

2010

NOAA SATELLITE AND INFORMATION SERVICE



NOAA SATELLITE AND INFORMATION SERVICE

Our mission is to deliver accurate, timely, and reliable satellite observations and integrated products and to provide long-term stewardship for global environmental data in support of the NOAA mission.

www.nesdis.noaa.gov

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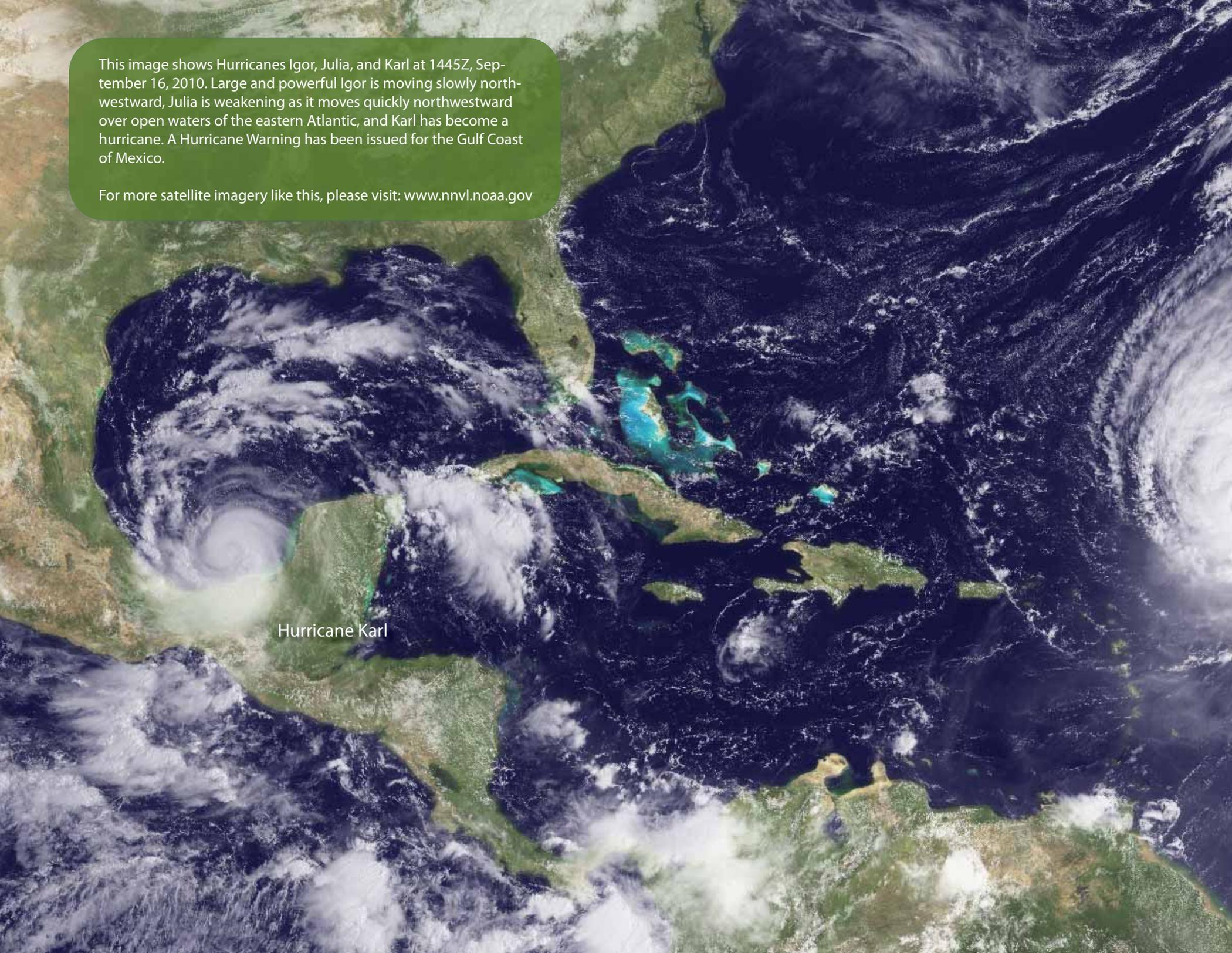
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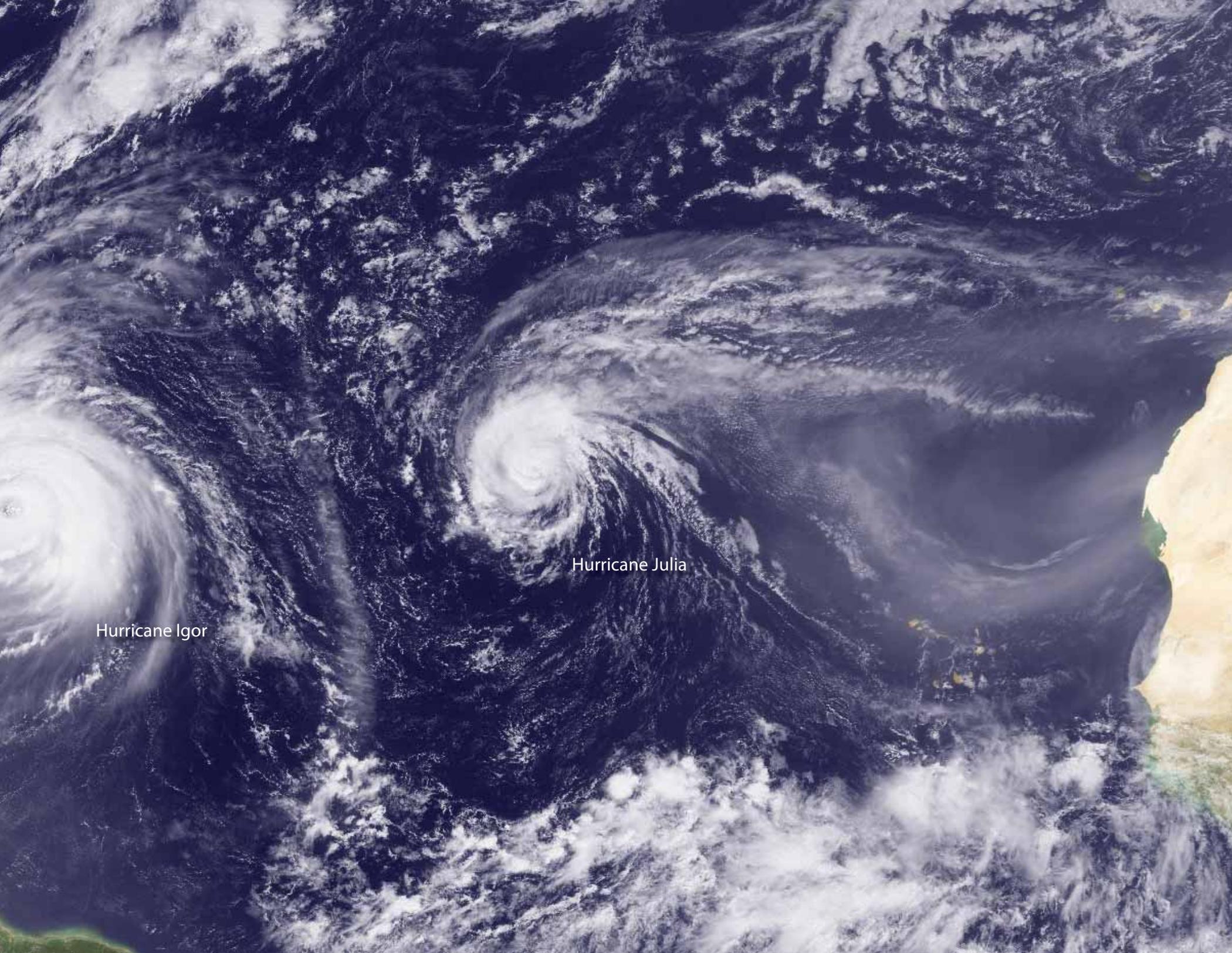


