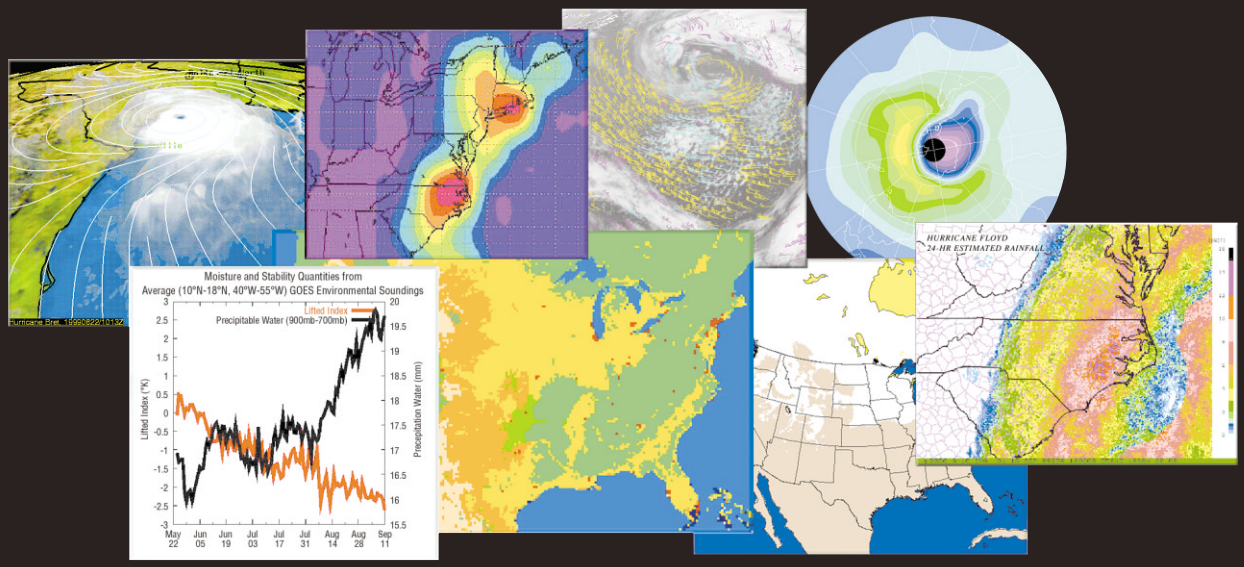
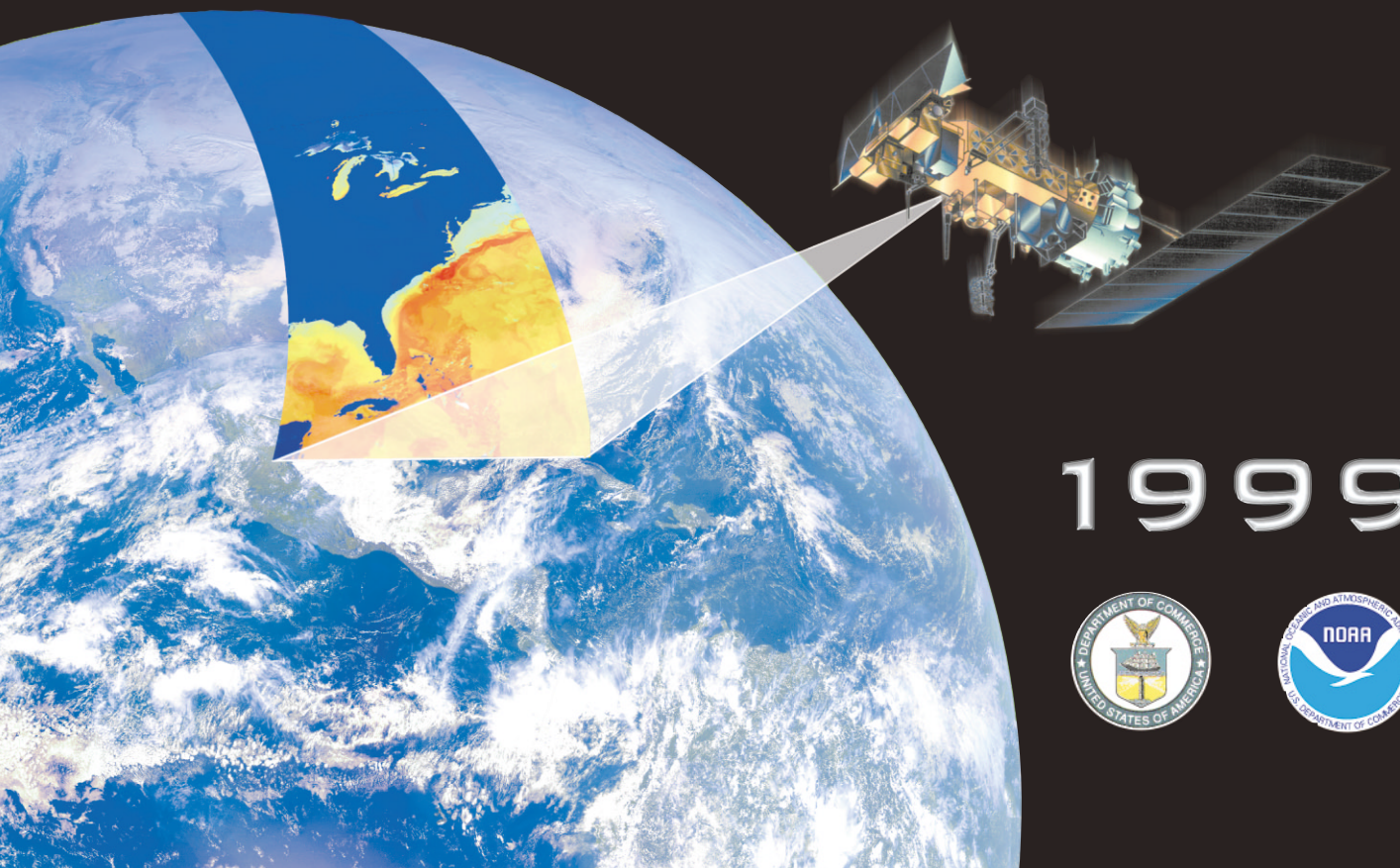
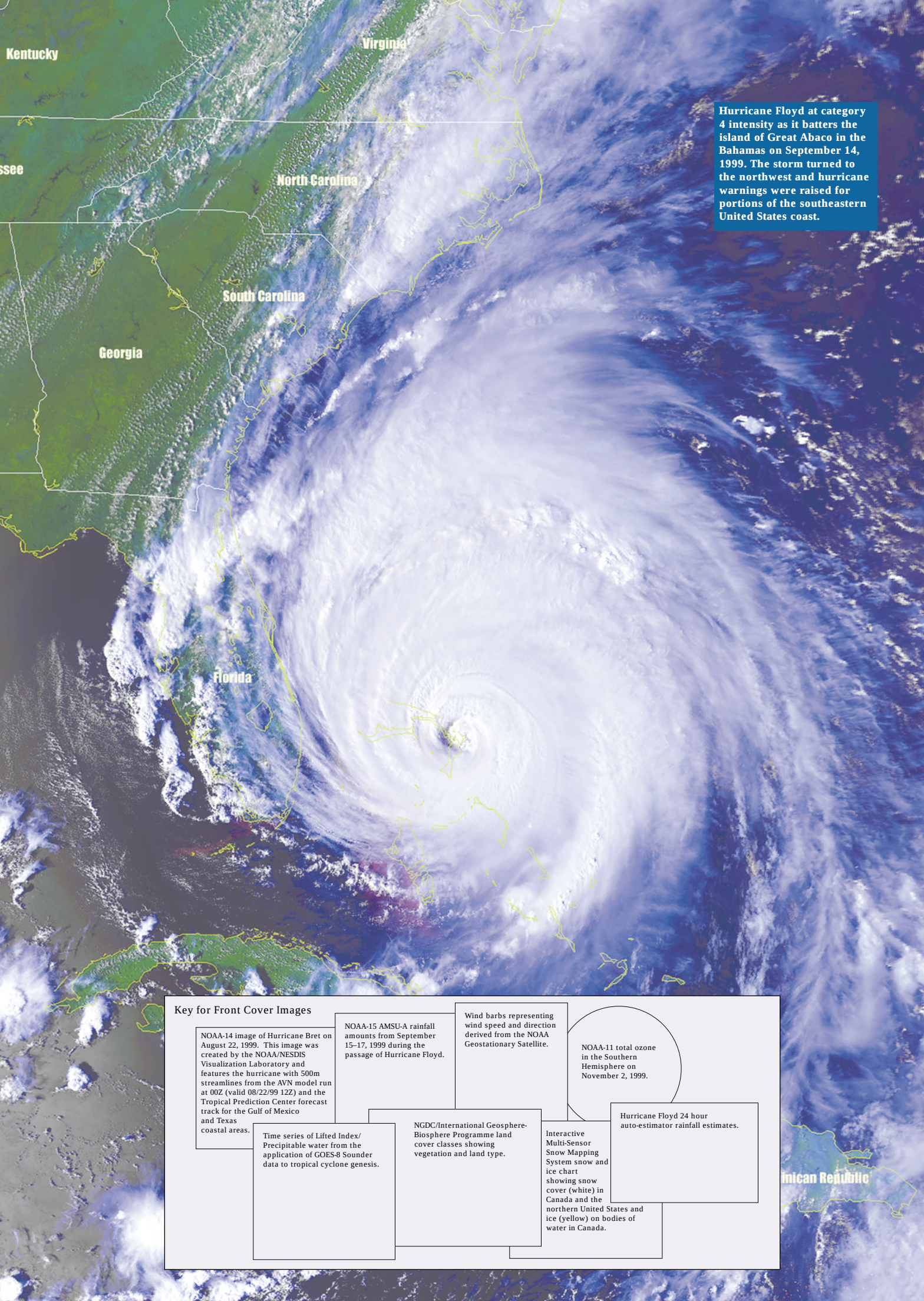
NESDIS

National Environmental Satellite, Data, and Information Service





1999



Hurricane Floyd at category 4 intensity as it batters the island of Great Abaco in the Bahamas on September 14, 1999. The storm turned to the northwest and hurricane warnings were raised for portions of the southeastern United States coast.

Key for Front Cover Images

NOAA-14 image of Hurricane Bret on August 22, 1999. This image was created by the NOAA/NESDIS Visualization Laboratory and features the hurricane with 500m streamlines from the AVN model run at 00Z (valid 08/22/99 12Z) and the Tropical Prediction Center forecast track for the Gulf of Mexico and Texas coastal areas.

NOAA-15 AMSU-A rainfall amounts from September 15–17, 1999 during the passage of Hurricane Floyd.

Wind barbs representing wind speed and direction derived from the NOAA Geostationary Satellite.

NOAA-11 total ozone in the Southern Hemisphere on November 2, 1999.

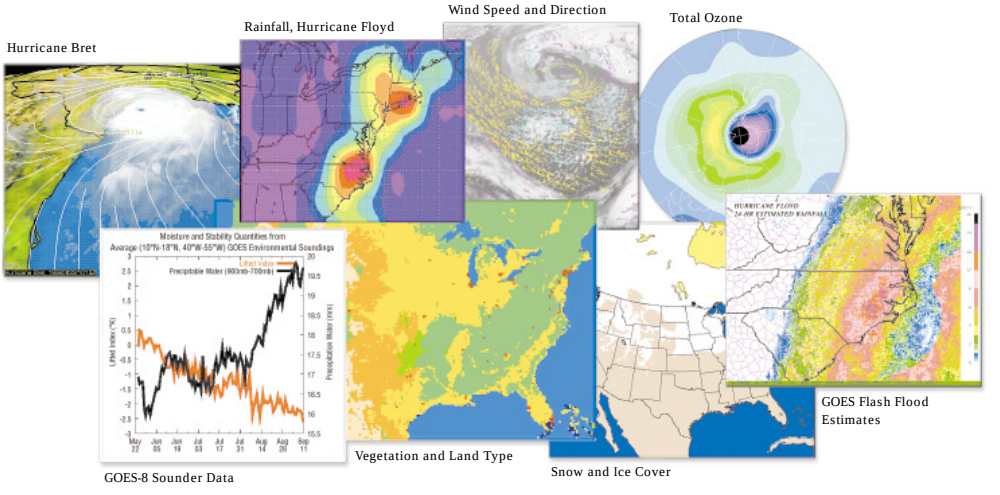
Time series of Lifted Index/ Precipitable water from the application of GOES-8 Sounder data to tropical cyclone genesis.

NGDC/International Geosphere-Biosphere Programme land cover classes showing vegetation and land type.

Interactive Multi-Sensor Snow Mapping System snow and ice chart showing snow cover (white) in Canada and the northern United States and ice (yellow) on bodies of water in Canada.

Hurricane Floyd 24 hour auto-estimator rainfall estimates.

National Environmental Satellite, Data,
and Information Service



Highlights of 1999

Visit our web site at
http://www.nesdis.noaa.gov

CD-ROM
INCLUDED

NOAA Commemorates 30 Years of Service

The National Oceanic and Atmospheric Administration (NOAA) was established as part of the Department of Commerce (DOC) on October 3, 1970, and NOAA proudly recognizes its 30th anniversary as an organization, although several of its programs have served the Nation for more than 200 years.

NOAA's mission is to describe and predict changes in the Earth's environment and to conserve and wisely manage the Nation's coastal and marine resources. NOAA's strategy consists of seven interrelated Strategic Goals for environmental assessment, prediction, and stewardship.

http://www.noaa.gov

http://www.pmel.noaa.gov/noaa-strategic/

http://www.30th.noaa.gov

40 Years of Civilian Weather Satellites

The United States launched its first civilian weather satellite on April 1, 1960, 40 years ago. Today, the National Environmental Satellite, Data, and Information Service (NESDIS) mission is to provide and ensure timely access to global environmental data from satellites and other sources to promote, protect, and enhance the Nation's economy, security, environment, and quality of life. To fulfill its responsibilities, NESDIS acquires and manages the Nation's operational environmental satellites, provides data and information services, and conducts related research.

http://www.nesdis.noaa.gov

http://www.nesdis.noaa.gov/40th.html

NESDIS Vision for the New Millennium

NESDIS will set the standard for world class environmental satellite operations and data services.

We will be a recognized authoritative source of global environmental data—the world's first stop for scientific information on the sun, the sky, the oceans and the Earth.

We will promote global ownership and sharing of all satellite observations and scientific information, providing well-documented data to all in their format of choice.

To accomplish the vision, NESDIS will:

- be a center of research excellence attracting top scientists from the U. S. and abroad;
- be a model of information technology efficiency;
- sustain a talented workforce in a stimulating collaborative environment with state-of-the-art facilities.

FOREWORD

The National Environmental Satellite, Data, and Information Service (NESDIS), with the support of its parent organizations, NOAA and DOC, enjoyed a very successful and productive year in 1999. We continued to provide the reliable environmental satellite observations and weather, climate, ocean and geophysical data products the Nation depends on for public safety, protection of property, national security, and sustainable economic development.

This past year, I was delighted to have been selected as Assistant Administrator for Satellite and Information Services and am proud to present this report on NESDIS activities of 1999. In addition to maintaining the continuous operation of NOAA's polar-orbiting and geostationary satellites, we completed our first full year of operating the Defense Meteorological Satellite Program (DMSP) spacecraft. This is one step closer toward our goal of converging the Department of Defense (DOD) and NOAA polar-orbiting programs into a single National Polar-orbiting Operational Environmental Satellite System (NPOESS). We served a record number of users from our three National Data Centers. In particular, the National Climatic Data Center (NCDC) made the headlines many times with analyses of temperature increases and evidence of increases of other environmental extremes.

To help ensure the technological future of our satellite programs, our relationship with NASA continued to grow. Our joint ventures on instruments and the NPOESS Preparatory Project were big steps toward guaranteeing a smooth transition from satellite research to satellite operations. Our cooperation overseas improved as well, with new arrangements defined with the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT) and Japan's National Space Development Agency (NASDA). A new emphasis on the licensing of commercial environmental satellites began, and a new industrial relationship is developing. To prepare ourselves for the challenges of the new century, we began a new strategic planning exercise.

We look forward to the opportunities of the future. We will continue to build partnerships with national and international agencies, as well as with our commercial partners, to deliver the best global environmental data from satellites and the most complete environmental data sets from our National Data Centers (NDC). Collectively these data will not only serve to improve our ability to forecast weather and understand climate but also will be useful in reducing the effects of natural disasters, providing seasonal weather forecasts, and a better understanding of our coastal and ocean environments.

Between the opportunities at hand and our talented and dedicated NESDIS workforce, the future is a bright prospect. I look forward to the year 2000 which brings us the 40th anniversary of the TIROS program as well as the 30th anniversary of NOAA.

Gregory W. Withee

ORGANIZATION CHART

National Environmental Satellite, Data, and Information Service

Gregory W. Withee
Assistant Administrator for Satellite and Information Services

P. Krishna Rao
Senior Scientist

Mary M. Glackin
Deputy Assistant Administrator for Satellite and Information Services

Susan F. Zevin
Deputy Assistant Administrator for Environmental Information Services

Douglas L. Namian
Budget and Planning Office

Ralph P. Conlin
Management Operations and Analysis Office

D. Brent Smith
International and Interagency Affairs Office

Vacant
Information Technology Management Office

John D. Cunningham
Integrated Program Office

Ida Hakkarinen
Environmental Information Services Office

Gary K. Davis
(Acting)
Office of Satellite Operations

Helen M. Wood
Office of Satellite Data Processing and Distribution

James F.W. Purdom
Office of Research and Applications

Gary K. Davis
Office of Systems Development

Thomas R. Karl
National Climatic Data Center

Henry R. Frey
National Oceanographic Data Center

Michael S. Loughridge
National Geophysical Data Center

CONTENTS

INTRODUCTION
- NOAA Commemorates 30 Years of Service ii
- 40 Years of Civilian Weather Satellites ii
- NESDIS Vision for the New Millennium ii

FOREWORD iii

ORGANIZATION CHART iv

HIGHLIGHTS OF 1999
- Geostationary Operational Environmental Satellites 2
- Polar-orbiting Operational Environmental Satellites 4
- Defense Meteorological Satellite Program 6
- National Polar-orbiting Operational Environmental Satellite System 8
- Satellite and Information Services 10
  - Systems Development 10
  - Operations 11
  - Data Processing and Distribution 13
  - Research and Applications 14
- Environmental Information Services 16
  - Climatic Data 17
  - Geophysical Data 20
  - Oceanographic Data 22
  - Library Services 23

FEATURED ARTICLES
- 40 Years of Civilian Weather Satellites 24
- Multi-Satellite Products Assist Emergency Managers During Hurricane Floyd 26
- Extreme Weather and Climate Events 28
- Ocean and Coastal Remote Sensing 30

ENVIRONMENTAL LEADERSHIP AND COOPERATION 32

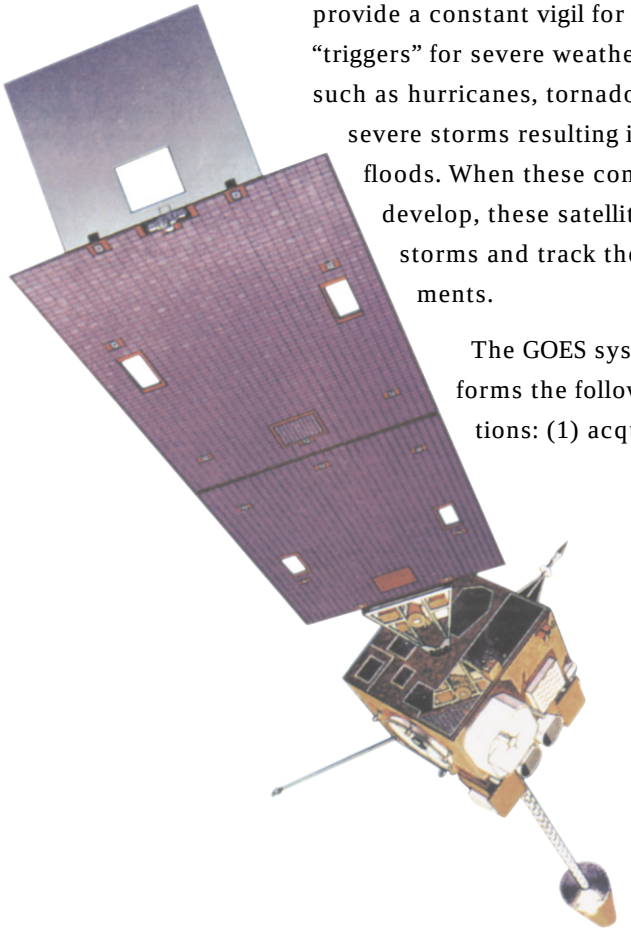
RESOURCES
- Financial Report 35
- Educational and Community Outreach Program 36
- Diversity 37
- Special Recognition 38

NEXT YEAR AND BEYOND
- Milestones for 2000 40

APPENDICES
- Selected New Products 43
- Selected References 48
- Contacts 49
- Acronyms 50

Geostationary Operational Environmental Satellites

The Geostationary Operational Environmental Satellites (GOES I-M series) provide continuous weather imagery and radiometric data. They circle the Earth in geosynchronous orbit (22,240 miles above the Earth) which means they orbit the equatorial plane of the Earth at a speed matching the Earth's rotation. This allows them to remain continuously over one position on the surface. Because these satellites stay on a fixed spot on the surface, they provide a constant vigil for atmospheric "triggers" for severe weather conditions such as hurricanes, tornadoes, and severe storms resulting in flash floods. When these conditions develop, these satellites monitor storms and track their movements.



The GOES system performs the following functions: (1) acquisition, processing, and dissemination of imaging and sounding data and derived products; 2) acquisition and dissemination of Space Environment Monitor data; 3) continuous relay of Weather Facsimile data; and 4) relay of distress signals from people, aircraft, or marine vessels to the search and rescue ground station.

The United States operates two GOES satellites: GOES-East located at 75° west longitude and GOES-West at 135° west longitude. The combined GOES system covers the central and eastern Pacific Ocean; North, Central, and South America; and the central and western Atlantic Ocean. Pacific coverage includes Hawaii and the Gulf of Alaska. The two operate together to send overlapping full-disk images of the Western Hemisphere, both day and night.

Each satellite carries two major instruments: an imager and a sounder. These instruments acquire high-resolution visible and infrared data, as well as information to derive temperature and moisture profiles of the atmosphere. Some of the data products are 1) day/night cloud imagery, 2) upper and lower tropospheric water vapor imagery, 3) land and sea surface temperatures, 4) winds from cloud motions,

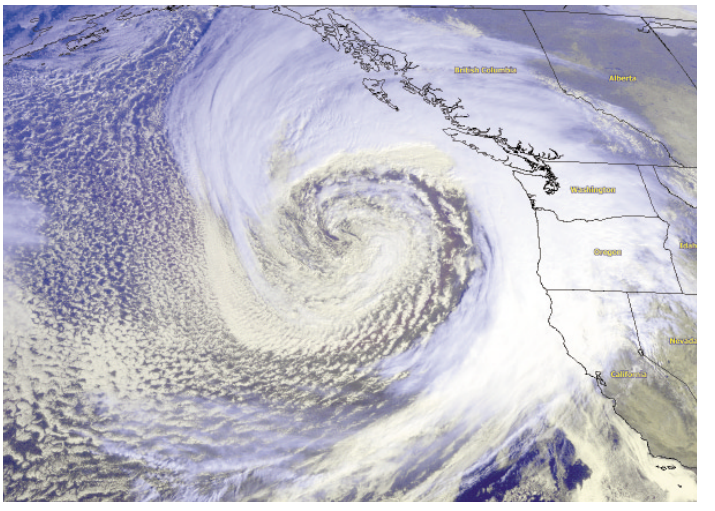
and 5) detection and monitoring of forest fires. GOES images are seen daily during television weather broadcasts. In addition, GOES imagery is used to estimate rainfall during thunderstorms and hurricanes for flash flood warnings, as well as snowfall accumulations and the overall extent of snow cover. Such data help meteorologists issue winter storm warnings and spring snow melt advisories. The GOES imager is used to map snow and ice.

