number in Monterey, logs onto the host

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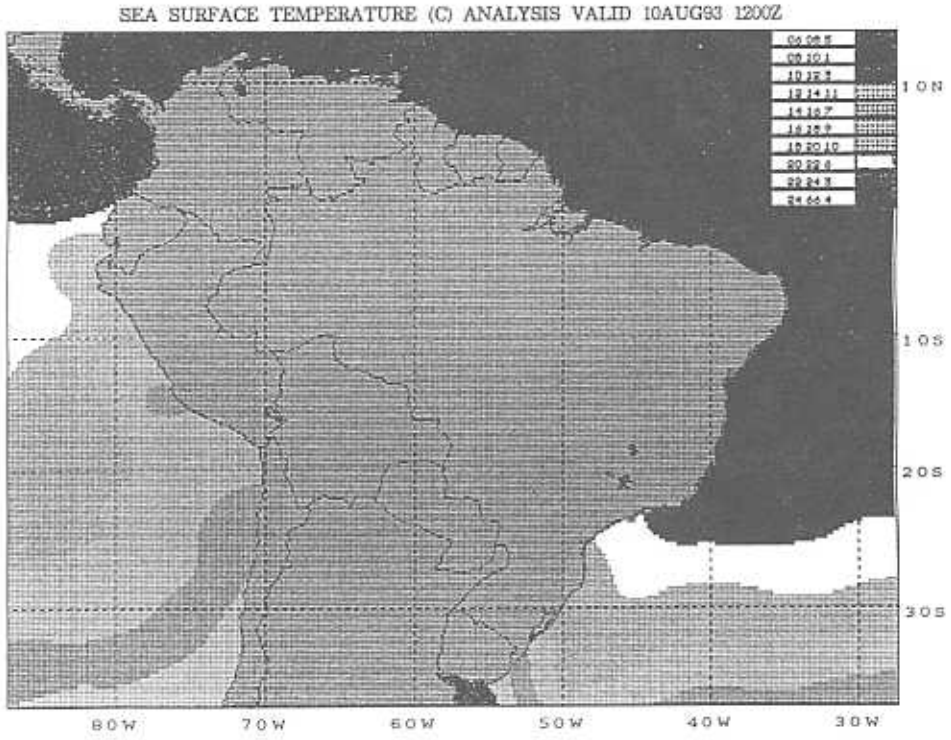


▲ **Figure 1.** Sample FNMOC sea surface temperature analysis available via NODDS.