This image shows Hurricanes Igor, Julia, and Karl at 1445Z, September 16, 2010. Large and powerful Igor is moving slowly north-westward, Julia is weakening as it moves quickly northwestward over open waters of the eastern Atlantic, and Karl has become a hurricane. A Hurricane Warning has been issued for the Gulf Coast of Mexico.

For more satellite imagery like this, please visit: www.nnvl.noaa.gov

Hurricane Karl





Hurricane Igor

Hurricane Julia

The Ye



NOAA Satellite and Information Service Deputy Assistant Administrator Charlie Baker, NOAA Administrator Dr. Jane Lubchenco, Secretary of Commerce Gary Locke, and NOAA Satellite and Information Service Assistant Administrator Mary Kicza during Secretary Locke's visit to Silver Spring.

Letter from the Assistant Administrator:

Dear Colleagues in Review

Dear Colleagues:

This has been a challenging year filled with extremes—temperature fluctuations, severe weather, natural disasters, and the oil spill in the Gulf region, just to name a few. Our response to these circumstances showcased a workforce steeped in dedication to the mission, the protection of people and natural resources, safety, and the continuity of top-notch service to the Nation.

Day after day, decision makers used NOAA's latest observations and data to aid in a host of disasters we experienced this year. For example, when the BP Deepwater Horizon oil rig exploded in the Gulf of Mexico on April 20, 2010, NOAA Satellite and Information Service (NESDIS)* scientists were on the front lines, using the latest satellite observations to support emergency responders, oil movement forecasts, and resource deployments. They also provided critical information to the response team assembled by the President. NESDIS's data and services also helped officials determine the overall extent and impacts of the spill.

Natural disasters such as the catastrophic 7.0 magnitude earthquake in Haiti in January 2010 and the eruption of a volcano under the Eyjafjallajökull glacier of Iceland in April 2010 sent ripple effects around the globe. NESDIS provided advice and critical data to the U.S. aviation community during the unprecedented closure of North Atlantic and European airspace, and we are currently involved in new international efforts to improve volcanic ash response. For the Haiti earthquake NESDIS provided data, products, and services such as light detection, satellite imagery, survey charts, and high resolution harbor bathymetry to support recovery efforts.

This year was also one of weather and climate extremes. In February 2010, the Federal Government closed because of a “one-two punch” from Mother Nature that left massive mounds of snow along the east coast and throughout the country. In spite of extreme conditions, NESDIS satellite operations and product processing remained fully operational throughout the blizzards as we continued to deliver superior service around-the-clock.

In 2010, we were called to respond to unparalleled circumstances. We look back with satisfaction and ahead with vigilance to improve and increase the environmental information we deliver. We endeavor, with our international and domestic partners, to continue to provide the best observations, data, products, and services to the Nation. In a year of extremes, we want to also recognize the extreme dedication, scientific achievement, innovation, stewardship, and distinguished service of NESDIS employees and team members. Thank you for your time, commitment, energy, and enthusiasm.

Mary E. Kicza

*Officially, NESDIS stands for National Environmental Satellite, Data, and Information Service. Informally, NESDIS is also called NOAA Satellite and Information Service.



Top 10 Accomplishments

Launched Newest NOAA Geostationary Satellite: GOES-15

On March 4, 2010, NOAA launched the Geostationary Operational Environmental Satellite, GOES-P, from Cape Canaveral, Florida, on a Delta IV Rocket. GOES-P, renamed GOES-15 once it reached final orbit, was placed into orbital storage mode after check-out. GOES-15, the final spacecraft in the latest series of NOAA geostationary satellites, took its first infrared image of Earth on April 26, 2010. GOES-15 will capture high resolution images of weather patterns and atmospheric measurements that help the agency's forecasters track life-threatening weather—from tornadoes, floods, and hurricanes to solar activity that can impact satellite-based electronics and the communications industry. High resolution imagery allows forecasters to pinpoint the location of severe weather with great accuracy. GOES-15 will also provide data for space and solar weather thanks to its Solar X-Ray Imager. GOES-15 will improve forecasts and warnings for solar disturbances, protecting billions of dollars of commercial and government assets in space and on the ground. This vital information will also reduce the effects of power surges for satellite electronics and the communications industry.

Provided Support during Deepwater Horizon Oil Spill

NESDIS aided in the response efforts for the Deepwater Horizon oil spill by supplying timely and easy access to data, information, and products. The National Oceanographic Data Center's (NODC's) Global Temperature-Salinity Profile Program (GTSP) group developed and implemented a strategy of providing ocean data for the Gulf Coast on a weekly basis. The group retrieved near-real-time ocean profile data from the GTSP Continuously Managed Database for the Gulf of Mexico area; converted these data into user-friendly formats for displaying the data in virtual globe application programs such as Google Earth and NASA's WorldWind; and populated these subsurface ocean profile data with other types of NODC data and information holdings. The near-real-time subsurface ocean profile data includes water temperature and salinity data from nine gliders and water pressure, temperature, and salinity data from eleven autonomous profiling floats. In addition, NODC's National Coastal Data Development Center (NCDDC) supported the Joint Analysis Group (JAG) for Surface and Sub-Surface Oceanography, Oil, and Dispersant Data—a group with members from NOAA, the

U.S. Environmental Protection Agency, the U.S. Geological Survey, and the White House Office of Science and Technology



A United Launch Alliance Delta IV rocket lifts off with the NASA/NOAA GOES-P from Space Launch Complex-37 at 6:57 p.m. EST., March 4, 2010.

ments

Policy. NCDDC acted as the JAG team lead for compiling and processing data and observations and created and hosts the JAG Web site. NCDDC, together with the Mississippi/Alabama Sea Grant Program, also created the Deepwater Horizon Oil Spill Research and Monitoring Activities Database, a single Web site for uploading and accessing information about research and monitoring activities related to the oil spill. The Office of Satellite Data Processing and Distribution's Satellite Analysis Branch (SAB) issued regular near-real-time satellite-based analyses of surface oil location in the Gulf of Mexico multiple times per day as well as a daily summary. SAB provided data to the National Ocean Service, the U.S. Coast Guard, and many other Federal, State, and local government personnel.

