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EARTH SYSTEM MONITOR

New database of North American paleodrought

Joint project of NGDC, NCDC, and the university research community

A guide to NOAA's data and information services

INSIDE

Connie A. Woodhouse, Edward P. Gille, and Jonathan T. Overpeck[1]
National Geophysical Data Center
NOAA/NESDIS

Thomas R. Karl and Nathaniel B. Guttman[2]
National Climatic Data Center
NOAA/NESDIS

Drought is one of the most devastating climate-related hazards that impacts societies. Although drought is a naturally-occurring phenomenon throughout most parts of the world, the effects of drought on water resources and agricultural production have tremendous repercussions on the physical, economic, social, and political elements of our society, and rank with the most severe hazards in terms of monetary losses. The drought of 1987-89, although not the worst in history, was the most recent severe drought in the U.S., resulting in $15 billion in crop losses (Riebsame *et al.* 1991). Agriculturally important areas such as the Great Plains remain extremely vulnerable to drought in spite of advances in long-term weather forecasting and agricultural technology. Historically, this region has been hit hard by the disastrous droughts of the 1930s and 1950s, and global change predictions suggest this area will experience warmer and drier conditions with increases in atmospheric CO_2 (Overpeck *et al.* 1990, Rind *et al.* 1990, Muhs and Maat 1993, Wetherald and Manabe 1995, Houghton *et al.* 1996, Gregory *et al.* 1997).

Our capacity to evaluate the impacts of drought and plan for future droughts is based almost entirely on our knowledge of droughts that have occurred during the period of instrumental record. The National Climatic Data Cen-

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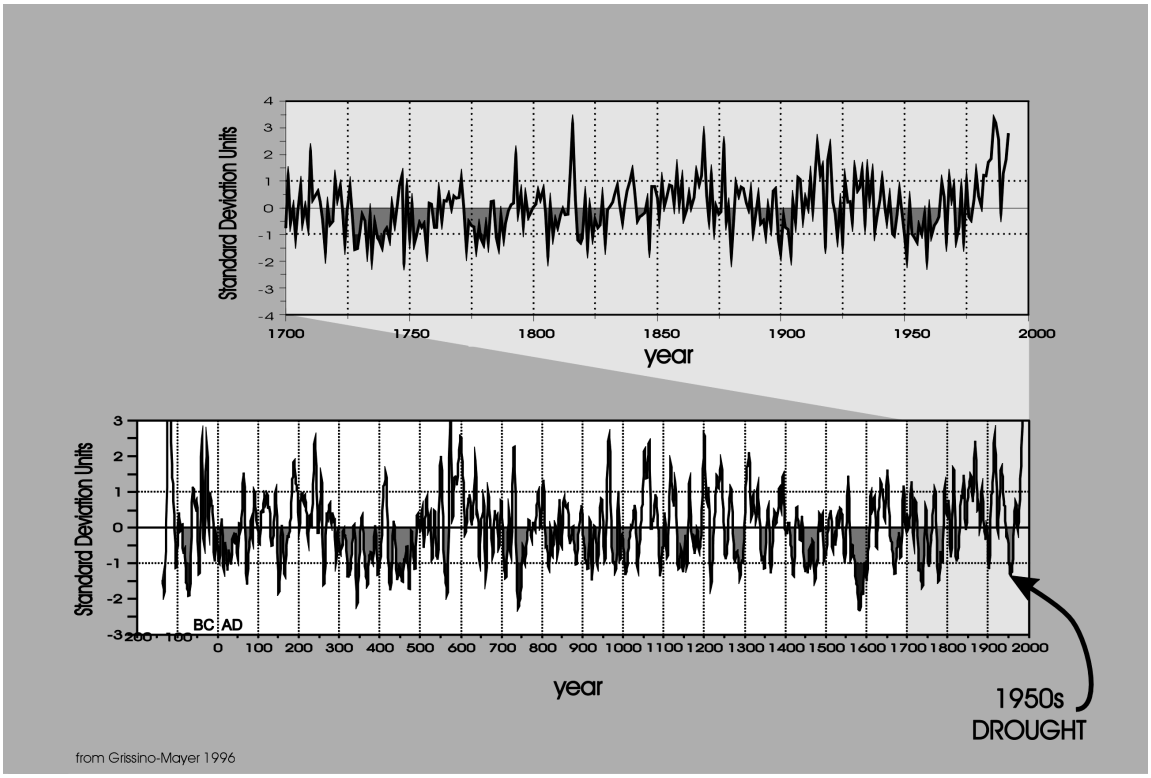

▲ **Figure 1.** Annual rainfall for western New Mexico reconstructed from tree-ring chronologies (Grissino-Mayer 1996). When the most severe drought of the 20th century (1950s) is evaluated in the context of the last 2,000 years, it is clear that a number of droughts have occurred in the past that have exceeded the severity and duration of the 1950s drought. Most notable is the >30 year drought that occurred in the last part of the 16th century.

U.S. DEPARTMENT OF COMMERCE
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ter (NCDC) has thus played a key role in assembling and making accessible these records. The droughts of the 1930s and 1950s are well-known for their severity and are the yardstick by which other droughts are currently gauged. However, instrumental records only exist for 100 years or less, and do not reflect the full range of drought variability possible. There is evidence for even more extreme droughts over decadal to century time scales (Figure 1). For example, much of the present-day vegetation in the western Great Plains serves to stabilize sand dunes and sheets that were deposited by wind and that have been active as recently as the 19th century (Overpeck 1996, Forman *et al.*1992, Madole 1994, Muhs and Holliday 1995, Muhs *et al.* 1996).

Historical documents, archaeological remains, tree rings, and geomorphological data provide evidence for periods of drought in the past 10,000 years that have equaled and far exceeded the severity of the droughts of the 1930s and 1950s. These proxy climate data demonstrate that the natural variability of climate is truly larger than revealed by the instrumental record (e.g., Figure 1, bottom), and also highlight the likelihood that future droughts more severe than those of the 20th century may occur in the future. Clearly, more detailed information about the long-term record of natural variability of drought is needed, especially where climate and land use practices make regions particularly vulnerable to drought.

Increasing our knowledge of drought variability

The Paleoclimatology Group at the National Geophysical Data Center (NGDC) has teamed up with scientists at the NCDC and researchers at the Lamont-Doherty Earth Observatory of Columbia University, the University of Arizona, and the University of Arkansas to create a new on-line database focused on drought variability in North America. The new database (*http://www.ngdc.noaa.gov/paleo/drought.html*) combines the perspective gained from *in situ* instrumental data with a network of drought records reconstructed from a collection of climatically-sensitive tree-ring chronologies.

At present, the drought variability database extends back 300 years and focuses on summer drought as reflected by the Palmer Drought Severity Index (PDSI). Data used to calibrate the tree-ring records were obtained from 1036 single-station records from the NCDC's U.S. Historical Climatology Network (USHCN, Karl *et al.* 1990). The USHCN is a high-quality data set of monthly averaged temperature and total monthly precipitation records that have been screened for length of record, percent missing data, number of station moves and other station changes that may affect the data homogeneity.

The period of record available for each stations varies, with starting years ranging from 1831-1913, but most beginning in the 1890s. This collection of instrumentally-based PDSI records was interpolated onto a 2° x 3° grid covering the coterminous United States (Figure 2a).

The tree-ring data used to reconstruct PDSI at each of the 2° x 3° grid points (Figure 2a) included 425 tree-ring chronologies in North America, many of which are available from the International Tree-Ring Data Bank at NGDC (Figure 2b). The tree-ring chronologies were calibrated with the gridded instrumental drought data using a point-by-point regression and were tested for predictive ability with independent data not used in the calibration models technique (Cook *et al.* 1996). Details of the actual reconstruction process and the quality of the reconstructions can be found in Cook *et al.* 1996 and Cook *et al.*, in review. In general, the quality of the tree-ring reconstructions is quite good, with an average of 55% of the variance in the instrumental PDSI explained by the tree-ring reconstructions.

The gridded instrumental (1895-1995) and tree-ring based (1700-1978)

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[1]*World Data Center-A for Paleontology*
NOAA/NESDIS/NGDC
325 Broadway
Boulder, Colorado 80303
E-mail: woodhous@ngdc.noaa.gov

[2]*National Climatic Data Center*
NOAA/NESDIS
151 Patton Avenue
Asheville, N.C. 28801-5001
E-mail: tkarl@ncdc.noaa.gov

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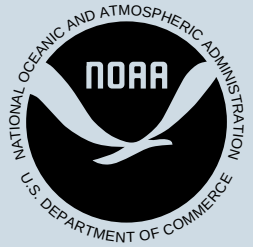
The mailing address for the *Earth System Monitor* is:
National Oceanographic Data Center
NOAA/NESDIS E/OC1
SSMC3, 4th Floor
1315 East-West Highway
Silver Spring, MD 20910-3282

MANAGING EDITOR
Dr. Anthony R. Picciolo
Telephone: 301-713-3281 ext.140
Fax: 301-713-3302
E-mail: apicciolo@nodc.noaa.gov

EDITOR
Sheri Phillips
Telephone: 301-713-3280 ext.127
Fax: 301-713-3302
E-mail: sphillips@nodc.noaa.gov

ASSOCIATE EDITOR
Roger Torstenson
Telephone: 301-713-3281 ext.107
Fax: 301-713-3302
E-mail: rtorstenson@nodc.noaa.gov



U.S. DEPARTMENT OF COMMERCE
William M. Daley, Secretary

National Oceanic and Atmospheric Administration
D. James Baker,
Under Secretary and Administrator

Retreat of the Larsen Ice Shelf

Thermal band Advanced Very High Resolution Radiometers imagery received at the National Snow and Ice Data Center (NSIDC) for February 15, February 26, and March 23 shows significant changes in the Larsen B Antarctic ice shelf. There appears to be a retreat of about 5 km along the northern portion of the ice shelf front; the front is significantly more embayed at latitude 65.6 degrees and northward on March 23 image than on February 15. By March 26, the retreat had continued, mostly in the northernmost 25 km of ice front.