GOES-8 (East) was launched on April 13, 1994, while GOES-10 (West) was launched on April 25, 1997. This satellite was initially stored at 105° west longitude to act as an on-orbit backup and was activated when GOES-9 showed signs of possible near-term failure of its momentum wheels in July 1998.

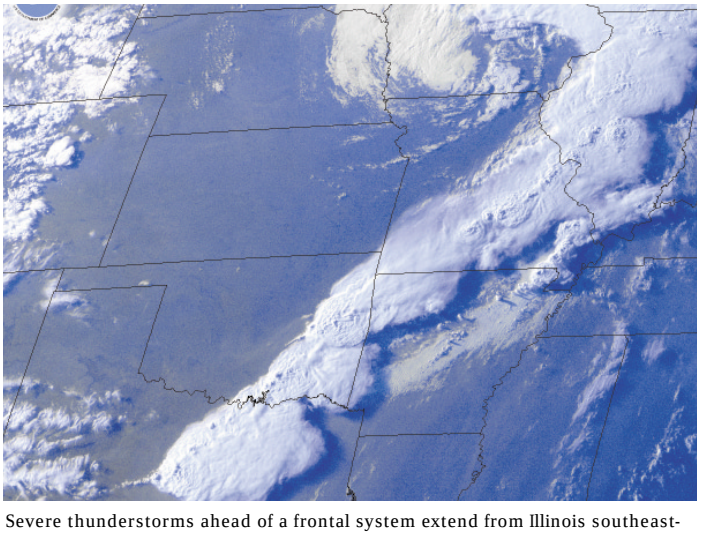
GOES-L, the next satellite, is planned for launch May 3, 2000. GOES-L will become the on-orbit spare.

Further information on GOES is available at web sites:

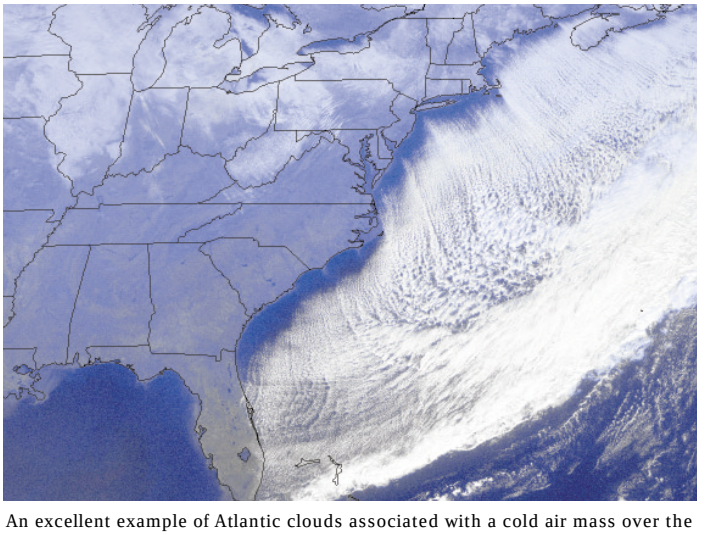
http://www.goes.noaa.gov/
http://www.wrh.noaa.gov/wrhq/satell.html
http://www.osd.noaa.gov
http://www.oso.noaa.gov/goes



A powerful Pacific storm moves into western Canada and the northwestern United States with heavy rain, mountain snow and very strong winds.



Severe thunderstorms ahead of a frontal system extend from Illinois southeastward over Missouri, extreme northwestern Arkansas, southeastern Oklahoma and northeastern Texas.

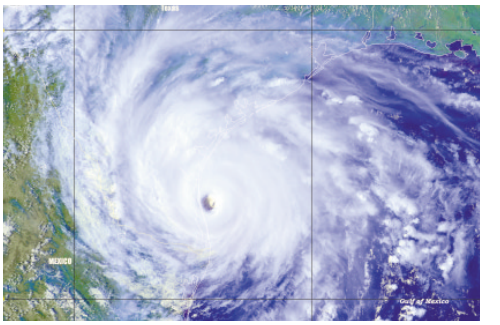


An excellent example of Atlantic clouds associated with a cold air mass over the eastern United States.

Polar-orbiting Operational Environmental Satellites

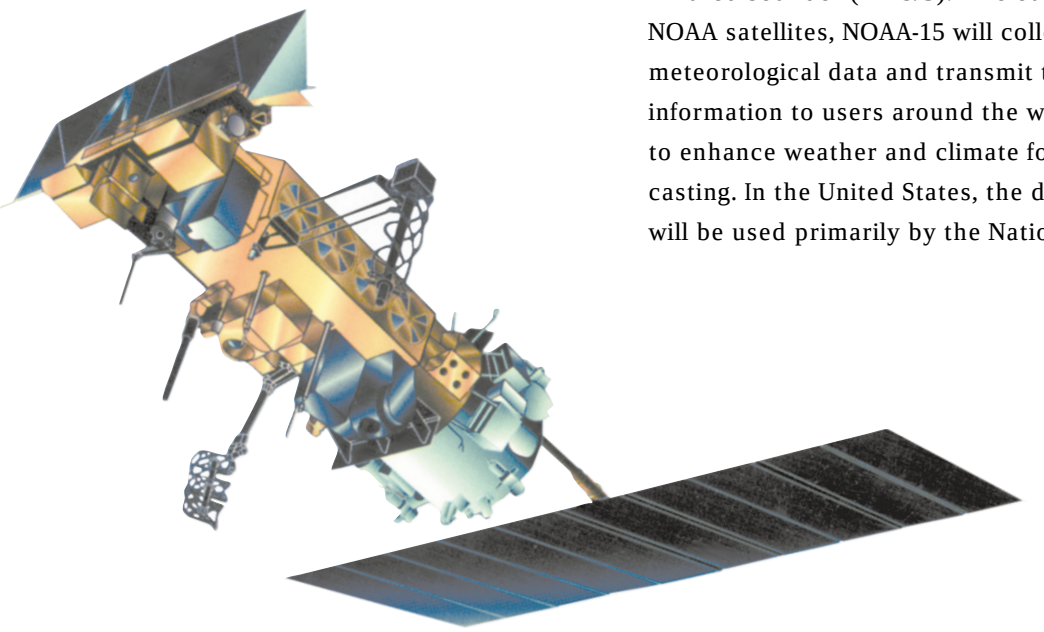
The NOAA Polar-orbiting Operational Environmental Satellite (POES) system has been providing continuous observations of the Earth since April 1960. This highly successful program continues to provide a variety of meteorological, oceanographic, climatic and other specialized data collection services. NOAA operates two polar-orbiting environmental satellites—NOAA-15, the primary morning satellite and NOAA-14, the primary afternoon satellite. Each circles the Earth every 102 minutes, passing over the North and South Poles on each orbit. Combined, the two satellites provide environmental observations for every location on the Earth four times per day.

NOAA-15 is the first in a series of five satellites representing a new generation of polar-orbiting satellites that will operate over the next 12 years. These satellites will carry new microwave sounding instruments (AMSU-A and AMSU-B) and improved versions of the visible/infrared imager/radiometer (AVHRR/3) and



Hurricane Bret, a Saffir-Simpson category 4 hurricane, nears landfall on the coast of Padre Island in Southeastern Texas.

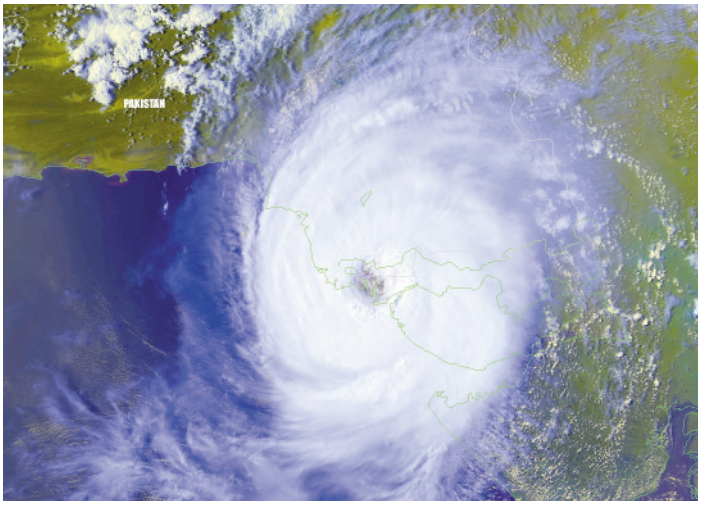
infrared sounder (HIRS/3). Like other NOAA satellites, NOAA-15 will collect meteorological data and transmit the information to users around the world to enhance weather and climate forecasting. In the United States, the data will be used primarily by the National



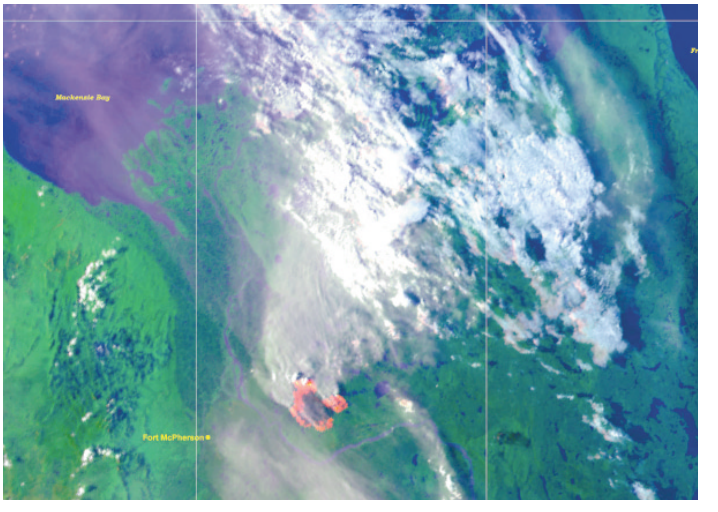
Weather Service (NWS) for its operational long-range weather and climate forecasts. Further information on this new series of polar-orbiting satellites is available at

http://poes2.gsfc.nasa.gov/
http://www2.ncdc.noaa.gov/docs/
http://oso.noaa.gov/poes/

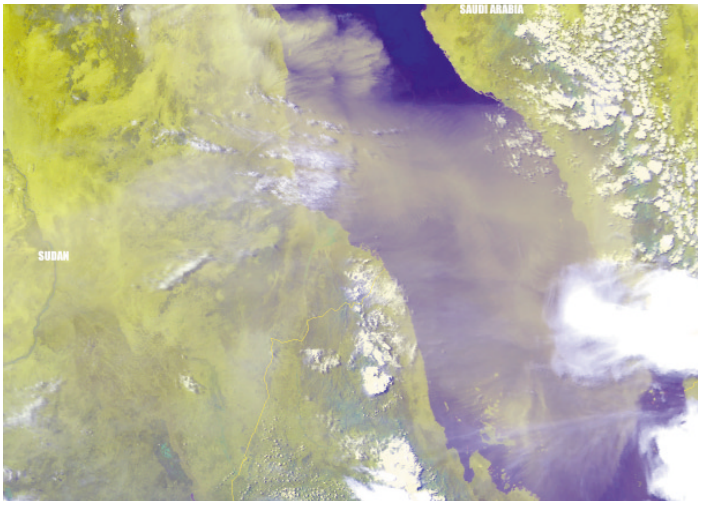
Our long-term plans call for increased cooperation with EUMETSAT. In November 1998, NOAA and EUMETSAT signed an agreement formally establishing the Initial Joint Polar-orbiting Operational Satellite System. Through this agreement, EUMETSAT's new polar-orbiting satellite, known as METOP, will carry NOAA instruments and serve as our morning satellite starting in 2003. In addition to receiving data from our instruments on the METOP satellites, NOAA and its users will have access to data from EUMETSAT instruments with improved infrared atmospheric sounders and scatterometers. Finally, NOAA and EUMETSAT, in cooperation with DOD and NASA, are in the initial phases of developing a new three-satellite polar constellation for 2008 and beyond which will meet the United States' civil and national security requirements for remotely sensed environmental data.



Tropical Cyclone 02A makes landfall on the coast of Pakistan and India on the afternoon (local-time) of May 20.



Heat signatures (red) and very dense smoke (gray haze) from large areas of fire burning in the Northwest Territories west of the Mackenzie River.

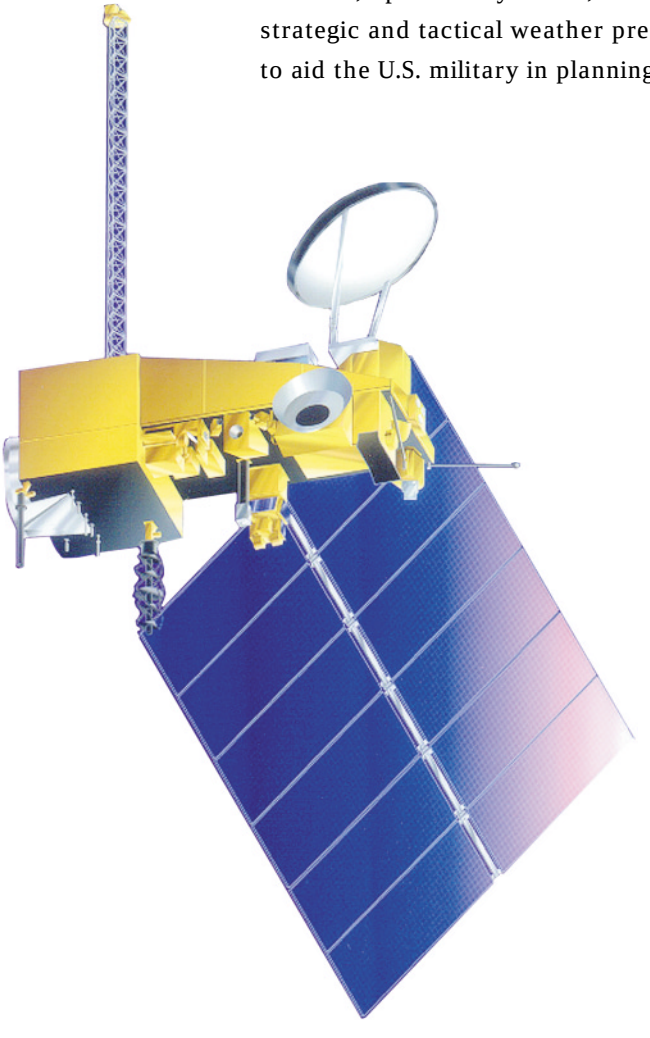


Clouds of airborne dust (light brown) over Sudan and the Red Sea. The dust clouds are particularly dense in northeastern Sudan and just offshore in the Red Sea.

Defense Meteorological Satellite Program

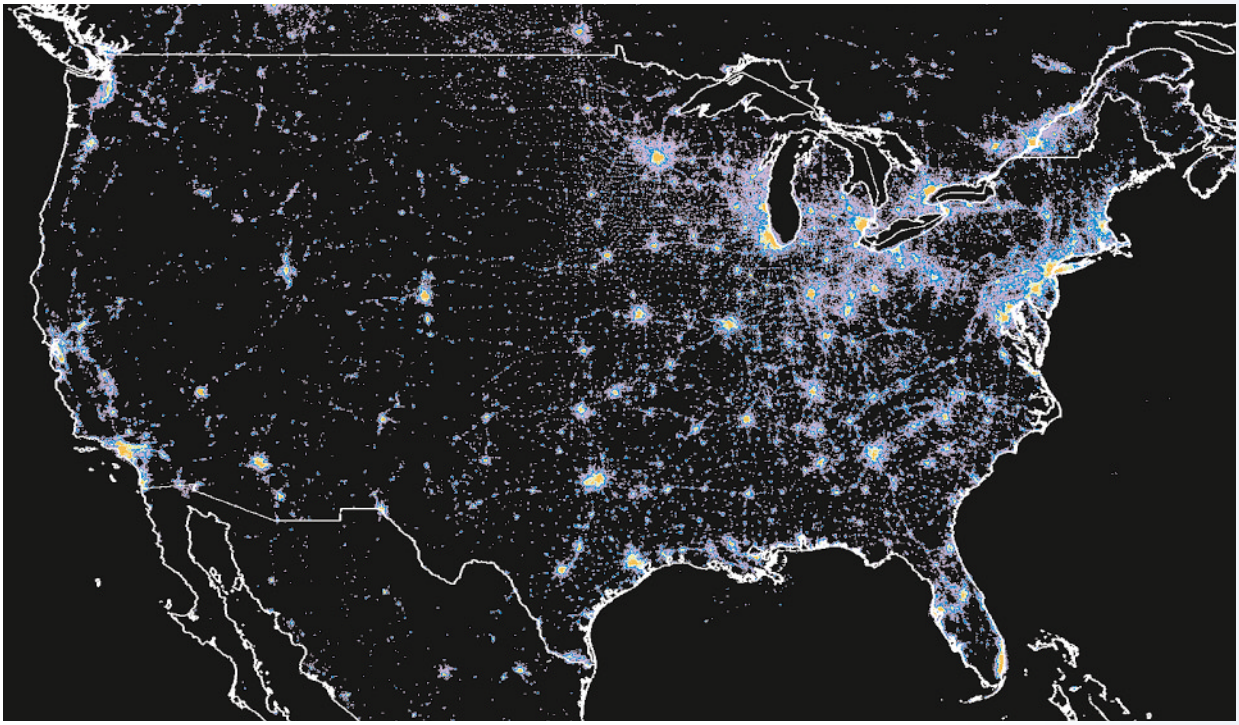
The United States Air Force (USAF) successfully launched the first of a new generation of military weather satellites, the DMSP Block 5D-3, aboard a Titan II rocket on December 12, 1999, from Vandenberg Air Force Base, California. A NOAA/USAF/ contractor launch team at NOAA's Suitland, Maryland, Satellite Operations Control Center (SOCC) supported the launch of a DMSP satellite for the first time ever.

DMSP, operated by NOAA, is used for strategic and tactical weather prediction to aid the U.S. military in planning operations at sea, on land, and in the air. Equipped with a sophisticated sensor suite that can create visible and infrared images of cloud cover, the satellite collects specialized atmospheric and oceanic information, as well as data about the sun's effects on the Earth in all weather conditions. The DMSP constellation comprises a minimum of two spacecraft in sun-synchronous, near-polar Earth orbits and ground-based electronic control facilities and equipment for military users. The satellites orbit at an altitude of approximately 830 km above the Earth. Each satellite crosses any point on the earth at least two times a day and has an orbital period of about 101 minutes, thus providing nearly complete global coverage of clouds every 6 hours.

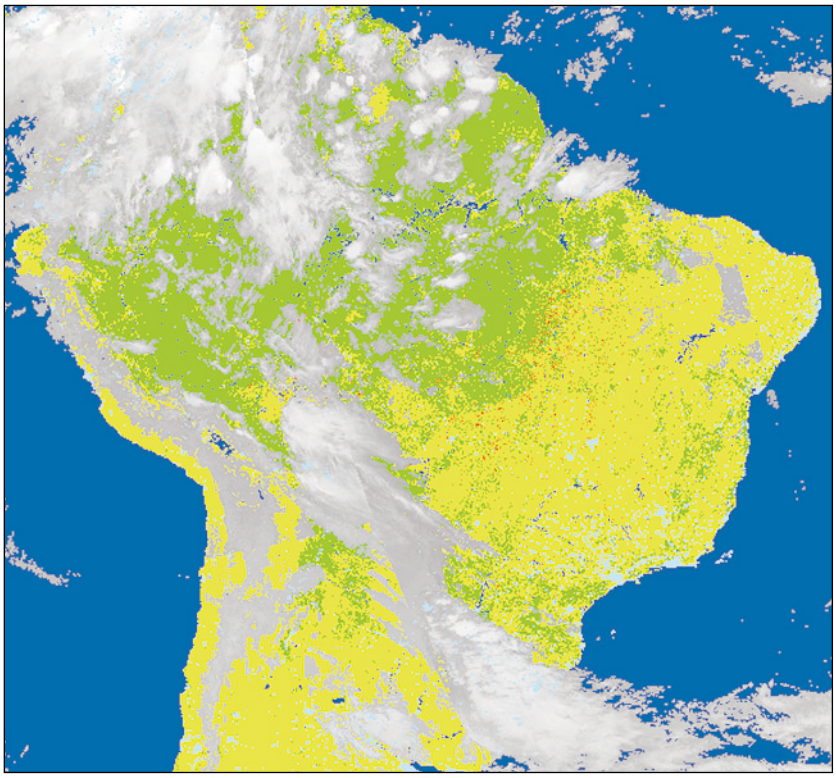


Early in the 21st century, launch and operations of the remaining DMSP and POES spacecraft, will cease. Instead, the converged NPOESS spacecraft will be launched beginning in late 2008, after NOAA and the USAF have both exhausted the satellites currently in the "pipeline."

http://www.ipo.noaa.gov/LINKS.HTM
http://www.oso.noaa.gov/dmsp



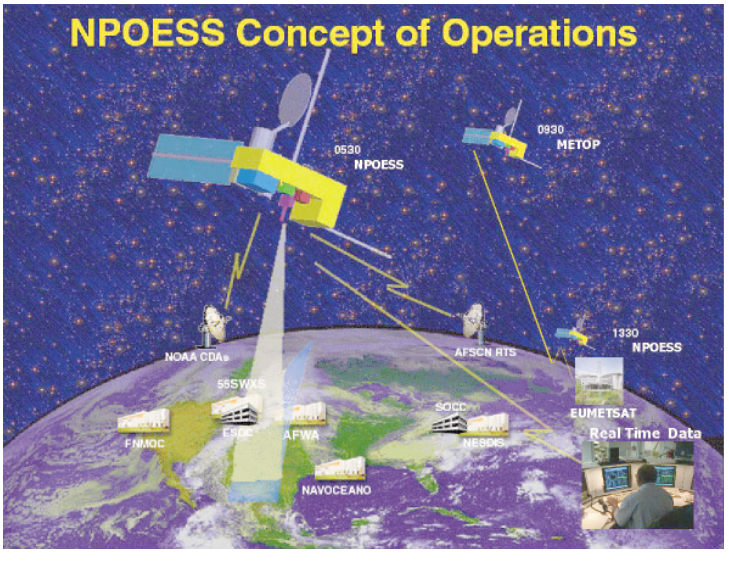
Radiance calibrated nighttime lights of the USA derived from DMSP data processed by NGDC.



DMSP derived fires (red) and clouds observed in South America on August 25, 1998, overlaying a land cover map indicating forest (green) and non-forest (yellow).

National Polar-orbiting Operational Environmental Satellite System

In May 1994, President Clinton initiated the merger of the United States' military and civil operational meteorological satellite systems into a single, national system capable of satisfying both civil and national security requirements for space-based remotely sensed environmental data. Convergence of NOAA's POES and DOD's DMSP is the most significant change in U.S. operational remote sensing since the launching of the first weather satellite in April 1960. For the first time, the U.S. Government is taking an integrated approach to identifying and meeting the operational satellite needs of both the civil and national security communities. This joint program, known as the NPOESS, is expected to provide approximately $1.8 billion in savings through the system life cycle of the program compared to the cost of continuing the previously planned separate POES and DMSP satellite systems.



In October 1994, NOAA, DOD, and NASA created an Integrated Program Office (IPO), organizationally within NOAA, to develop, manage, acquire, and operate NPOESS. NOAA has overall responsibility for the converged system, including satellite operations, and NOAA is also the primary interface with the international and civil user communities. DOD is responsible for major systems acquisitions, including launch support. NASA has a primary responsibility for facilitating the development and incorporation of new cost-effective remote-sensing technologies into the converged system.