How to become a NODDS user

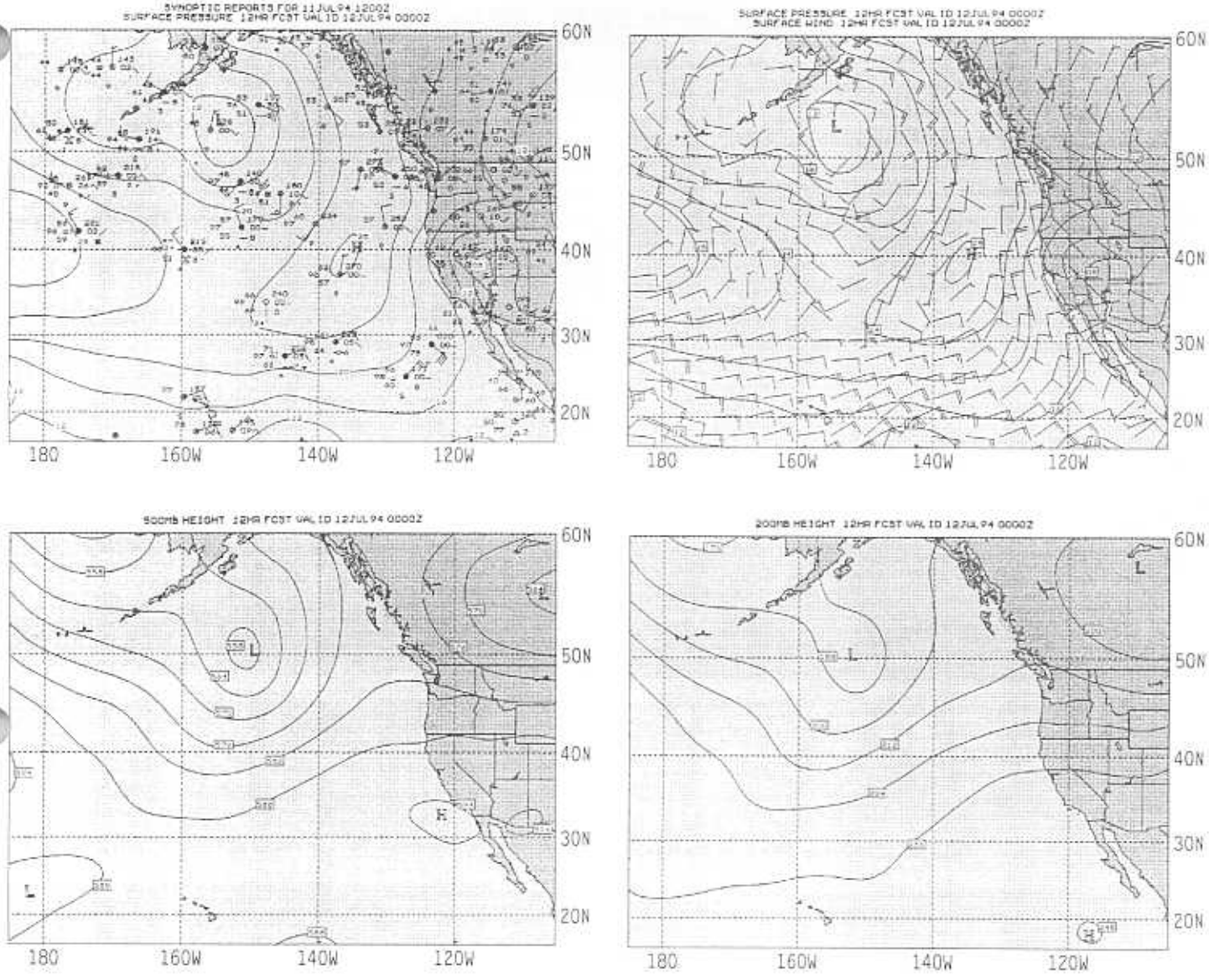
1. Contact the Chief, NOAA Ocean Applications Branch, 7 Grace Hopper St., Monterey, CA 93943.

2. OAB will send you a Users Agreement to complete and return.

3. Upon receipt of the completed Users Agreement, OAB will provide the NODDS client software on floppy disk, a users manual, installation instructions, and a password.

4. Each user provides their own hardware including modem and ProComm Plus software (commercial software available for about $50) for telephone communications.

5. The users manual explains how to install the system, how to use the system to select an area or areas of interest and select products from the menu, and how to download and display information.



▲ **Figure 2.** FNMOC product showing synoptic reports and 12-hour forecasts for surface pressure, surface wind, 500 mb height, and 200 mb height.

data base server, downloads the data, and hangs up the phone. The client software then provides options for displaying the data, saving it for future use, or porting it to other applications programs. The third option is possible because the system downloads actual data and not vector graphics.

As mentioned above NODDS works on computers as simple as 286-class PCs, as well as on 386 and 486 PCs. A VGA monitor is needed to display satellite images, a mouse is desirable, a hard disk is required and at least 1 MB of RAM, but all these hardware specifications are available on most PCs. (Macintosh and UNIX versions of NODDS are being tested as well.)

Now that the Navy has provided NODDS to NOAA, civilians can share in the use of this new technology. The NOAA adaptation of NODDS is called NOAA NODDS and it is managed by the NOAA's Ocean Applications Branch (OAB). A component of the National Ocean Service, OAB is collocated with FNMOC in Monterey. OAB was established in Monterey in 1985 to provide a gateway for civilian access to Navy products and technology such as NODDS. The OAB host for the NOAA NODDS system is a data base management system called NEONS (described in the June 1993 issue of the *Earth System Monitor*).