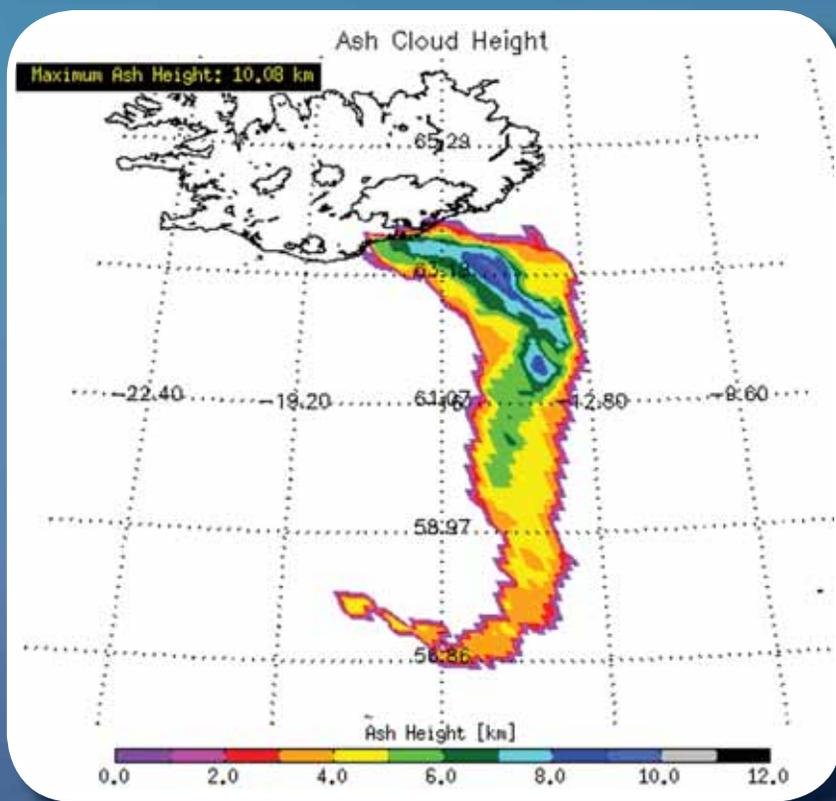
Provided Critical Information during the Icelandic Eyjafjallajökull Volcanic Eruption

In response to the eruption of the Eyjafjallajökull volcano in April 2010, NESDIS began providing near-real-time information about the resulting ash cloud to the London Volcanic Ash Advisory Center. Using an algorithm developed for the next generation geostationary satellite series, GOES-R, and data from the European Organisation for the Exploitation of Meteorological Satellites's Spinning Enhanced Infrared and Visible Imager, NESDIS provided estimates of volcanic ash cloud height, mass loading, and particle size. These data proved critical to tracking and forecasting the dispersion of dangerous volcanic ash clouds. This Icelandic volcano's eruption led to the unprecedented closure of North Atlantic and European airspace, disrupting commerce and travel in the area. Volcanic ash poses a major threat to jet aircraft and must be avoided.

Expanded U.S. Climate Reference Network

After year-long evaluations and data quality tests, NOAA's National Climatic Data Center (NCDC) formally commissioned the first two U.S. Climate Reference Network (USCRN) stations in Alaska. USCRN consists of 114 stations across the Nation that NOAA uses to monitor climate change. The two Alaskan stations—one located at Sand Point and the other at Port Alsworth—increase our understanding of how high-latitude areas of the world respond to a rapidly changing climate and provide real-time weather information for public use. In addition to air temperature and precipitation, these stations also measure solar radiation, surface skin temperature, and surface winds. The two Alaskan stations are the first of what will be a 29-station network covering the ecologically diverse state. In addition, two new USCRN sites were installed at Red Dog Mine and Kenai; following a testing and evaluation period, these are expected to be commissioned in 2011. Previously, NOAA had only experimental USCRN stations in Alaska. The climate reference network will establish a high quality climate record that will inform the scientific and policymaking communities about the rate and character of climate change in Alaska—the part of the Nation most susceptible to climate change. The data collected in the brief history of the network has already been used to confirm the reliability of U.S. temperature records from long term climate stations.

As of September 2010, NCDC has outfitted 80 of the USCRN stations with soil moisture and soil temperature sensors that will provide scientists and deci-



Ash cloud height chart from the Eyjafjallajökull Volcano, Iceland on May 6, 2010.

sion makers with information to support climate change assessments. These sensors will also aid in the Nation's ability to better monitor, plan for, and respond to drought events as they develop. Soil data from 40 of those sites are now posted on the USCRN Web site at www.ncdc.noaa.gov/crn. The remaining 34 sites will be outfitted with soil sensors in 2011. In the United States, drought affects more people than any other natural hazard. It is one of the most costly phenomena with direct losses, such as lowered agricultural yields and increased water use, that average \$6-8 billion each year.