The ice shelf area lost in this event is about 175 to 250 square km. The shelf appears to still be connected to Robertson Island in the north, an important pinning point. NSIDC researcher Ted Scambos notes that when taken in the context of recent models of the ice shelf, these images may mark the beginning of the end for Larsen B. The images are posted on the NSIDC website at *http://www.nsidc.colorado.edu/NSIDC/LARSEN/larsenb.html.*

Butterfly population extinction rates and changes in climate

At over 160 sites from Baja California to British Columbia, Dr. Camille Parmesan of the University of California at Santa Barbara (UCSB) has been assessing the relationship between butterfly population extinctions and changes in climate. To control for urban effects, Dr. Parmesan used assessments of urban land cover, based upon DMSP-OLS city lights frequency, that were provided by the National Climatic Data Center (NCDC). Preliminary analysis of the urban statistics indicates that high butterfly population extinction rates at southern sites are not due to subtle influences of near-by urban centers.

WCRP/JCS task group formed on Climate and Cryosphere Project

The Joint Scientific Committee (JSC) XIX, March 16-20,1998 formally endorsed the establishment of an *ad hoc* World Climate Research Program (WCRP) task group on climate and cryosphere to formulate a scientific and coordinated plan for a WCRP Climate and Cryosphere Project. The appointment of the membership of the group was entrusted to the Arctic Climate System Study (ACSYS) Scientific Steering Group (SSG). The group should report progress (through ACSYS) to JSC XX in March 1999 and deliver a final proposal for review at JSC XXI in March 2000 (again through ACSYS).

This action responds to a proposal submitted to the JSC XIX by the ACSYS SSG, deriving from recommendations prepared by an *ad hoc* group of the ACSYS SSG, chaired by Roger G. Barry, National Snow and Ice Data Center Director, during the Sixth Session of the ACSYS SSG meeting in Seattle in November 1997.

News briefs

DoD transfers control of weather satellites to NOAA

The United States recently achieved a major milestone in the merger of its civil and military weather satellite programs, when the U.S. Air Force transferred control of its weather satellites to the National Oceanic and Atmospheric Administration (NOAA). The merger was directed by President Clinton on May 5, 1994. Operational control of the Defense Meteorological Satellite Program (DMSP) was passed from Air Force Space Command to NOAA, who will operate the satellites from its Satellite Operations Control Center in Suitland, Md.

NOAA's Suitland facility will become the primary location for providing functions associated with command and control of all U.S. weather satellites, including early orbit checkout following launch operations, satellite state of health maintenance, and satellite sensor and payload management.

NOAA currently operates two polar-orbiting satellites, NOAA-12 and NOAA-14. NOAA-15, launched May 13, is currently being checked out. NOAA also operates the nation's geostationary weather satellites, GOES-8, overlooking the East Coast and well out into the Atlantic Ocean, and GOES-9, overlooking the West Coast and well out into the Pacific Ocean, including Hawaii. GOES-10 is currently stored in orbit. With the transfer of the Defense satellites, NOAA also is operating five DMSP satellites.

Ocean Community Conference '98

The Marine Technology Society (MTS), the MTS Washington, DC Section and co-participating organizations are pleased to announce the MTS Ocean Community Conference '98 (OCC '98), to be held from November 16 to 19, 1998 at the Baltimore Convention Center in Baltimore, Maryland.

The Marine Technology Society is focusing OCC '98 on 'Celebrating 1998, the International Year of the Ocean' (YOTO). Sessions will address four themes which are receiving national attention as part of YOTO: Exploration in the Sea; Energy, Transportation & Communications; Sustainable Use of the Coastal Ocean; and the Ocean's Influence on Weather & Climate. For more information:
ITCMS Attn: Vita Feuerstein
445 Hoes Lane Piscataway, NJ 08855
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Internet: *www.noaa.gov/public-affairs/MTS98.html*
E-mail: *mts-occ98@ieee.org*

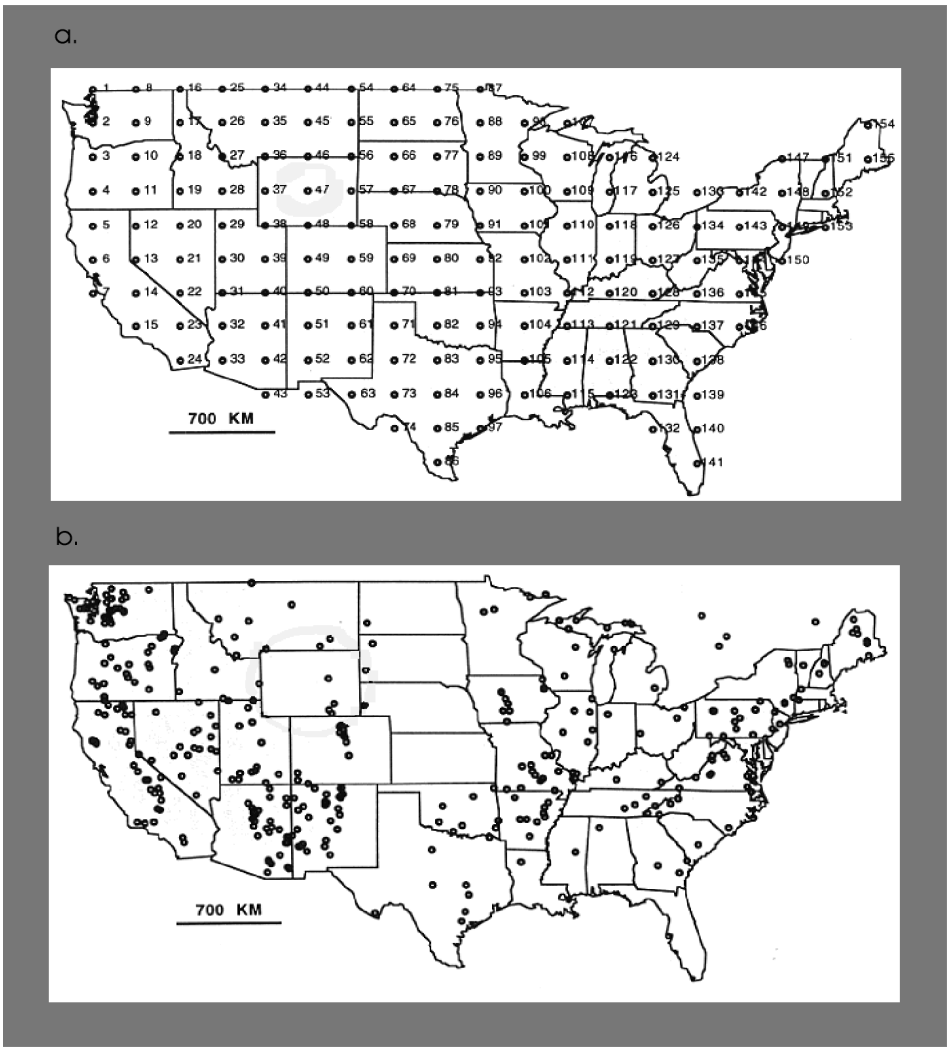
NOAA scientists win prestigious research publication award

Three scientists from the National Oceanic and Atmospheric Administration (NOAA) have been honored by the International Association for Great Lakes Research for a paper they published in the *Journal of Great Lakes Research*.

Troy L. Holcombe and Lisa A. Taylor, both of NOAA's National Geophysical Data Center in Boulder, Colo., and David F. Reid of NOAA's Great Lakes Environmental Research Laboratory in Ann Arbor, Mich., received the award along with colleagues John S. Warren of the Canadian Hydrographic Service, and Charles E. Herdendorf of Ohio State University.

The scientists received the association's prestigious Chandler-Misener Award, which is presented annually to the authors of the paper judged to be most notable in the *Journal of Great Lakes Research*. Their paper, "Lakefloor Geomorphology of Western Lake Erie," presents a discussion of western Lake Erie geology, as revealed by new bathymetry compiled by the authors.

The bathymetry and resulting paper are an outgrowth of NOAA's Great Lakes Data Rescue Project, carried out at NOAA's National Geophysical Data Center, and the Office of Oceanic and Atmospheric Research's Great Lakes Environmental Research Laboratory. An agreement between NOAA and the Canadian Hydrographic Service serves as the basis for U.S. and Canadian cooperative efforts to assemble new bathymetry for the four Great Lakes shared by the two countries.



▲ **Figure 2.** a) Observed climate data were interpolated from 1036 single-station records to the 155 grid points shown in this figure; PDSI was then reconstructed for each grid point. b) Locations of the tree-ring chronologies used to reconstruct PDSI.