Requests for NOAA NODDS service come from a large number of NOAA offices in all five of the NOAA line organizations, other Federal, state and local government offices, universities and K-12 schools, researchers, commercial interests and foreign users. The reasons for requesting NOAA NODDS service are as varied as the backgrounds of the different user groups making the requests. The reason mentioned most often is the ability to use NODDS with simple, inexpensive, available desk-top PCs. Users don't have to buy new equipment. (I use it on my desk with the same 286-class PC that I use for simple tasks such as word processing and e-mail.) A second reason often stated is the flexibility the user has to select different areas of interest and different sets of products as desired. Other reasons include the ac-

– *continued on page 8*

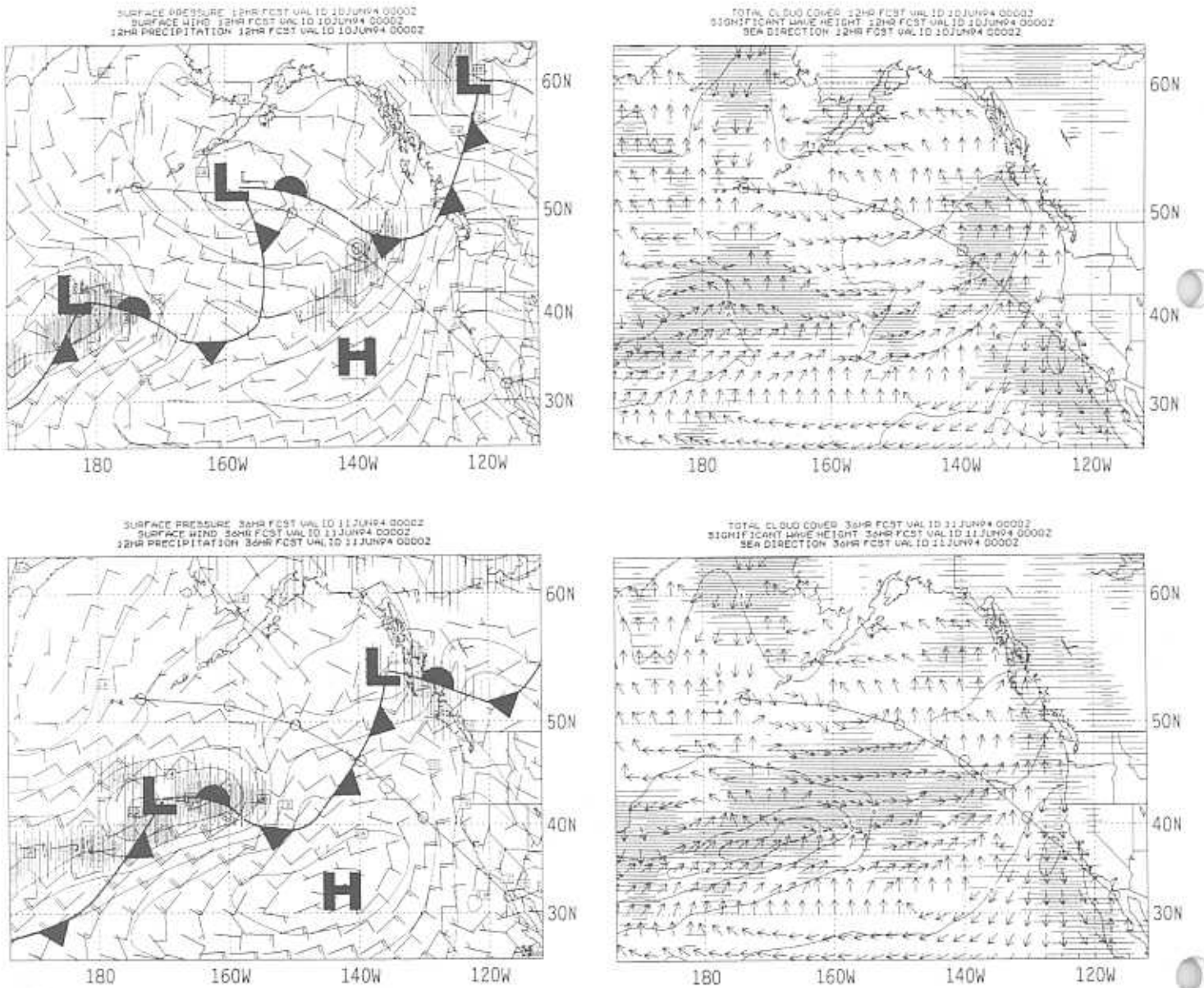
NODDS, from page 7

cess to FNMOC data that is not otherwise available, the ability to port the NODDS data into other applications programs and new and different display options incorporated into NODDS.

