Vol. 16, No. 3 ● February 2008

EARTH SYSTEM MONITOR

Observing the Earth from Space

A guide to NOAA's data and information services

INSIDE

U.S. Department of Commerce
National Oceanic and Atmospheric Administration

Mary E. Kicza, NOAA Assistant Administrator for Satellite and Information Services

At NOAA, we observe the Earth with a variety of systems—including buoys, airplanes, and satellites—to provide up-to-date data to emergency planners, meteorologists, the public, and other users. One of the best ways to provide consistent, long-term, 24/7 measurements of the Earth is by using Earth observation satellites. As technology improves, and the demand for new and more detailed information increases, satellites will continue to play a major role in monitoring the Earth and its processes.

NOAA operates two types of satellites for the United States: geostationary and polar-orbiting. Our geostationary satellites constantly monitor the Western Hemisphere from around 22,240 miles above the Earth, and the polar-orbiting satellites circle the Earth, supplying global information from 540 miles above the Earth. Geostationary satellites are our weather sentinels; they help us constantly monitor severe storms and hurricanes. Our polar-orbiting satellites are used for long-range forecasting and a variety of climate observations. Both types of satellites are essential to weather prediction; they provide major input to weather prediction models. Satellite measurements are also important for monitoring our oceans and coastal areas.

Our satellite observing program is end-to-end. We develop the requirements for building satellites; work with NASA or the Department of Defense to acquire the systems, operate the satellites 24/7; process the satellite data to make it useable for forecasters and researchers; and archive the data for scientists, researchers, and future generations. We also use satellite data to develop new applications and to look at trends in historical data.

We are in the process of building the next generation of polar-orbiting and geostationary satellites, with partners at NASA and the Department of Defense. These satellites will be launched in the next decade and will drastically improve our ability to observe the Earth. They are crucial to improving our ability to monitor weather, climate, wildfires, drought, hazards in coastal areas such as red tide, and many other areas that impact us each day.

To fulfill our mission, NOAA also works with other government agencies and international organizations for data access and sharing and to find ways to best use satellite data now and in the future. No one country can afford to build and maintain all the equipment needed to gather all the different types of measurements scientists are interested in. Therefore, we must work with our international partners and share observations and data among the global community. The efforts include integrating satellite data with ground, ocean, and air-based systems. This type of view provides comprehensive information to users around the world.

▲ Mary E. Kicza

NOAA is committed to leading the way in which integrated environmental observations and information are captured, managed, stored, shared, and used to benefit the world. The articles in this *ESM* on satellite applications, the future of satellite data use, and the importance of our international partnerships demonstrate our commitment to serve the needs for environmental observation to solve global and national concerns that affect our daily lives. ■

Letter from the New NODC Director Dr. Margarita Conkright Gregg

▲ Dr. Margarita Conkright Gregg

It is my distinct privilege to be the new Director of the National Oceanographic Data Center (NODC). This data center acquires and preserves a historical record of the Earth's changing environment that is used for operational applications and ocean climate research. NODC manages the world's largest collection of publicly available oceanographic data and provides access to the Nation's coastal and ocean data resources. As the NODC director, my job is to lead NODC in achieving its mission to ensure that global oceanographic datasets collected at great cost are maintained in a permanent archive that is easily accessible to the world science community and other users. Scientific stewardship of *in situ* and satellite ocean data is at the core of our mission, which can only be accomplished through the partnerships and interactions we develop with the national and international collectors, providers, and users of ocean data. I look forward to interacting with the *Earth System Monitor* community in order to hear firsthand your requirements for ocean data and how NODC can better serve you.

I started my career with NOAA as an Oceanographer working in NODC's Ocean Climate Laboratory on chemical and biological databases. Later in my career, I was the Deputy Director of NOAA's Climate Program Office where I was in charge of the day-to-day management of the office and leading the budget planning and formulation processes for NOAA's Climate Program. I have the following degrees from the University of South Florida: Master of Science in Marine Science (Biological Oceanography) and Doctor of Philosophy in Marine Science (Chemical Oceanography).

My experiences have solidified a strong belief in the preservation of data. NODC data holdings extend back over one hundred years, and the volume is expected to grow exponentially as new ocean observing systems are deployed. The NODC archive includes *in situ* and remotely sensed physical, chemical, and biological oceanographic data from coastal and deep ocean areas. NODC also manages the NOAA Library and Information Network, which includes millions of books, journals, CD-ROMs, DVDs, and audio and video recordings. Through the archive and access services, ocean data are used not only to understand the role of the oceans in a warming climate, but also to bring together diverse coastal data from a variety of sources to support ecosystem management and improve the ability of our coastal and global models.

This issue of the *Earth System Monitor* addresses the role of satellites in NOAA. Inside, you will find articles on topics such as promoting our international partnerships and progressions in remote sensing, which are put into perspective by Mary Kicza, Assistant Administrator for NOAA Satellite and Information Services. Future issues will have different themes that we hope will address important topics throughout NOAA in a timely manner. We at NODC and NOAA Satellite and Information Service welcome your feedback and recommendations on any aspect of our data center. ■

Margarita

EARTH SYSTEM MONITOR

The *Earth System Monitor* (ISSN 1068-2678) is published quarterly by the NOAA National Environmental Satellite, Data, and Information Service. Past issues are available online and are syndicated by an RSS feed. See: www.nodc.noaa.gov/General/NODCPubs/ESM/esm.html

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Global Environmental Satellites—Past, Present, and Future

Brian Hughes, Staff Physical Scientist and Operations Manager, Office of Satellite Data Processing and Distribution

In 1960, the launch of the first environmental satellite, TIROS, ushered in the era of modern space-based environmental monitoring and remote sensing. Today, NOAA is one of many international organizations that have developed and launched hundreds of satellites designed to monitor and measure the global environment.