Paleodrought database, *from page 2*

summer drought series form the basis for the new NESDIS drought variability web pages at NGDC. Tree-ring reconstructions of PDSI, as well as the instrumental data for each grid point, can be examined graphically. Both graphs and numeric data can be downloaded. In addition, maps of U.S. drought patterns for a given year can be displayed (e.g., Figure 3). Series of maps, either for the instrumental or tree-ring data, can also be viewed as multi-year animations, so that the changes in the spatial distribution of drought over time can be viewed and studied.

The new NESDIS drought variability site now enables an assessment of the magnitude and general spatial patterns of drought across the coterminous U.S. for each year back to 1700. The set of drought reconstructions has provided information about the long-term temporal and spatial characteristics of drought. For example, an analysis of instrumental data suggests that the coterminous U.S. can be split up into nine drought regions (Karl and Koscielny, 1982). When Cook *et al.* (in review) examined the spatial patterns of reconstructed drought over the last three centuries, they found essentially the same nine regions, suggesting that these regions have been stable over time.

These reconstructions also enable an assessment of the severity of 20th century droughts in the context of the last three centuries. When the extreme 1950s drought is compared to other drought in the past 300 years, reconstructions suggest that a drought that occurred around 1820 was similar in length, and perhaps greater in severity and spatial extent (Cook *et al.*, in review) (Figure 3). A drought of similar magnitude and extent occurred around 1860.

Another study used this set of gridded drought reconstructions to investigate a bidecadal drought rhythm in the U.S. (Cook *et al.* 1997). Results indicate that the bidecadal drought rhythm has been a feature of drought in the western U.S. since at least 1700. Frequency domain analyses suggest that there may be some phase-locking between the extent of area experiencing drought (as measured by a drought area index) and both Hale solar cycle minima and lunar tidal maxima, although no mechanisms have yet been identified.

Other types of paleoclimatic data provide additional information

The current NESDIS drought variability website is just a beginning, and plans exist to add additional centuries-long records and information. The goal will be to expand the geographic coverage, sample density, and record lengths covered. All together, the combination of instrumental and paleoclimatic data from multiple sources can offer a much more complete picture of natural drought variability than offered by instrumental data or any one proxy source alone.

Lake, alluvial, and eolian sediments, tree rings, lake level changes, archaeological data, and historical accounts all provide evidence for periods of great drought in the Great Plains and the western U.S. that surpass droughts of the 20th century and indicate changes in the character of drought variability over the past 2000 years (e.g., Figure 4).

Proxy data for drought are available through NGDC WDC-A for Paleoclimatology web page (*http://www.ngdc.noaa.gov/paleo/paleodat.html*). Paleoclimatic data containing information about precipitation and drought variability at this web site include: historical accounts, tree-ring chronologies, varved lake sediments, pollen, lake level, and isotopic data.

Acknowledgments

Thanks to the individuals who helped generate the NOAA/NESDIS North American Drought

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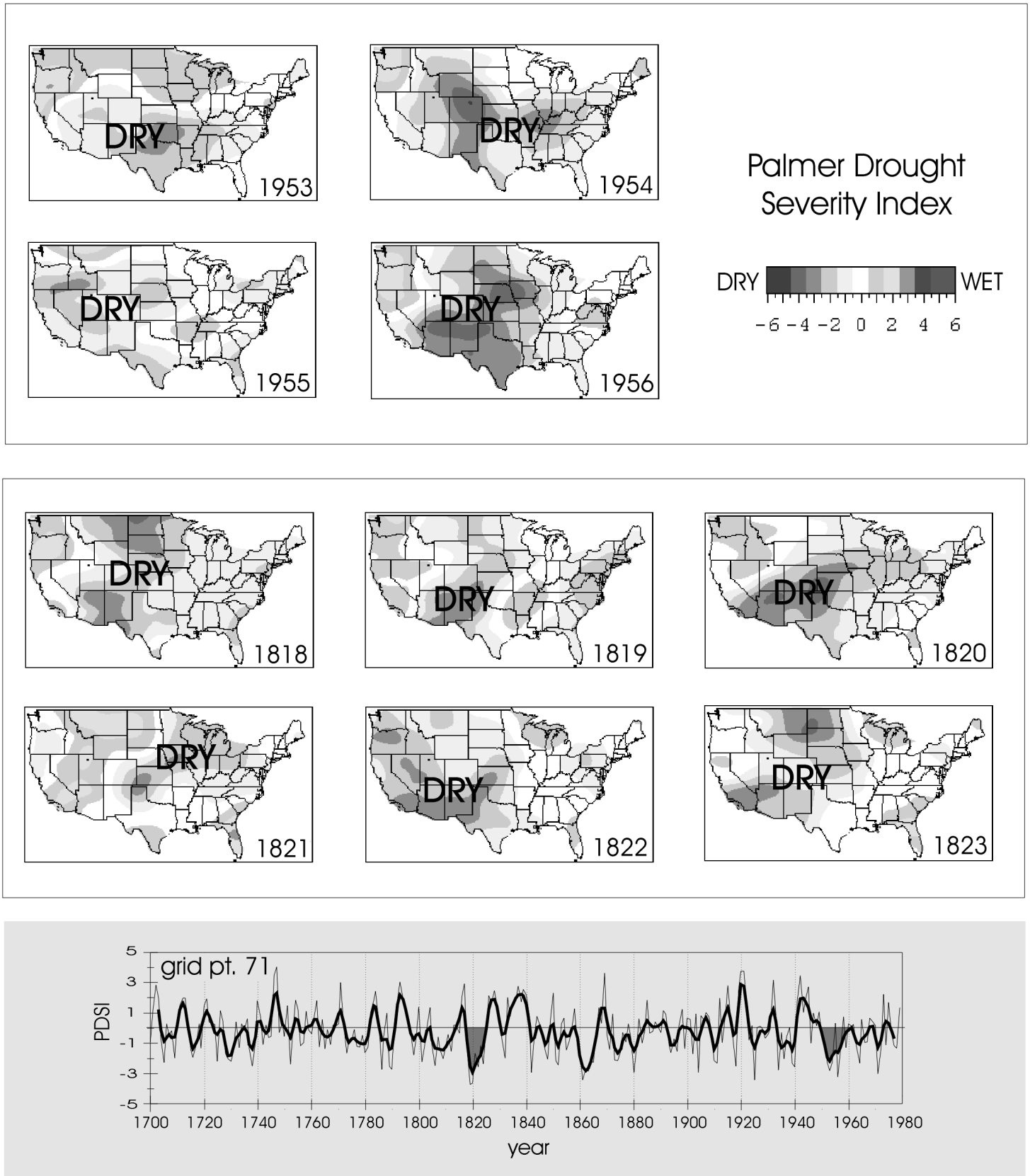
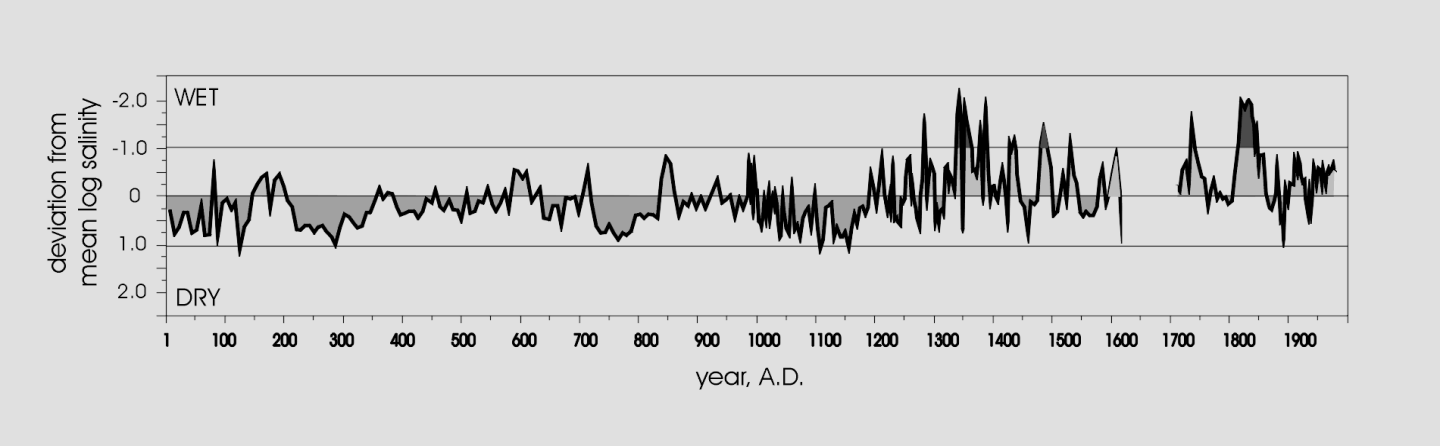


▲ **Figure 3.** The top two sections of this figure contrast the spatial extent of the 1950s and 1820s droughts, here, both reconstructed from tree rings. The bottom graph shows the reconstructed record of PDSI for grid point 71, centered in the Texas panhandle (see Figure 2b). Although a severe drought, the 1950s drought was at least matched in spatial extent, and likely exceeded in severity by the 1820s drought. Reconstructions also show the 1860s drought to have been quite severe.



▲ **Figure 4.** This graph shows a record of salinity in Moon Lake, North Dakota for the past 2,000 years (Laird *et al*. 1996). The centuries after A.D. 1200 are characterized by a climate regime wetter and less drought-prone than the centuries before this time. A number of proxy records in the western and central U.S. reflect a severe and extensive multidecadal drought at the end of the 12th century which may have been the last great drought of this prolonged dry regime.