The products presently available with NOAA NODDS service include FNMOC oceanographic and meteorological products such as winds, atmospheric pressures, waves, air and ocean temperatures (Figures 1-3). All these numerical products are provided as gridded data and then contoured on the users PC for display. They are available as analyses and as forecasts. Other products include infrared and visual satellite images, synoptic surface and upper-air observations and warnings. Later this year NOAA products from sources such as the NOS Ocean Products Branch will be added to the suite of products available through NOAA NODDS.

NODDS display options include map displays using either mercator or polar stereographic projections, looping of time series data, split-screen displays, satellite displays including enhancement and overlay options, a slide show option that allows the preparation of up to 99 screen displays for later use, and displays of three-dimensional gridded data. Users also have the option of annotating the displays with lines, symbols or words and storing that information along with the downloaded data.

NOAA NODDS is an outstanding example of dual-use technology transfer and interagency cooperation. It also represents a major change in the way in which NOAA can provide the public with access to environmental information. For additional information on NOAA NODDS and how to apply for the service, please contact the Chief, NOAA Ocean Applications Branch, 7 Grace Hopper Street, Monterey, CA 93943. ■



WEATHER FORECAST FOR USS HAZE GREY: 12Z 10 JUN - 12Z 11 JUN 94

▲ **Figure 3.** FNMOC data product that provides 12-hour (upper panels) and 36-hour (lower panels) forecasts for surface pressure, surface wind, 12-hour precipitation, total cloud cover, significant wave height, and sea direction.

Defense Meteorological Satellite Program data and services available from NGDC/NSIDC

DMSP data offer unique opportunities for environmental studies

Herbert Kroehl, Gregory Deuel, and Capt. Carl Davis
National Geophysical Data Center
NOAA/NESDIS

Gregory Scharfen and Robert Bauer
National Snow and Ice Data Center
University of Colorado

Coincident multispectral imagery recorded by instruments on Defense Meteorological Satellite Program (DMSP) satellites offer a unique opportunity for researchers to study the Earth's environment. Two DMSP monitoring satellites provide global images of visible, infrared, and microwave reflections and emissions of the atmosphere, ocean, and Earth on a daily basis. Imagery, soundings, and measurements recorded on these satellites are processed at the National Geophysical Data Center (NGDC) using the same ephemeris, calibration, geolocation, assumptions, and corrections.

The DMSP mission is "...to collect and disseminate global visible and infrared cloud cover and other specialized meteorological, oceanographic, and solar-geophysical data to support Department of Defense (DoD) operations..." The DMSP Program Office provides management and support for the DMSP mission. This function will become part of the Integrated Program Office on October 1, 1994.

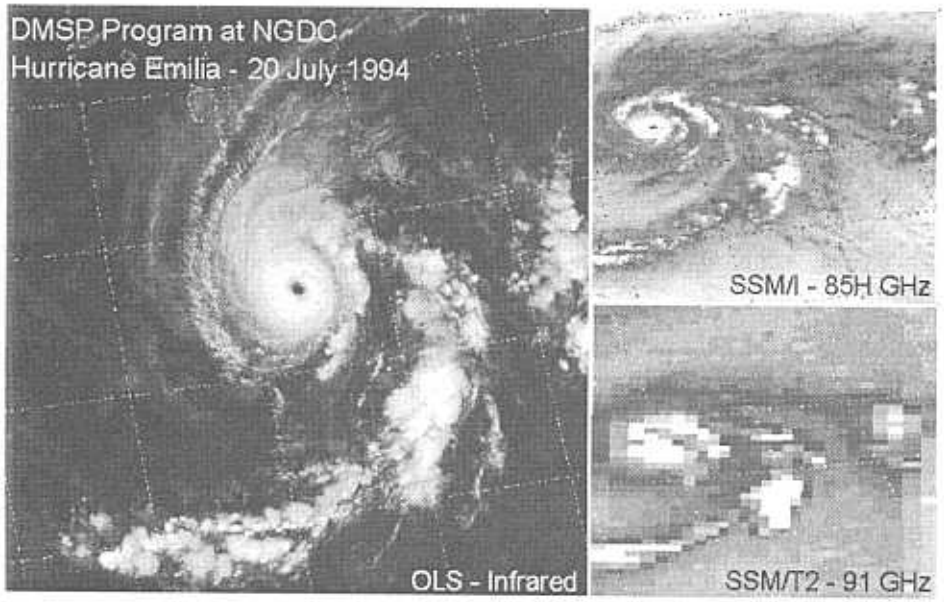
Objectives of the Defense Meteorological Satellite Program at NGDC are:

- to prepare research quality data sets;
- to rescue all primary and mission sensor data;
- to provide timely, cost-effective access to archive data sets;
- to develop on-line services, products, display software, and analysis tools for the atmospheric sciences and the oceanographic, solar-geophysical, and environmental communities; and
- to conduct research.

DMSP satellites are in a low-altitude, sun-synchronous, polar orbit. The orbital period is 101.5 minutes. The DMSP satellites presently in operation are designated as F10 and F11. Their current equatorial crossing times are 1756 LT for F11 and 2147 LT for F10.

Sample DMSP images are presented in Figure 1, which shows Hurricane Emilia as it approached Hawaii on July 20, 1994. Brightness temperatures are recorded at thermal infrared wavelengths by the Operational Linescan System (OLS) and at microwave wavelengths by the microwave imager (SSM/I) at 85 GHz and by the microwave water vapor sounder (SSM/T2) at 91 GHz. In the images the high water content of the hurricane and its surrounding con-

– *continued on page 10*



▲ **Figure 1.** Hurricane Emilia imaged at infrared and microwave wavelengths as it approached Hawaii on July 20, 1994. Whiter pixels represent colder brightness temperatures.

Table 1. Instruments on DMSP satellites F10 and F11 and geophysical parameters derived from them.

INSTRUMENT	ENVIRONMENTAL PRODUCTS
Visible and infrared imager - OLS	Clouds, cloud top temperature, aurora
Microwave imager - SSM/I	Ocean surface wind, ice, liquid water, precipitation
Microwave sounder - SSM/T	Temperature profiles
Microwave sounder/imager - SSM/T2	Water vapor profiles
Electrostatic analyzer - SSJ/4	Auroral particle fluxes
Ionospheric parameters - SSIES	Electric fields, densities, temperatures

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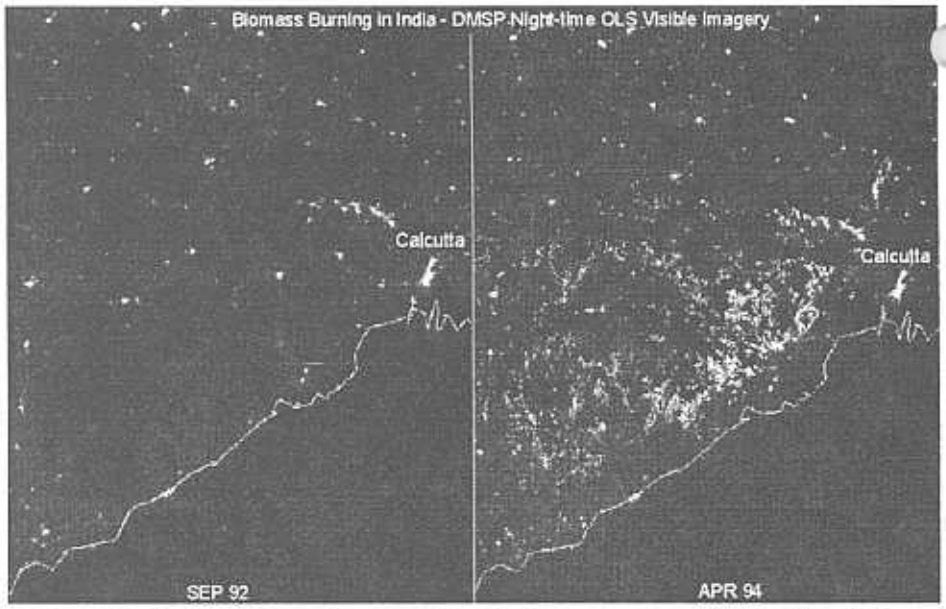
DMSP data, from page 9

vective clouds is highlighted in the microwave imagery.