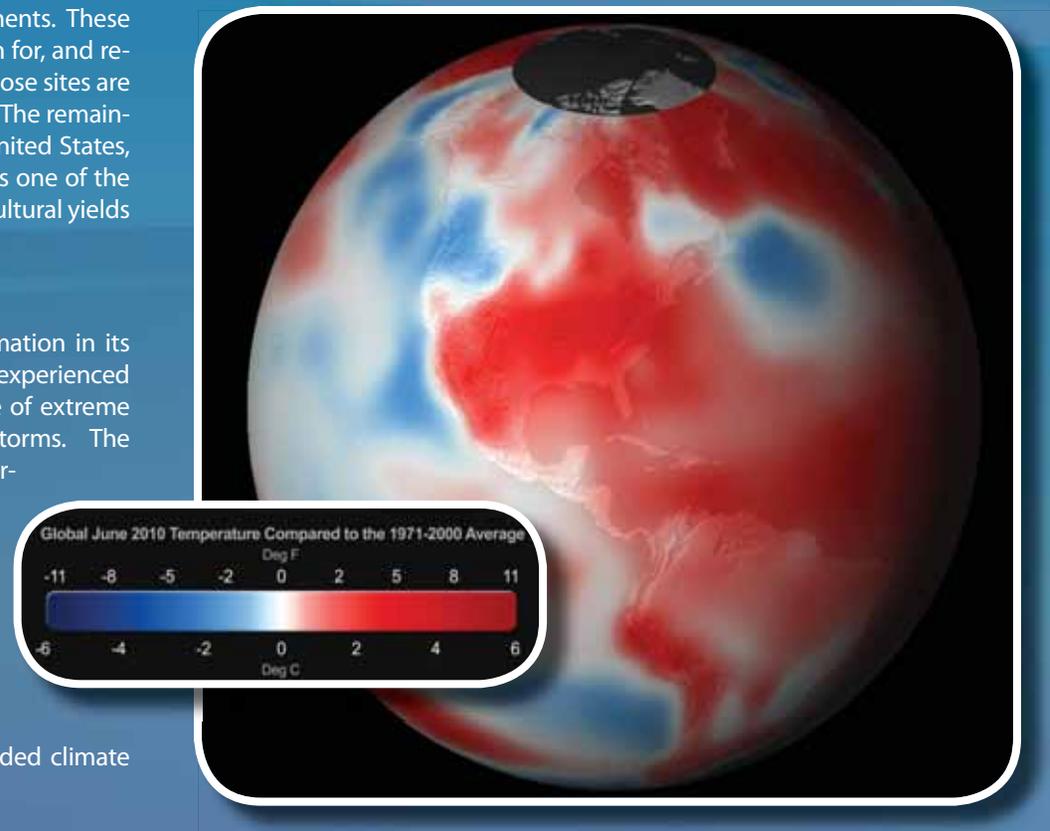
Provided Detailed Data on Global Warming

NOAA's National Climatic Data Center (NCDC) published information in its *2009 State of the Climate Report* that showed the Earth's climate experienced consistently warmer temperatures likely to result in an increase of extreme events, such as severe drought, torrential rain, and violent storms. The 220-page report, released on July 28, 2010, defined 10 measurable planet-wide features used to gauge global temperature changes. The relative movement of each of these key indicators proved consistent with global warming. Air temperature over land, sea-surface temperature, air temperature over oceans, sea level, ocean heat, humidity, and tropospheric temperature in the "active-weather" layer of the atmosphere closest to the Earth's surface rose while arctic sea ice, glaciers, and spring snow cover in the Northern hemisphere declined. These data cleared up much public confusion due to misinformation that surrounded climate change.

The *2009 State of the Climate Report* was a result of the contributions of more than 300 scientists from 160 research groups in 48 countries. Ice and ocean data was collected from diverse sources across the planet including satellites, weather balloons, weather stations, ships, buoys, and field surveys. NCDC led the coordination, writing, editing, and publishing of the *2009 State of the Climate Report*, which was a special supplement in the *Bulletin of the American Meteorological Society*.