Paleodrought database, *from page 4*

WWW pages: Edward Cook, David Meko, David Stahle, and Malcolm Cleaveland. For data contributions thus far, we thank Henri Grissino-Mayer and Kathleen Laird. Dr. Woodhouse's Post-doctoral Fellowship at NGDC is funded by the National Research Council Fellowship.

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An overview of the NOAA/NESDIS data processing systems and derived products for NOAA-KLM

NOAA-15 carries new instrumentation for climatological monitoring and global weather forecasting

Pamela M. Taylor
Office of Systems Development/
Polar Program
NOAA/NESDIS

Barbara A. Banks
Office of Satellite Data Processing
and Distribution
NOAA/NESDIS

NOAA/NESDIS has provided operational, satellite-based, meteorological and environmental products since the launch of the first POES (Polar-orbiting Operational Environmental Satellite) in April of 1960. In May 1998, NOAA launched the first spacecraft, NOAA-K, of its fifth generation of operational polar-orbiting satellites. This spacecraft, now designated NOAA-15, carries advanced versions of the POES visible/infrared imager—the Advanced Very High Resolution Radiometer (AVHRR/3), and infrared sounder—the High Resolution Infrared Radiation Sounder (HIRS/3). In addition, NOAA-15 carries two new microwave instruments, the Advanced Microwave Sounding Units A and B (AMSU-A and AMSU-B), for production of improved atmospheric temperature and moisture profiles and surface products.

The Solar Environmental Monitoring (SEM), Data Collection System (DCS) and Search and Rescue (SAR) packages on NOAA-K, L and M have minor improvements related to data content, storage, calibration and transmission capabilities. These space segment improvements and additions are associated with numerous ground system upgrades required for the most efficient processing of the NOAA-KLM data into quality products. This paper will overview NOAA/NESDIS' current environmental polar data processing systems for the AVHRR and HIRS instruments, changes to these current systems required for NOAA-15 processing, and the new product systems developed for the AMSU-A and AMSU-B instruments. These systems include those necessary for processing operational products in the following disciplines:

- cloud cover imagery;
- global and local sea surface temperatures;
- aerosol distributions;
- radiation budget;
- atmospheric temperature and moisture;
- ozone concentrations;
- the hydrological cycle (precipitation rate, cloud liquid water, total precipitable water), and;
- surface parameterization (sea ice, snow cover and vegetation index).

Solar products generated from the SEM and services provided by the DCS and SAR packages are not included in this overview.

NOAA/NESDIS
Office of Systems Development E/OSD
4700 Silver Hill Rd., Stop 9909, Rm 3301
Washington, DC 20233-9909
bbanks@nesdis.noaa.gov

Current status/plans

NESDIS' current operational polar-orbiting assets include a primary afternoon orbiter, NOAA-14 (launched December, 1994) and a supplementary and back-up morning orbiter, NOAA-12 (launched May, 1991). NOAA-15 was successfully launched on a Titan II on May 13, 1998 from Vandenberg Air Force Base, CA into a morning orbit (0730L) to replace the aging NOAA-12 spacecraft. In 2003, the first European polar orbiter, METOP-1, will carry NOAA's baseline set of instruments and assume fulfillment of NOAA's morning mission (0930L).

In addition, the first NOAA-DoD converged polar-orbiter (NPOESS) will be launched late in the next decade and will fulfill the afternoon mission. Therefore the orbits and planned launch dates of the remaining POES satellites are as follows in Table 1:

▲ **Table 1.** Orbits and planned launch dates for remaining POES satellites.

NOAA-L	PM	Dec 1999
NOAA-M	PM	Apr 2001
NOAA-N	PM	Dec 2003
NOAA-N'	PM	Jul 2007

NOAA-KLM Instrumentation changes

The most significant change to the NOAA-KLM AVHRR/3 is the addition of a sixth channel (3a) at 1.6 microns which will be time-shared with the current Channel 3 at 3.7 microns (3b). This new channel has been added to aid in improved snow and ice discrimination and aerosol detection and is expected to be used during the daylight portions of the afternoon spacecraft orbits (NOAA-L). However, limited testing and data collection of the 1.6 micron channel will be conducted with NOAA-15 during its checkout period to aid in preparations for NOAA-L and selection of the channel switching configuration.

Time-sharing of Channel 3 was selected to allow for access to this new frequency while maintaining data formats. A flag will be set to identify which channel is selected. An additional upgrade of the AVHRR/3 is the split gains in Channels 1, 2 and 3 which increase the sensitivity at low light/energy levels. This increased sensitivity will improve snow and ice coverage, aerosol distribution and vegetation index products.

The NOAA-15 HIRS/3 instrument has several upgrades to the current HIRS/2 on-board NOAA-14 and NOAA-12. First, the calibration sequencing has changed to remove viewing of the cold internal target allowing an additional scan line of data each calibration period. Secondly, while the HIRS is used primarily for temperature sounding, Channel 20 has been upgraded to enhance generation of radiation budget products. And finally, the instrument has been improved to achieve greater overall detector performance and lower noise levels (Wrublewski, 1996).

NOAA-15 also carries the first AMSU instruments dedicated to the improved generation of temperature and moisture profiles, particularly in cloudy regions. The AMSU-A is a cross-track microwave sounder which replaces the current 4-channel MSU and 3-channel SSU instruments and is com-

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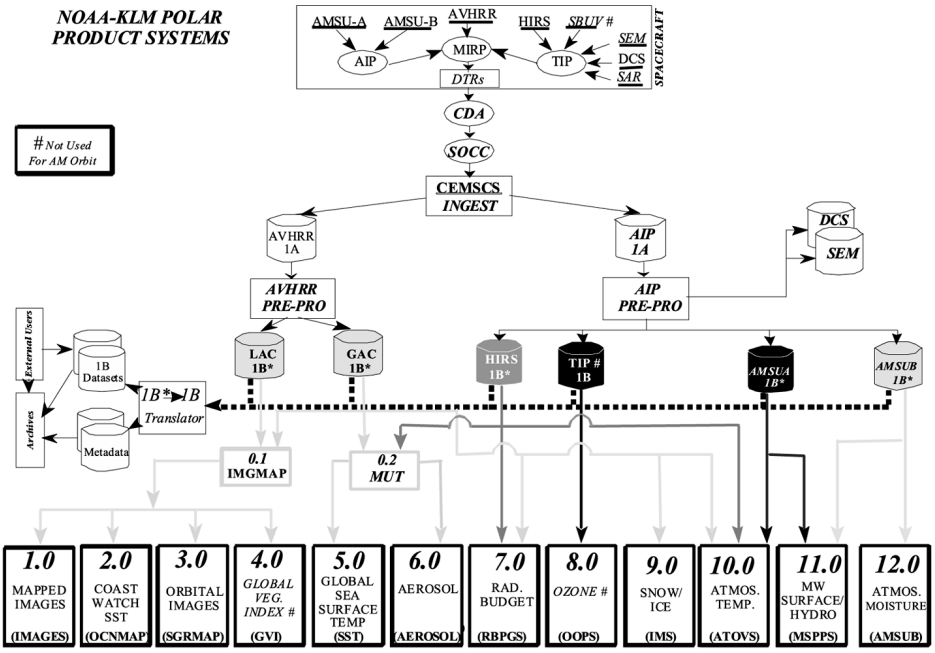
NOAA-KLM products, *from page 7*
prised of a thirteen channel AMSU-A1 (temperature sensing) and two channel (window/surface) AMSU-A2 unit. Processed in conjunction with the HIRS, the AMSU-A will significantly enhance the NESDIS temperature sounding products and independently allow for production of new surface and hydrological products based on experience gained from the DMSP (Defense Meteorological Satellite Program) microwave imager (SSM/I).

The AMSU-B is a five channel cross-track sounder and is the first dedicated microwave moisture sounder to be flown on a NOAA polar-orbiter. In addition to providing high resolution atmospheric moisture profiles, this instrument will be used to produce precipitation and surface products from two window channels. NOAA-15, due to its morning orbit, does not carry an SBUV instrument. This instrument is planned to be on-board NOAA-L and, most likely, NOAA-M. These NOAA-KLM instrument changes have resulted in significant modifications to existing pre-processing and product generation systems and the need to develop new product systems for processing of the AMSU datastreams.

Polar product processing

Figure 1 is an overview of the planned NOAA/NESDIS data and product processing systems for NOAA-KLM. Global, orbital data from each of the instruments are merged into the spacecraft datastream by the on-board processors (Manipulated Information Rate Processor [MIRP], TIROS Information Processor [TIP], AMSU Information Processor [AIP]), which is then recorded for future playback on one of five on-board digital tape recorders (DTRs). Upon overflight, this data-stream is read out by a NOAA Command and Data Acquisition (CDA) site (Wallops Island, VA or Fairbanks, AK) and relayed via a communications satellite to the NESDIS Satellite Operations Control Center (SOCC) in Suitland, MD. The SOCC performs quality control and instrument health and safety monitoring and then transmits the datastream to the NESDIS Central EnvironMental Satellite Computer System (CEMSCS).

New NOAA-15 data ingestors decommutate the data into two Level



▲ **Figure 1.** NOAA-KLM polar product systems.

1A datasets; one unique for the AVHRR data and another containing all remaining instrument data (AIP 1A).