The current complement of DMSP instruments is summarized in Table 1. Both F10 and F11 have the OLS, SSM/I, SSM/T, SSJ/4, and SSIES instruments. In addition, satellite F11 has the SSM/T2 instrument. All instruments on F10 and F11 are operating within defined specifications, except for the 150 GHz channel on T2. F10 and F11 have only one-fourth of the recorders working correctly. Satellite F12 was successfully launched on August 29, 1994. It has the same complement of instruments as F11 plus a magnetometer (SSM).

The OLS instrument has two components: a telescope for monitoring daytime clouds, and a photomultiplier tube for monitoring aurorae (Figure 2) and nighttime visible imagery including moonlit clouds (Figure 3). The OLS field-of-view is nominally 3,000 km, which provides complete global coverage during both the ascending and descending parts of the orbit each day. Complete global coverage at 2.7 km resolution is recorded during daytime and nighttime. High resolution data at 0.5 km are recorded for limited times.

▲ **Figure 2.** A nighttime visible image of the aurora australis captured over Antarctica on July 21, 1994.



▲ **Figure 3.** The large dynamic range of the OLS instrument records city lights (left) and fires (right) over eastern India. The left panel, recorded in September 1992, shows only city lights from Madras to Calcutta. The right panel, recorded in April 1994, shows approximately 500 separate fires; most of these fires are due to agricultural burning before the monsoons arrive in May. OLS nighttime visible imagery represents one tool for monitoring fires in remote areas, such as the western U.S. forest fires this summer.

The SSM/I, SSM/T, and SSM/T2 effective fields-of-view are nominally 1,400 km, and their spatial resolutions are nominally 20 km, 28 km, and 100 km, respectively. The SSJ/4 and SSIES instruments record *in situ* plasma densities, gradients, temperatures, and drifts.

The NGDC receives the complete satellite data stream on magnetic tape from the Air Force Global Weather Central (AFGWC). NGDC decompresses the data tapes, restructures the data into increasing time order, and constructs orbits from one ascending equatorial crossing to the next. NGDC also decommutates mission sensor data, deinterleaves all data, and calibrates and geolocates each pixel, sounding, or value. Quality assessments of each value are also provided.

Archive data are processed to the level recommended by the DMSP Mission Sensor Working Group (MSWG), i.e., linear calibration only. Subsequent processing to meet Department of Defense needs produces products of the special archive.

NGDC executes two special programs to prepare research quality data. The first concerns the position of the spacecraft. A processing program corrects the onboard clock, and computes satellite ephemerides (using Bevel vectors as input) to a first principles, orbital mechanics model. As a result, errors in satellite position as tested and documented are less than 0.2 km.

To ensure data integrity NGDC locates, evaluates, tests, and corrects critical parameters from each block of telemetry that are adversely affected by ionospheric scintillations. This problem would result in the loss of more than 200 scans of the SSM/I imager per orbit. The reconstruction effort is better than 98% successful.

Data, products, and services are provided by NGDC and the National Snow and Ice Data Center (NSIDC). NSIDC provides services to the cryospheric community. As an example of the type of products available from NSIDC, an OLS daytime image of Greenland is shown in Figure 4.

NGDC began receiving tapes from the Air Force Global Weather Central on March 9, 1992. Routine processing began on March 1, 1994. The backlog is being processed at the rate of two days per day; archive data sets are provided for each instrument. In addition, NGDC routinely prepares a detailed inventory

– continued on page 12

SSM/I F-11 brightness temperatures for polar regions

Four CD-ROM volumes of the Defense Meterological Satellite Program (DMSP) F-11 SSM/I Brightness Temperature Grids for the Polar Regions are now available from the National Snow and Ice Data Center (NSIDC). These four volumes (covering the period 12/3/91 - 11/30/92) extend the time series of gridded DMSP F-8 SSM/I passive microwave products produced and distributed by the NSIDC. The F-11 SSM/I gridded products are in the same polar stereographic projection as that used for the products derived from the DMSP F-8 data stream.