NOAA's Satellite and Information Service (NESDIS) is charged with the acquisition, development, operation, and maintenance of several key environmental satellite programs. NESDIS builds and operates the ground systems needed to obtain data from satellite sensors. This organization also processes the data to create products useful to everyone from research scientists to weather forecasters to the public.

Weather forecasters around the country routinely use satellite images to show the progress of clouds and storms. To the casual observer, a satellite image is a picture of the Earth as seen from space. The white clouds, green land, brown mountains, and blue ocean areas seen in these images are generated to simulate what an observer would see if they were hovering above the Earth. In reality, these images are computer-generated satellite products, prepared using millions of bits of data from instruments aboard satellites.

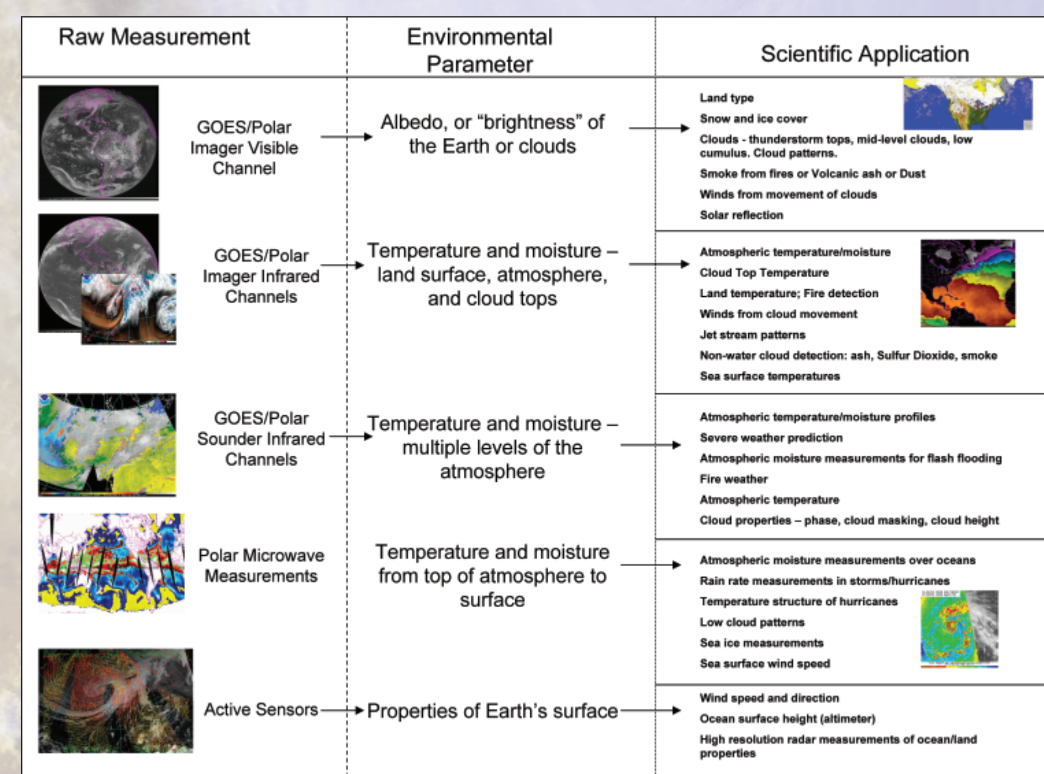
Environmental satellites and associated ground systems create products by capturing raw data from satellite instruments and processing these data using complex mathematical algorithms. The resulting output can be displayed in graphical form or sent directly to other computer systems that produce National Weather Service numerical weather prediction models.

These products, which now number in the thousands, are produced many times every day, 365 days per year. NESDIS ingests, processes, generates, and distributes several terabytes of data each day. To put this into perspective, it would take over 30 iPods each with 80 Gb of storage to hold all of the data processed and distributed by NESDIS every day.

Environmental satellites have a unique advantage over many other types of environmental monitoring mechanisms such as weather balloons, aircraft, and radars. Satellites maintain a constant view of the Earth and its atmosphere and are built to withstand the harsh surroundings of space for many years. These attributes allow the precise measurement and understanding of weather and climate. In addition, satellites can play a key role in detecting and monitoring other events such as volcanic eruptions, large wildfires and associated smoke, El Niño and La Niña, snow and ice recession, severe droughts, and tsunamis.