These 1A datasets are then processed to individual instrument Level 1B* ("1B Star") datasets which contain earth-located, time-tagged instrument counts with calculated calibration parameters appended. All new Level 1A and 1B Pre-Processors have been developed for NOAA-15. The AVHRR datastream generates two Level 1B* datasets: the GAC (Global Area Coverage) data at 4 km resolution and selected LAC/HRPT (Local Area Coverage/High Resolution Picture Transmissions) datasets at 1 km resolution.

The Level 1B* datasets are new for the NOAA-KLM processing and are uncompressed data used solely by the internal follow-on product processing systems. A Level 1B* to Level 1B Translator has been developed to provide NOAA-K 1B instrument formats, comparable to formats from previous POES satellites, for archive purposes and external user access. The translation can also be reversed to allow for any future required reprocessing of the archived data. Changes to the AVHRR and HIRS 1B* formats and the new AMSU-A and AMSU-B 1B* formats are available in the *NOAA-K Polar Orbiter Data Users Guide* (Kidwell, 1997).

After generation of the Level 1B* datasets numerous product processing systems are initiated, as shown in Figure 1. The current NOAA-12 and NOAA-14 product network is comprised of ten product systems requiring varying degrees of modifications to interface to and process the NOAA-KLM instrumentation. These modifications range from minor upgrades (IMAGES, OCNMAP, SGRMAP, GVI, SST, AEROSOLS, RBPGS, OOPS, IMS) to complete redevelopment (ATOVS) along with the addition of two new systems (MSPPS and AMSUB). Upgrades to the product distribution and archive systems are also required.

In order to consolidate some system functions and reduce redundancy, particularly in Level 1B dataset access, two pre-product processing subsystems are initiated each orbit. These include the IMGMAP (Image Mapping) and MUT (Multi-Unit Tasking) subsystems. IMGMAP accesses each AVHRR GAC/HRPT/LAC 1B* dataset and applies the calibration parameters for generation of intermediate files containing channel albedos and radiance/brightness temperatures needed for the mapped and swath imagery (IMAGES and SGRMAP), CoastWatch SST (OCNMAP) and Global Vegetation Index (GVI) systems.

In a similar manner, the MUT accesses the AVHRR GAC and HIRS Level 1B* datasets, calibrates the data and generates full resolution orbital retrievals of global sea surface temperatures

and aerosol distributions for their associated mapping systems (SST and AEROSOL, respectively). Both IMGMAP and MUT have been modified to read in the new Level 1B* formats and adjust for the instrument changes in non-linear calibration (AVHRR) and additional scan lines of data (HIRS). The following overviews each of the twelve NOAA-KLM product systems including their data input, major processing steps, and suite of output products.

Image Map System (IMAGES)

IMAGES accesses the lower resolution (GAC - 4 km) intermediate files from IMGMAP each orbit and updates gridded images of Channel 1 and 4 during the day and Channel 4 at night. These images are mapped to both polar stereographic (5.9 km) and mercator (9.8 km) [40N - 40 S] projections. From this system 11.9 km resolution WEFAX products, 7-Day Composites and End-of-Day product files are generated. This system primarily uses the afternoon spacecraft for imagery production but has already been modified to interface to NOAA-15 data for immediate backup to NOAA-14 and preparation for NOAA-L.

Ocean Map (OCNMAP)

OCNMAP is the CoastWatch or Coastal Sea Surface Temperature System. OCNMAP uses primarily the high resolution AVHRR LAC and HRPT intermediate datasets from IMGMAP for generation of local SST (1.5 km) and regional SST (4-6 km) product files for selected CoastWatch nodes. Limited AVHRR GAC data are also used to produce these products. A non-linear SST algorithm using channels 3b, 4, and 5 is used to compute the nighttime SSTs while the daytime algorithm uses only channels 4 and 5 (Sapper, 1998).

Additional parameters included on the product file are the channel brightness temperatures and albedos and the cloud masks used to derive the SST. To achieve the required coverage the high resolution data from both the afternoon and morning polar orbiters are processed in the CoastWatch system. This system has been modified to allow for processing from the upgraded NOAA-15 AVHRR/3.

Stretched Gridded Products (SGRMAP)

Each orbit of AVHRR GAC Level 1B* data is currently accessed directly by the SGRMAP system. After the application of calibration parameters and geometric corrections to the data, it is merged with a lat/long grid and coastline databases for production of full orbital swaths of the 4 km data for each of the five imagery channels.

Upgrades are underway to interface this system to the intermediate IMGMAP files to consolidate calibration processes and for processing of the additional Channel 3a. This system primarily uses the afternoon spacecraft for imagery production but is being modified to interface to NOAA-15 data for immediate backup to NOAA-14 and preparation for NOAA-L.

Global Vegetation Index (GVI)

The GVI system reads the AVHRR GAC Level 1B datasets directly for access to the daylight portions of each orbit. Orbital maps at 16 km resolution are generated which include counts for Channels 1 and 2, brightness temperatures for Channels 4 and 5 along with the solar zenith and scan angles. Daily maps representing the highest difference between channels 1 and 2, i.e., the simple difference vegetation index (associated with clear sky conditions) during the given day are then generated for each 7-day period (Mon - Sun) followed by the weekly composite of each of the above parameters.

The "Third Generation" GVI includes a cloud flag based on channel 4 for those retrievals remaining cloud-contaminated (Tarpley, 1998). Nonlinear calibration corrections are applied to channels 4 and 5 and post launch calibrations applied to channels 1 and 2. The final set of weekly products also include Precipitable Water and Normalized Difference Vegetation Indices.

Due to sun angle constraints the GVI system uses only the afternoon polar orbiter. Upgrades are planned to have the GVI system interface to the intermediate IMGMAP files to consolidate calibration processes and to process data from the NOAA-L AVHRR including the new 1.6 micron channel.

Sea Surface Temperature (SST)

The global Sea Surface Temperature (SST) system accesses the AVHRR GAC intermediate retrieval files from the MUT along with the HIRS data for cloud-screening. Like the OCNMAP system, a non-linear SST algorithm using channels 3b, 4, and 5 is employed to compute the nighttime SSTs while the daytime algorithm uses only channels 4 and 5.

An 8-day observation file is updated every six hours and is used to produce the following final product files (Sapper, 1998): a) Daily Global SST Field (100 km); b) Bi-Weekly Regional SST Field (50 km); c) Bi-Weekly Local SST Field (14 km); and d) Monthly Mean Field (250 km). This system primarily uses the afternoon spacecraft for SST production but has already been modified to interface to NOAA-15 data for immediate backup to NOAA-14 and preparation for NOAA-L.

Aerosols (AEROSOL)

The AEROSOL system accesses the AVHRR GAC intermediate files from the MUT and generates weekly aerosol optical thickness retrievals over the ocean from Channel 1 radiances. A single channel algorithm, under clear sky conditions, uses a radiative transfer model to scale the upward radiances to an aerosol optical thickness (Kidwell, 1997). This system is actually embedded within the SST system to make use of the HIRS cloud-clearing processing and for future availability to correct the computed SSTs for aerosol contamination (Sapper, 1998). Like the SST system, an 8-day observation file is updated every six hours and is then used to produce global Weekly Analysis and Monthly Mean fields, both at horizontal resolutions of 100 km.

Due to sun angle constraints the AEROSOL system currently uses only the afternoon polar orbiter. Only limited (latitudinal) products would be available from the morning orbiter. Preparations are underway for upgrades to this system for processing of the NOAA-L AVHRR data.

Radiation Budget Product Generation System (RBPGS)

The current Radiation Budget Product Generation system (RBPGS) directly accesses both the AVHRR GAC and HIRS Level 1B datasets for generation of top-of-atmosphere (TOA), outgoing

– continued on page 10

NOAA-KLM products, *from page 9*
longwave (OLR) and short wave absorbed radiation (SWAR) products. This suite of products is divided into day (ascending) and nighttime (descending) products and also include histograms of both the OLR and SWAR parameters. The output products include monthly, seasonal and annual polar stereographic and linear lat/lon (2.5 degree) maps of SWAR and OLR (Sapper, 1998).

This system generates operational products from both the POES afternoon and morning orbiters. Upgrades to the RBPGS system for the NOAA-KLM instrumentation include the production capability of daily 1 degree equal area maps of AVHRR GAC OLR and SWAR, a new HIRS OLR and associated histograms.

Ozone (OOPS)

Ozone products are made from the SBUV instrument which is flown only on the afternoon POES satellites. The Operational Ozone Product System (OOPS) system first accesses the TIP 1B dataset (see Figure 1) and strips out the SBUV data to form the SBUV Level 1B dataset. This is the only system which generates its own Level 1B data file versus production by one of the CEMSCS preprocessors. This system also accesses the temperature profile files (see ATOVS section) needed in the calculation of the final Level (1000 to .3 mb), Layer (1000 to .01 mb) and Total Ozone products contained in the Product Master File. Orbital and daily products are generated from the nadir-view of the instrument at a 200 km resolution. A historical file is also generated which contains information on the characterization of the instrument.

Currently, operational products are being generated from the NOAA-14 satellite. System upgrades are planned for the processing of the SBUV data from NOAA-L.