The NPOESS development and acquisition plan is designed to make best use of in-production and existing POES and DMSP assets, to reduce risk on critical sensor payloads and algorithms, and to leverage civil, governmental, and international payload and spacecraft developments. In 1997, the IPO initiated a robust sensor risk reduction effort that has been focused on early development of the critical sensor suites and algorithms necessary to support NPOESS. The IPO is currently overseeing the development of NPOESS instruments for monitoring ozone, making atmospheric soundings, and imaging the Earth's atmosphere and surface. The instruments are currently in a design stage or in the early engineering

and manufacturing phase. In 2000, IPO will initiate a program definition and risk reduction contract to define the requirements for total system architecture, including space, ground, and communications components, as well as to develop specifications for sensor to spacecraft integration.

To support the converged civil and military requirements for space-based, remotely sensed environmental data, the NPOESS spacecraft will carry the following payloads:

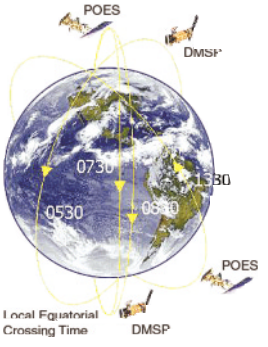
- Visible/Infrared Imager Radiometer Suite (VIIRS)
- Conical Microwave Imager Sounder (CMIS)
- Cross-track Infrared Sounder (CRIS)
- Advanced Technology Microwave Sounder (ATMS)
- Ozone Mapping and Profiler Suite (OMPS)
- Global Positioning System Occultation Sensor (GPSOS)
- Space Environment Sensor Suite (SESS)
- Cloud and Earth's Radiant Energy System (CERES)
- Total Solar Irradiance Sensor (TSIM)
- Radar Altimeter (ALT)
- Search and Rescue Satellite Aided Tracking System (SARSAT)
- ARGOS/Data Collection System (DCS)

As a critical part of the NPOESS development strategy, early flight testing of instruments is planned to reduce development risk and to demonstrate and validate global imaging and sounding instruments, algorithms, and pre-operational ground systems prior to the first NPOESS flight in 2009. In 1999, IPO completed and signed an initial implementation agreement with NASA for development of an early risk-reduction and demonstration spacecraft system called the NPOESS Preparatory Project (NPP).

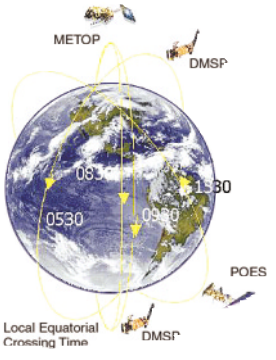
Plans and programs are in place to provide continuous polar satellite coverage well into the new millennium. In the near term, progress toward implementing these plans can be measured with the completion of the NPOESS concept definition phase, the start of the acquisition of the key NPOESS instruments, the start of the development phase for the METOP spacecraft, and the successful launch of NOAA-15 in 1998. NPOESS will provide significantly improved operational capabilities and benefits to satisfy the critical civil and national security requirements for space-based, remotely sensed environmental data. These activities represent a sound beginning for achieving the planned national and international programs in the new millennium and ensuring continuous support to a variety of users.

http://www.ipo.noaa.gov/

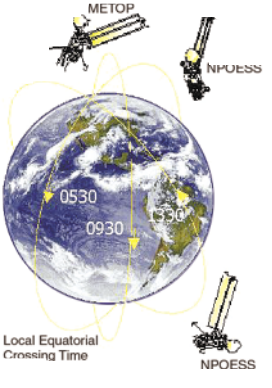
TODAY



TOMORROW (2003–2009)



FUTURE (2009 and Beyond)



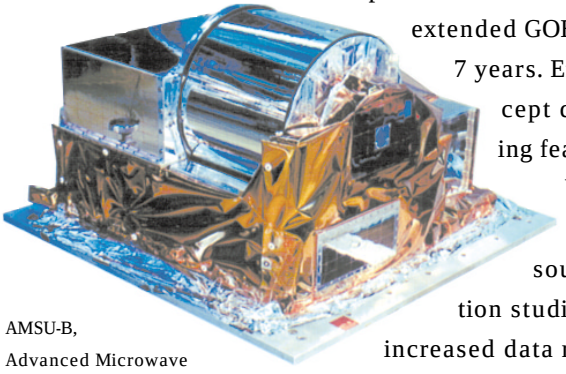
Satellite and Information Services

NESDIS is pleased to welcome Mary Glackin as Deputy Assistant Administrator for Satellite and Information Services. Ms. Glackin will oversee the Office of Systems Development, Office of Satellite Operations, Office of Satellite Data Processing and Distribution, and the Office of Research and Applications.

Systems Development

http://www.osd.noaa.gov

New Sensors. Development of the next-generation GOES imager and sounder sensors continued, working toward a GOES-Q introduction as early as 2009. The new improved capability sensors will meet NWS geostationary requirements for operational weather forecasts, and will provide cost savings from an extended GOES lifetime to 7 years. Efforts involved concept design and engineering feasibility studies for both the imager and an interferometric sounder, communication studies for delivering the increased data rates, program cost evaluations, satellite architecture studies that explored the cost benefits of longer lifetimes, and the development of a NESDIS imager requirements document. The PRIT studies were conducted at a number of Federally Funded Research and Development Centers. The imager will scan many times faster than the current one, increase its visible and infrared bands from 5 to as many as 10–12 bands, double the resolution, and improve radiometry. The sensors will support improved hurricane path, tornado warnings, and severe storm forecasting.



AMSU-B, Advanced Microwave Sounding Unit

Development of New NOAA Services For the GOES Platform. Concept and program development efforts continued to define and introduce a new GOES sensor, the Special Events Imager (SEI). The SEI mission will support coastal oceans with 300-meter resolution color observations for science research and applications and disaster monitoring. PRIT, working with the NESDIS Office of Research and Applications, continued to assess concept designs, technologies, spacecraft system impacts, develop program and budget plans, assess science benefits, and work to introduce the sensor into the Department's budget.

Radio Frequency Management. In its role as the DOC's frequency manager, the Office of Radio Frequency Management (ORFM) is charged with protection and coordination of DOC radio systems and of the radio spectrum they use. The protection of meteorological spectrum continues as a major issue since commercial interests (e.g., the Mobile Satellite Service, Fixed Wireless Access, IMT-2000, Ultra-Wideband systems) have targeted these bands for their own use. Met bands currently threatened include 400.1–406 MHz (MetSats and radiosondes), 406–406.1 MHz (SARSAT), 1675–1710 MHz (MetSats and radiosondes) and 2700–3000 MHz (NEXRAD). In protecting them, ORFM

coordinates the work of NOAA technical staff in preparing for and attending numerous domestic and international sessions held under the auspices of the International Telecommunications Union (ITU), World Meteorological Organization (WMO), and Inter-American Telecommunication Commission. ORFM also coordinated solutions for various domestic issues, such as protection of the Table Mountain Radio Quiet Zone at the DOC Boulder Laboratories; implementation of past World Radiocommunication Conferences (WRCs), spectrum auctions and other actions having impact on Commerce radio operations. It obtained spectrum support approval for various NOAA radars, satellites and ground stations, Emergency Managers Weather Information Network (EMWIN), and other new systems and uses while protecting existing systems from proposed operations by others.

New POES VHF Receive Antenna at FCDAS, Fairbanks, Alaska, capturing emergency (contingency) health and safety data from Polar Spacecraft in the event of loss of the primary S-Band communications on the satellite.

Operations

http://www.oso.noaa.gov

GOES Update. The GOES program began in 1974 and has been highly efficient in providing weather imagery and quantitative sounding data. The current GOES program of three-axis stabilized spacecraft has maintained accurate continuous observations of the near-Earth environment. GOES-8, launched in 1994, has successfully provided 231,674 precisely navigated images and 86,813 soundings of the East Coast Atlantic region. GOES-10, launched in 1997, has provided 57,867 images and 23,281 soundings of the West Coast Pacific region. The GOES-8 momentum wheel No. 2 continues to experience elevated currents, sometimes peaking at maximum current. The GOES-8 reprogram patch has been developed and is now available for use. The reprogram patch will allow operational use of momentum wheel No. 1. This component is part of the Attitude and Orbit Control Electronics, and provides gyroscopic pointing control. The GOES-10 Data Collection Platform Interrogation transponder operations were switched to Side-B in July. GOES-9 has been in an on-orbit storage mode for more than a year. If needed, GOES-9 could be brought out of storage to be a limited replacement for GOES-East or GOES-West. The launch of GOES-L is scheduled for May 2000.

One of two new identical 13-Meter S-Band POES Transmit/Receive Antennas at WCDAS, Wallops, Virginia. Providing telemetry and instrument data reception for all in-orbit POES spacecraft, and command capability to NOAA-15 and the to-be-launched NOAA-L -M, -N, and -N' spacecraft.

The GOES-N/Q spacecraft critical design review occurred in October 1999. This new series of GOES satellites will utilize

The FCDAS, located in Gilmore Valley, 13 miles northeast of Fairbanks, Alaska, on an 8,500-acre Federal Reservation.

onboard command schedule capability, thereby improving scan operations.

The Wallops Command and Data Acquisition (CDA) GOES backup site at the Goddard Space Flight Center in Greenbelt, Maryland, is nearing readiness testing. This will allow for continuous GOES satellite data collection in the event of a prime site anomaly.

http://www.oso.noaa.gov/goes/

POES Update. Another successful year was attained by the POES program providing visible and infrared radiometer data in continuous pole to pole orbits. The NOAA-11 Microwave Sounding Unit (MSU) was turned off March 22, after 10.5 years of faithful service. NOAA-11 is providing Solar Backscatter Ultraviolet Spectrometer (SBUV) data as a result of the drift in an orbit angle of NOAA-14. POES engineers have provided data collection and data analysis to support the future spacecraft S-Band redesign effort. The NOAA-L launch is planned for August 2000. New 13M antenna systems at the Fairbanks CDA are now operationally supporting both POES and DMSP operations. Full automation control of the antenna systems through Polar Acquisition and Control System (PACS) and Integrated Polar Acquisition and Control System (IPACS) schedule directives has been implemented and is currently undergoing acceptance testing. The Fairbanks complement of three 13M antennas will continue support of the DMSP and POES program, future NPOESS spacecraft and with X-Band receive capability, can support other non-NOAA missions.

http://www.oso.noaa.gov/poes/

DMSP Update. The mission for DMSP is to provide global meteorological and environmental data for DOD and authorized users. The constellation consists of two fully operational satellites and other secondary satellites. These satellites are three axis stabilized injected into circular, Earth-centered, sun-synchronous orbits. NESDIS successfully completed the first year of NOAA operations of the DMSP satellites. The backup control center at Schriever AFB is now operational. DMSP-F13 and DMSP-F12 continue to provide fine (0.3 resolution) and smooth (1.5 resolution) Operational Linescan System (OLS) visual and infrared data to DOD customers. DMSP-F14 has experienced reduced power capability which is now being automatically monitored by new onboard software and continues to provide global smooth OLS data and other mission sensor data. The DMSP-F11 OLS Scanner was returned to service to support the Kosovo situation. Engineers continued to monitor its power capability especially during an eclipse season when several sensors were turned off to reduce the spacecraft power load. NESDIS had a successful launch of the DMSP spacecraft, F15, on December 11, 1999. This was the first launch of a new spacecraft bus.

http://www.oso.noaa.gov/dmsp/

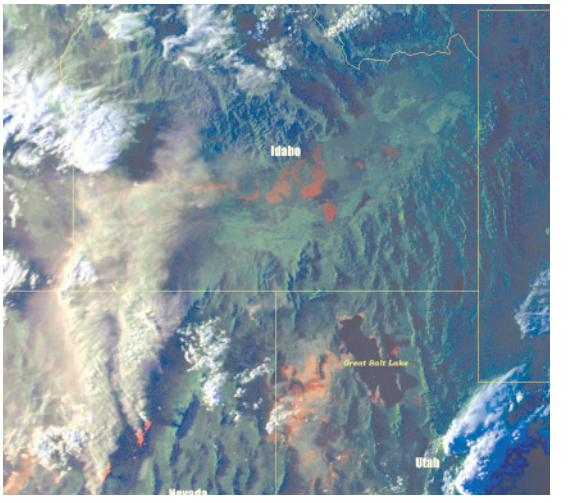
Data Processing and Distribution

http://psbsgi1.nesdis.noaa.gov:8080/OSDPD/OSDPD.html

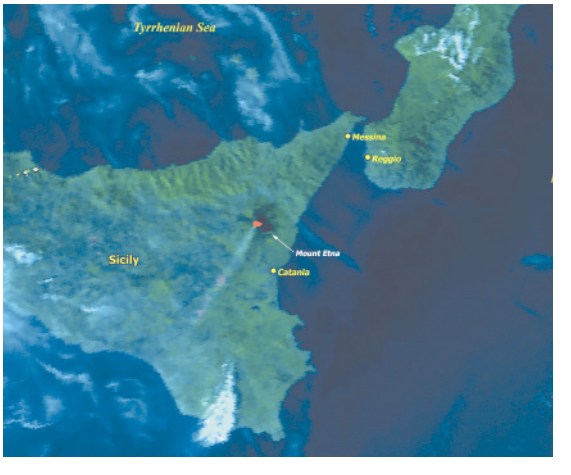
Product Development and Enhancement. NESDIS provided new satellite products to the user community. They included a new sounding system (ATOVS) from polar satellite instrument to application code; a new Interactive Multisensor Snowmapper (IMS), which included all geostationary satellite data sets (GOES, Meteosat, and Geostationary Meteorological Satellite (GMS)); a new multi-year digital ice climatology; and an experimental real-time GOES Sea Surface Temperature (SST) product for the CoastWatch Regional Nodes. Enhancements were made to some existing products: modernized GOES-I NOAAPORT Ingestor (GINI2) was implemented; the visible high-density satellite wind data for the Northern Hemisphere were placed on the Global Telecommunications System (GTS); and NESDIS satellite precipitation messages were distributed to Advanced Weather Interactive Processing System (AWIPS), with the addition of quality monitoring capabilities for all AWIPS satellite products with the purchase of an AWIPS workstation. Finally, the weekly snow analysis product was retired after 33 years of successful operation.

Hazard Support. NESDIS continued to provide satellite-based support to national and international hazard monitoring activities. NOAA civil data streams were successfully implemented into the Hazard Support Center in Reston, Virginia. A Hazard Support System (HSS) operational demonstration was successfully initiated. A prototype interactive Hazard Mapping System for hot spot and smoke detection was demonstrated. The operational system is under development. A new automated notification system for volcanic ash advisory messages was implemented. NESDIS provided experimental fire analysis support on a daily basis for Florida, California, and Alaska to the NWS and continued to provide Operational Significant Event Imagery (OSEI) support for these fire events as well as hurricane and volcanic ash image products for disaster managers and the public.

http://www.ssd.noaa.gov



Heat signatures (red) and very dense smoke plumes from large areas of fire burning in northwestern Nevada.



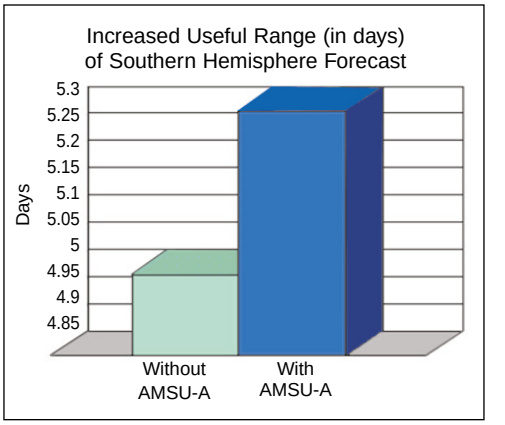
Heat signature (red) and an ash plume (blue haze extending from the hot spot to the southwest) from eruptions of the Mount Etna volcano in northeastern Sicily.

NOAA's Data Collection Systems. DCS provides a unique, essential reporting tool for many mission-critical programs used by emergency response managers and other resource planners around the globe. These systems are carried onboard NOAA's POES and GOES and are used to report on everything from fisheries monitoring to forest fire detection. The POES DCS (a cooperative program with France) provides a global tool to study and monitor the Earth and its environment. More than 40 countries use the POES DCS (also known as ARGOS) for applications ranging from observing the world's oceans with moored and drifting buoys to monitoring wildlife habitats and migration paths. Additionally, the ARGOS DCS provides vital environmental data to the world weather community via the GTS. The GOES DCS provides a more regional tool (primarily Western Hemisphere) for more timely dissemination of information, making it the system of choice for emergency warnings of such events as flooding, forest fires, tsunamis, hurricanes, and earthquakes. The GOES DCS is an integral part of NWS monitoring and forecasting system in the U.S. and in other countries in North America, Central America and South America. Approximately 15,000 stations (platforms) are located in the U.S. and its neighboring countries and oceans, providing reports as frequently as once an hour to the world weather, hydrological, and oceanographic communities. These services have become essential tools for the protection of U.S. and global citizens and economies.

Research and Applications

http://orbit-net.nesdis.noaa.gov/ora

Use of AMSU Data in Weather Forecast Models. AMSU measures microwave radiation emitted by the Earth and its atmosphere. The NWS and NESDIS faced several major challenges in bringing this unique global observing system to operational status: developing the algorithms to enable NWS to assimilate these new data into its weather prediction models, developing the scientific algorithms for extracting the meteorological information from the basic satellite observations of microwave radiation, and developing a processing system prior to launch for a completely new instrument. Early use of AMSU data and products, within 1 year of launch, have produced



forecast improvements, evidenced by better forecast scores and improved NWS forecast and warning services. The AMSU data produced distinct positive impact in the NWS global forecast system for both the Northern and Southern Hemispheres.

Monitoring Fires in South America. The GOES Automated Biomass Burning Algorithm (ABBA) has been used for 5 years to analyze fires in South

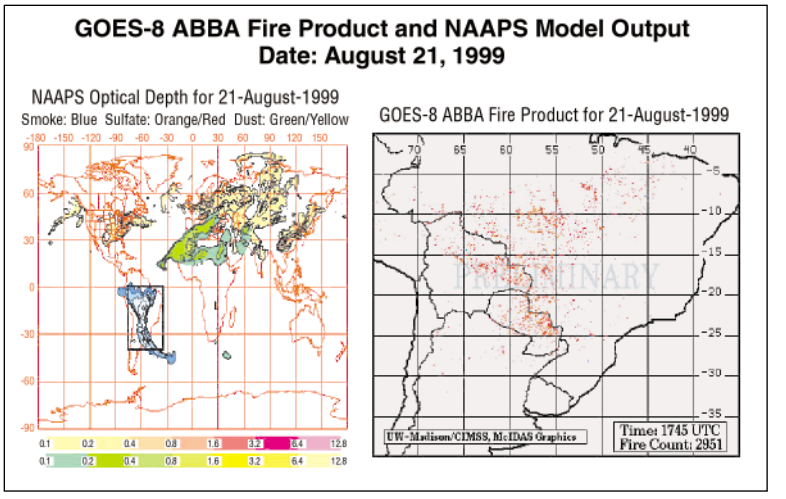
America. This year, for the first time, ABBA fire products were produced in real-time and the resulting fire locations were incorporated into forecast models to accurately predict the transport of smoke and aerosols. This project is a collaborative effort of NESDIS scientists, the University of Sao Paulo (Brazil), and the Naval Research Laboratory. Two models, the Colorado State University Regional Atmospheric Modeling System and the Navy Aerosol Analysis and Prediction System, are utilizing these data. Smoke from the large number of fires is often transported thousands of kilometers away from its source and frequently covers the entire length of South America or much of the South Atlantic Ocean. The Wildfire Analysis Technique, a modified version of the ABBA product, is also being developed for North America. It is undergoing testing in the U.S. and Canada.

http://cimss.ssec.wisc.edu/goes/burn/abba/html

Satellite Anomaly Accumulations Point to Potential Coral Reef Mortality. A new experimental product was developed and directed toward the recent "Coral Reef Watch" efforts:

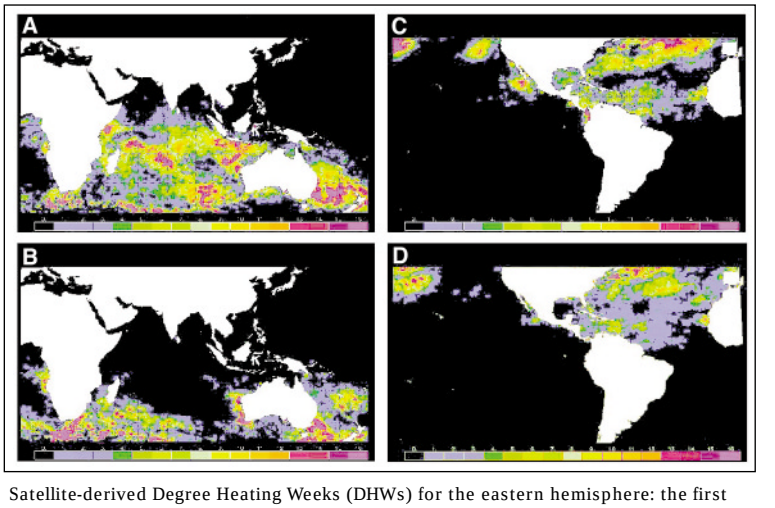
http://psbsgi1.nesdis.noaa.gov/PSB/EPS/SST/dhw_new.html

This "Degree Heating Weeks" (DHW) chart is designed to assist pinpointing coral reef recovery/mortality following coral reef bleaching events. It is an attempt to promote a satellite "expert system" based on marine expert systems under development for use with in-situ (e.g., buoy) data. Our initial DHWs accumulate Bleaching HotSpot anomalies over a period of 3 months (13 weeks).



http://psbsgi1.nesdis.noaa.gov/PSB/EPS/SST/climohot.html

Most coral reef scientists studying bleaching see this technique as promising for identifying those areas where thermal stress on coral reefs exceeded recent historical records, thereby causing coral mortality of some species at that site. NESDIS scientists are working with scientists in Australia to attempt to identify what thermal stress levels might be needed to cause coral mortalities based on recent observations in the Great Barrier Reef. Other sites being studied are in the Bahamas and Florida Keys.



Satellite-derived Degree Heating Weeks (DHWs) for the eastern hemisphere: the first 3 months of the record-breaking bleaching event in 1998—Feb–Apr (a) contrasted with a more normal Feb–Apr 1999 (b) and the western hemisphere: Aug–Oct 1998 (c) and somewhat less active Aug–Oct 1999 (d).

Environmental Information Services

Susan Zevin serves as the Deputy Assistant Administrator for Environmental Information Services. Dr. Zevin oversees NOAA's National Data Centers, Environmental Information Services Office, Information Technology Management Office, Digital Earth and Space Applications Laboratory, and the Environmental Data Rescue Program.

Environmental Information Services (EIS). EIS coordinates and oversees NOAA-wide activities to improve data and information management. EIS represented NOAA on two groups that report to the U.S. Global Climate Research Program (USGCRP), specifically, the Data Management Working Group and its subgroup, the U.S. Global Change Data and Information System.

http://www.gcdis.usgcrp.gov/

EIS represents NOAA on the Federal Geographic Data Committee to coordinate the development of the National Spatial Data Infrastructure.

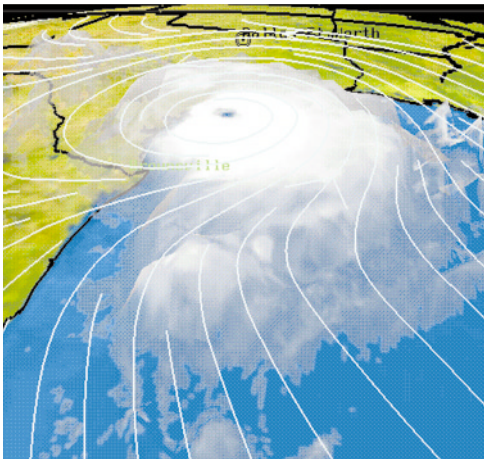
http://www.fgdc.gov/

Information Technology (IT) Management. An IT Operational Plan and a Strategic Information Technology Plan were developed this year. The plans focus on the importance of IT systems to be used in the accomplishment of our mission and for the planning of future systems. The final steps to verify the readiness of the National Virtual Data System (NVDS) were initiated. This web-based system integrates information services across the three National Data Centers (NDC). In addition, NVDS serves as a web portal to 16 other environmental databases within NOAA. A key element of the NVDS is an e-commerce component allowing users to browse, select, order, and pay for NOAA data products on-line.