Many different types of satellite products can assist weather forecasters. While many people focus on satellite images of hurricanes bearing down on populated areas, there are other types of satellite data used for similar purposes. For example, infrared measurements of oceans are made into maps of sea surface temperature critical to forecasting the intensity of hurricanes. Special sensors on environmental satellites can emit pulses of energy toward the ocean surface, measure the reflection of that energy, and create a map of surface winds located in the center of a storm. Other sensors can measure the internal temperature of a hurricane and the temperature of the cloud tops to determine the strength of the storm. Ahead

(continued on page 5)



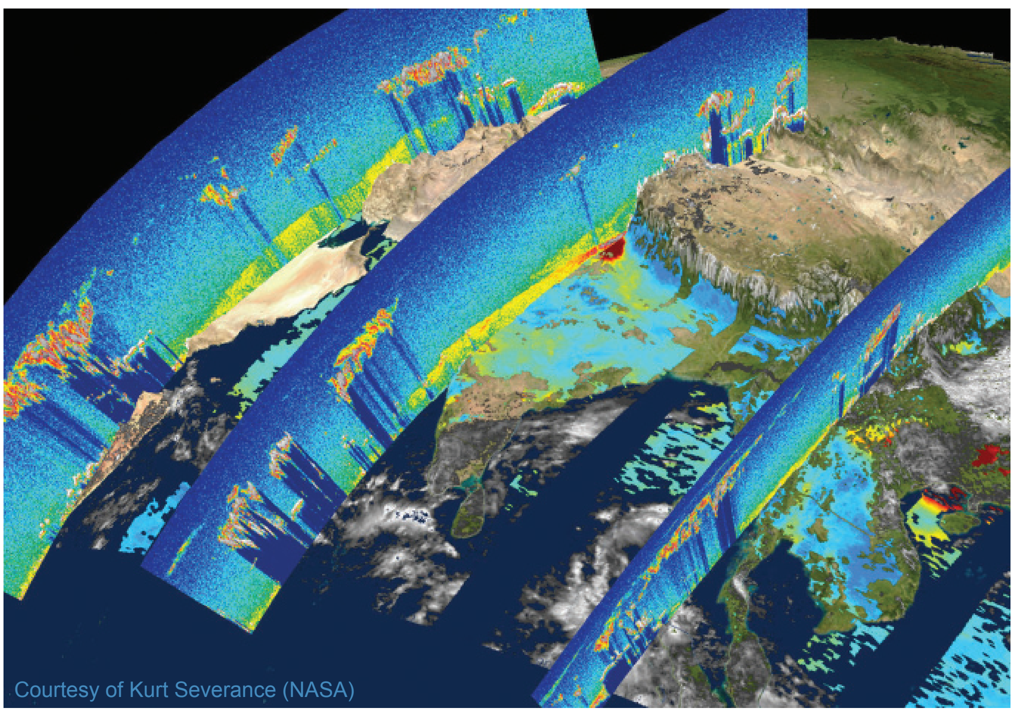
Movin' on Up: Progress in Satellite Remote Sensing and Modeling

Ingrid Guch, Director, NOAA Satellite and Information Service Cooperative Research Program

From manual labor to movies

In the early days of remote sensing, producing one picture of the Earth from space required significant manual labor. Each satellite image showed just a small section of the world, and many pictures needed to be stitched together to create the larger picture of the Earth.

Even with hundreds of years of observations by weather watchers and mariners, scientists were startled when these early pictures revealed so many clouds in the sky. Nowadays, the public can comfortably watch the weather report and see imagery loops taken from satellites and ground-based radar, providing an excellent picture of how storm systems move. Unfortunately, these satellite and radar images provide only a two-dimensional view of the weather, so anything that is not moving horizontally is a mystery. For example, we can't see air moving from the Earth's surface up over tall mountains to higher, cooler altitudes where clouds form when the air reaches its dew point.



Courtesy of Kurt Severance (NASA)

▲ Calipso vertical slices of clouds and aerosols over India.

Vertical structures revealed

Today, atmospheric observations go beyond the cloud tops seen on television. Space, ground, and aircraft-based Light Detection and Ranging (LIDAR) and cloud radars are providing new views of the vertical structure of the atmosphere. These technologies make it possible to determine the characteristics of each cloud layer; however scientists and the media are struggling with how to present this new vertical "slice of the atmosphere" information to a wider audience. Each slice of the atmosphere is based on three points: one point is on the Earth's surface and the other two points are chosen to best capture the path of the air masses heading toward the first point. But a movie loop of a particular slice of the atmosphere is impossible at this time without ground-based observations or weather models to fill in the gaps between satellite images. Unfortunately the observations, models, and our understanding of the dynamics are still missing the information needed to provide this.

The future of satellite remote sensing research lies in combining current and new observations and models to improve our understanding of the atmosphere and ocean. The resulting science and 3-D visualization will greatly improve the accuracy of the information and forecasts presented to the public.

Key components of weather and ocean vertical structure

There are several items that, combined with solar heating, are especially important to presenting global 3-D (vertical and horizontal) dynamics of the atmosphere and ocean: temperature, moisture, salinity, and wind/currents. Temperature, moisture, and salinity provide density data and critical information about the movement of air or water. The most dense air (cold and dry) and water (cold and salty) will sink; conversely the least dense air and water will rise. However, even the densest air will rise when pushed toward a mountain, and even the densest water will rise from the ocean floor when pushed toward a continent. Because we are interested in gaining a global, 3-D understanding of the atmosphere and ocean, we need to focus on both topography and full air and water profiles, from the bottom of the sea floor to the top of the atmosphere.

1. *The industry is moving toward hyperspectral instruments that provide 200-2000 (rather than the current 10-20) channels.* Each channel is sensitive to a different layer of the atmosphere. The U.S. series of low-orbiting weather satellites is expected to include this type of instrumentation for operational applications within a decade. Progress is being made toward putting this type of instrument on the high-flying geostationary satellites; this could provide temperature profiles over the same location every 30 minutes.