Released NOAA Climate Services Portal

When the NOAA Climate Services Portal launched in February 2010, NOAA officials aimed to make it the "go-to" Web site for anyone wanting access to



The global average combined land and ocean surface temperature for the month of June 2010 was the warmest on record. The National Climatic Data Center calculated that June's average temperature was 61.1°F (16.2°C), which is 1.22°F (0.68°C) above the 20th century average of 59.9°F (15.5°C). The Extended Reconstruction Sea Surface Temperature data shown here plots areas that were warmer than the climatic average in red, areas cooler than the average in blue, and areas around the average temperature for June in white.

the agency's climate data, products, and services. NOAA's National Climatic Data Center worked with a NOAA team to develop the site, which provides a clearly defined central point-of-access for climate information. The portal allows users to find climate data and information sets in formats that are useful to them. With thousands of disparate NOAA Web pages focused on climate information, NOAA's Internet presence lacked coherent access to its state-of-the-art science, observations, monitoring, and assessment. The portal significantly reduced the time required for customers to find datasets, products,

and services. This climate information benefits users such as city planners, the insurance industry, energy businesses, and State and local governments. The team that developed the portal used a testing and feedback process to collect input from a variety of stakeholders and customers, tailoring the portal for a wide cross-section of users.

Supported Haiti Disaster Relief

NOAA's National Oceanographic Data Center's National Coastal Data Development Center (NCDDC) provided critical support for recovery efforts in Haiti after the catastrophic 7.0 magnitude earthquake in January 2010. At the request of the U.S. Navy, NCDDC provided IT support and distributed data for products and services including light detection and ranging survey charts, high resolu-

Photo courtesy of Larry Ledlow, Jr.



Fairbanks Alaska Satellite Operations Facility.

tion harbor bathymetry, and overhead satellite imagery. Charts were used by the U.S. Navy, as well as other agencies, to navigate safely through debris in Haiti's ports. In addition to the U.S. Navy, NCDDC's data and information were pivotal to the Department of Defense, first responders, Fleet Survey Teams, the Haitian government, and other foreign government workers.

Completed Construction of Fairbanks Alaska Satellite Operations Facility

NESDIS achieved a major infrastructure milestone in fiscal year (FY) 2010 with the construction of the Fairbanks Alaska Satellite Operations Facility (FSOF), a new operations center for satellite command and control. FSOF, which was completed on September 30, 2010, will support a broad range of U.S. and international environmental monitoring satellites, thus providing critical datasets, products, and services to users worldwide. FSOF replaces the current Fairbanks Command and Data Acquisition Station, parts of which date to the early 1960s. Modernizing this facility ensures reliable and robust satellite tracking for NOAA far into the future. On a global scale, public safety and economic interests will continue to benefit from the comprehensive and accurate information derived from the site's work. The new 20,000 square foot FSOF was a shovel-ready project, using approximately \$9 million of *American Recovery and Reinvestment Act* (ARRA) funds and \$2.7 million from NESDIS to complete the project. NESDIS vigorously advocated for ARRA funds and provided invaluable technical and management expertise for the complex project. The U.S. Army Corps of Engineers oversaw construction, which took place between July 2009 and September 2010. Satellite operations will transition to FSOF during the first three quarters of FY 2011.