Environmental Services and Data Information Management (ESDIM) Program. ESDIM supports a variety of data management and technology innovations throughout NOAA. A total of 54 grants covering projects involved in data management, data access, innovative data displays, and environmental data rescue were awarded.

http://www.esdim.noaa.gov

Environmental Data Rescue Program (EDRP). NESDIS completed the rescue of data contained on 850,000 index cards from Woods Hole oceanographic collection and began work to rescue a collection of data from the Scripps Institution of Oceanography contained on 500,000 index cards. More than 130,000 pages from the Coastal Zone Information



Center Library were converted using Optical Character Recognition. Continuing rescue activities included imaging meteorological observations, bathymetric fishing maps, and library documents and rescuing solar and meteorological data onto electronic media. Projects initiated included digitizing and vectorizing shoreline data from topographic sheets and imaging the film archives of the DMSP.

http://www.csc.noaa.gov/edrp

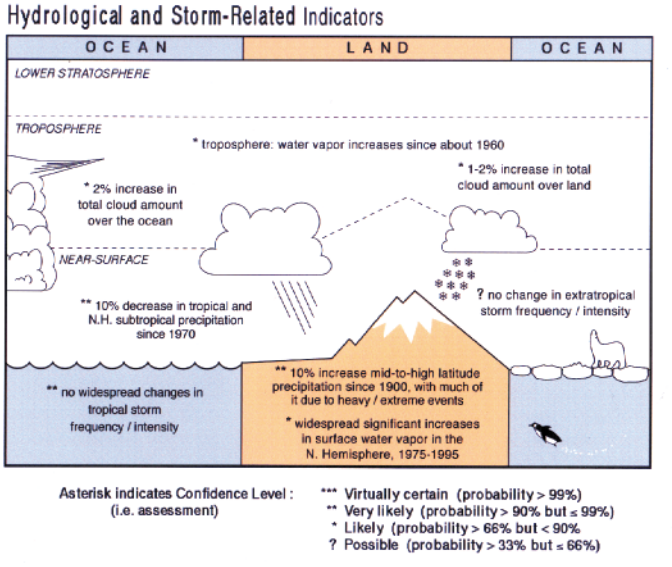
Digital Earth and Space Applications Laboratory. The Laboratory created a unique 3D satellite image shown on major television networks during the hurricane season. In addition, NOAA data sets were combined into imagery of the last sunset of the millennium and first sunrise of 2000, incorporating clouds and the night lights of the world.

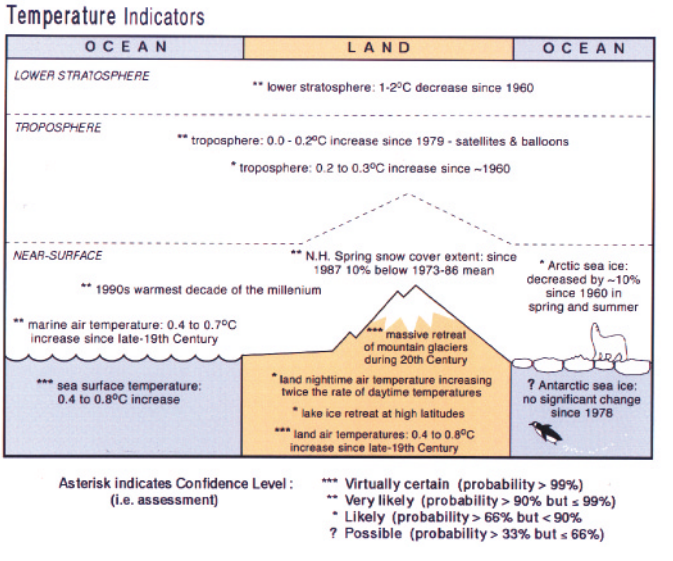
http://www.nnvl.noaa.gov

Climatic Data

http://www.ncdc.noaa.gov

Climate Watch. The monthly web-based Global Climate Monitoring Report includes a new section called "Climate Watch," which details current significant meteorological events on a continually





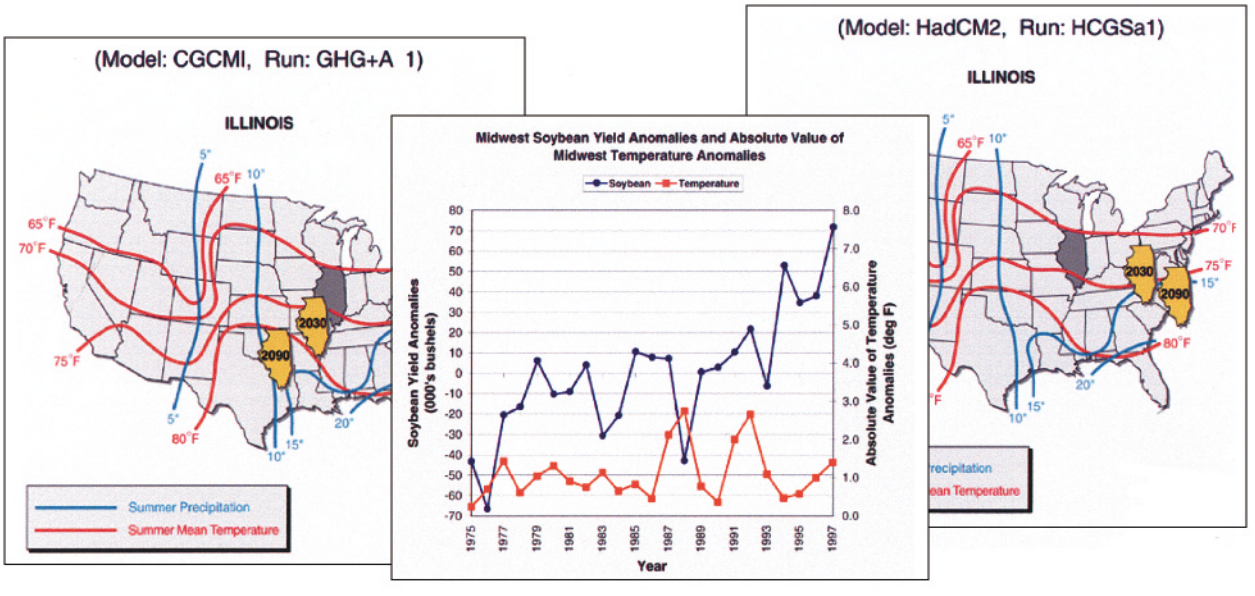
updated basis during the month. This page will periodically include reports of significant historical events. The May 1999 Severe Tornado Outbreaks in Oklahoma and Kansas, the Great Cold Wave and Blizzard in February 1899, Hurricane Camille . . . 30 Years Ago, and the 1999 Eastern Droughts are included on this web site. The Global Climate Monitoring Report also places global land/ocean trends and anomalies in historical perspective and includes global-regional analyses and excerpts from the Climate Variation Bulletin for U.S. national/regional/state analyses. All current and archived Climate Watch pages can be accessed on the "Worldwide Weather Events of 1991–1999" page at

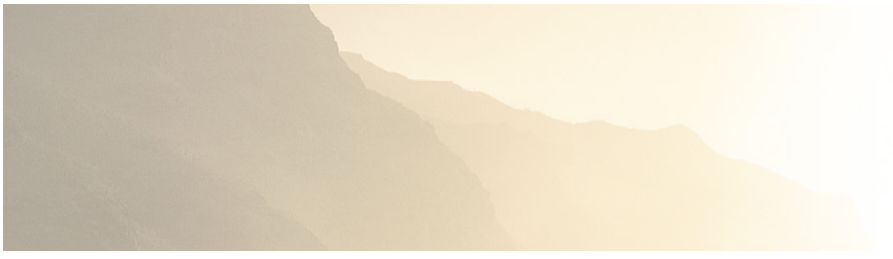
http://www.ncdc.noaa.gov/ol/reports/weather-events.html

Applications for Customer Service Systems. NESDIS completed its most needed and requested applications for the NOAA National Data Centers (NNDC) Climate Data On-line (CDO) System and Hierarchical Data Storage System Access System (HAS). Each system has six data sets available, comprising surface, upper-air, and marine data. The NNDC CDO uses both on-line (through On-line Store) and off-line methods for filling customer orders, while HAS is used off-line in filling orders. The extensive list of applications includes various summaries (e.g., wind rose, mixing height summary, daily summary from hourly data) and data format conversions. The current HAS data sets and applications will gradually be moved into the NNDC CDO system, which provides a much higher level of data selectivity, much quicker response, and a complete help system for on-line users. Other large array data sets will gradually be moved into HAS. Both systems are designed to be easily adapted to new data sets, provide e-mail notices to the user when final files are available, and to provide media options not previously available (CD ROM, zip disk, FTP). The development of these systems resulted in lower customer servicing costs and data user costs.

Intergovernmental Panel on Climate Change. The Intergovernmental Panel on Climate Change (IPCC) held three consecutive meetings during the week of March 8–12, 1999. The first meeting was an IPCC and U.S. National Research Council workshop on satellite-derived tropospheric temperature record: "Understanding the Uncertainties." The second meeting was an IPCC Chapter 2 Experts meeting on trends in climate extremes. The third meeting was among IPCC lead authors to plan and coordinate IPCC 2000–2001 scientific contributions.

U.S. National Assessment. NESDIS provided a variety of support for the U.S. National Assessment: The Potential Consequences of Climate Variability and Change. This support included providing a number of high quality data sets for use by impacts researchers, including the U.S. Historical Climatology Network data set, Historical Daily Data Set, and the Climate Epochs data set. NESDIS also developed a CD-ROM that includes data and software to allow researchers to investigate how probabilities of having days exceed a specified temperature threshold (e.g., over 90° F) might change with warmer temperatures. NESDIS scientists provided a variety of climate analyses and graphics for the Assessment, such as the latest U.S. temperature, precipitation, and soil moisture trends for both the observed record and model scenarios of climate change.





Geophysical Data

http://www.ngdc.noaa.gov

New Paleoclimate Data, Activities Focus on Interannual-Decadal Scale Climate Variability. NESDIS scientists received new paleoclimate data sets on the past variability of El Nino and drought and led field expeditions to collect new records from land and ocean sites. Scientists demonstrated that at least two major droughts in the past two millennia significantly exceeded the severity, length, and spatial extent of 20th-century droughts. New data sets included a paleo record of the North Atlantic Oscillation derived from ice cores, the 15,000-year record of El Nino, and 2,000-year record of drought described above, and the many other new time series.

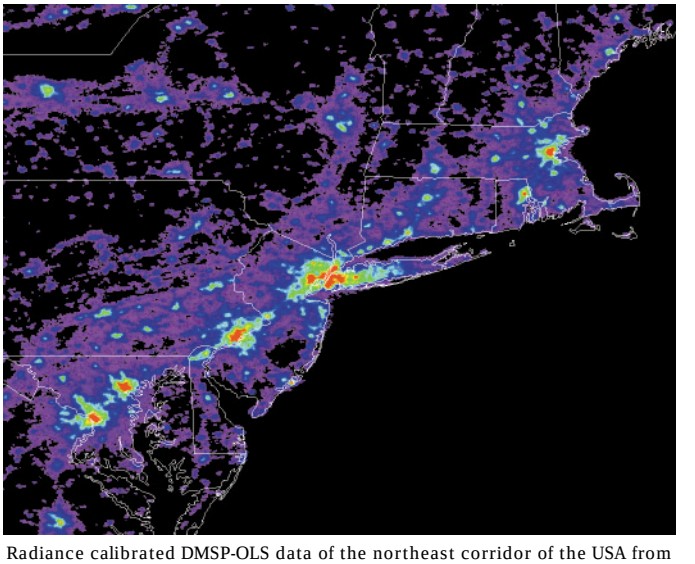
Global Land One-kilometer Base Elevation (GLOBE) Released on CD-ROM and On-line. GLOBE is an internationally designed, developed, and independently peer-reviewed global digital elevation model (DEM), at a latitude-longitude grid spacing of 30 arc-seconds. GLOBE data are suitable for many applications such as communications infrastructure design, logistical design for civil works, development of flight safety systems, processing of satellite data, and various forms of environmental study. This is the definitive global digital elevation data set at better than 1 kilometer gridding.

http://www.ngdc.noaa.gov/seg/topo/globe.shtml

Upward- and Downward-Looking Submarine Sonar Data for the Arctic. Major additions to their Arctic Ocean databases were received from the U.S. Naval Research Laboratory and the Arctic Submarine Laboratory. These new data consist of upward- and downward-looking sonar soundings from the Arctic basin, yielding both bathymetry and ice thickness distributions. Because of the extensive ice cover, the detailed shape of the Arctic Basin is poorly known. These data, collected from submarines, provide a major advancement in describing the sea floor morphology of the basin. Likewise, ice thickness distribution influences heat transfer between the oceanic and atmospheric boundary layers. Thus, input of ice thickness to general circulation models is critical, and trends in the ice thickness distribution are an integral part of global warming studies.

Development of Coastal Relief Model Continues. Volume three of the Coastal Relief Model, the integration of land elevations and sea floor soundings in a unified three arc-second grid, is expected to be released early in 2000 covering both the Atlantic and Gulf coasts of Florida. The paucity of digital hydrographic data on the southwest coast of Florida forced a delay while NESDIS scientists carefully combined contour data from the International Bathymetric Chart of the Caribbean and Gulf Areas with the existing, sparse soundings to produce an accurate and realistic offshore model. In a parallel effort, a prototype web page was developed with an underlying Oracle database, to offer "one-stop access" to U.S. coastal bathymetry information, characterizing web sites by source, type, and geographic area.

DMSP Nighttime Lights and Fire Products. Two global nighttime lights products from DMSP-OLS data were completed. The first product, from the 1994–95 time period, included data from nearly 2,000 sub orbits spanning a 6-month time period. The large numbers of orbits are required in order to assemble a cloud-free product with sufficient observations to discriminate lights from persistent sources from ephemeral events such as fire. The product shows the locations and frequency of observation of city lights, gas flares, fires, and heavily lit fishing boats. The second global product, assembled using 28 nights of data from 1996–97, is calibrated to radiance units, providing the first quantitative mapping of brightness patterns found within human settlements worldwide. Numerous groups are now using these global products for a variety of applications including the analysis of population distribution, light pollution, energy use patterns, and the impacts of urban sprawl on agricultural production. NESDIS scientists participated in fire monitoring projects using DMSP data in Brazil, Southeast Asia, and Mexico and established new applications for DMSP nighttime lights data for the nightly tracking of squid fishing activity in California, the Sea of Japan, and the South Atlantic Ocean.

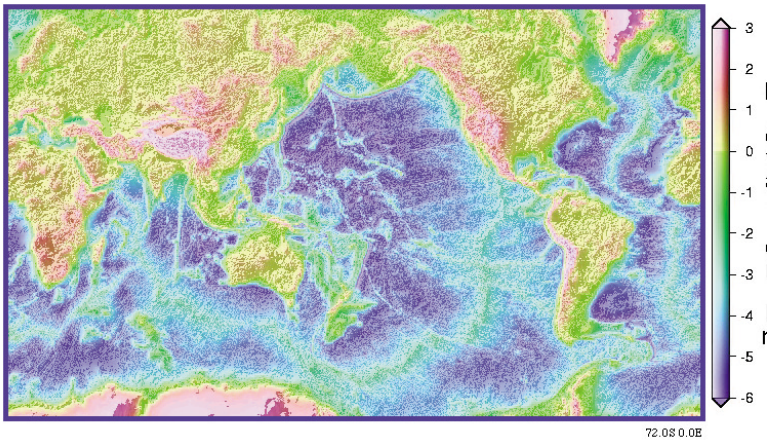


Radiance calibrated DMSP-OLS data of the northeast corridor of the USA from Washington, DC to Boston.

Oceanographic Data

http://www.nodc.noaa.gov

Global Sea Floor Topography. An interactive web site was developed to provide the public with easy access to the Smith and Sandwell (1997) map of global sea floor topography. The map is based on a combination of ship depth



soundings and previously classified satellite altimeter data and represents the most detailed description of the Earth's sea floor ever constructed. It has led to discovery of previously unknown undersea volcanoes, mountain ranges, trenches, and fracture zones. Users can select any geographic region at nine different resolutions and download data or images for use in research and publications.

http://ibis.grdl.noaa.gov/SAT/SAT.html

World Ocean Atlas. NESDIS completed and distributed global, objectively analyzed fields and statistics of ocean variables in a product titled World Ocean Atlas 1998. In addition to the digital fields available as part of this series, more than 30,000 color figures have been made available on CD-ROM and on-line which users can access at

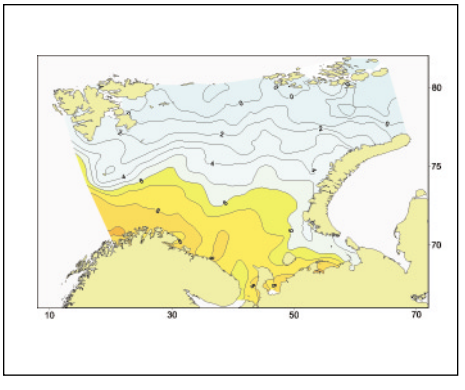
http://www.nodc.noaa.gov/OC5/indprod.html

This product represents an extension of earlier works which have become standard products for diagnostic and modeling studies of the world ocean.

http://www.nodc.noaa.gov/OC5/index.html

Atlas of the Barents Sea 1998. In conjunction with the Murmansk Marine Biological Laboratory, NESDIS completed and distributed the Atlas of the Barents Sea 1998. The atlas includes objectively analyzed fields and statistics of ocean variables for the Barents Sea and was made possible by a large increase in oceanographic data exchanged for this region. In addition to the digital fields available as part of this series, color figures have been made available on CD-ROM and on-line at

http://www.nodc.noaa.gov/OC5/barsea/barindex1.html



Harmful Algal Bloom (HAB) Data Management System (DMS). The project aims to provide coastal physical, chemical, and biological data to support decision makers and model developers. During FY 1999, a database design was chosen and work began on obtaining significant data sets. The HAB DMS devel-

opment is being guided by industry and research representatives.

http://www.nodc.noaa.gov/col/index.html

http://www.nodc.noaa.gov/col/projects/habs/

Information Systems Management. NESDIS took several steps to maintain reliable, up-to-date systems. A Redundant Array of Independent Disks system was installed on the database server, giving the public better access to the Ocean Profile Database and NOAA CoastWatch Active Access System databases. A new tape back-up unit improves efficiency and capacity and a new firewall handles more volume, transfers data faster, and allows more types of data through, all at lower cost.

Coral Reef Information Management System. NESDIS established important links with NOAA and other groups studying coral reefs—the rainforests of the sea. NOAA is participating in the Working Group on Coral Reefs and the U.S. Coral Reef Task Force. A web site for coral reef, sea grasses, and mangrove forests is under development, and lists of coral reef locations and coral reef-related species are being compiled.

http://www.coralreef.noaa.gov

A Coastal Ocean Time Series Database. The database includes all of the current meter mooring data at more than 10,000 stations. The web-based interface permits graphical selection of region and time period of interest, and various graphical displays of the data. It features on-demand time series data analysis and display.

http://www.nodc.noaa.gov/dsdt/ocdb/index.html

Library Services

http://www.lib.noaa.gov

The NOAA Central Library provided on-line enhancements to the NOAA Photo Image Collection, Brown Bag Luncheon Programs, access to electronic journals, and served on NOAA 30th Anniversary Planner Team. In May 1999, the NOAA Central Library hosted representatives from 18 countries and four United Nations agencies for the Aquatic Sciences and Fisheries Abstracts Board Meeting. This was followed by the International Oceanographic Data Exchange-Group of Experts on Marine Information Management meetings.

Japanese representatives from the United States-Japan Cooperative Program in Natural Resources (UJNR) spent 3 weeks at the NOAA Central Library receiving training on home page design and content for the UJNR home page that the library supports on its server. As a result of this information exchange and cooperation, the home page is now bilingual.

The NOAA Central Library was co-recipient of the 1999 Federal Library of the Year Award by the Library of Congress Federal Library and Information Network Committee. The library was recognized for “its initiative and dedication in creating a distinctive combination of original information products and services, and for service excellence in meeting the needs of its defined user groups.”

40 Years of Civilian Weather Satellites

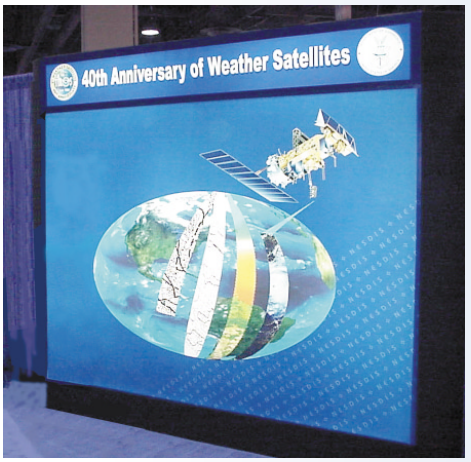
P. Krishna Rao

The first United States civilian weather satellite, Television Infrared Observation Satellite-1 (TIROS-1), was launched on April 1, 1960. A successful launch of TIROS-1 confirmed the idea that spectacular cloud photographs could be used immediately for weather analysis and forecasting. Over the last 40 years, significant progress has been made in the instrumentation and the use of remotely sensed observations from space to monitor, describe, and model the Earth's atmosphere and surface.

The first satellite carried two vidicon cameras. To obtain nighttime coverage, Infrared Radiometers (IR) were introduced on TIROS-2 and the follow-on satellites. In 1966, this series of satellites was called Environmental Science Service Administration (ESSA) and they continued (ESSA 1–9) until 1976. Advanced cameras and radiometers were introduced on these satellites.

In 1970, the configuration of the satellites changed based on NASA's NIMBUS satellite technology. This series was called Improved TIROS Operational Satellites and then changed to NOAA to reflect the agency's name. The series NOAA 1–5 continued until 1979, after which a major change occurred in the polar satellites.

More demand was placed on sensors to provide measurements not only to observe the weather but oceans, agriculture, and land use. The numerical modeling community demanded better observations of temperature and moisture at several levels in the atmosphere. To meet the requirements of the various user communities, a new series of polar satellites was developed (called NOAA K–Q series). NOAA-15, the first one in the

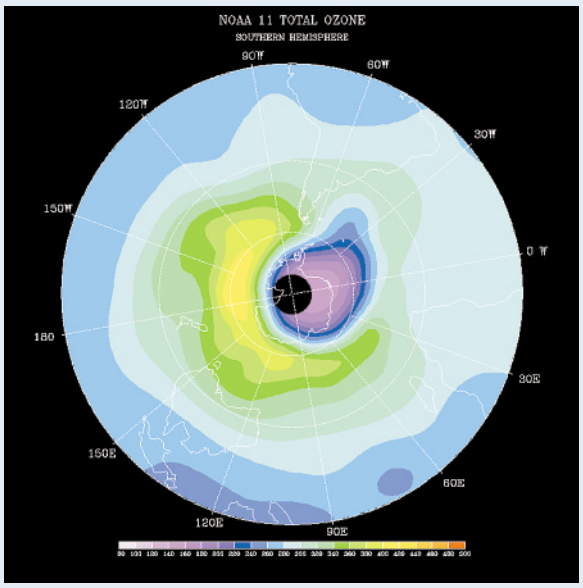


series, was launched in May 1998, and is still functioning. Improved radiometers and new microwave sounding instruments were included. This series of satellites is expected to continue until 2009.