Interactive Multi-sensor Snow and Ice Mapping System (IMS)

Since 1966, NOAA/NESDIS has been producing a weekly Northern Hemisphere snow and ice extent product using the POES AVHRR GAC data as its primary input. Additional sources include data from the NOAA GOES, Japanese GMS and European METEOSAT geostationary satellites. These data are used to obtain enough clear-sky imagery over a week's period to manually identify the snow and ice coverage. This very manual and time intensive procedure, along with a need to improve both the temporal and spatial resolution of the weekly product, has led to the development of the Interactive Multi-sensor Snow and Ice Mapping System (IMS) as described in Ramsay, 1998.

The IMS became operational in November of 1997, producing a more accurate daily digital product at a 23 km (vs. 190 km) horizontal resolution. This system allows for access, overlay and analysis of additional data sources such as the DMSP SSM/I and POES AMSU snow and ice products. The addition of the microwave data, which are generally unaffected by cloud cover, was crucial to allow for daily product generation. This workstation-based system has also decreased map production time from 10 hours to less than one hour.

The IMS is currently undergoing a 15-month validation period during which both the weekly and daily products will be generated, compared and validated over two northern hemisphere snow seasons. This system, while not being developed directly for NOAA-KLM, is being updated to access the data from the AMSU products from the Microwave Surface and Hydrological Product System (MSPPS) and from the upgraded AVHRR/3, particularly for use of the new 1.6 micron channel which will improve the discrimination between snow and clouds.

Temperature retrieval (ATOVS)

The Revised TIROS Operational Vertical Sounding (RTOVS) replaced the TOVS in October 1997 for both the NOAA-14 and NOAA-11 sounding instrument suites (the NOAA-12 HIRS degraded beyond operational use in June, 1997). This system's primary input data are the HIRS, MSU and SSU Level 1b datasets and the first inclusion of the AVHRR data to aid in cloud detection. Ancillary databases of snow/ice coverage, SST, forecast temperature fields, and daily radiosondes data are also accessed by this system. On an orbital basis the RTOVS system produces a variety of products to include channel radiance data, temperature and HIRS-based moisture Level (40) and Layer (15) retrievals from the surface to .01 mb at a resolution of 40 km. In addition, the HIRS system also produces a HIRS-based Total Ozone product along with cloud and radiation budget products (Casey, 1998).

To process the new and high volume AMSU data available from NOAA-15, a new Advanced TOVS (ATOVS) has been developed. This system will access the NOAA-KLM AVHRR GAC, HIRS and AMSU-A Level 1B* datasets along with the same ancillary databases as the RTOVS system. An upgraded processing architecture, along with optimization of the AMSU data for cloudy regions where HIRS data is contaminated, will result in a more efficient and accurate atmospheric profiling system.

RTOVS currently produces operational products from both the afternoon and morning polar orbiters. Upon checkout of the ATOVS system NOAA-14 data will continue to be processed by the RTOVS system while NOAA-15 data will be processed by the ATOVS system.

Microwave Surface and Hydrological Product System (MSPPS)

A new NESDIS polar product system has been developed to provide a suite of surface and hydrological products from NOAA-15 and follow-on AMSU-A and AMSU-B instruments. While these instruments' "sounding" channels will allow production of advanced atmospheric temperature and moisture profiles through the ATOVS and Moisture Retrieval (AMSUB) systems, they also include several microwave "imaging" channels.

After accessing the new AMSU-A and AMSU-B Level 1B* datasets the

imaging channels will be used to produce initial (Day-1) Snow Cover, Sea Ice Concentration, Rain Rate, Total Precipitable Water and Cloud Liquid Water products based on the AMSU-A instrument. Day-2 products include production of Ocean Surface Wind Speed, Snow Depth, Soil Moisture and Shelter Temperature, along with the original Day-1 products using AMSU-B. Algorithm development for these products was built upon the heritage of the DMSP SSM/I products with adjustments for different instrument scanning geometry (cross-track vs. conical), field of view resolutions and channel polarization (Ferraro, 1998).

These products, along with the AMSU-A and AMSU-B brightness temperatures, will be available in full instrument resolution orbital files (45 and 15 km nadir, respectively). In addition, the derived products will be available in 1/8th mesh polar stereographic daily and weekly mapped files.

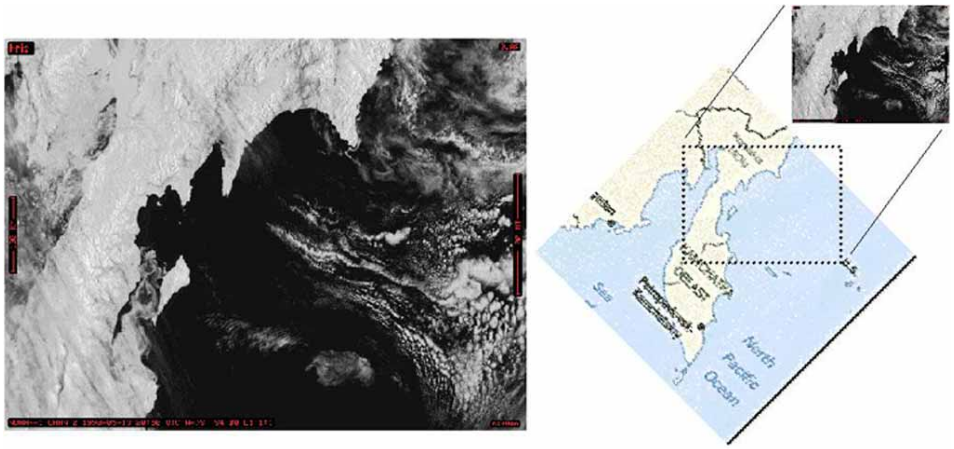
The MSPPS system will initially produce operational products from only NOAA-15, after an extensive validation period. With the launch of NOAA-L, and the second suite of AMSU instruments, the MSPPS will produce operational products from both the morning and afternoon POES satellites.

Moisture retrieval (AMSUB)

The AMSUB Moisture Retrieval System is also a new system developed for NOAA-15. The ATOVS system was originally designed to provide simultaneous retrievals of both temperature and microwave based moisture products but has been separated into individual systems, ATOVS and AMSUB, to ease the implementation of the extensive ATOVS system.

The AMSUB system is largely based on the NESDIS operational DMSP SSM/T2 system due to its efficiency, accuracy and similarity to the SSM/T2 instrumentation. AMSUB will generate channel radiances, fifteen Level Mixing Ratios from the surface to 300 mb, three Layer Precipitable Water values and a Cloud Liquid Water parameter. Initial (Day-1) products will be produced orbitally at one-half, or 30 km, resolution.

Future upgrades include possible merging of the ATOVS and AMSUB systems and product generation at the full (15 km) resolution. Additional system specifications can be found in Casey, 1998. The AMSUB system will initially produce operational products from only NOAA-15, after an extensive validation period. With the launch of NOAA-L, and the second suite of AMSU instruments, AMSUB will produce operational products from both the morning and afternoon POES satellites.



▲ **Figure 2.** NOAA-15 was successfully launched on May 13, 1998 into a near-polar, 0730 ascending orbit, 516 miles above the earth on a U.S. Air Force Titan II rocket. This is the first image taken from the NOAA-15 AVHRR (Advanced Very High Resolution Radiometer), captured minutes after visible channels were established. Further information may be obtained online at: *http://poes2.gsfc.nasa.gov/campaign/*.

NOAA-15 check-out and validation

After the launch of NOAA-K on May 13, 1998 (Figure 2), NASA is conducting a two-month On-orbit Verification (OV) period before satellite handover to NOAA. The OV will consist of a variety of tests to assess the performance of the numerous spacecraft subsystems and each of the instruments. At launch plus 4 months (September, 1998) generation of the Level 1B datasets is expected to be validated followed by operational performance of the current AVHRR and HIRS based systems (IMAGES through RBPGS) at launch plus 6 months (November, 1998). New systems of ATOVS, MSPPS, and AMSUB will undergo more extensive validation periods with expected operational performance within 12-15 months after launch.

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Project ACCESS: community coastal monitoring for Year 2007

Cooperative long-term monitoring program with links to needs of infrastructure community

Michael Crane
NODC Liaison for Southeast U.S.
NOAA/NESDIS

The economic and operational requirements of the coastal ocean regime in terms of data management have become more focused in terms of details and timeliness. Project ACCESS (Accelerated Coastal Community Environmental Science Service) is a planned long-term, multi-agency ocean monitoring program that is designed to support the information needs of the infrastructure community. Near-real time data values will be collected, processed and delivered among the participants. The flow of data will be maintained as a dynamic process from a series of underwater sites and then distributed to the community.

Project ACCESS is being constructed to maintain an ocean monitoring network which measures the fundamental parameters of ocean temperature, salinity, the velocity profile, turbidity, visibility, surface velocities and the wind field at each of the nodes of the network. A grid of nodes will be determined from the requirements of the infrastructure community that receives the data from the monitoring sites and executes the mission of the organization based in part on these values.

Transmission of data from the nodes would be supported by a variety of cables and radio transmission sites. The Internet is the path for the delivery of the data. New nodes will be added to the network as participants define the requirements and the means of financial support. The implementation is a cooperative model where a "need" is matched with a "contribution".

Some of the values can be used immediately as presented in the scenarios above. Some will be used following a series of analyses using data from several years of data collection. Monitored ocean parameters would be linked directly to the needs of the infrastructure community. The participants in the project would span the Federal agencies, state agencies, local governmental agencies, port authorities, ocean operators and emergency managers. A roster of potential participants is listed in "ACCESS Constituents" (Appendix).