2. *More operational satellites than ever have receivers that can change GPS radio signals into temperature and moisture profile information.* The orbit of the GPS receivers is lower than the orbit of GPS satellites, and so GPS receivers can track GPS satellites as they rise and set over the Earth, giving full profile information. Using the temperature information from the hyperspectral instruments, moisture profiles from GPS receivers are comparable in accuracy to profiles from weather balloons.[1]

3. *More active instrumentation on satellites, providing cloud reflectivity profiles from radar (Cloudsat), aerosol profiles from lidar (Calipso), sea surface winds (QuikSCAT and ASCAT) from scatterometers, and sea level height (Jason) from radar altimeters.* NOAA has made significant progress using measurements of sea level height and sea surface temperature to predict intensity changes in hurricanes about to make landfall. High sea surface temperature indicates the immediate energy needed for a hurricane to intensify is available. Sea levels indicate the depth of warm water in the ocean and thus the length of time a hurricane is likely to stay a threat.[2]

4. *New measurements of salinity at the surface of the ocean will be made in the next few years on the Aquarius mission (a partnership between NASA and Argentina's space agency).* The instruments on this mission will include three radiometers sensitive to salinity and a scatterometer that corrects for the ocean's surface roughness.

5. *New measurements of wind profiles with the launch of Europe's Atmospheric Dynamics Mission in the next few years.* On this mission, a laser will be tuned to reflect light when it comes into contact with air molecules and aerosols. The time the light takes to return back to the spacecraft determines the location of the particle and the frequency of the returning light provides the speed at which the particle was traveling.

The benefits to come

Almost all of the Earth observing partners—Federal, academic, international, nonprofit, and corporate—are working toward the same societal benefits that can be achieved with a more accurate understanding of Earth observations. These benefits include helping us protect ourselves against natural and human-induced disasters, managing energy resources, responding to climate change and its impacts, safeguarding freshwater resources, and improving weather forecasts. The profiles of temperature, moisture, salinity, and currents/winds will go a long way toward improving our understanding of general circulation patterns in the air and oceans. Observations of vegetation, glaciers, ground and air pollutants, wildlife migrations, human and animal health, fires, carbon monoxide/dioxide, and ocean acidity will be collected and play critical roles. Applications and model developers will have a better observational foundation than ever before to understand and predict our weather and climate. The tools that everyone uses to make better decisions about the future will be more accurate, more useful, and, hopefully, more fun. ■

[1]Anthes, R. A., P. A. Bernhardt, Y. Chen, L. Cucurull, K. F. Dymond, D. Ector, S. Healy, S.-P. Ho, D. C. Hunt, Y.-H. Kuo, H. Liu, K. Manning, C. McCormick, T. K. Meehan, W. J. Randel, C. Rocken, W. Schreiner, S. V. Sokolovskiy, S. Syndergaard, D. C. Thompson, K. E. Trenberth, T.-K. Wee, N. L. Yen, and Z. Zeng, 2008. "The COSMIC/FORMOSAT-3 Mission: Early Results," *BAMS (Bulletin of the American Meteorological Society)*, American Meteorological Society, in press for February or March 2008.

[2]Goni, G. and J. Trinanes, "Ocean Thermal Structure Monitoring Could Aid in the Intensity Forecast of Tropical Cyclones," EOS, Transactions American Geophysical Union, Vol. 84, pp. 573-580, 2003.

(Global Environmental Satellites continued from page 3)
of the storm, we can estimate atmospheric winds using algorithms that track cloud movement. Temperature and moisture data from other types of sensors can be used in computer models to forecast storm movement.

Environmental satellites can support many disciplines other than weather forecasting; they can be used to study climate, land science, ocean science, ecosystems, space weather, air quality, and many others. We also use satellites to explore connections across these disciplines. For example, pollutants affecting air quality can be detected by a satellite, and their long-term effects can be measured by climate sensors. In addition, dust from the Sahara Desert in Africa, as "seen" from a satellite sensor, can inhibit the development of tropical storms in the Atlantic. Also, atmospheric moisture detected by special sensors aboard polar-orbiting satellites can influence the amount of rainfall thousands of miles away.

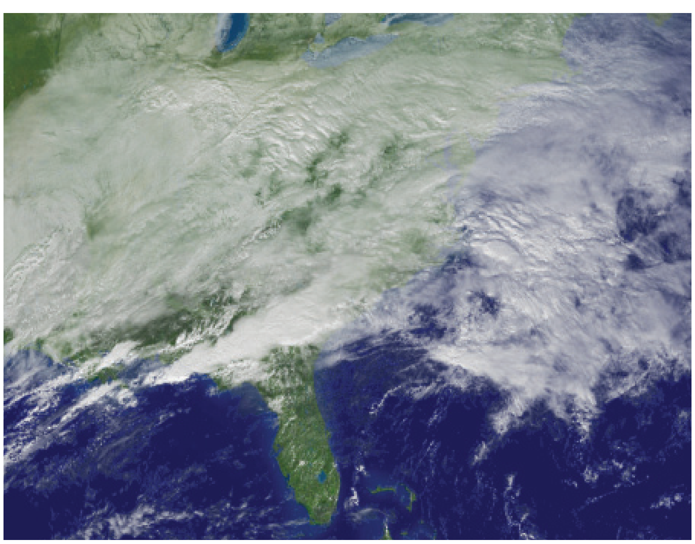
The future is exciting yet challenging for the environmental satellite community. New instruments with cutting edge technology are set to be launched on the next generation of satellite platforms, increasing the number of measurements that can be taken and providing hundreds of new products or improvements to existing products. These new sensors will give scientists a more complete picture of Earth's environment, thus saving more lives and enhancing the Nation's economy. ■