The next polar satellites (beyond 2009) will be a converged DOD (USAF), NOAA, and NASA system called NPOESS. It will carry an entirely new complement of sensors to meet defense and civilian requirements. Unlike earlier systems, the new sensors will use the latest detector

arrays, improved calibration, and large quantities of measurements will be transmitted.

Forty years ago, the images were used primarily for cloud analysis (neph-analysis) and the information was transmitted to various weather forecast offices nationally and internationally. With the introduction of radiometers, quantitative data were available for monitoring, diagnostics, and prediction of weather events. In the 1970s and 1980s, the data were used extensively in numerical modeling of weather phenomena. Satellite observations were used for temperature and moisture-like conventional observations available from in-situ platforms. The major advance occurred around 1995 in the use of satellite observations. The actual satellite measurements (radiances) were directly assimilated in numerical weather prediction models and the results were astonishing! New techniques are being developed to directly assimilate the satellite measured radiance in various numerical models and the results are encouraging.

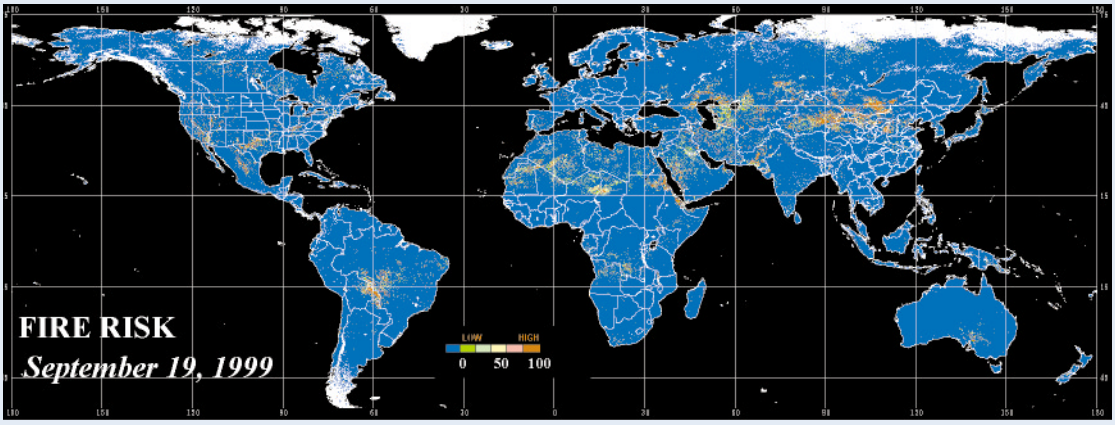


NOAA-11, SBUV/2 Ozone Total, Nov. 2, 1999

Earlier satellites were primarily designed for weather. However, the introduction of new channels on various instruments has expanded the utility of the data for other applications related to oceans, coastal regions, agriculture, land use, detection of forest fires and deforestation, and the “ozone hole” over the south pole. The user community has expanded and the demand for more data has increased.

http://www.nesdis.noaa.gov

http://www.nesdis.noaa.gov/40th.html



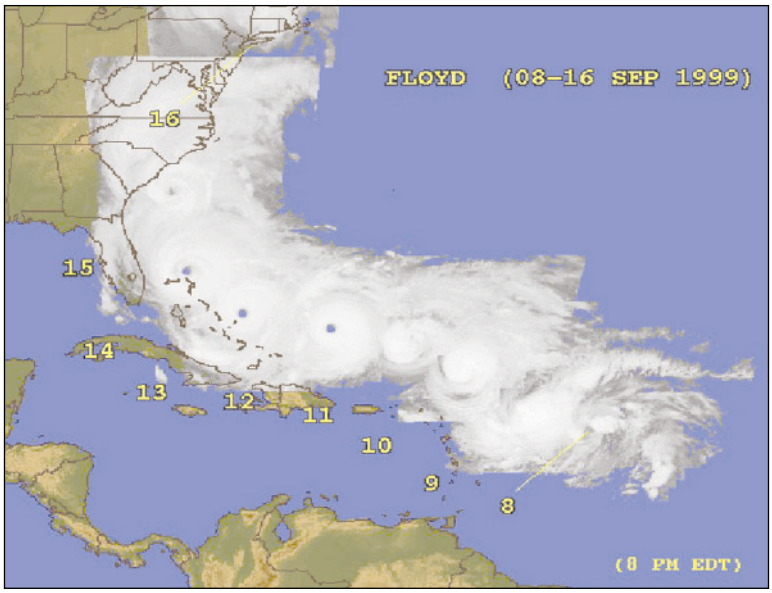
Areas of High Probability of Fire Risk

Multi-Satellite Products Assist Emergency Managers During Hurricane Floyd

Frances C. Holt

Hurricane Floyd formed in the eastern Caribbean on September 8, 1999, and became the United States' most destructive Atlantic storm of the year. Emergency preparedness managers from Florida to New England utilized the GOES imagery to watch Floyd march across the Bahamas, with its eye aimed at the Florida coast late on September 14. Overnight it began its recurvature to the north, just brushing the Florida coast and setting its aim on North Carolina, a state already recovering from the earlier landfall of Hurricane Dennis.

GOES-8 Montage of Hurricane Floyd



The figure shows portions of a series of daily GOES-8 10.7 micron images of Hurricane Floyd from September 8–16, 1999.

Emergency managers and the South Carolina Department of Transportation overlaid up-to-the-minute GOES satellite images together with NOAA's radar data on the state's transportation maps. From this database, they managed traffic flow along the evacuation routes and set up detours and alternates as the weather worsened. Memories of 1989's Hurricane Hugo prompted more than 700,000 residents of this state alone to heed the governor's orders to evacuate. In all, millions of East Coast residents evacuated the coastlines as the powerful hurricane threatened.

NESDIS' polar and geostationary satellite-based products such as high-density cloud drift winds, vertical temperature profiles, atmospheric moisture, rainfall estimates, and SSTs fed a continuous stream of updated information to prediction models and to local forecasters.

Although winds and waves from Hurricane Floyd exerted their toll on beaches and ocean front property, it was the heavy rainfall in North Carolina, southeastern Virginia, and eastern New Jersey that caused the most destruction. Already saturated ground could not absorb the 8–24″ deluge of rain. During the storm, rainfall estimates from GOES data were computed every 15 minutes, and were provided directly to local NWS forecasters. More than 16 inches of rain were estimated for the 24-hour period from 7:00 a.m. September 15, to 7:00 a.m. September 16. The newest observations from the twice-daily AMSU instruments on NOAA-15 put the 3-day total

- Experimental SST anomaly chart on Sep. 21, 1999.
- Up to 2.5K cooling at ocean's surface
- Strong persistance

(September 15–17, 1999) at better than 8 inches not only in the Carolinas but also in the coastal states of New Jersey, New York, and Connecticut.

Precipitation estimates from the GOES satellite are available at

http://www.ssd.noaa.gov/SSD/ML/realtime
http://orbit-net.nesdis.noaa.gov/arad/ht/ff

and from the polar satellites at

http://orbit18i.nesdis.noaa.gov

in real time.

Current wind, temperature, and other atmospheric measurements are also available from these web sites:

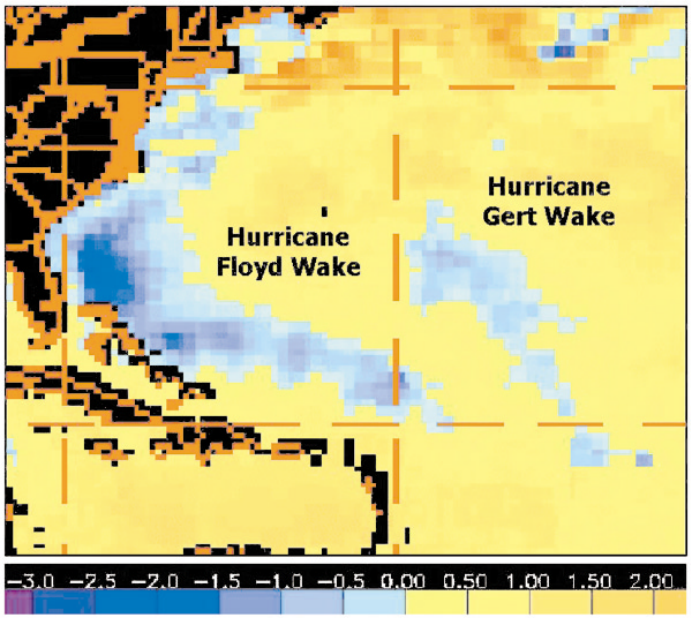
http://www.ssd.noaa.gov/SSD/ML/realtime.html
http://orbit-net.nesdis.noaa.gov/arad/fpdt/

Hurricane Floyd's impact on East Coast residents is well known; however, the storm also left its mark in the ocean as a path or wake of cooler water caused by the upwelling of cooler subsurface waters in response to its persistent strong winds and its large cloud shield. This was seen in the sea surface anomaly product.

http://psbsgi1.nesdis.noaa.gov/PSB/EPS/SST/climohot.html

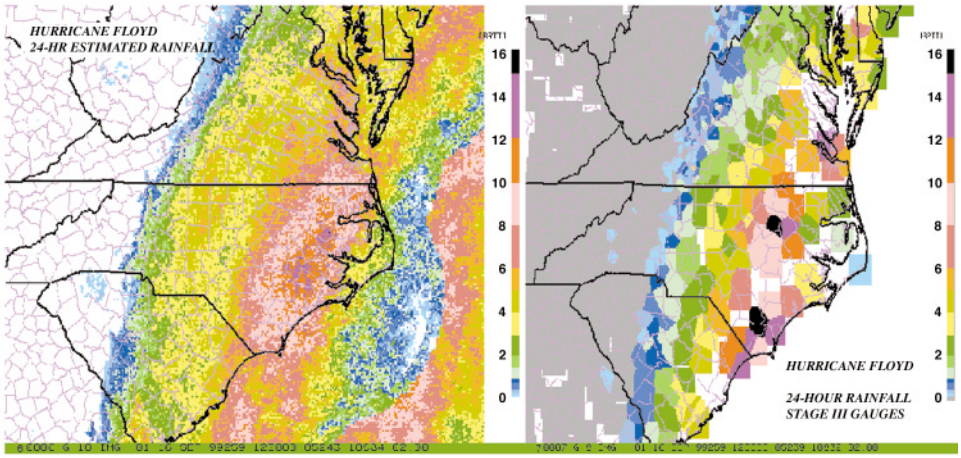
It typically lasts from 7 to 10 days. If a new tropical storm had followed in Floyd's wake, the cooler waters would have affected the potential intensity of the storm because warm ocean temperatures are necessary to fuel development. Areas of suspended sand around the Bahamas could also be seen after Floyd. Hurricane Floyd's effects were far-reaching. NESDIS' satellite data played an important role in monitoring, forecasting, and decision making during this event.

NESDIS Sea Surface Anomaly Processing Captures Hurricane Thermal Wakes



SST Anomaly in Deg K

24 Hour Auto-Estimator Rainfall Estimates (in) campared to Gauges Ending 9-16-99 1200 UTC



Auto-Estimator Rain Gauges

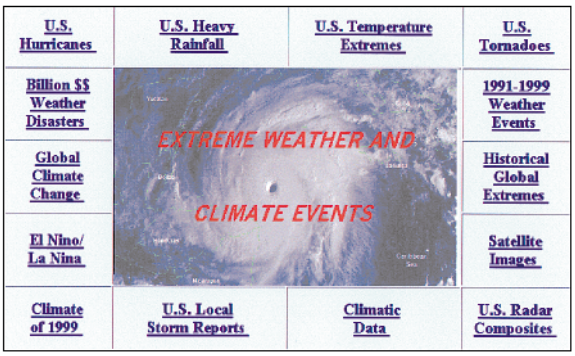
Extreme Weather and Climate Events

Michael J. Changery, Thomas F. Ross, and Thomas R. Karl

Climate extremes and their impact on society have received increasing interest from the media, policy makers, insurance and agriculture industries, and the general public. Changes in the frequency and intensity of climate extremes are also of interest to the research community since these changes may be an initial signal of a changing climate. NESDIS is participating in extremes-related research as well as providing a consolidated source for current extremes information and functions as the final validator for national climate extremes.

U.S. National Assessment. NESDIS has performed a variety of analyses in support of the National Assessment which is being conducted under the auspices of the USGCRP. The National Assessment includes analysis of past and future climate trends using historical data and climate models. For the observed record, temperature and precipitation extremes were analyzed. Analyses showed:

- On a national basis, slight decreases (2 days per year) in the number of freezing days were observed for the 20th century with much larger decreases in the western U.S. (10 days per year) but with moderate increases (6 days per year) of days with freezing temperatures in the southeastern United States.
- Nationally there was not a significant trend for more droughts, but there was a trend toward more wet spells.
- Coupled Ocean Atmosphere Climate Models were used in the Assessment to simulate the climate impacts of global warming due to increases in greenhouse gases. Models project an increase in heavy precipitation consistent with the trend that has been observed over the 20th century.

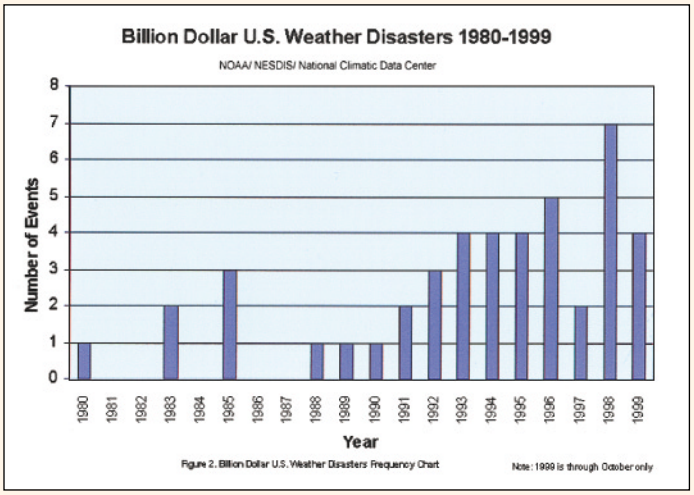


The IPCC 2000 Report. Global extreme weather and climate events analyses were developed for the IPCC 2000 report. The findings included:

- Widespread increases in heavy and extreme precipitation events in mid- and high-latitude regions with increased precipitation;
- No decrease in areas affected by extreme drought, but with an increase in areas affected by excessive wetness;
- Decrease in temperature variability, with freeze-free season lengthening due to higher nighttime temperature;
- Significant reduction in frequency of much below normal seasonal temperatures, with a less apparent increase in the frequency of much above normal temperatures;
- No widespread trends of tropical system frequency and intensity, but considerable interdecadal variability;
- No change in the frequency of strong tornadoes.

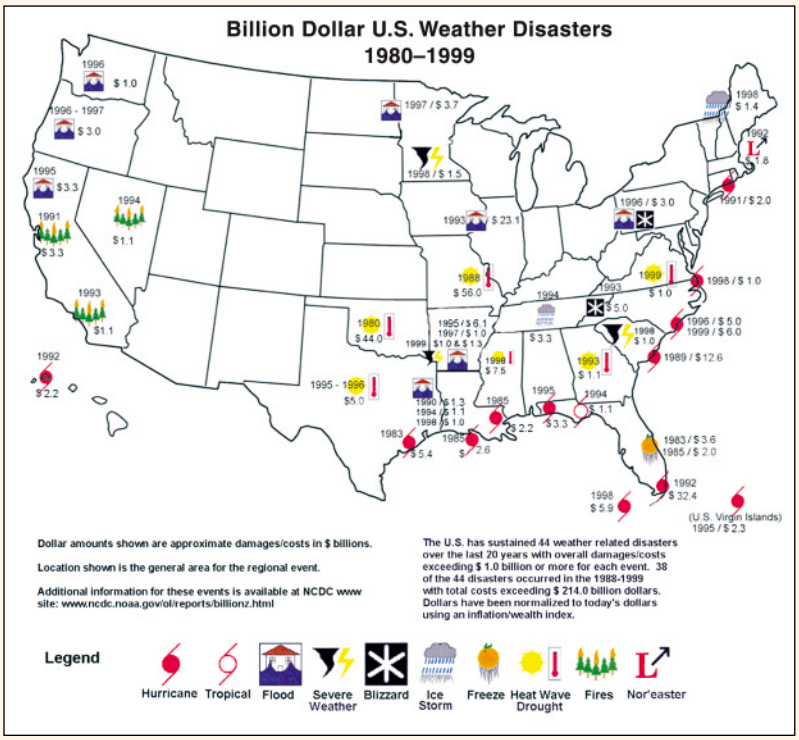
Climatic Extremes and Weather Events. NESDIS developed a new web site titled "Climatic Extremes and Weather Events" which provides access to a large variety of information related to extreme climate events. The popularity and utility of the site continue to grow, with over 366,000 hits during September 1999, partially due to the passage of hurricanes along the eastern coast of the United States. An increasing number of news media, educational, and government web systems have links to the site. In addition to a variety of information on climate extremes, severe weather, weather events and climate change, the site provides information on Billion Dollar Weather Disasters. The United States has sustained 44 weather-related disasters over the past 20 years in which overall damages and costs reached or exceeded $1 billion. Of these disasters, 38 occurred during the 1988–1999 period with total damages/costs exceeding $214 billion in today's dollars, and the totals for 1999 are still preliminary. Seven events occurred during 1998 alone—the most for any year on record—though other years have recorded higher damage totals.

The graph reflects a trend toward increasing susceptibility of the U.S. economic base to damage from extreme climatological events, and does not even consider the toll in human suffering and loss during these events. The U.S. map provides a spatial depiction of the types of extreme weather and climate events and the related costs labeled in today's



dollars by adjusting each event's assessed cost by a multiplier based on a combination of inflation and a wealth index. This adjustment considers both the increased cost of goods due to inflation as well as the greater variety and quantity of goods both in the commercial and domestic sectors. The extremes web site is

http://www.ncdc.noaa.gov/extremes.html



Ocean and Coastal Remote Sensing

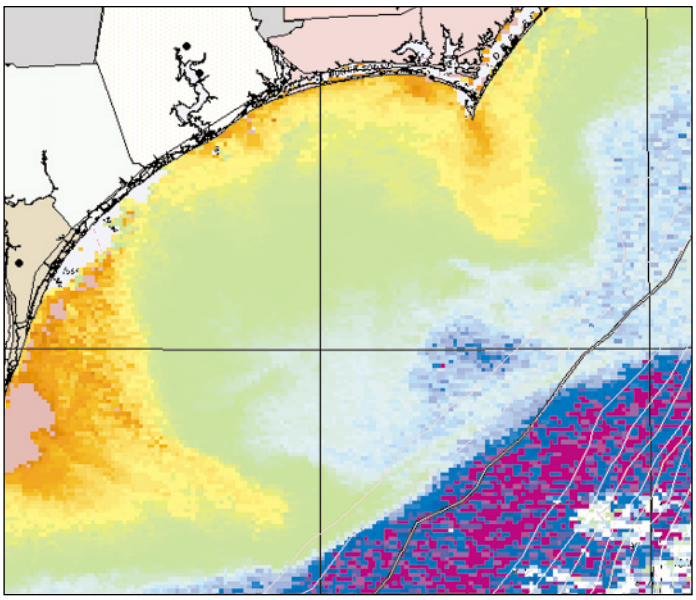
H. Lee Dantzler, Jr.

Notwithstanding its transcontinental span, the U.S. is a coastal nation. Coastlines of 36 U.S. states and territories stretch for some 97,000 miles. More than half of the Nation's population lives within 50 miles of the coast. Coastal recreation and tourism are the second largest employers in the Nation with more than 180 million visitors coming to the coast each year.

The NESDIS Ocean Remote Sensing Program made significant advances in 1999 in providing satellite data and information to coastal constituencies. Highlights include: 1) Simplifying access by users to regional environmental satellite data; 2) Improving the suitability of these data for use in regional applications by state and other users; 3) Bringing new sources of high-resolution environmental satellite data on-line for important coastal environmental, economic and resource management activities; and 4) Outreach to our users.

Access. Ninety percent of coastal states and territories use geographic information systems (GIS) as a principal land management software tool, but very few were able to handle the complexities associated with environmental satellite data. We successfully demonstrated an operational capability to simplify the delivery of satellite imagery data by the Internet in a GIS-compatible format. This is an important step in the transition of satellite image processing from the scientific to the resource management users communities, and takes full advantage of the users' already-installed GIS software base.

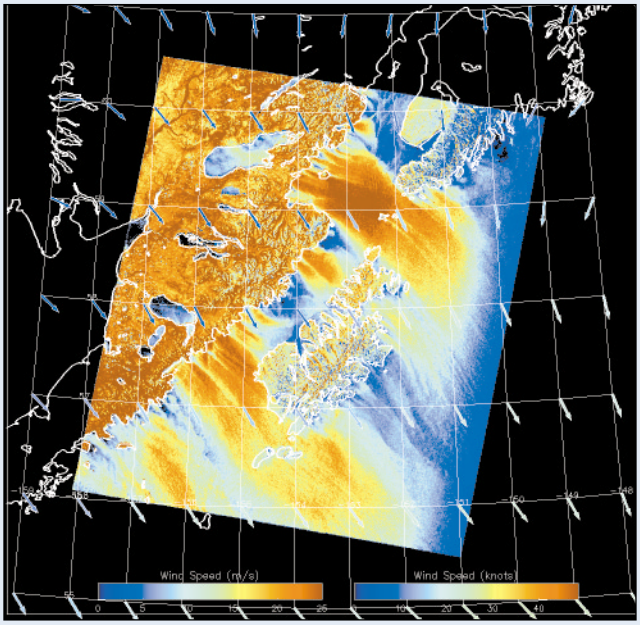
Regional Applications. The Ocean Remote Sensing Program has major demonstrations underway in Maine and Alaska. The Maine Penobscot Bay Project is a watershed partnership in which an interdisciplinary team of state and Federal scientists and managers is working with commercial fishermen who are using satellite observations to put together a comprehensive understanding of the ecosystem of the largest bay in the Gulf of Maine. We are working with NWS, U.S. Coast Guard, and the State of Alaska to expand environmental remote sensing services in the Alaskan region focusing on coastal weather forecasts, safety at sea, and fisheries management.



NESDIS' experimental use of coastal satellite imagery data in estimated ArcInfo™ geographic information system computing environment. Image is that of coastal chlorophyll levels in Onslow Bay, North Carolina.

Image courtesy of OrbImage, Inc.

Analysis by Johns Hopkins University Applied Physics Laboratory. Data from RADARSAT ScanSAR Wide B, imagery data copyright Canadian Space Agency (1999), 25 Oct, 1999, 1637Z.



Exploratory use of Canadian RADARSAT synthetic aperture radar satellite data to estimate near-coastal high-wind conditions associated with flow through mountain passes in the Cook Inlet, Alaska region.

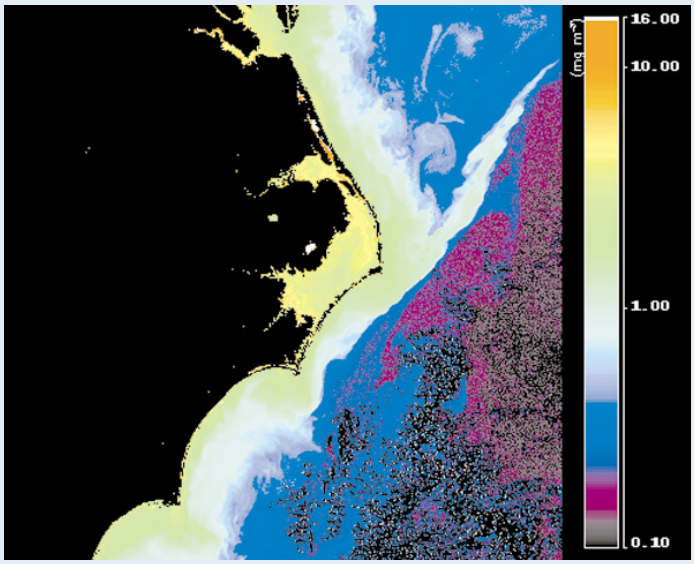
Expanding Capabilities. A new generation of improved resolution, environmental-sensing Earth satellite applications is emerging. These new applications, derived from commercial, domestic, and international satellites, bring needed additional environmental data to the coasts. This year saw the first NESDIS purchase of commercial satellite data to explore coastal ocean color, turbidity, and biological productivity issues. NASA's QuikSCAT's active microwave scatterometer satellite is now providing experimental high resolution coastal wind speeds and directions data twice daily for improving coastal forecasts.