Repositioned GOES-12 as the GOES South America Satellite

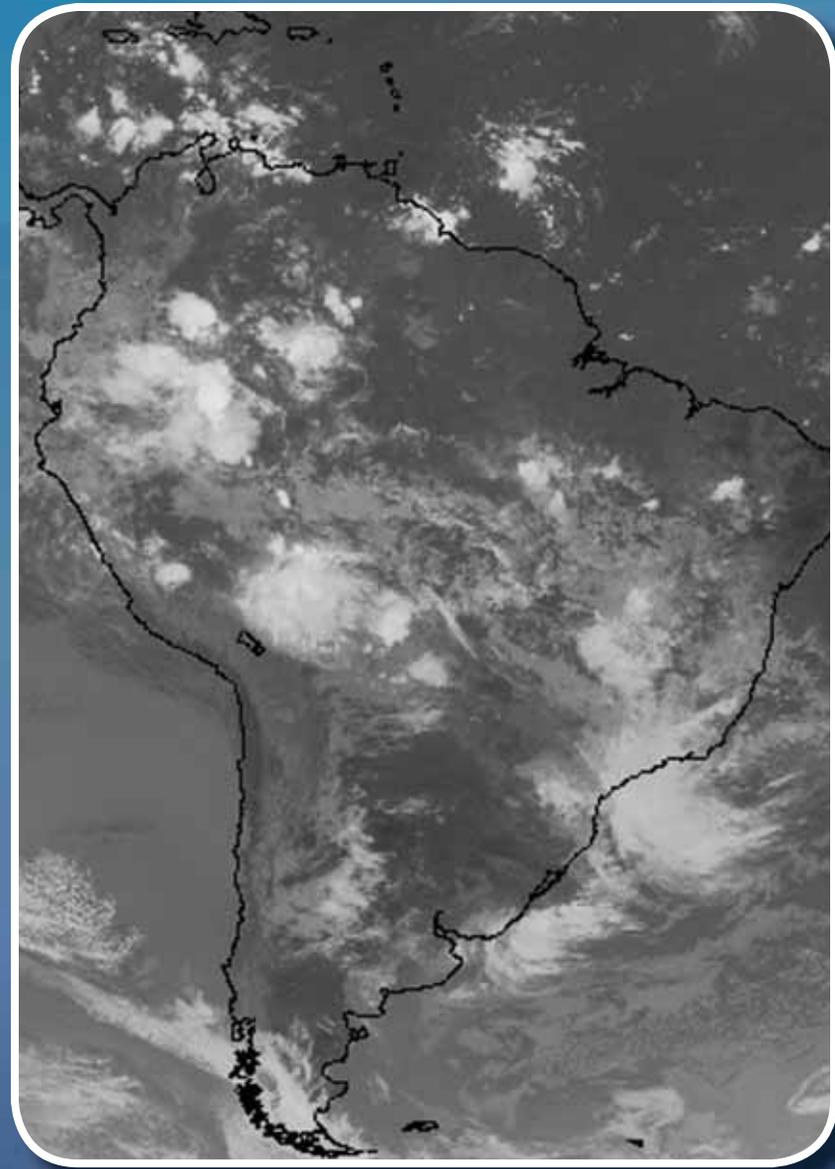
In May 2010, NESDIS repositioned the Geostationary Operational Environmental Satellite 12 (GOES-12) at 60° West over South America, thus continuing critical coverage for the region. GOES-12 replaced GOES-10, which was launched in 1997 and decommissioned on December 1, 2009, because it had exhausted its fuel, surpassing its original planned five-year mission. Continuing cooperation in the region, NESDIS determined that once GOES-13 replaced GOES-12 as the operational GOES East satellite, GOES-12 could be moved to support South America. To ensure a smooth transition, NESDIS analyzed the implications, developed the transition schedules so that GOES East operations would not be impacted, and developed and implemented

plans for informing users, both domestically and internationally, of the satellite changes. NESDIS also developed the GOES-12 South America imaging schedules for the instruments.

Without a dedicated satellite at 60° West, during extreme weather events in the United States, the GOES East coverage of South America was reduced from every 30 minutes to every three hours. Consequently, South Americans could not track severe weather activity in the Southern Hemisphere. The repositioning of GOES satellites over South America supplies forecasters in South America with more imagery and data to track dangerous storms, including the storms that can trigger potentially deadly mudslides. In addition, the sounders on GOES East are not used over South America, depriving the region of vital datasets. The reassigning of GOES-12 gives South Americans uninterrupted imager data every 15 minutes and sounder data that greatly improve the ability of South Americans to predict and track severe weather events. In addition, this information improves their normal forecasting capabilities.

Published the World Ocean Atlas 2009

NOAA's National Oceanographic Data Center (NODC) published the *World Ocean Atlas 2009*, one of the most cited works in climate and oceanographic sciences. Preceding versions of this atlas have been cited approximately 400 times per year. The internationally distributed *World Ocean Atlas 2009* includes climatological information about temperature, salinity, oxygen, and nutrients for the world's oceans at selected standard levels. Understanding the role of the ocean as part of Earth's climate system depends critically on the availability of such climatologies. NODC used oceanographic profile data from the United States and countries around the world to compile this publication from the "World Ocean Database 2009," released in November 2009. This database is the largest, most comprehensive collection of scientific information about the oceans with records dating as far back as the late 1700s. The 2009 database provides approximately 9.1 million temperature profiles and 3.5 million salinity reports. It also captures 29 categories of scientific information from the oceans, including oxygen levels and chemical tracers. It includes information on gases and isotopes that can be used to trace the movement of ocean currents. Climate scientists use the "World Ocean Database" to track changing conditions, which adds to the international science community's understanding of global climate change.



GOES-12 Full Disk Longwave Infrared imagery, from November 16, 2010.



LOCAL
HIGH
WATER

8

Weather

Improved Coastal Precipitation Forecasts Using Geostationary Satellite Data

Heavy precipitation associated with severe storms can cause flooding and damage to life and property. Accurate predictions of precipitation amounts near coastal areas are often very difficult due to our limited understanding of storm development and a lack of applicable computer forecast models. To address this issue, scientists in NOAA's Center for Satellite Applications and Research (STAR), Florida State University, and the National Centers for Environmental Prediction (NCEP) assimilated infrared radiances from Geostationary Operational Environmental Satellite 11 (GOES-11) and GOES-12 using the gridpoint statistical interpolation (GSI) analysis system. GSI is an analysis system developed at NCEP that allows for uses of new observational data and produces an optimal initial condition so computer models can generate better forecasts. The team's studies demonstrated that the precipitation amount, especially for severe storm conditions, can be better predicted using GOES-11 and GOES-12 imager radiance data in computer models. GOES data assimilation requires a fast radiative transfer model for ingesting GOES imager data in the computer forecast model and an adequate quality control algorithm for removing bad-quality data. To meet these needs, STAR scientists developed the community radiative transfer model and a better quality control procedure to detect and remove the measurements affected by clouds and precipitation.