International Partnerships: Ensuring Access to Global Observations

Dr. D. Brent Smith, Chief, Office of the International and Interagency Affairs, NOAA Satellite and Information Service

There are more than 60 civil environmental satellites orbiting the Earth, sending environmental information such as cloud cover, sea surface winds, and volcanic activity to ground stations and space centers around the world. This information has many uses including letting the public know when to grab an umbrella before leaving the house for work; enabling whale watching boat operators to know when they must return to port because the sea state is too high to see humpback whales frolicking in the waves; and providing up-to-date information to commercial airliners about volcanic ash clouds so they can travel safely. Environmental satellites can be owned and operated by governments, international organizations, commercial companies, research and academic institutions, and others. Because of the varied ownership, many of these systems operate independently, exchanging little or no information with other organizations. Producing better information on the global environment has become a worldwide priority, and international partnerships are essential to achieving this goal because no country can monitor the entire Earth by itself.

Bringing space-based sensors, ground-based data analysis systems, and skilled experts together requires a well-coordinated international effort and strong commitments from space agencies. To address this need, several space agencies created the Committee on Earth Observation Satellites (CEOS) in 1984. This committee is dedicated to international collaboration among space systems and Earth observation missions. Twenty-eight member agencies support CEOS and work to develop national satellite programs with common standards and systems that can provide data to the international community. The purpose, mission, and requirements of space systems, however, remain the responsibility of individual space agencies. This ensures that each space agency will always have control over its space system priorities. NOAA is a founding member of CEOS, and is currently leading the effort to identify how CEOS members will step up to contributing to key international Earth observations in the future.



▲ GOES-12 1 kilometer imagery from February 22, 2008, at 1145Z. This imagery shows a storm system producing a wintry mix over parts of the Eastern, Southern, and Midwestern United States.

NOAA participates in other important international partnerships for space-based Earth observation including the Group on Earth Observations (GEO). GEO is an intergovernmental partnership of governments and international organizations created to exploit the growing potential of Earth observations to support decision-making in an increasingly complex and environmentally stressed world. This group is building the Global Earth Observation System of Systems (GEOSS) that will provide comprehensive and sustained access to remotely sensed and *in situ* Earth observations. GEOSS strives to transform data collected from existing and future, national, regional, and international Earth observation systems into easily accessible, standardized, and understandable formats for all GEO members. By ensuring the data are widely available and easily understood, GEOSS will benefit society by reducing loss of life and property from natural and human-induced disasters, improving predictability of climate variations and change, and improving the management of coastal and marine ecosystems. These GEOSS societal benefits also happen to be NOAA goals supporting our mission and vision proving how important international partnerships are to NOAA. The U.S. contribution to GEOSS is overseen by the United States Group on Earth Observations (US GEO), a partnership of 15 government agencies, including NOAA. US GEO depends on input from federal sources as well as state and local governments, industry, academia, and nongovernmental organizations, which play a major role in the leveraging of observation systems for social and economic benefit.

No agency or country can observe the entire Earth alone. International partnerships such as CEOS and GEO help the global community have access to critical data that help many people—from individual families to heads of state—make decisions that affect our economies, ecosystems, and everyday lives. ■

Office of Space Commercialization Promotes U.S. Space Industry

Michael Beavin, Senior Program Analyst, Office of Space Commercialization

Space has always fascinated the American public, and over the years, it has become increasingly vital to our Nation's economic interests. In many cases, space-related activities have become so routine, dependable, and convenient that the public may forget the services they rely on and enjoy are actually beamed to them from orbit. Space activities are important to our daily lives, and it is in our economic interest to encourage further development in this area and to ensure the long-term viability of the U.S. space industry.

The NOAA Satellite and Information Service Office of Space Commercialization (OSC) is the principal unit for space commerce policy activities within NOAA and the Department of Commerce. OSC fosters the conditions for economic growth and technological advancement in the U.S. commercial space industry. To that end, OSC focuses its efforts on several commercial space industry sectors, including satellite navigation, satellite imaging, space transportation, and entrepreneurial space businesses.

The Global Positioning System (GPS) is a constellation of over 24 U.S. Government satellites providing positioning, navigation, and timing (PNT) services to civilian and military users on a continuous, worldwide basis—free of direct user charges. GPS provides a precise, common location and time reference to an unlimited number of people in all kinds of weather, day and night, anywhere in the world. Thanks to our Nation's longstanding policy to make GPS available free of direct user fees and our long track record of dependable service, tens of millions of users worldwide have benefited. GPS technology can be found in everything from cars and planes to cell phones and wristwatches. It is being used to improve productivity in areas as diverse as farming, mining, construction, surveying, taxicab management, and package delivery. It is also enhancing public safety by preventing transportation accidents and reducing the response times of ambulances, firefighters, and other emergency services. In addition, GPS is advancing scientific aims such as weather forecasting, earthquake prediction, and environmental protection. Furthermore, the precise GPS time signal, derived from atomic clocks, is being applied to critical economic activities such as synchronizing communication networks, managing power grids, and authenticating electronic financial transactions.