Coastal Outreach. We are committed to engaging our users to ensure that our data and information services remain relevant and useful. This year saw NESDIS' first national open call for research initiatives targeting coastal states' coastal and ocean resource management issues. Collaborations were also beginning with the National Marine Sanctuaries, regional aquaria, and K–12 science educators to help bring ocean and coastal remote-sensing resources to the public.

The future for expanded coastal and ocean remote-sensing services is bright indeed. The rapid pace of information and computing technologies now puts data processing and analysis capabilities on users' desktops that were previously only available through access to large, installed high-performance computing systems. This increase in user capabilities together with the Internet are revolutionizing how we deliver data and information, and is creating an accelerating demand from users for near real-time access to data. Looking back, what began in the 1960s as primarily a national weather satellite system now provides expanding daily applications for our coasts and oceans to improve the future use and stewardship of our coastal resources, economy, and ecosystems.

http://orbit-net.nesdis.noaa.gov/orad

NOAA analysis. Image data provided through contract with OrbImage, Inc.



Monitoring increased chlorophyll levels associated with Hurricane Floyd floods on September 26, 1999 in North Carolina. Data from OrbImage, Inc., SeaWiFS multispectral imaging satellite.

Integrated Global Observing Strategy (IGOS). The IGOS concept moved from the Committee on Earth Observation Satellites (CEOS) arena, becoming a formal IGOS Partnership in 1998. IGOS unites the major satellite and surface-based systems for global environmental observations of the atmosphere, oceans and land. It is a strategic planning process, involving the major international organizations responsible for global observations and linking research, long-term monitoring, and operational programs in a structure that helps determine observation gaps and identify the resources to fill observation needs.

Robert Winokur, former NOAA Assistant Administrator for Satellite and Information Services, served in 1999 as Chair of the CEOS Strategic Implementation Team (SIT), which is tasked to implement and develop the IGOS space component and to coordinate CEOS agency activities with regard to IGOS. The SIT provided a collective response to pilot project requirements, developed the IGOS theme concept, and transitioned the IGOS elements of the pilot projects to current or prospective IGOS themes. The SIT initiated a prototype Oceans Theme, encouraged Disaster Management Support and Carbon Cycle Themes to be developed, and proposed, as well as developed with the Partners, an IGOS brochure and IGOS bulletin.

Disaster Management Support Project. A DMS Project was created by the Committee on Earth Observation Satellites (CEOS) Strategic Implementation Team (SIT) in February 1997 to help demonstrate the viability of the Integrated Global Observing Strategy (IGOS) concept and develop the interactive process with users envisioned under IGOS. Led by NOAA, the DMS Project has found strong support among CEOS space agencies and other IGOS Partners, as well as an enthusiastic reception from numerous international, regional, and national users, and distinct interest from the commercial sector, with over 300 participants from over 140 organizations currently involved. At the CEOS Plenary in Stockholm, November 1999, NOAA garnered broad concurrence in establishing an ad hoc *Disaster Management Support Group* within CEOS to maintain the strong, positive momentum of the activities underway in disaster management support and to move toward the demonstration of coordinated space agency responses and the development of suitable response models.

UNISPACE-III. The NOAA Administrator led the U.S. delegation to the UNISPACE-III in Vienna, Austria, on July 19–30, 1999. Under the theme “Space Benefits for Humanity in the Twenty-first Century,” UNISPACE-III convened as a special session of the United Nations Committee on the Peaceful Uses of

Outer Space open to all Member States. UNISPACE-III presented a unique opportunity for the world's experts and decision makers to meet and exchange information and ideas to advance the human condition into the next millennium. NOAA advisors on the U.S. delegation were successful in negotiating provisions and recommendations of particular concern to the U.S. into the report of the Conference, especially into "The Space Millennium: Vienna Declaration on Space and Human Development." The NOAA Administrator and other NOAA representatives delivered several invited presentations during the Technical Forum—an integral part of UNISPACE-III—that examined in detail various issues of Earth and space science, technology, and law related to the substantive items on the agenda of the Conference.

Second ESCAP Space Ministerial Conference. The NOAA Assistant Administrator for Satellite and Information Services led the U.S. delegation to the second Ministerial Conference on Space Applications for Sustainable Development in Asia and the Pacific in New Delhi, India, on November 15–20, 1999. He also led the U.S. delegation to the Senior Officials Meeting on November 15–17, 1999, that preceded the Ministers' Meeting on November 18–20, 1999. The Conference took into account the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE-III) and brought the impact of this global event into the regional arena. The Conference also provided a unique forum for policy planners and decision makers to exchange perspectives and information, develop fresh new policy scenarios, map out a blueprint for regional space development, and decide upon a result-driven and action-oriented program under a new phase of implementation of the Regional Space Applications Program for Sustainable Development. The NOAA Assistant Administrator delivered the U.S. statement at the Conference and NOAA Assistant officials delivered invited presentations at an associated science symposium.

Commercial Remote-Sensing Licensing. A number of key milestones in NOAA's efforts to promote the commercial remote-sensing industry occurred in FY 1999. With the launch of the world's first 1-meter commercial remote-sensing satellite in September, the U.S. regained its qualitative lead in the global imagery market thus fulfilling the vision of the Congress and the Administration. NOAA also licensed the world's first hyperspectral systems in 1999. Four amendments and four foreign agreements were also approved enabling U.S. licensees to garner the investment and foreign partnerships needed to sustain these complex systems. Finally, in agreement with its statutory responsibilities, NOAA

established a monitoring and compliance program including recruitment of the first two full-time officers.

U.S.-Japan Cooperation. In 1999, NESDIS continued cooperation with Japan's NASDA on the development, launch, operation and distribution of scatterometry, ocean color, and ARGOS DCS data from Japan's Advanced Earth Observing Satellite (ADEOS) series. Additionally, NESDIS expanded its already extensive cooperation with Japan in Earth observation and data exchange. In January, NESDIS participated in the first meeting of the Asia-Pacific Satellite Data Exchange and Utilization meeting, which was hosted in Tokyo by the Japan Meteorological Agency and attended by major meteorological centers in the region. The work done by this group is expected to increase the amount of satellite and in-situ data and products exchanged throughout the region, and take advantage of new operational data sources from future national systems. In 1999, NESDIS and NASA concluded an arrangement with Japan for provision of near real-time scatterometry products from NASA's QuikSCAT satellite. Data from this satellite will be valuable in a variety of meteorological and oceanographic forecasting models, particularly for severe storms over the open oceans. NESDIS also initiated a major new initiative with NASDA through the establishment of a bilateral working group on Earth observation. This working group will address future cooperative opportunities in satellite mission planning (including closer space and ground segment cooperation), data utilization, and advanced research and applications.

Additional International Cooperation. The SARSAT team organized Cospas-Sarsat's Third Meeting of the Americas in Miami, Florida. NESDIS installed all necessary hardware and software to support the Indian Ocean Experiment (INDOEX) in the U.S., France, and India, and began operational distribution of INDOEX data; installed all necessary hardware and software to receive Indian National Satellite (INSAT) data via a cooperative agreement between India's Department of Space and Science and Technology, NASA, and NOAA; negotiated an agreement for Meteo-France to provide enhanced High Resolution Picture Transmission (HRPT) analyses of the Kosovo region, using INDOEX communications, in support of the USAF Director of Weather during Operation Allied Forces; and brokered an agreement for the National Marine Fisheries Service (NMFS) Vessel Monitoring System to use the ARGOS system (a cooperative program between France's Centre Nationale d'Etudes Spatiales (CNES) and NOAA) to monitor and protect migratory species of fish in the Atlantic.

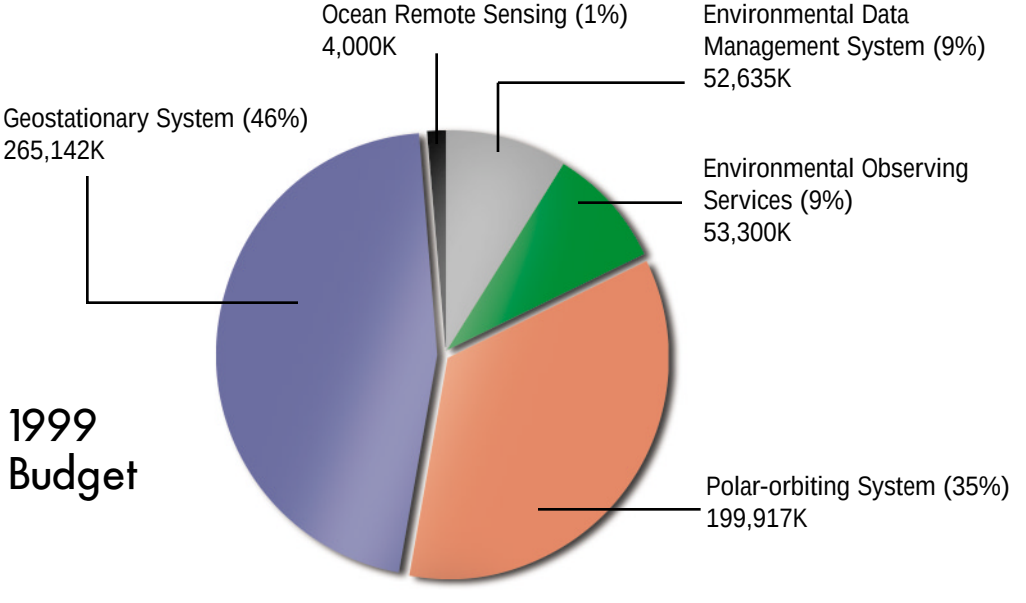
Financial Report

Fiscal Year 1999 Funding

NESDIS satellites are the mainstay of the Nation's weather information system and provide environmental data for Federal agencies, state and local governments, and private users. NESDIS' goals include the procurement, launch, and operation of the satellites required to maintain two environmental systems, as well as provide worldwide environmental data and information products and services. NESDIS has two budget sub-activities.

Satellite observing systems account for 91 percent of the budget and include the polar-orbiting and geostationary satellites. These systems obtain global environmental data and provide near continuous observations of the Western Hemisphere. Monitoring activities that include ocean remote sensing, new and improved applications and products; improved atmospheric, oceanic, U.S. coastal observations; as well as data distributions are also included in the sub-activity.

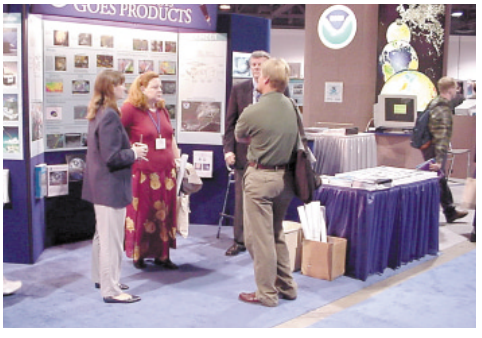
The Environmental Data Management System (EDMS) is the other sub-activity that provides worldwide environmental data and information products and services in the atmospheric, marine, solid Earth, and solar-terrestrial sciences in order to meet the needs of users in commerce, industry, agriculture, science and engineering, the general public, and governments at all levels. The EDMS sub-activity accounted for 9 percent of the NESDIS budget.



1999 Budget

Educational and Community Outreach Program

The NESDIS Educational and Community Outreach (ECO) Program enhances the awareness of career opportunities among the students attending and instructors teaching at various institutions. The organization's goal is to increase specific ethnic or minority group participation in the workforce by



providing minority students the opportunity to experience a range of professional careers and teachers the opportunity to conduct research and develop school curricula materials. This initiative program directly assists NESDIS in accomplishing its affirmative action objectives.

NESDIS continues to establish partnerships with numerous institutions and organizations such as the Hispanic Association of Colleges and Universities, the American Indian Science and Engineering Society, the Oak Ridge Institute for Science and Engineering, and the District of Columbia Metropolitan Consortium for Minorities in Science and Engineering.

The NESDIS ECO Program objectives are to:

- Create a pool of talented students through exposure to research, development, technology, and the Government environment.
- Strengthen the relationships between NESDIS and the community in which it serves by offering internships and workshops for teachers in satellite and ocean remote sensing.
- Encourage students to pursue careers within NOAA.
- Provide internships that merge relationships between academic studies and practical application for students and teachers studying and teaching math, physics, and engineering.
- Assist teachers in developing curricula materials and educational tools for the classroom.
- Continue partnerships (such as Adopt A School Program) with schools.

More Hispanic, African-American, and Native-American students continue to enter the workforce but these groups are still underrepresented. Through effective and innovative programs such as the ECO Program, NESDIS can enrich its workforce with the diversity and talent these students and teachers represent.

http://www.nesdis.noaa.gov

Diversity

NESDIS is changing the cultural climate and ensuring career and economic opportunity by recruiting, retaining, promoting, and managing its employees.

Diversity encompasses the uniqueness of all individuals of different ethnic, social, cultural, religious, and racial backgrounds to work harmoniously to achieve the organization's mission.

NESDIS has developed a Diversity Plan that values personal differences whether national origin, color, disability, age, religion, or gender; rewards an individual's performance, productivity, and talent; and provides equitable treatment and opportunities. The Plan maximizes employees' talents to accomplish its mission.

Managing Diversity is the process of creating and ensuring a positive attitude and securing an environment where all individual differences are recognized, understood, and valued.

To effectively achieve diversity, NESDIS is continuously improving its commitment toward individual support and communicating its necessity throughout all levels of the organization. Teams created within the organization to support managerial, personnel, special projects, and other organizational tasks are being constructed to include diverse gender, ethnicity, ability, age, expertise and location. Our publications, brochures, posters, and other marketing tools are designed and distributed to represent our diverse organization for the recruitment of talented and gifted employees, so that we can accomplish our mission.

NESDIS is committed to managing diversity because it is critical to the productivity and competitiveness of its organization to meet its mission.

http://www.rdc.noaa.gov/diversity.html
http://www.nesdis.noaa.gov

Special Recognition

Each year the DOC and NOAA honor employees who have performed exemplary work with the Gold, Silver, and Bronze medals and with the NOAA Administrator's Award. A list of NESDIS recipients and their achievements follows:

Gold Medal

Roderick A. Scofield. For research and leadership in the use of satellite data to obtain estimates of heavy precipitation that are used in NOAA's critical flash flood forecasting program.

Silver Medal

Pamela Taylor. For contributions to the NOAA Polar-orbiting Operational Environmental Satellite (POES) program in preparing NOAA's product processing systems to handle data from new and improved instruments on a new series of POES.

Mike Chalfant, Ralph Ferraro, Mitchell Goldberg, Norman Grody, Thomas Kleespies, Larry McMillin, Tsan Mo, Anthony Reale, David Wark. For accelerating the use of new Advanced Microwave Sounding Unit (AMSU) satellite observations in weather prediction.

Brent Smith, Robert Masters. For negotiating the landmark Initial Joint Polar Orbiting Satellite System Agreement with the European Organisation for the Exploitation of Meteorological Satellites.

Alan Strong. For contributions in the field of ocean remote sensing and improved understanding of the world's oceans and their fragile ecosystem.

Stanley Elswick, Anna Fiolek, Steven Quillen, Doria Grimes, Jean Conrad, Linda Pikula, Maureen Woods, Elaine Collins, Janice Beattie, Dorothy Anderson. For designing NOAALINC, an interactive on-line database that provides access to the collections of 28 NOAA libraries nationwide.

Bronze Medal

Michael Doney. For exceptional leadership and expertise in developing a state-of-the-art network for the David Skaggs Research Center in Boulder, CO.

Robert Aune, Jaime Daniels, Gary Ellrod, Donald Hillger, W. Paul Menzel, Debra Molenar, Roger Phillips, Timothy Schmit, Roderick Scofield, Gary Wade, John Weaver, Raymond Zehr. For the development and implementation of Distance Learning Technology to enhance the expertise of NWS forecasters.

Felix Kogan, Stephen Ambrose, Jane D'Aguanno, Christopher Elvidge, Debra Molenar, Elaine Prins, Janice Sessing, Thomas Snell, Linda Williams. For extraordinary development of unique and specialized remote sensing products that were used to protect the Amazonian rainforest from wildfires.

Paul Chang. For outstanding and innovative contributions in experimental satellite ocean surface wind products development.

J. Neal Lott, Dawn Anders, Stephen Fleming, Douglas Ross, Hilery Whitehurst, Vickie Wright. For developing a state-of-the-art Electronic Commerce system that provides direct access to the world's climate data via the World Wide Web.

Paul Pellegrino. For outstanding and extraordinary contributions to quality assurance of meteorological satellite data and products.

J. Dane Clark, Kira Alvarez, Robert Bassett, Barbara Brooks, H. James Silva, Charles Wooldridge. For extraordinary achievements in leadership and management involving the U.S. Space-based Data Collection System.

John Weaver. For outstanding public service in the application of forecast products to emergency preparedness and response.

David McAdoo, Karen Marks. For advancements in geophysics and tectonics of the Southern Oceans and Antarctic region using satellite altimeter data.

William Pichel, Pablo Clemente-Colon. For superior contributions in the field of ocean remote sensing and pathfinding applications of spaceborne synthetic aperture radar systems.

Michael Fitzmaurice, Steven Schaffer. Systems Acquisition Office (SAO) group. For management excellence resulting in the acquisition of the highly successful NOAA polar-orbiting satellite series.

Terry Babb, Barbara Brooks, Donald Nortrup, Kimberly Nye. Office Finance Administration (OFA) group. For helping NOAA workgroups focus energy on identifying issues from the SFA survey and recommending improvements to help improve NOAA's work environment.

Peter Sloss. Office of Oceanic and Atmospheric Research (OAR) Organizational. For the Common Spaces Committee of the David Skaggs Research Center, Boulder, CO, for their work in enhancing the public spaces of DSRC.

Charles Wooldridge, Timothy Stryker, Michael Mignogno, Kira Alvarez, Daniel Cohen. For excellence in developing NOAA's remote-sensing licensing program which promotes and enhances U.S. commercial and national security interests.

Office of Satellite Operations (OSO) Organizational. For exceptional service in the transition from Air Force to NOAA DMSP satellite operations ahead of schedule saving $10 million per year in operations costs.

Administrator's Award

Barbara Boyd. For exceptional administrative support that contributed to efficient facility management and employee health and safety in NESDIS and NOAA.

Lawrence Enomoto. For extraordinary coordination of the Global Observation Information Network and for preparing and conducting Third United Nations Conferences on the Exploration and Peaceful Uses of Outer Space.

John Fauerback. For design, development, and implementation of Help Desk and Information Desk systems that dramatically improved user support services at the National Climatic Data Center.

John Kinsfather. For exemplary leadership and innovative vision in the management, development, and implementation of NOAA's Information Systems.

Lance Seman. For outstanding contributions to the NOAA–NESDIS Fairbanks Command and Data Acquisition Stations' 13-Meter Antenna System Upgrade Project.

Leanchan Charles Sun. For technical leadership in the development of the Web-based Interactive Data Access and Retrieval System that improved access to oceanographic data at the National Oceanographic Data Center.

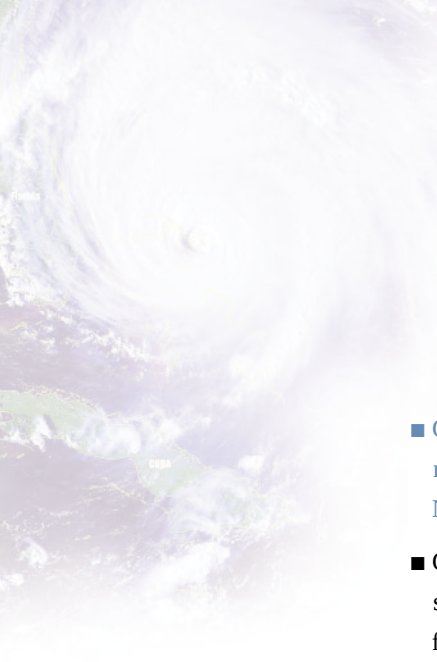
Diversity Spectrum Award

Catherine Godfrey. For significant contributions toward promoting NOAA's managing diversity goals.

Milestones for 2000

- Conduct first launch of DMSP (S-15) using Integrated NOAA SOCC for primary launch control.
- Initiate acquisition of next-generation GOES sensors with submission of imager Request for Proposal (RFP) requirements to NASA.
- Establish work plan for Virtual Laboratory for coming year and external evaluation procedures.
- Establish a bilateral working group to focus on long-term cooperation with the National Space Development Agency of Japan (NASDA).
- Establish competitive solicitation for Ocean Remote Sensing Program grants.
- Establish Multimedia Visualization Laboratory full production (i.e., video) capability.
- Complete imaging and key entry of 850,000 Woods Hole collection of oceanographic data.
- Conduct an international workshop on Global Environmental Database Development.
- Conduct source selection and award multiple contracts for NPOESS PD&RR effort for ground system design.
- Complete GOES-N imager and sounder instruments.
- Publish final commercial remote sensing regulations in Federal Register.
- Operational production and distribution of near real-time SeaWinds (QuikScat) ocean surface wind vector products.
- Merge incoming data, maintain archives and improve access and dissemination.
- Specialized data sets based on user workshops.
- CoastWatch Caribbean region node at Atlantic Oceanographic and Meteorological Laboratory (AOML) Miami becomes fully operational.
- Establish the U.S. Global Climate Observing System Secretariat (GCOS).
- Improve WSR88D NEXRAD data access through on-line robotics storage system.
- Establish on-line links to full-text NOAA documents and report through the Library Catalog.
- Update Environmental Data Rescue inventory and identify FY2000 rescue projects.
- Complete key entry of 1.2 million pages (stored on microfilm) of hourly precipitation data.
- Establish new Climate Data Modernization Program at NCDC.
- Complete SFR and PDR for critical NPOESS sensor. Visible/Infrared Imager Radiometer Suite (VIRS).
- Resolve vibration issue with U.S. instruments on METOP.

- Implement operational GOES solar radiation and surface temperature products and generate a monthly vegetation-type atlas for North America for NWS regional prediction model.
- Implement automated ice classification system.
- Auto-estimator precipitation products operational.
- Establish a remote sensing industry advisory committee.
- Generate centuries-to-millennia-long time series of climate variability for sensitive parts of the climate system.
- Provide updated and improved global database of centennial to millennial length time series of paleoclimatic change.
- Provide leadership and other facilitation in IPCC (2000).
- Commerce operational delivery of GOES Sea Surface Temperature data.
- Commence operational NOAA Ocean Color Validation System for SeaWiFS data.
- CoastWatch ocean color processing systems operational.
- Establish Multimedia Visualization Laboratory automatic NOAA web page update capability, including animation loops.
- Convene a World Wide Web/ Geographic Information Systems Workshop.
- Implement electronic transfer of POES data to NCDC.
- Demonstrate Harmful Algal Bloom data base prototype with Gulf of Mexico and East Florida data sets.
- Complete Version 2 of World Ocean Database product.
- Implement EDRP multi-year acquisition vehicle.
- Establish NOAA operation to deliver climate data to the financial and energy markets.
- Add NOAA-L Data to Satellite Active Archive (SAA).
- Launch NOAA-L.
- Reduce the time drift of NOAA satellites starting with NOAA-L.
- Launch GOES-L, checkout, and store in-orbit.
- Determine agreement mechanism for placement of U.S. instruments on EUMETSAT's METOP-3 satellite.