The F-11 SSM/I gridded products are being generated from the SSM/I Antenna Temperature tapes which NSIDC receives from Remote Sensing Systems. A study comparing the DMSP F-8 SSM/I and DMSP F-11 SSM/I gridded products was conducted by investigators at both the Byrd Polar Research Center, Ohio State University, and the Cooperative Institute for Research in Environmental Sciences, University of Colorado. The analysis showed that although the two data sets were highly correlated", [temperature] "corrections on the order of 1K should be applied" to adjust "the F-11 data to the F-8 baseline." Further information about differences betwqeen the F-8 and F-11 data products is available from NSIDC.
Contact: NSIDC User Services, NSIDC, CIRES, Campus Box 449, Univerity of Colorado, Boulder, CO 80309; Telephone: 303-492-6199; Fax 303-492-2468; Internet nsidc@kryos.colorado.edu

Tsunami data and publications

The National Geophysical Data Center (NGDC) and the World Data Center A for Solid Earth Geophysics have compiled a unique set of tsunami-related products as part of a continuing program to support the interests of engineers, oceanographers, seismologists, and the general public. As part of this effort, *Tsunamis Affecting the West Coast of the United States, 1806-1992* is now available in both hard- and soft-cover versions. This new version substantially increases the amount of data, number of events, and information available in respect to west coast tsunamis. The 242-page volume is illustrated with pictures, tables, marigram records, and other figures.

In addition, a new tsunami slide set, *The Major Tsunamis of 1992 - Nicaragua and Indonesia*, has also been released. The slide set shows damage from the two major tsunami events of 1992: the September tsunami along Nicaragua's Pacific coast, and the December tsunami in the Flores region of Indonesia. The slides illustrate how a tsunami may affect an area economically and ecologically. A flier listing these and other tsunami-related products is available from NGDC.
Contact: NGDC

Data products and services

Tropical Pacific Ocean atlas

The *Atlas of the Tropical Pacific Ocean Annual Cycle* (NOAA Atlas No. 13) is based on monthly gridded analyses of ocean temperature and current data over a ten year (1983-1992) period generated by an ocean-data assimilation system at the NOAA National Meteorological Center. This atlas shows maps of the long-term mean, monthly standard deviation, mean annual cycle (harmonic dial) and the amount of variance explained by the annual cycle for surface and subsurface quantities of the tropical Pacific ocean.

The main focus of this atlas is subsurface variations. but the surface wind-stress curl and sea-surface temperature are also included. The main variables presented are subsurface temperature, currents, and the depth of the 20°C isotherm. A few trajectories of water parcels along the depth of the 20°C isotherm during the course of the annual cycle are also shown. Data are shown on level surfaces at selected depths, depth integrated, and on meridional and zonal cross sections.
Contact: Thomas M. Smith, NOAA/NWS, W/NMC25,NOAA Science Center, 5200 Auth Road, Camp Springs, MD 20746; Telephone: 301-763-8227; Fax: 301-763-8395; Internet : wd52mc@sgi25.wwb.noaa.gov

Experimental Long-Lead Forecast Bulletin

The Climate Analysis Center of the NOAA National Meterological Center issues a quarterly bulletin that provides experimental forecasts with a long lead times. The *Experimental Long-Lead Forecast Bulletin* is designed to present new ideas, disseminate information, and stimulate research on long lead forecasting. The forecasts are mainly for the surface climate in the United States, such as a forecast of winter U.S. surface temperature six months or a year in advance. Forecasts for other aspects of climate, such as El Niño/Southern Oscillation (ENSO), hurricane season severity, or surface climate in other parts of the world are also welcome.