Commercial space-based remote sensing, the collection of Earth images from space by private firms, has a multitude of applications spanning many sectors of the Nation's economy. These applications include mapping, weather prediction, agricultural and land management, environmental analysis, and national security reconnaissance activities. Satellite imagery is most useful when combined with GPS, electronic maps, and local data into a geographic information system (GIS). The most popular GIS is Google Earth™, which has made commercial satellite imagery freely available to almost anyone via the Internet. NOAA also licenses the operation of commercial imaging satellites used for mapping, agriculture, and other applications.

The space transportation industry includes launch vehicle manufacturers, operators, suppliers, and spaceport facilities that serve commercial and government customers. The growing demand for satellite-based services has contributed to the development of a competitive, worldwide market for commercial launch services and has attracted interest in several entrepreneurial start-up companies.

The Commerce Department established OSC to provide a voice for the U.S. commercial space industry within government policy discussions affecting space. The Office works to ensure that U.S. government policies support and do not impede the growth of U.S. commercial space companies, and that there is a level playing field on which these companies can compete internationally. ■

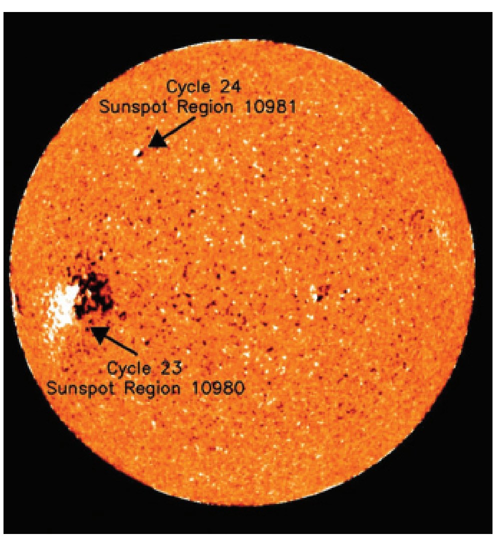
News Briefs

NOAA: Sunspot is Harbinger of New Solar Cycle, Increasing Risk for Electrical Systems

A new 11-year cycle of heightened solar activity, bringing with it increased risks for power grids; critical military, civilian, and airline communications; GPS signals; cell phones; and ATM transactions, showed signs it was on its way on January 3, 2008, when the cycle's first sunspot appeared in the Sun's Northern Hemisphere, NOAA scientists said.

A sunspot is an area of highly organized magnetic activity on the Sun's surface. The new 11-year cycle, called Solar Cycle 24, is expected to build gradually, with the number of sunspots and solar storms reaching a maximum by 2011 or 2012, though devastating storms can occur at any time.

During a solar storm, highly charged material ejected from the Sun may head toward Earth, where it can bring down power grids, disrupt critical communications, and threaten astronauts with harmful radiation. Storms can also knock out commercial communications satellites and swamp GPS signals. Routine activities such as talking on a cell phone or getting money from an ATM machine could suddenly halt over a large part of the globe.



▲ First official sunspot belonging to the new Solar Cycle 24.

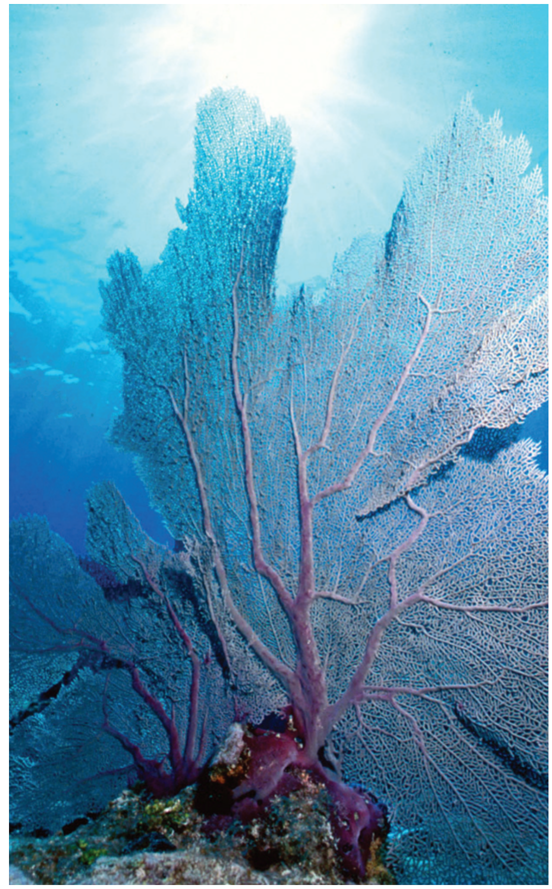
"Our growing dependence on highly sophisticated, space-based technologies means we are far more vulnerable to space weather today than in the past," said Vice Admiral Conrad C. Lautenbacher, Jr., Under Secretary of Commerce for Oceans and Atmosphere and NOAA administrator. "NOAA's space weather monitoring and forecasts are critical for the Nation's ability to function smoothly during solar disturbances."

The new sunspot is the latest visible spot to appear since NOAA began numbering them on January 5, 1972. Its high-latitude location at 27° North and its negative polarity leading to the right in the Northern Hemisphere are clear-cut signs of a new solar cycle, according to NOAA experts. The first active regions and sunspots of a new solar cycle can emerge at high latitudes while those from the previous cycle continue to form closer to the equator.

New *Science* Article Says Carbon Emissions Threaten Coral Reefs

NOAA Coral Reef Watch coordinator Mark Eakin and 17 fellow coral scientists from around the globe say corals could begin to disappear in 50 to 75 years due to steadily warming temperatures and increasing ocean acidification caused by carbon dioxide emissions. Their findings were published as the cover story in *Science* on December 14, 2007.