- Conduct, with NASA, mission requirements review for joint IPO/NASA NPOESS Preparatory Project.
- Conduct source selection and award single design and fabrication contract for critical NPOESS sensor, VIIRS.
- ADEOS-II ground system launch readiness complete.
- Transition NOAA AMSU-B rain and snow products to operations.
- Complete 20-year data sets of ozone total amount and vertical profiles from satellite measurements; tropospheric deep-layer mean temperatures from satellite sounder measurements; an Earth radiation budget from infrared measurements.
- Provide quantitative measures of climate variability for long-term planning of resources (number of request filled: (20K–40K).
- Maintain and upgrade data sets: GHCN, COADS, CARDS, SSM/I, rain and snow, radiation, and clouds, USHCN, ocean profiles, ocean buoys, ocean currents, paleoclimate database, global relief database [these are data sets funded by Office of Gobal Programs (OGP)].
- Rescue Historical Data.
- Convene Gulf of Alaska Marine Synthetic Aperture Radar Maritime Users Workshop in cooperation with NWS, Anchorage, AK.
- Finalize arrangements for NOAA access to ENVISAT data.
- Complete Coastal Ocean Time Series Database.
- Provide on-line access to National Oceanographic Data Centers (NODC) archive of originators' data sets.
- Complete system Target Architecture Plan for NEDAAS.
- Complete Version 1 of the "Paleoperspective on North American Drought" WWW data and Information product.
- Produce new U.S. Climate Atlas on CD-ROM.
- Open new National Coastal Development Center in Bay St. Louis.
- Provide ocean physical/chemical/biological data in digital form to assist in species assessments.
- Provide archived physical environmental data sets to assist in species assessment.

Selected New Products

Global Land One-kilometer Base Elevation. GLOBE digital elevation model is the most thoroughly designed, reviewed, and documented global digital elevation data set to date. GLOBE was developed by an international group of specialists, cooperating with CEOS Working Group on Information Systems and Services, International Geosphere-Biosphere Programme's Data and Information System (IGBP-DIS), and IGBP Working Group IV/6. GLOBE comprises a global 30 arc-second latitude-longitude array, with land areas populated with integer elevation data. GLOBE is available on the World Wide Web, and on CD-ROM in a format convenient for image processing and raster GIS. Full GLOBE documentation is available on the CD-ROM and web site.

http://www.ngdc.noaa.gov/seg/topo/globe.shtml

Paleo Perspective on Global Warming. A new web "handbook" on global warming titled "A Paleo Perspective on Global Warming" was featured in the March 2, 1999, issue of EOS and in the February 19, 1999, issue of the journal Science as a Pick of the Month. What makes this site stand out is how it places current warming in the context of past temperature variations through the use of paleoclimatic data archived at NGDC.

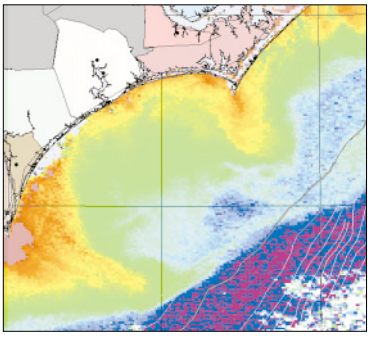
http://www.ngdc.noaa.gov/paleo/globalwarming/home.html

Historical Soviet Daily Snow Depth. National Snow and Ice Data Center's (NSIDC) Historical Soviet Daily Snow Depth CD-ROM product has been updated with an additional 10 years of data. The data set now spans from 1881 (for the earliest operational stations) through 1995. Historical Soviet Daily Snow Depth is based upon observations made by personnel at 284 WMO stations throughout Russia and the former Soviet Union. Parameters include a site characterization flag and quality flags in addition to snow depth. Updating the data set provided an opportunity to improve the product with an HTML interface and Java tool for data browsing and extraction. The new release also underwent improved quality control procedures. The original data and the update were provided to NSIDC via the State Hydrometeorological Service in Obninsk, Russia, through the Bilateral U.S.-U.S.S.R. Working Group Eight data exchange agreement.

http://www-nsidc.colorado.edu/NSIDC/CATALOG/ENTRIES/

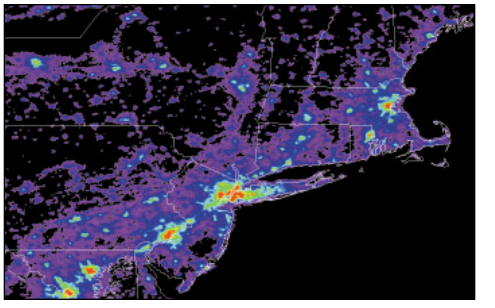
Coastal Relief Model. Volumes I and II of the Coastal Relief Model were issued this year. The Coastal Relief Model is an integrated, uniform grid of elevations and depths in the coastal zone, bridging the cultural and disciplinary gap between land and marine surveying, and providing a single, GIS-compatible database of land and sea floor relief for the

Nation's coasts. This raster database provides the first comprehensive view of the U.S. Coastal Zone. The coverage extends from the coastal state boundaries to where the National Ocean Service (NOS) hydrographic data no longer support a continuous view of the sea floor. Each volume of the Model has six directories: (1) elevation grids, (2) sounding-density grids (for quality assessment), (3) images of the elevation grids, (4) images of the sounding-density grids, (5) radius grids (indicating grid node proximity to primary data), and (6) software for easily navigating the CD-ROM, viewing the grids, and creating custom grids for exporting to hard disk. Ultimately, the library of volumes will include the entire U.S. Coastal Zone.



http://www.ngdc.noaa.gov/mgg/coastal/coastal.html

Nighttime Lights of the World. An impressive "Nighttime Lights of the World" map was presented as the centerfold map for the October issue of *National Geographic* magazine. The map displayed the nighttime lights of cities, towns, wildfires, gas flares, and fishing boats. The database was developed from an analysis of DMSP OLS nighttime imagery. Information about the population and economy of selected regions prepared by the National Geographic Society accompanied the map. National



Geographic reported that this centerfold map generated more interest than any other map. Additional products (i.e., an NGDC poster, slides and CD) are being prepared. This database and the DMSP nighttime imagery have attracted a great deal of attention as the year 2000 approached. The database can be viewed and accessed on the web site at:

http://julius.ngdc.noaa.gov:8080/production/html/BIOMASS/night.html

Daily Topex Data. Sea level analyses based on satellite altimetry are provided each day (with a 2-day delay). Users are the National Hurricane Center and the NOAA Coastal Ocean Forecasts Systems.

http://ibis.grdl.noaa.gov/SAT/near_rt/topex_gulfstream.html

NOAA Retrospective AVHRR Data. NESDIS and OAR have jointly developed a graphical user interface-based data management system that will allow visual browsing of the CoastWatch AVHRR SST images available online at NODC. The objective of the system is to enhance the functionality of the NOAA CoastWatch Active Access System. It was designed to easily access CoastWatch AVHRR SST images on the fly.

http://www.nodc.noaa.gov/dsdt/cw/

World Ocean Atlas 1998. This atlas enables users to learn about the ocean's properties, including temperature, salinity, dissolved oxygen, derived oxygen variables, nutrients (phosphate, nitrate, silicate) and chlorophyll along with fields of various statistics. The atlas, a three-CD-ROM set, is based on data in World Ocean Database 1998 (WOD98) on-line at

http://www.nodc.noaa.gov/OC5/wod98.html

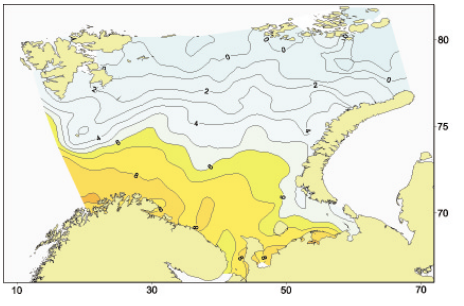
This product represents an extension of earlier works which have become standard products for diagnostic and modeling studies of the world ocean.

http://www.nodc.noaa.gov/OC5/WOA98F/open_1st.html

Global Sea Floor Topography. An interactive web site was developed to provide the public with easy access to the Smith and Sandwell (1977) map of global sea floor topography. The map is based on a combination of ship depth soundings and previously classified satellite altimeter data, and represents the most detailed description of the Earth's sea floor ever constructed. It has led to discovery of previously unknown undersea volcanoes, mountain ranges, trenches, and fracture zones. Users can select any geographic region at nine different resolutions and download data or images for use in research and publications.

http://ibis.grdl.noaa.gov/SAT/SAT.html

Barents Sea Atlas 1998. The time and space distribution of 74,256 ocean stations (temperature, salinity, and oxygen) occupied in the Barents Sea during 1898–1993 are presented in this CD-ROM atlas. These data are recorded in a format designed for use in electronic spreadsheets and/or databases. Monthly maps defining the station distribution over the Barents Sea are given



for every year, and monthly mean fields of temperature and salinity distribution for the depths 0, 30, 50, 100 and 200 meters, with a grid distance of 10' x 30' are plotted using objective analysis techniques. A description of the summer and winter seasons is given in terms of the spatial-temporal variability of thermohaline characteristics of the Barents Sea.

http://www.nodc.noaa.gov/OC5/barsea/barindex1.html

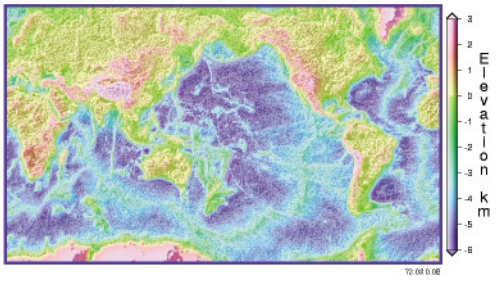
Harmful Algal Bloom DMS. This project will provide coastal physical, chemical, and biological data to support decision makers and model developers. During 1999, a database design was chosen, and work began to obtain significant data

sets. The HAB DMS development is being guided by industry and research representatives.

http://www.nodc.noaa.gov/col/index.html

http://www.nodc.noaa.gov/col/projects/habs/

International Surface Weather Observations (INSWO) CD-ROM. INSWO CD-ROM set which contains five CDs and is compatible with MS-DOS, Windows-95, Windows-98, and Unix systems is now available. The data set includes hourly and/or synoptic (every 3 hours) data, with 17 weather elements, for approximately 1,500 stations for 1982–1997. It provides good coverage of city locations around the world, with more than 900



international stations and nearly 600 U.S. sites. The overall set contains nearly 15 gigabytes of data when uncompressed and is now available for purchase through NNDC's on-line store at:

http://nndc.noaa.gov/?http://ols.nndc.noaa.gov:7777/plolstore/plsql/olstore.main?look=1

Global Climate Normals CD-ROM Released. The Global Climate Normals CD-ROM describing the 1961–1990 global standard climate normals has been released. Normals data from more than 4,000 stations worldwide computed by more than 135 countries and territories were provided as part of the WMO Climatological Normals activity. The CD-ROM contains data files, documentation files, eye-readable ASCII table files, graphics files showing which countries submitted data, and limited DOS extraction software. It also contains limited narrative metadata files, which describe normals computational methodologies for some countries. Climatic variables include maximum temperature, minimum temperature, mean temperature, precipitation, snowfall, snow depth, wet bulb temperature, dew point temperature, relative humidity, sea level pressure, vapor pressure, wind speed, wind direction, cloud cover, sunshine duration, soil temperature, evaporation, solar radiation, number of days with various weather elements (occurrence/nonoccurrence), and number of days with weather parameters beyond various threshold values. Computed statistics include mean, median, quartiles, extremes, frequency distribution, standard deviation, and number of years with nonmissing data. The normals data and metadata that were provided vary from station to station and from country to country. The CD-ROM is available through the NNDC on-line store at:

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwAW~MP

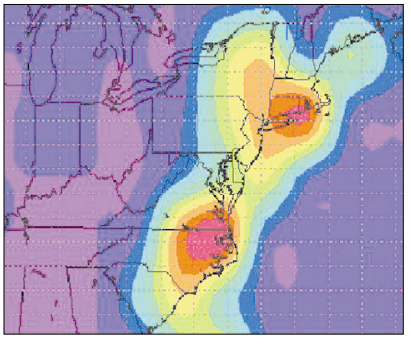
Monthly Publication Available on CD-ROM. NESDIS, working with the Government Printing Office, has developed a CD-ROM which contains the NCDC's five monthly serial publications: Hourly Precipitation Data, Climatological Data, Local Climatological Data, Storm Data, and Monthly Climate Data for the World. Each CD-ROM will have all the

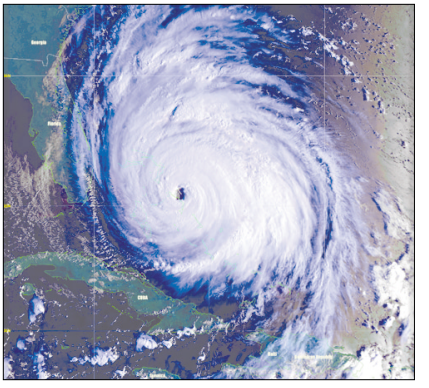
publications for a 3-month calendar period beginning with January–March 1998. The CD-ROM will replace the paper copies currently distributed to the Federal Depository Library System and the Library of Congress. Beginning with the January–March 1998 period, the CD-ROM contains all serial publication (pdf) images and ASCII file data for a calendar quarter. These publications are available on the NNDC on-line store at:

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwAW~MP

"Climate Watch" Page Added to Web. A new monthly feature "Climate Watch" provides a review of significant climate events and extremes during the month. It links to reports of particular events and to other web sites (e.g., Regional Climate Center reports). The page will also periodically contain historical climatological reports of unusual significance (i.e., the February page has a report dealing with the Great Cold Wave of February 1899). The "Climate Watch" feature began in January 1999 and is accessible at:

http://www.ncdc.noaa.gov/ol/reports/weather-events.html





Temperature Extremes CD-ROM Released. Selecting climate change scenarios means answering the question: "How much will climate vary in the U.S. during the 21st Century?" To help answer this question, the NCDC, together with the Office of Science Technology Policy, the Environmental Protection Agency, and the NOAA's OGP has produced a CD-ROM "Probabilities of Temperature Extremes in the U.S.A." Using model projections, users can query the CD and obtain estimated probabilities of extreme temperature occurrences (both warm and cold) for any period during the next 100 years. For some locations, the projections imply that dangerously hot temperatures may be more frequent, while at other places and times, dangerously cold temperatures will be less frequent. The CD can be ordered from:

http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwAW~MP

Selected References

Boyer, T.P., M. Conkright, and S. Levitus, 1999: Seasonal variability of dissolved oxygen and percent oxygen saturation in the Atlantic and Pacific Oceans. *Deep-Sea Research,* 46, 1593–1613.

Clemente-Colon, P., and X.-H. Yan, 1999: Observations of east coast upwelling conditions in synthetic aperture radar imagery. *IEEE Transactions on Geoscience and Remote Sensing,* 37 (5), 2239–2248.

Ellrod, G.P., 1999: The use of GOES sounder imagery for the detection of hazardous volcanic ash plumes. *National Weather Digest,* 22 (4), 3–9.

Ferraro, R.R., S.J. Kusselson, and M. Colton, 1999: An introduction to passive microwave remote sensing and its applications to meteorological applications to meteorological analysis and forecasting. *National Weather Digest,* 22 (3), 11–23.

Gallo, K.P., and T.W. Owen, 1999: Satellite-based adjustments for the urban heat island temperature bias. *Journal of Applied Meteorology,* 38, 806–813.

Goldberg, M.D., and L.M. McMillin, 1999: Methodology for deriving deep-layer mean temperatures from combined satellite infrared and microwave observations. *Journal of Climate,* 12, 5–20.

Graumann, A., and N. Lott, 1999: 1998 Atlantic Tropical Storms. National Climatic Data Center *Technical Report 99-01,* Department of Commerce, National Climatic Data Center, Asheville, N.C.

Groisman, P., E. Peck, and R. Quayle, 1999: Intercomparison of recording and standard non-recording U.S. gauges. *Journal of Atmospheric and Oceanic Technology,* 16 (5), 602–609.

Hittelman, A.M., and S.J. McLean, 1999: Web effects: Frontiers in information delivery. *Proceedings of the International Union of Geodesy and Geophysics,* Birmingham, England, July 19–20, 1999.

Kroehl, H.W., and D.C. Wilkinson, 1999. Will space radiation affect ISS astronauts? Relativistic electrons and the International Space Station. Chapter 3, *Radiation and the International Space Station: Recommendations to Reduce Risk,* National Academy Press, Washington, D.C.

Lott, N., S. McCown, and T. Ross, 1999: *1998–1999 Tornadoes and a Long-Term U.S. Tornado Climatology.* National Climatic Data Center Technical Report 99-02, Department of Commerce, National Climatic Data Center, Asheville, N.C.

Marks, K.M., J.M. Stock, and K.J. Quinn, 1999: Evolution of the Australian-Antarctic discordance since Miocene time. *Journal of Geophysical Research,* 104, 4967–4981.

http://ibis.grdl.noaa.gov/SATkmm/aad.intro.html

Mitchum, G., R. Cheney, L. Fu, C. Provost, Y. Menard, and P. Woodworth, 1999: The future of sea surface height observations. *Proceedings of the OCEANOBS99,* St. Raphael, France.

http://ibiss.grdl.noaa.gov/SAT/pubs/Mitchum.pdf

Peterson, T.C., K.P. Gallo, J. Lawrimore, T.W. Owen, A. Huang, and D.A. McKittrick, 1999: Global rural temperature trends. *Geophysical Research Letters,* 26 (3), 326–332.

Pratson, L., D. Divins, T. Butler, D. Metzger, G. Sharman, M. Steele, T. Berggren, T. Holcombe, and R. Ramos, 1999. Exposing the U.S. Coastal Zone. *EOS, Transactions, American Geophysical Union,* 80 (4), 37–42.

Quayle, R.G., T.C. Peterson, A.N. Basist, and C.S. Godfrey, 1999: An operational near-real-time global temperature index. *Geophysical Research Letters,* 26 (3), 333–335.

Rao, C.R.N., and J. Chen, 1999: Revised post-launch calibration of the visible and near-infrared channels of the Advanced Very High Resolution Radiometer on the NOAA-14 spacecraft. *International Journal of Remote Sensing,* 20, 3485–3491.

Scofield, R.A., and C. Margottini, 1999: Earth observation satellites for flood management and flash flood analysis and prediction. *Space Forum,* 4, 199–222.

Serreze, M.C., J.R. Key, J.E. Box, and J.A. Maslanik, 1999: New monthly climatology of global radiation for the Arctic and comparisons with NCEP/NCAR reanalysis and ISCCP-C2 fields. *Journal of Climate,* 11, p. 121–136.

Strong, A.E., T.J. Goreau, and R. Hayes, 1999: Ocean hotspots and coral reef bleaching: January–July 1998. *Reef Encounters,* 24, 20–22.

Sun, L.C., 1999: Data inter-operability driven by oceanic data assimilation needs. *Journal of Marine Technology Society,* 33, 55–66.

Tikku, A.A., and S.C. Cande, 1999: The oldest magnetic anomalies in the Australian-Antarctic basin are they isochrons? *Journal of Geophysical Research,* 104, 661–677.

http://ibis.grdl.noaa.gov/SATat/tikku_cande_jgr_99.html

Vossepoel, F., R. Reynolds, and L. Miller, 1999: Use of dynamic height observations to estimate salinity variability in the equatorial Pacific. *Journal of Atmospheric Oceanic Technology,* 16 (10), 1400–1414.

Woodhouse, C.A., and J.T. Overpeck, 1999: 2000 years of drought variability in the central United States. *Bulletin of the American Meteorological Society,* 79, 2693–2714.

Wu, X., W.P. Menzel, and G.S. Wade, 1999: Estimation of sea surface temperatures using GOES-8/9 radiance measurements. *Bulletin of the American Meteorological Society,* 80 (6), 1127–1138.

Complete 1999 bibliography listings may be found on the following home pages:

http://www.ncdc.noaa.gov/ol/climate/bibliography.html

http://www.ngdc.noaa.gov

http://www.nodc.noaa.gov/general/NODCPubs/

http://orbit-net.nesdis.noaa.gov

Contacts

Climatic Data

National Climatic Data Center
151 Patton Avenue
Asheville, NC 28801-5001
828-271-4800

http://www.ncdc.noaa.gov

Constituency Information

NESDIS Constituent Affairs Officer
Federal Building 4, Room 3208
5200 Auth Road
Suitland, MD 20746-4304
301-457-5272

Education and Diversity Information

Educational and Diversity Coordinator
SSMCI
1335 East-West Highway, Room 8244
Silver Spring, MD 20910-3282
301-713-9200 x118

http://nesdis.noaa.gov

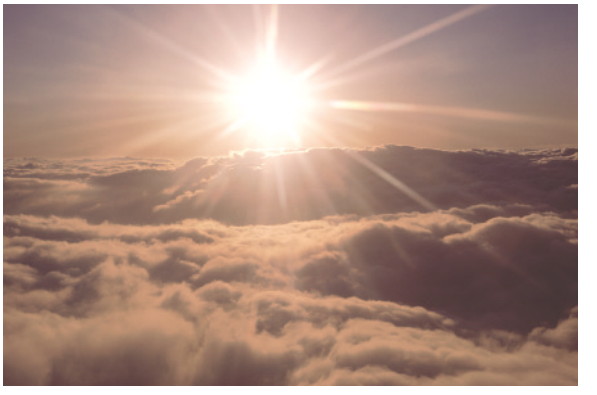
Geophysical Data

National Geophysical Data Center
325 Broadway
Boulder, CO 80303
303-497-6826

http://ngdc.noaa.gov

International and Interagency Policy

International and Interagency Affairs Office
SSMCI
1335 East-West Highway, Room 7311
Silver Spring, MD 20910-3282
301-713-2024



Library Services

NOAA Library
SSMC3
1315 East-West Highway, 2nd Floor
Silver Spring, MD 20910-3282
301-713-2607

http://www.lib.noaa.gov

Media Information and Interviews

NESDIS Public Affairs Officer
Federal Building 4, Room 3313A
5200 Auth Road
Suitland, MD 20746-4304
301-457-5005

Oceanographic Data

National Oceanographic Data Center
SSMC3
1315 East-West Highway, 4th Floor
Silver Spring, MD 20910-3282
301-713-3277