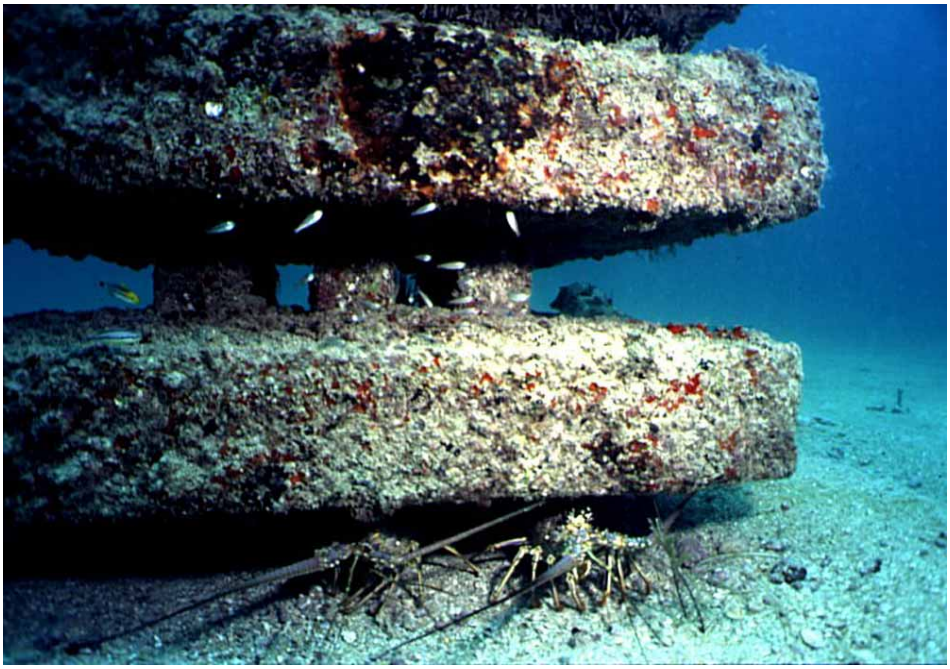
The geographic footprint of the prototype project is the ocean region in south Florida which stretches from the shoreline to the Gulf Stream, and Sebastien Inlet to Key Largo. Approximately one hundred fifty miles of linear coast, the region is defined in terms of the coastal community and the operational limitations. A manageable scale is one consideration in selecting the prototype region.

Scenarios for the year 2007

The concept of simultaneous use by a variety of constituents is presented in the following hypothetical situations in the year 2007: Late afternoon in the fall an oil tanker waits for the pilot to guide the forty-eight foot draft vessel into Port Everglades, Fla. The tank farm at the port supplies the majority of gasoline products to South Florida. The wind has been blowing stronger within the hour and the pilot checks the ocean currents at the sea buoy. The resulting vector of *wind forces* and *ocean current forces* is used by the pilot to steer the large vessel through the channel.

Simultaneously, further north of the port is a community planning meeting to discuss the plans for waste water management. A projected growth of 1.5 million people in ten years requires a serious decision on the design of an offshore effluent site. The presence of long term *ocean currents* helps the coastal engineers to move the outfall five miles to the north and three miles further to the east.

One week later, biologists at the county's environmental resource protection department review the *underwater photographs* (Figure 1) from the digital camera mounted near the reef track. The *turbidity measurements* are



▲ **Figure 1.** Digital image of artificial reef off Broward County, Florida; courtesy of NOVA Southeastern University Oceanography Department.

NODC Southeast Liaison Office
NOAA/AOML
4301 Rickenbacker Causeway
Miami, FL 33149
E-mail: crane@aoml.noaa.gov

evaluated for sand deposition and damage from a ship dragging the anchor after a storm from the previous week.

Earlier that morning, the life guards have issued a warming for *beach rip currents* based on forecasts generated by the National Weather Service. The forecast office used the *pressure gauge data* and the *temperature/salinity values* to determine the effect of wind driven ocean levels on the beach. The U.S. Coast Guard receives a message that a boat has lost power and has a sick crew member on board. The surface ocean velocities are checked for the latest measurements of the *surface back-scatter radar* system in the area.

The Port of Miami has an opportunity to host larger vessels if the channel is dredged. The authorities and the US Army Corps of Engineers must evaluate the options for deepening and widening the channel. One issue is the disposition of the dredge spoils and benefits of dredging. *Ocean current measurements* in the region during the last five years have indicated the best seasonal time frame and the stability of sand migration.

The potential site is well suited for the purpose because the site minimizes the risk to the reef track and the other underwater structures such as the waste water outfall pipeline. The dredge spoil site is located in the former southern anchorage area. The new offshore anchorage area was created following *wind and current measurement* analyses.

The U.S. Army Corps of Engineers was able to capture a sand lens as it migrated southward offshore and provided a local source of sand for beach renourishment. This sand lens was monitored with high resolution bathymetric devises calibrated with the *temperature and salinity measurements* made near-real time.

The summer beaches are favorite spots for local residents and tourists alike. Monitoring of ocean eddies offshore has indicated the potential for advection of tropical water that contains a large percentage of dinoflagellates. The *acoustic doppler current meters* have tracked a series of eddies and the biologists have focused their sampling within the core of the eddy. Lab analysis determines that a significant number of “red tide” species is present.

This week is the start of the sea turtle hatching time frame and the biologists use the data on the location of the eddies to plan the release of the hatchlings. At the same time a tug operator checks the *ocean currents* to help manage the fuel consumption as the barges are steered to the channel entrance.

Project implementation in 1998

The first step is to define the community, and the infrastructure community was chosen for two reasons. The first reason is the direct benefits that will be used immediately by ocean monitoring, and the second is the lack of direct support historically. Potential participants were contacted by phone in a preliminary survey. The initial responses were reviewed in terms of the information needs and the level of interest. Categories of participants were defined in terms of the type of infrastructure supported. Ports (Figure 2), offshore reefs, beaches, emergency response, waste water management and other types were selected as areas of support.

Some of the potential participants have sponsored ocean monitoring as part of a permit or as a priority task endorsed by the management of the agency. The existing monitoring programs are limited to a single site and a finite time period of measurement. As a small-scale test platform for Project ACCESS, the U.S. Navy established an ocean monitoring plan for the South Florida Test Facility in the marine waters off Broward County.

The participants are separated into two groups - one group which would receive the data and another group which would generate the data. The user group is the larger one and is more diverse. The generating group includes NOAA, the U.S. Army Corps of Engineers, the Environmental Protection Agency, and state agencies plus the academic institutions. In some instances an agency or institution may be a generator and a receiver of data.

The initial survey is only the first step. The next step is formal generation of the requirements, and a workshop is the most efficient method of defining the written requirements. The format of the workshop would have two sections: one section where the user community presents its requirements and the second section with the science community to provide services for data collection.

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▲ **Figure 2.** Aerial view of Port Everglades, Florida; courtesy of Port Everglades Authority, Broward County, Florida.

Project Access, *from page 13*

Representatives of each group of constituents outline the needs of data for that category of infrastructure. Many requirements overlap, and in turn one node can support the data needs of several constituents simultaneously.

The efforts of the workshop would result in a report on specific needs with the associated response from the scientific community and the mechanism to promote further cooperation among all the constituents. A forum for dialogue and a plan of action would follow the dialogue over time. Specific sites would be identified where measurements are now being collected and where additional measurements are needed. NOAA would provide the clearing house mission for the data.

Data collection and distribution

The essential elements of the project are the systematic collection of fundamental oceanographic parameters and the dynamic distribution to the infrastructure constituents. The workshop would define the types of parameters and the specific sites of interest. The next step is to provide instruments at the sites in the priority of funding availability. Not all sites in the plan can be completed in the first year. Each site has a roster of devices which is necessary and sufficient to obtain the monitoring values.

The radio telemetry system or the cabling system to transmit the data to the central or regional clearing house for the data would be located at each site. As each data burst is acquired, the initial processing would be applied to the parameter. Following the initial processing, the data values would then be captured for archival and distribution. The participating members will be sent a "packet" of data from each site. A schedule of data transmission is maintained for each constituent. As defined by the user, data will be transmitted to an FTP site.

After each site has transmitted data and the data have been processed, the copy of the data will be indexed at the clearing house and prepared for archival. At the same time an entry into the directory of data sets will be made on the web page. The anticipated roster of monitoring parameters consists of the following:

- ocean currents measured via an ADCP device;
- ocean temperatures;
- ocean salinity;
- turbidity measurements;
- visibility via a digital camera at reef sites;
- ocean pressure for water level determination;
- surface ocean currents via a backscatter radar technology; and,
- wind velocities of the marine atmosphere.

A table will reference the roster of parameters at each site, which may include all or some of the parameters. Depending on the data distribution schedule, an automated transfer of data packets will be made to the distribution list. Data from all sites will be transmitted to the distribution list in order to encourage regional appreciation of the ocean variability.

Using the National Data Buoy Center as a model for data transmission and archive, the plan is to bundle the data at each site and transmit the processed values to the National Oceanographic Data Center (NODC) on a monthly basis. The expertise of the NODC is essential in the long-term archive and the service to any interested party who is not a participant in the project directly. Local resources will be optimized to verify the validity and the operational status of the measurement system. The process of documenting and indexing will be automated to promote efficient and timely data handling at the front-end.