The scientists are leading members of the international Coral Reef Targeted Research and Capacity Building for Management Program, of which NOAA is a member. They argue that if rising global CO_2 emissions are allowed to continue unchecked, this "irreducible risk" will rapidly outpace the ability of local coastal managers and policy makers to maintain the health of these critical ecosystems.


▲ Common sea fan (Gorgonia ventalina).

Under guidance from the U.S. Coral Reef Task Force, co-chaired by NOAA, local ecosystem managers have been devising action plans to cope with coral bleaching impacts. Developing partnerships with the World Bank and others, local managers have been seeking to reduce overfishing, pollution, and unsustainable coastal development—the major local environmental threats caused by human activity.

One of the important tools these managers have been using is the NOAA Coral Reef Watch warning system, launched in 2000. This system provides managers with automated e-mail alerts when NOAA satellite observations indicate rising water temperature beyond critical limits, conditions warranting extra measures to reduce stress on local reefs.

NOAA recently expanded the warning system, adding 36 new virtual stations designed to monitor conditions that can lead to coral bleaching and reef disease or death. The new virtual stations, while currently experimental, more than double the available monitoring stations of coral ecosystems, increasing from 24 to 60 sites.

"The data collected from the coral reef components of the developing integrated ocean observing system are documenting the increase in water temperature caused by global warming and providing additional measures of the impacts of human activity on corals," notes Eakin. "Corals are the sentinel of the seas and it is critical for us to listen and make adaptive responses to the warnings they are giving us."

Gas Flaring Study Picks Up Steam

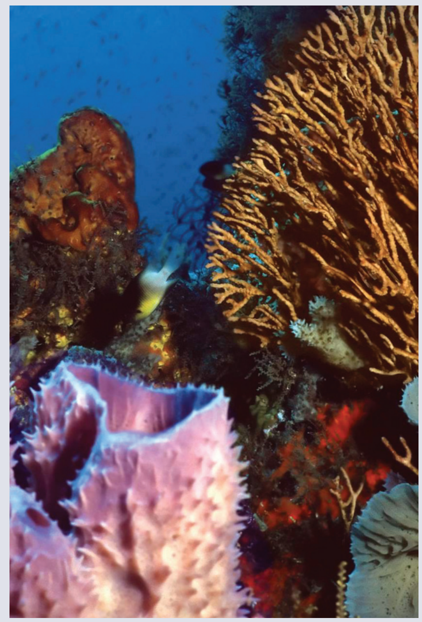
Gas flaring is a widely used practice for the disposal of natural gas in petroleum producing areas where there is no infrastructure to make use of the gas. Gas flaring is widely recognized as a waste of energy and an added load of carbon emissions for the atmosphere. Despite this recognition, there is substantial uncertainty regarding the magnitude of gas flaring.

The National Geophysical Data Center (NGDC) produced the first globally consistent survey of natural gas flaring volumes using low-light imaging data from the U.S. Air Force Defense Meteorological Satellite Program Operational Linescan System. NGDC's results indicate that in 2006 global gas flaring totaled 168 billion cubic meters; this is more natural gas than the combined use of Japan, China, and India.

The study was commissioned by the World Bank Global Gas Flaring Reduction (GGFR) initiative. Previously, GGFR had gas flaring volumes reported for twenty countries. Using satellite data, NGDC tripled the number of countries found with gas flaring estimates. ■

11th International Coral Reef Symposium

Wendy Wood, Coordinator of Administrative Operations, NOVA Southeastern University, Oceanographic Center



This July, the 11th International Coral Reef Symposium (ICRS) will be held in Ft. Lauderdale, Florida, marking the first time ICRS is held in the continental United States in 30 years. Every four years, this major scientific conference convenes to provide the latest knowledge about coral reefs worldwide. Natural scientists, resource managers, and conservationists will come together to discuss and advance coral reef science, management, and conservation. The theme of this symposium is "Reefs for the Future" and the goals are:

- To provide a scientific basis for coral reef ecosystem management by articulating the state of the science with respect to current and emerging stressors
- To improve the understanding of reef condition, function, and productivity
- To grow the field of coral reef ecosystem science and encourage multidisciplinary research by facilitating the exchange of ideas

The 11th ICRS will include exhibits, educational displays, social events, and 26 mini-symposium sessions, which will feature prominent scientific and management topics on coral reef ecosystems. Field trips will take advantage of the South Florida venue allowing experts and policy makers to visit and study reef systems in the Atlantic, Caribbean Sea, Gulf of Mexico, Meso-America, and Eastern Pacific. ■

11th International CoralReef SYMPOSIUM 2008
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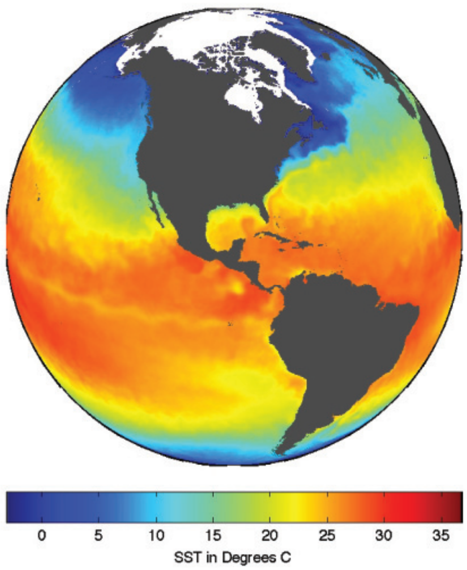
For more information on ICRS, visit www.nova.edu/ncri/11icrs.