Long range forecasting, with or without a lead time, is in an early stage of development, and current forecasting skill tends to be at a minimal level. Some recent progress has been made with dynamical approaches to such forecasts, using either simple or complex, coupled ocean-atmosphere or uncoupled atmospheric general circulation models (GCMs). A comparable level of achievement has also been attainable using empirical methods. Therefore, the contents of the *Bulletin* are not routine, and the forecasts presented vary widely in their methodology, lead time, and specific predicted quantity from issue to issue. The *Bulletin* is available to researchers as well as those with more applied interests.
Contact: Climate Analysis Center, NOAA/NWS, W/NMC51, Room 604, Washington, DC 20233; Telephone: 301-763-8155.

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National Oceanographic Data Center (NODC)
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Fax: 202-606-4586
Internet: services@nodc.noaa.gov

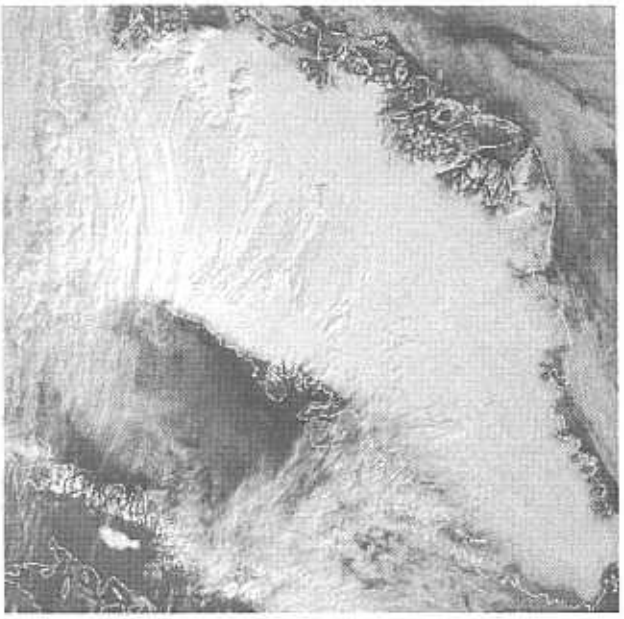
NOAA Environmental Services Data Directory
202-606-5012
(Gerald Barton)
Fax: 202-606-0509
Internet:

NOAA Central Library
Reference Services:
301-713-2600
Fax: 301-713-4599

DMSP data, from page 10

of data availability and integrity, and data subsets and products, as recommended by the DMSP MSWG. NGDC products currently include browse imagery, an auroral image subset, SSM/I brightness temperatures, and SSIES plasma densities, temperatures and drifts. NGDC also provides tape copies, prepares publication quality prints, and provides analysis and display software.

Archive data tapes are in XDR, a standard binary format. Each OLS tape contains an automated format statement, an inventory, browse imagery, and full resolution images. Each file contains data from one orbit, with a header that includes the appropriate geophysical, instrumental, and software information. Other sensor data tapes contain the same information, without the browse imagery.



▲ **Figure 4.** An OLS visible (0.4 - 1.1 mm) image of the Greenland ice sheet and surrounding sea ice recorded on August 4, 1994.

Online data and information are available on Internet via Mosaic, Gopher, and FTP servers. DMSP sample data, imagery, an inventory of available data, and browse imagery are now online. Of special interest are the hurricane images, such as the one shown in Figure 1. The National Hurricane Center updates the information on the prvious week's hurricanes, tropical storms, and depressions. Within several days, selected DMSP OLS images, usually one visible and one infrared image per storm per day, are placed online. In a typical month, over 3,000 external users receive over 30,000 DMSP images from our Mosaic server.

Image display and analysis software have been developed at NGDC and NSIDC. NSIDC developed an in-house OLS imaging program and the geolocation program. Other display programs are being developed by NGDC using the commercial software package, Interactive Data Library (IDL). NGDC is also developing software to derive geophysical parameters, in accordance with DMSP MSWG recommendations. These programs are available to users.

For information about DMSP thermal, infrared, and auroral data, please contact:

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E-mail: *info@ngdc.noaa.gov*
Mosaic: *http://www.ngdc.noaa.gov/ngdc.html*
Gopher: *gopher.ngdc.noaa.gov*
FTP: *ftp.ngdc.noaa.gov (192.149.148.109)*

For snow and ice data, contact:

National Snow and Ice Data Center
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