Infrastructure community use of data

As a result of the activities of Project ACCESS, direct observations supporting activities would be available to those groups that have operational priorities in the coastal marine waters, such as:

- pilots monitoring ocean currents to assess the drift due to water movement;
- waste water managers will have information on the circulation of coastal waters (as treatment plants emit waste water into the ocean);
- emergency managers can plan responses to seasonal storms;
- waterway managers can assess dredging success and select a preferred site for dredge spoils;
- the U.S. Army Corps of Engineers can modify coastal transport models to improve the sediment transport models;
- tug operators can select coastal routes to improve fuel efficiency;
- reef resource managers can observe conditions on the reef directly with underwater cameras (Figure 3);
- regional planners can select the optimal site for future facilities such as harbors, waste water plants, and bridges; and,
- beach and shoreline managers can assess the sources of sand to be used in beach renourishment.

Internally within the Department of Commerce, the program supports the agency mission of ocean resource assessment. The National Weather Service will have more detailed data on ocean currents and sea state to improve marine forecasts, the National Marine Fisheries Service will have environmental context for fishery stock assessment and sea turtle habitat, the National Ocean Service will be supported in the safe navigation mission and the marine sanctuary mandates, and the Office of Oceanic and Atmospheric Research will

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▲ **Figure 3.** Digital image of reef track off Southeast Florida; courtesy of NOVA Southeastern University.

Geomagnetic data added to SPIDR

The National Geophysical Data Center (NGDC) completed the addition of all archived geomagnetic one-minute data for the year 1983 to the Space Physics Interactive Data Resource (SPIDR) system. The addition included 26 magnetic observatories from North America, Europe, Asia, and the Pacific Area for a total of 369 megabytes of data. In total, geomagnetic data sampled at a one-minute interval for the years 1983-1997 are now available in SPIDR.
Contact: NGDC

NOAA/AVHRR global monthly vegetation cover CD-ROM

A CD-ROM of the time series of global monthly vegetation cover from NOAA/AVHRR (Advanced Very High Resolution Radiometer) has been produced by the National Climatic Data Center (NCDC). This new data set was developed by Garik Gutman, Dan Tarpley and Aleksandr Ignatov of NESDIS/Office of Research and Applications and Steve Olson of Research and Data Systems Corporation. In this version (1.0), the Third Generation C-Level Monthly Normalized Difference Vegetation Index (NDVI) data is presented for each month from April 1985 through December 1997 in both image and digital form. Viewing is via web browser or Navroad, an off-line browser included on the CD-ROM.
Contact: NCDC

National Geographic Society to publish new satellite atlas

The National Geographic Society asked several National Oceanic and Atmospheric Administration (NOAA) agencies to cooperate in an effort to produce what promises to be one of the best satellite atlases of the world. The new atlas, entitled *National Geographic Satellite Atlas of the World*, is expected to be published before the end of this year. The atlas will feature many colorful photographs taken by a number of satellite platforms, as well as a comprehensive introduction summarizing the history and importance of remote sensing. A description of NOAA's contribution to remote sensing will also be included. The National Climatic Data Center (NCDC) is providing several of the satellite images, including full disk GOES-8 and GOES-9 images.
Contact: NCDC

Data products and services

World Ocean Circulation Experiment Data on CD-ROM

Global ocean data from a ten-year, $1 billion observation program are available from the National Oceanographic Data Center (NODC). The World Ocean Circulation Experiment (WOCE) Data Products Committee released Version 1.0 of the complete data set at the WOCE Conference held in Halifax, N.S. Canada in May. The data set is being distributed by NODC on 13 CD-ROM disks and contains over 4.6 gigabytes of data, documentation, and product graphics.

Through the participation of many countries, organizations, institutions, and individuals, WOCE (part of the World Climate Research Program), obtained measurements of the oceans to provide much-needed improvements in ocean circulation models for use in climate prediction.

CONTACT POINTS

National Climatic Data Center (NCDC)
704-271-4800
Fax: 704-271-4876
E-mail: *Climate Services - orders@ncdc.noaa.gov*
Satellite Services - satorder@ncdc.noaa.gov
WWW: *http://www.ncdc.noaa.gov/*

National Geophysical Data Center (NGDC)
303-497-6419
Fax: 303-497-6513
E-mail: *info@ngdc.noaa.gov*
WWW: *http://www.ngdc.noaa.gov/*

National Oceanographic Data Center (NODC)
301-713-3277
Fax: 301-713-3302
E-mail: *services@nodc.noaa.gov*
WWW: *http://www.nodc.noaa.gov*

NOAA Environmental Services Data Directory
301-713-0572
(Gerry Barton)
Fax: 301-713-1249
E-mail: barton@esdim.noaa.gov
WWW: *http://www.esdim.noaa.gov/#data-products*

NOAA Central Library
Reference Services:
301-713-2600
Fax: 301-713-4599
E-mail: *reference@nodc.noaa.gov*
WWW: *http://www.lib.noaa.gov/*

The 13 CDs and their contents are:
- *Data Information Unit* - overview and inventories of the WOCE data set;
- *Hydrographic Program Data* - hydrographic data (CTD, bottle);
- *Hydrographic Program Data and Products* - hydrographic data and products;
- *Upper Ocean Thermal* - upper ocean temperature measurements (XBTs);
- *Subsurface Floats* - neutrally buoyant drifting float tracks;
- *Surface Velocity Programme* - surface drifting buoy tracks;
- *Current Meter Moorings* - subsurface moored current meter records;
- *Acoustic Doppler Current Profilers* -ADCP data from underway ships;
- *Sea Level* - hourly, daily, and monthly sea level measurements at tide stations;
- *Surface Meteorology (Pacific and Indian Oceans)* - meteorology observations;
- *Surface Meteorology (Atlantic and Southern Oceans)*;
- *Surface Fluxes* - air-sea flux fields; and,
- *Satellite* - sea surface heights from TOPEX/POSEIDON and sea surface temperatures from AVHRR.

WOCE Data Assembly Centers and Special Analysis Centers assembled data from WOCE principal investigators, reviewed the data for quality, produced analyses and products, and created the CD-ROMs. The CDs are designed to be read with a web browser, and contain data, inventories, and documentation. More WOCE data is planned for release as it becomes available.
Contact: NODC

Summit Ice Core data available

The data from the Greenland Summit Ice Cores are now online and will soon be available on CD-ROM. The ice core records from the U.S. Greenland Ice Sheet Project Two and the European Greenland Ice Core Project represent a data set containing some of the highest resolution paleoclimate data ever obtained. Compilation of these data was a collaborative effort involving a multi-institutional team from the World Data Center A for Paleoclimatology at the National Geophysical Data Center (NGDC), the National Snow and Ice Data Center at the University of Colorado, and the University of Colorado Institute of Arctic and Alpine Research. The data are available at: *http://www.ngdc.noaa.gov/paleo/icecore/greenland/summit/index.html.*
Contact: NGDC

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have detailed coastal data for applied research projects and the Sea Grant Program. The NODC will be the central clearing house for the data so vital to these agency missions.

A workshop is planned for mid-fall in Miami to gather the requirements from the infrastructure community and to identify the responding agencies and institutions. The leader of the planning effort is Judy Gray, Deputy Director of the Atlantic Oceanographic and Meteorological Laboratory (AOML). Her team members at AOML can answer questions on the planning and the future of the project. Based on the response of the infrastructure community, the action phase could begin in the fall or winter of calendar year 1998. ■

▲ **Appendix:** Community constituents associated with Project ACCESS.

U.S. Department of Commerce, NOAA
- Oceanic and Atmospheric Research
- National Environmental Satellite, Data and Information Service
- National Ocean Service
- National Marine Fisheries Service
- National Weather Service

U.S. Environmental Protection Agency

U.S. Army Corps of Engineers

Florida Department of Environmental Protection
- Florida Marine Research Institute
- Bureau of Beaches and Shoreline

South Florida Water Management District

Saint Johns Water Management District

Federal Emergency Management Agency

State of Florida Emergency Management Agency

Governor's Commission for a Sustainable South Florida

U.S. Department of the Interior
- National Park Service, Biscayne Bay
- Geological Survey, Coastal Geology
- Fish and Wildlife

U.S. Department of Energy

Florida counties
- Miami-Dade DERM
- Broward DNRP and Port Everglades Port Authority
- Monroe DERM
- Palm Beach DERM and Public Works
- Martin Public Works
- St Lucie Public Works
- Indian River DE

Cities
- City of Delray Beach Public Works
- Miami Port Authority
- West Palm Beach Port Authority

Utilities
- Dade Waste Water
- Broward Waste Water
- City of Hollywood
- City of Boca Raton
- Palm Beach Waste Water
- Martin Waste Water
- St Lucie Waste Water
- Indian River Waste Water
- Florida Power and Light
- Sebastian Inlet Tax District

Port Authorities
- Port of Miami
- Port Everglades
- Port of Fort Pierce

Florida Regional Planning Councils
- South Florida Regional Planning Council
- Treasure Coast Regional Planning Council

Florida Inland Navigation Authority

Marine Transportation Industry
- Florida Pilots Association
- Florida Marine Tug Operators

Florida Beaches and Shoreline Preservation Association

Indian River Lagoon Program

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
Publication Distribution Facility
1315 East-West Highway
Silver Spring, MD 20910-3282
ATTN: Earth System Monitor