Ocean Remote Sensing in 2008 and Beyond—A View from the Archives

Kenneth S. Casey, Ph.D., Satellite Oceanography Group Leader, National Oceanographic Data Center



▲ This figure demonstrates a global analysis SST product created as part of the GHRSST project and used to improve operational weather forecasting. (NOAA created this image and the UK Met Office supplied the data to generate the image, Crown Copyright 2007.)

Looking forward to the future of ocean remote sensing in 2008 and beyond, an Albert Einstein quote comes to mind: "In the middle of difficulty lies opportunity." Satellite-based ocean remote sensing is going through a difficult time as the quality and availability of continued ocean color observations is now in question. The venerable Sea-viewing Wide Field of view Sensor (SeaWiFS) instrument will soon surpass 10 years in space, and NASA's ocean color sensor on Aqua is approaching six years in service. The Visible/Infrared Imager/Radiometer Suite (VIIRS) instrument on the National Polar-orbiting Operational Environmental Satellite System (NPOESS) Preparatory Project (NPP) is slated to take over measuring ocean color parameters; however NPP will not launch until 2009 or 2010, making an overlap between the existing sensors and new sensors unlikely. Our future ability to monitor all-weather sea surface temperature (SST) and ocean surface topography is also in doubt because of the removal of the Conical Microwave Imager/Sounder (CMIS) and Radar Altimeter sensors, respectively, from the NPOESS platforms. Ocean observations from space are critical to a tremendous range of applications, including weather and hurricane prediction, coral reef monitoring, climate change studies, and fisheries management.

Although this outlook may appear bleak, opportunities exist in the middle of these difficult times and there are several reasons to be optimistic about the future of ocean remote sensing. International collaborations have increased dramatically in recent years as our awareness of the need for data sharing and access has grown in the ocean remote sensing community. Within NOAA, progress has been made toward using the European MEdium Resolution Imaging Spectrometer (MERIS) sensor as an ocean color backup for SeaWiFS and Aqua ocean color products. Products like these are critical for identifying harmful algal bloom outbreaks in areas such as the Chesapeake Bay and Gulf of Mexico. The United States and other countries are making progress toward merging ocean color observations from multiple sensors, and efforts are underway to archive a 10-year ocean color record produced by the European GlobCOLOUR project at the National Oceanographic Data Center (NODC). To monitor sea level and ocean currents, the joint U.S.-French Jason-2/Ocean Surface Topography Mission (OSTM) mission is scheduled to launch later in 2008. This mission will continue the ocean altimeter record into the next decade. Also, the international Global Ocean Data Assimilation Experiment (GODAE) High Resolution SST (GHRSST) project has matured and is now delivering to the NODC archive almost a terabyte of SST data each month from almost every satellite sensor capable of measuring SST, along with numerous analysis products. These SST observations are being used by thousands to achieve societal benefits. For example, late in 2007 the United Kingdom Met Office began using a new global SST analysis product made possible by GHRSST to improve its operational weather forecasting.

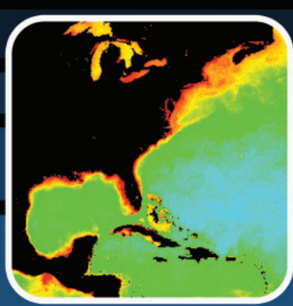
In addition to these international collaborations, new efforts have also begun within the United States to make both current and historical ocean remote sensing observations more accessible through modern data formats, metadata, and climate data records. For example, NODC is preparing a new Advanced Very High Resolution Radiometer (AVHRR) SST dataset to provide an even more accurate SST climate data record through the international GHRSST effort.

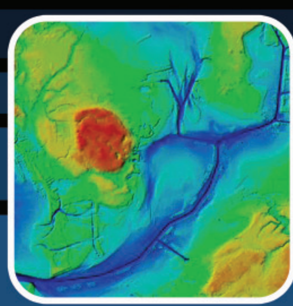
So despite the numerous difficulties and challenges ahead, efforts to improve international relationships and strengthen existing archives will increase data usability, coverage, and access and will enable even greater benefits from ocean remote sensing observations in the future. ■

For more information on the European GlobCOLOUR project, GHRSST project, and Jason-2 mission, visit www.globcolour.info, http://ghrsst.nodc.noaa.gov, and www.aviso.oceanobs.com/html/missions/jason2.

Satellite Data & Applications

NOAA SATELLITE AND INFORMATION SERVICE



Poster Designed By: Marc Pulliam

Libraries Are Always Changing

Neal K. Kaske, Ph.D., Chief of the Public Services and Regional Libraries Branch, NOAA Central Library

As communications systems evolve so do libraries and what they provide. Librarians select, acquire, organize, and preserve information; they try to make the information easily accessible for everyone. Librarians also help people locate needed information, and provide a space—real or virtual—to use the materials.

A key challenge for librarians is maintaining not only past records in traditional formats, but also adding an ever increasing number of new forms of information. Searching current and past materials is increasingly complicated. The speed at which we desire and require information and its global nature add to the complexities of providing library services. Librarians love these challenges—especially providing innovative services to their users. ■

If you have not visited a NOAA library recently, in person or virtually, you will be in for some surprises. Drop in at www.lib.noaa.gov.

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