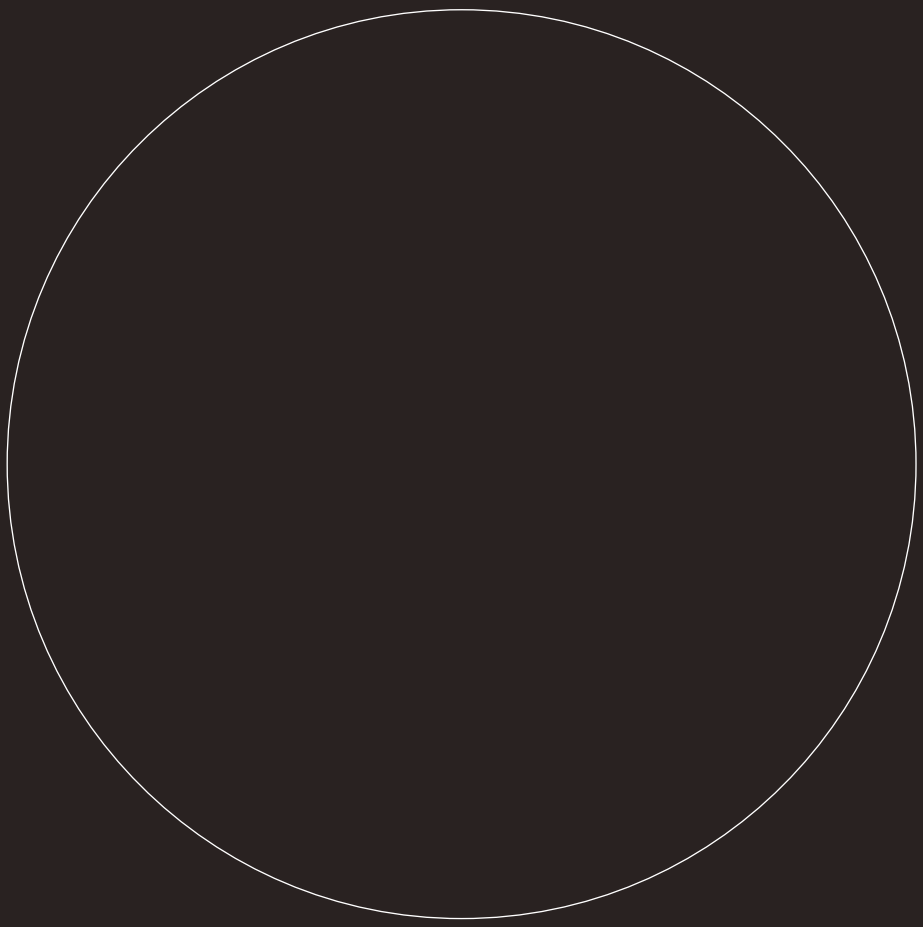
http://www.nodc.noaa.gov

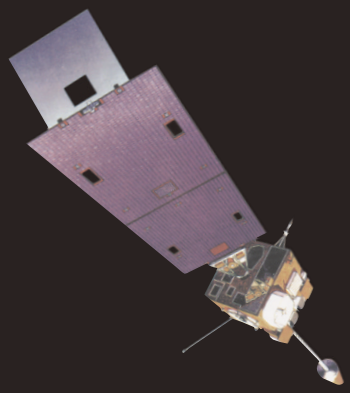
Acronyms

ABBA	Automated Biomass Burning Algorithm
ABI	Advanced Baseline Imager
ADEOS	Advanced Earth Observing System
AMSU-A	Advanced Microwave Sounding Unit-A
AMSU-B	Advanced Microwave Sounding Unit-B
AOML	Atlantic Oceanographic and Meteorological Laboratory
ARGOS	French Data Collection and Location System
ATOVS	Advanced TOVS
AVHRR	Advanced Very High Resolution Radiometer
AWIPS	Advanced Weather Interactive Processing System
CDA	Command and Data Acquisition
CDO	Climate Data On-Line
CEOS	Committee on Earth Observation Satellites
COL	Coastal Ocean Laboratory
COMPS	Customer Order Management Processing System
CNES	Centre Nationale d'Etudes Spatiales
DCS	Data Collection System
DEM	Digital Elevation Model
DHW	Degree Heating Weeks
DMS	Data Management System
DMSP	Defense Meteorological Satellite Program
DOC	Department of Commerce
DOD	Department of Defense
ECO	Educational and Community Outreach
EDMS	Environmental Data and Information System
EDRP	Environmental Data Rescue Program
EMWIN	Emergency Managers Weather Information Network
EOS	Earth Observing System
ESDIM	Environmental Services and Data Information Management
ESSA	Environmental Science Service Administration
EUMETSAT	European Organisation for the Exploitation of Meteorological Satellites
FFRDCs	Federally Funded Research and Development Centers
GIS	Geographical Information System
GLOBE	Global Land One-kilometer Base Elevation
GMS	Geostationary Meteorological Satellite
GOES	Geostationary Operational Environmental Satellite
GSFC	Goddard Space Flight Center
GTS	Global Telecommunications System
HAB	Harmful Algal Bloom
HIRS/3	High-resolution Infrared Sounder/3
HRPT	High Resolution Picture Transmission
HSS	Hazard Support System
IGOS	Integrated Global Observing Strategy
IMS	Interactive Multisensor Snowmapper
INDOES	Indian Ocean Experiment
INSAT	Indian National Satellite
INSWO	International Surface Weather Observations
IPACS	Integrated Polar Acquisition and Control System
IPCC	Intergovernmental Program on Climate Change
IPO	Integrated Program Office
IT	Information Technology
ITU	International Telecommunications Union

LAC	Local Area Coverage
MSU	Microwave Sounding Unit
NASA	National Aeronautics and Space Administration
NASDA	National Space Development Agency
NCDC	National Climatic Data Center
NDC	National Data Centers
NESDIS	National Environmental Satellite, Data, and Information Service
NGDC	National Geophysical Data Center
NMFS	National Marine Fisheries Service
NNDC	NOAA National Data Centers
NOAA	National Oceanic and Atmospheric Administration
NOAALINC	NOAA Library and Information Network
NOAAServer	NOAA Distributed Data and Information Server
NODC	National Oceanographic Data Center
NOS	National Ocean Service
NPOESS	National Polar-orbiting Operational Environmental Satellite System
NPP	NPOESS Preparatory Project
NRL	Naval Research Laboratory
NSIDC	National Snow and Ice Data Center
NVDS	NOAA Virtual Data System
NWS	National Weather Service
OAR	Office of Oceanic and Atmospheric Research
OCL	Ocean Climate Laboratory
OGP	Office of Global Programs
OLS	Operational Linescan System
OPD	Ocean Profile Database
OPI	Ocean Profile on the Internet
ORA	Office of Research and Applications
ORFM	Office of Radio Frequency Management
OSD	Office of Systems Development
OSEI	Operational Significant Event Imagery
OSO	Office of Satellite Operation
PACS	Polar Acquisition and Control System
POES	Polar-orbiting Operational Environmental Satellite
PRIT	Planning Requirements and Integration Team
RFP	Request for Proposal
SAA	Satellite Active Archive
SAB	Satellite Analysis Branch
SAR	Search and Rescue
SARSAT	Search and Rescue Satellite-aided Tracking
SBUV	Solar Backscatter Ultraviolet Spectrometer
SeaWiFS	Sea-viewing Wide Field-of-view Sensor
SEI	Special Events Imager
SFA	Survey Feedback Action
SIT	Strategic Implementation Team
SOCC	Satellite Operations Control Center
SSM/I	Special Sensor Microwave/Imager
SST	Sea Surface Temperature
TIROS	Television Infrared Observation Satellite
UJNR	United States-Japan Cooperative Program on Natural Resources
UNISPACE-III	Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space
USAF	United States Air Force
USGCRP	U.S. Global Climate Research Program
VIIRS	Visible Infrared/Radiometer Imager/Suite
WEFAX	Weather Facsimile
WMO	World Meteorological Organization
WRC	World Radiocommunication Conference

Barbara Abbott • Everett
Abbott • Diana Abney • Stanley Abney • Mary
Adams • Andrew Adkins • Carolyn Alderman • Andrew Allegra •
Donald Allen • James Allen • Paul Allen • Stephen Ambrose • Dawn Anders •
David Anderson • Donna Anderson • Dorothy Anderson • Gloria Anderson • William Angel •
Jimi Anzelc • Steven Arnett • Jeffrey Arnfield • Joseph Askew • Steven Atkins • Robert Aune • Lynne
Axtell • Garry Ayres • Terry Babb • Lisa Babe • James Bailey • John Bailey • Shyam Bajpai • Thomas Baldwin •
Grace Ballard • Edward Baker • Clifford Baker • Anne Ball • James Ballou • Barbara Banks • Celso Barrientos • Richard
Barth • Gerald Barton • Alan Basist • Robert Bassett • Bruce Bauer • Lashawn Baylor • John Beall • Janice Beattie • Michael
Beckman • Phyllis Bellamy • Edward Belote • Patrick Belote • Curtis Benner • David Benner • Delma Bennett • James Berger •
Eugene Berry • Paula Berry • Donald Biersch • Harriett Blevins • Brian Bloedel • Matthew Bodosky • Mark Boland • Arthur Booth • Robert
Boreman • Richard Borneman • Lisa Botluk • Karen Bowie • Harold Bowman • David Bowman • Barbara Boyd • Thomas Boyd • Timothy Boyer •
Carolyn Bradford • Veronica Bradford • James Brady • George Brandon • Opal Brass • Douglas Brauer • Debra Braun • Mark Briele • Danny Brinegar •
Randal Brinker • Robert Britter • Barbara Brooks • Frances Brooks • Todd Brooks • Daniel Brown • Alonzo Brown • Christopher Brown • Cynthia Brown •
David Brown • Dorothy Brown • Ellen Brown • Linda Brown • Joseph Brust • Charles Bryant • Susan Buczek • James Budd • Ronald Buhmann • Michael Burgin •
William Burkhart • Theodore Burlew, • Mary Burris • Angela Burrus • Alva Butler • Andrea Butler • Cheryl Caldwell • Patrick Caldwell • John Callaghan • Geary Callan,
• Louis Cambardella • Robert Cameron • John Campagnoli • Joyce Campbell • John Canter • Changyong Cao • Sharon Capps-Hill • Robert Carey • Howard Carney •
Charles Carpenter • Jan Carpenter • Larry Carr • Lila Carr • Donald Carroll • Emily Carter • Lillian Carter • Shirley Carter • Steven Carter • William Carter • Joseph Catalan •
Michael Chalfant • Paul Chang • Michael Changery • Laura Chapman • Dimitri Chappas • Douglas Charnock • Robert Cheney • Homer Cherrix • Eric Chipman • Johnny Clark •
Craig Clark • David Clark • Debra Clark • Dennis Clark • James Clark • Jeffrey Clark • Pablo Clemente Colon • Wendell Clouse • Helen Coffey • Rosalind Cohen • Morris Cole • Berry
Coleman • Richard Coley • Donald Collins • Elaine Collins • Kay Collins • Richard Collins • Marie Colton • Alfreda Comeger • Gustave Comeyne • Raymond Conkright • Ralph Conlin •
Jean Conrad • Barbara Cook • Brenda Cooke • George Cooper • Dennis Cope • Kevin Cox • Richard Cram • Michael Crane • Van Crawford • Tamara Creech • Angela Crenshaw • Michael
Crison • Roy Crockett • Dennis Crockett • Lawrence Crone • Eveline Cropper • David Crosby • Michael Crowe • Ruby Cubano • Brenda Cumbie • John Cunningham • Jane D'Aguanno •
Ernest Daddio • Harry Dahlberg • Jaime Daniels • Carol Dash • David Dater • Kenneth Davidson • Vaughn Davis • Gary Davis • John Davis • Vicki Davis • Arthur Decotiis • Sylvia Decotiis •
Margaret Dekshenieks • Stephen Delgreco • Claude Dellinger • Mark Demaria • George Demetriades • Charles Dennis • Robert Dennis • Jill Derby • Thomas Derrickson • Susan Devine • Howard
Diamond • Alfonso Diaz Del Castillo • Dianne Dicus • Kyle Dion • Gerald Dittberner • Michael Doney • James Donovan • Jerome Dorsey • Warren Dorsey • Stephen Doty • Henry Drahos • Andre
Dress • John Drummond • Robert Dryden • Christopher Duda • Brownie Dudley • Mary Duggan • Paula Dunbar • Anita Dungan • Ann Dunker • Michael Duran • Parmesh Dwivedi • Tina East • David
Easterling • Dennis Eberts • David Eddy • Mai Edwards • James Ellickson • Leon Ellison • Gary Ellrod • Joe Elms • Stanley Elswick • Christopher Elvidge • Lawrence Enomoto • Marcus Ertle • Edward
Erwin • Terri Esham • Robert Eskridge • Allan Eustis • Craig Evanego • Freida Evans • Stephen Evans • William Evans • Nancy Everson • Elizabeth Ewell • Devoyd Ezell • Wayne Faas • Rebecca Farr •
John Fauerbach • Robert Fennimore • Charles Fenno • Angela Ferguson • Ralph Ferraro • Katherine Fincher • Robert Finson • Anna Fiolek • Edwin Fisher • Andrew Fitzgerald • Michael Fitzmaurice • Robert
Fleeman • Rose Fleming • Stephen Fleming • Lawrence Flynn • Delores Ford • Michael Ford • David Forsyth • Walter France • Deborah Franklin • Phala Franks • Helen Frederick • Richard Freeman • Paul
Fulenwider • David Furlong • Michael Galeone • Kevin Gallo • Nancy Gardner • Richard Garey • Robert Gelfeld • Cynthia Gerecht • Helen Gibson • Mary Glackin • Byron Gleason • Brent Goddard • Catherine
Godfrey • Hilda Gohrband • Mitchell Goldberg • David Goldsmith • Andrew Goldstein • Geoffrey Goodrum • Lynn Goss • Sylvia Graff • Axel Graumann • Donald Gray • Margarita Gregg • Larry Griffin • Mary Griffin •
Doria Grimes • Peter Grimm • Norman Grody • Wendy Gross • Arnold Gruber • Ingrid Guch • Carol Gunning • Jose Gutierrez • Garik Gutman • Nathaniel Guttman • Ray Habermann • Ida Hakkarinen • George Hall •
Alan Hall • Devery Hall • Mark Hall • Norman Hall • Edward Hamblin • Douglas Hamilton • Melanie Hamilton • Gregory Hammer • Cynthia Hampton • Dong Han • Jerry Hardy • Billy Harless • James Harley • James
Harmon • Charles Harris • Heidi Harris • Emily Harrod • Clifford Hartley • Chantell Haskins • David Hastings • Sharon Hawkins • Debria Hayes • Michael Hazel • Mark Healy • Andrew Heidinger • Lisa Heilmeier •
Richard Heim • George Heimerdinger • Claude Hensley • Edward Herbrechtsmeier • Roger Heymann • John Holdzkom • Gary Holt • Brian Hill • Michael Hill • Donald Hillger • Cornelia Hinojosa • Conrad Hinson •
Oliver Hirschfeld • Allen Hittelman • Samuel Hocking • Michael Hodges • John Hoffman • Amy Holbrooks • Curtis Holland • Mary Hollinger • Frances Holt • Charles Hook • Karen Horan • Vicki Horton • Seyed Hosseini •
Colby Hostetler • Philip Hovey • Jason Howard • Tynisa Hubbard • Paul Hudspeth • Joan Hufton • Brian Hughes • George Hughes • Jeffrey Hughes • John Hughes • Kent Hughes • Pamela Hughes • Anne Hulit • Brenda
Humphriesrobinson • Toby Hutchings • Neil Huyck • Glenn Hyatt • Joy Ikelman • Cheryl Ingram • Antonio Irving • David Irwin • Denise Jackson • Nina Jackson • Scott Jackson • Herbert Jacobowitz • Russell Jacobs •
Linda Jamerson • Lawrence James • Richard James • John Jensen • Juanita Jiles • Beverly Johnson • Carloyn Johnson • Daphne Johnson • Gregory Johnson • Larry Johnson • Mary Johnson • Phillip Johnson •
Gwendolyn Jones • Queen Jones • David Joyce • Kenneth Justis • Charles Kadin • Michael Kane • Cynthia Karl • Thomas Karl • Carl Karlburg • Otto Karst • William Kayes • Kathleen Kelly • William Keull • Jeffrey Key •
Alexander Kidd • Katherine Kidwell • Eric Kihn • John Kineman • Beverly King • Edward King • John Kinsfather • Patricia Kirk • Thomas Kleespies • Joseph Klein • Kristin Kniskern • Darrell Knoll • John Koba • Brenda
Koenig • Chad Koenig • Felix Kogan • Shobba Kondragunta • Joseph Kraft • Jeffrey Krob • Herbert Kroehl • John Kuhn • Robert Kuligowski • Sheldon Kusselson • Dennis Lackey • Susan Ladenheim • Johanna Lang •
Leon Larry • Blake Lasher • Levin Lauritson • Phillip Lautenschlager • Reginald Lawrence • Jay Lawrimore • Rosalind Ledford • Kathleen Lefevre • Donna Lefler • Verna Leftwood • Richard Legeckis • Eugene Legg •
Robert Levin • Keith Levinson • Sydney Levitus • Arnold Levy • Mary Lewis • Kirk Liang • John Lillibridge • George Linvill • Patricia Lockridge • Elizabeth Long • Jack Lott • Michael Loughridge • Susan Love Brotak • John
Loving • Phillip Lucich • Kevin Ludlum • Forrest Macdowell • Charles Macfarland • Eric Madsen • Joanne Magoulas • Dennis Mailhot • Robert Mairs • Keith Mann • Daniel Manns • Christine Markomanolakis • Karen
Marks • James Martin • Kathleen Martin • Catherine Marzin • Anthony Mason • Brooks Mason • Elaine Mason • James Mason • Robert Masters • Karon Mathews • Michael Matson • Eileen Maturi • Billie Maybin • Beverly
Menier • David Mcadoo • Gary Mcbrien • Kimberly Mccarty • Milton Mccown • Robert Mccoy • Douglas Mcelreath • William Mcelyeen • Alvin Mcgahee • David Mcginnis • Keith Mckenzie • Tammy Mclaughlin • Susan
Mclean • Albert Mcmath • Larry Mcmillin • Alan Mcnab • Roberta Mcquilkin • Albert Mears • Ajay Mehta • Ralph Meiggs • Matthew Menne • Wolfgang Menzel • Nancy Merckle • Eugene Merritt • Laura Metcalf • Theressa
Metcalf • Barbara Metz • Dan Metzger • Michael Mignogno • Christopher Miller • Dolores Miller • Karen Miller • Laurence Miller • Martha Miller • Barry Mills • Francis Mitchell • Gary Mitchell • Tsan Mo • Ronald Moffatt •
Gordon Moiles • Debra Molinar • Robert Money • Linda Moodie • Carla Moore • John Moore • Rhonda Mooring • Edward Moran • John Moran • David Moreno • Leslie Morris • Kenneth Mugford • Joseph Mulligan •
Patricia Mulligan • Ronald Mumma • Gregory Mundy • Paulette Murphy • William Murphy • Derrick Murray • Regina Murray • Kenneth Myles • Robert Nagan • Douglas Namian • Selina Nauman • Cheryl Nave •
Phillip Neal • Bruce Needham • Ryan Nelson • Teresa Nero • Arthur Neuendorffer • Carl Newlon • Viha Nguyen • Catherine Nichols • Murray Nicodemus • William Nock • Donald Nortrup • Kimberly Nye • Todd O
Brien • Christopher O'Connors • Eric Ogata • David Ogden • George Ohring • Jon Olson • Regan Oney • Andrew Orrison • Timothy Owen • Rhonda Paluba • John Paquette • Gregg Parent • Cecil Paris • Freud
Park • Walter Parks • Jackie Passmore • Samuel Patterson • Catherine Paxton • Debbie Payne • Ernest Payne • Jessica Pejsa • Paul Pellegrino • Ronald Penn • John Pereira • Joseph Perez • Marlin Perkins •
Thomas Peterson • Gilbert Phelps • Charles Phillips • John Phillips • Roger Phillips • Sharon Phillips • Sheri Phillips • Anthony Picciolo • William Pichel • Linda Pikula • Karol Pittman • Walter Planet • Marc
Plantico • David Plich • Daniel Poltar • Penny Poole • Michael Porch • Virginia Pressley • Linda Preston • Elaine Prins • Ann Proctor • James Purdom • Peter Pytlowany • Robert Quayle • Steven Quillen •
Dennis Quinn • Diedra Raboteau • Ronald Rademacher • Bruce Ramsay • Myra Ramsey • Nagaraja Rao • Krishna Rao • Nancy Rathburn • Henry Ray • James Ray • Ronald Ray • Anthony Reale • Joan
Reed • George Reedy • Thomas Reek • Letecia Reeves • Ann Reiser • Thomas Renkevens • Alan Revell • Richard Reynolds • Richard W. Reynolds • Thomas Reynolds • Sharon Rich • Rashelle
Richardson • Deborah Riddle • Barry Riggin • Karin Ring • Anthony Rios • Noel Risnychok • George Ritchey • Carmelo Rivera • Jeannette Rivera • Jeffrey Robel • Keegon Roberts • Thomas Roberts •
Timothy Roberts • Robert Robertson • Robert Robie • Diane Robinson • Thomas Robinson • Wendy Robinson • Robert Roblin • Jennifer Rochester • Michael Rodriguez • Carol Rogers • John Rogers
• Douglas Ross • Thomas Ross • Louis Rubin • Mark Ruminski • Irwin Ruff • Glenn Rutledge • Steven Rutz • Joseph Salazar • Shahid Salman • Patricia Sanchez • Richard Sandridge • John Sapper
• Richard Savage • George Saxton • Charlotte Sazama • William Sazama • Joann Sceizina • Steven Schaffer • Jean Schiro Zavala • Richard Schlapia • Walter Schleicher • Kenneth Schmidt •
Timothy Schmit • Kurt Schnebele • David Schoolcraft • Richard Schreitz • Alan Schwartz • Roderick Scofield • Mark Seiderman • Glen Selby • Edward Seman • Lance Seman • Janice Sessing
• Cyril Settles • Michael Settles • John Shadid • Joyce Shaffer • George Sharman • James Sheridan • Rick Shimon • Lester Shipley • August Shumbera • Natalie Sichina • Raymond Silfa •
Herman Silva • John Simko • Michael Simmons • Naaman Simpson • George Sinclair • Margaret Skeoch • Donnie Slack • Peter Sloss • Rhapsody Smith-Dearring • Alisa Smith • David
B. Smith • David N. Smith • David P. Smith • Elizabeth Smith • Johnny Smith • Jonathan Smith • Walter Smith • Marshall Smyly • Thomas Snell • Douglas Snowden • Nicole Solomon
• Jesus Sotelo • Sharon Souther • Jesse Speidel • William Speidel • Kenneth St. Louis • Roberta Standa • Bethel Stanton • Linda Statler • Raymond Steiner • Eric Stengel •
Catherine Stephens • George Stephens • Scott Stephens • Peter Steurer • William Stewart • Sidney Stillwaugh • Robert Stone • Larry Stowe • Jesse Strand • Davida Streett •
Alan Strong • Timothy Stryker • Jerry Sullivan • Robert Summers • Leanchwan Sun • Michael Suranno • Grace Swanson • Denise Sylvester • Edward Tabor • Chang Tai •
George Talarski • Jerald Tarpley • Lisa Taylor • Pamela Taylor • Gene Terry • Roe Terry • Margaret Tessier • Albert Theberge • John Thomas • James Thomas •
Charles Thomason • Joseph Thornton • Arla Tillman • Michael Tomlinson • Michelle Tomlinson • Peter Topoly • Roger Torstenson • Charles Towles • Janis Trainor
• Ervin Trammell • William Tseng • Yo Tsui • Michael Turk • Kevin Turner • Kyle Turner • Steven Turner • Robert Tye • Michael Urzen • Michael Van Woert •
Charles Vance • Robert Vanwie • David Vercelli • John Vincent • Anne Vironi • Frederick Vizbulis • Russell Vollmers • Angelo Wade • Gary Wade •
Leesalee Walker • Janet Wall • Carla Wallace • Steven Wallace • Alva Wallis • Timothy Walsh • Regis Walter • Linda Warden • Andrew Wardrett •
David Wark • Barbara Warnick • Robin Warnken • Donna Warren • Michael Warren • Eunice Warrington • Leroy Waters • Benjamin Watkins •
Carmella Watkins • Jesse Watkins • Marcia Weaks • John Weaver • Michael Weinreb • Roger Weldon • Ingrid Wells • James Welsh •
Fuzhong Weng • Philip Whaley • Joseph White • Frederick White • James White • Sandra White • Hilary Whitehurst • Harry
Whiteley • Marie Whitt • Peter Wilczynski • John Wilkerson • Daniel Wilkinson • Claude Williams • Donna Williams •
Howard Williams • Linda Williams • Lindsey Williams • Wayne Wilmot • Monroe Wilson • Roger Winchell •
Robert Winokur • Wayne Winston • Gregory Withee • Vernell Woldu • Winifred Womack • Harold Wood
• Helen Wood • Maureen Woods • Charles Wooldridge • Vickie Wright • Angela Wyatt •
James Yoe • Sharolyn Young • Carl Yowell • Marilyn Yuen • James Zaitzeff •
Domon Zawkhin • Steven Zegalia • Raymond Zehr • Cynthia
Zeigler • Susan Zevin • Jerome Ziemianski •





U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Environmental Satellite, Data, and Information Service