This work highlights the importance of geostationary satellite observations for improved cloud and precipitation forecasts. The GOES observations in regions of little or no clouds provide especially beneficial information to the computer forecast models for improved coastal precipitation forecasts. The developed data assimilation technique will also prepare our customers, such as the National Weather Service, for using advanced satellite data from the next generation GOES-R series.



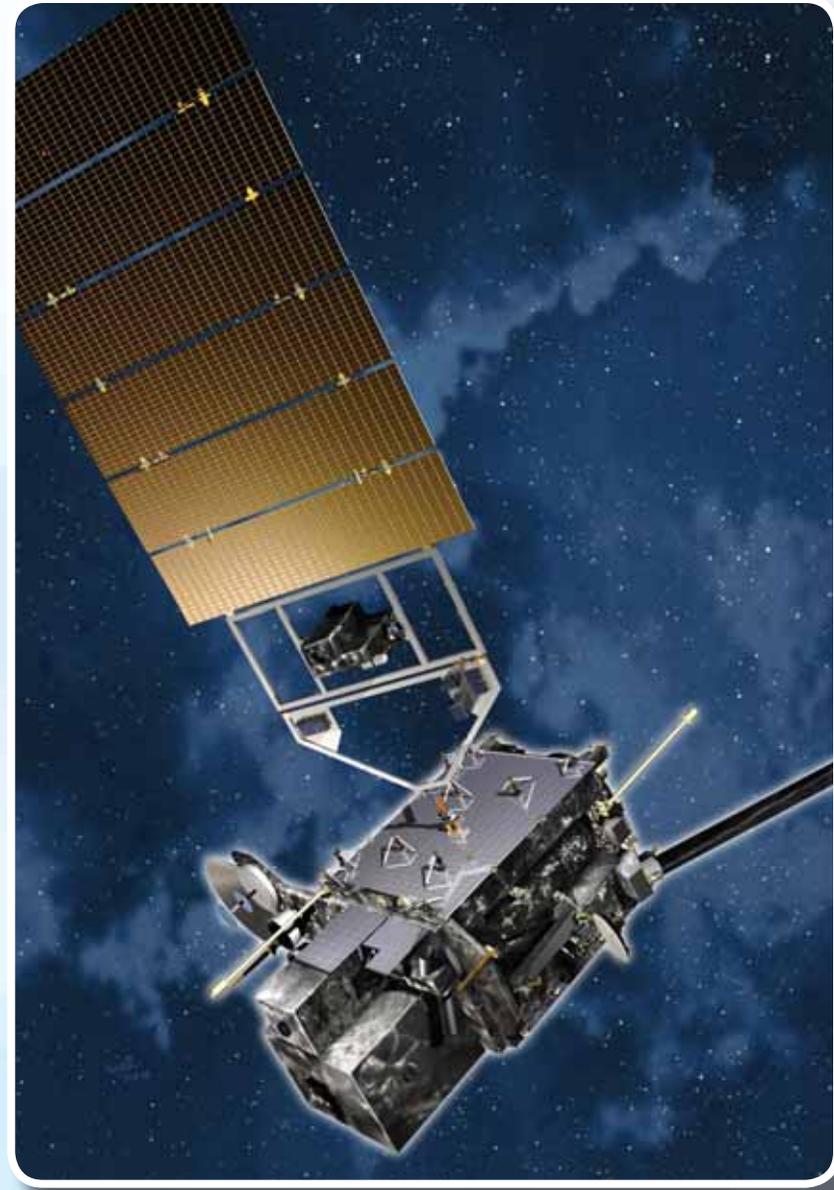
This GOES-12 image from January 2010 shows a frontal system off the U.S. east coast and a derecho (a violent, linear storm system) spanning the width of Florida.

Selected Harris Corporation to Develop GOES-R Antenna System

In July 2010, NOAA selected Harris Corporation of Melbourne, Florida, to develop the antenna system that will support NOAA's Geostationary Operational Environmental Satellite Series R (GOES-R). This new series of spacecraft, set to begin launching in 2015, is expected to double the clarity of today's satellite imagery and provide at least 20 times more atmospheric observations. The GOES-R antenna system will be developed and operated at NOAA's Wallops Command and Data Acquisition Station in Wallops, Virginia, and at NOAA's GOES-R Remote Backup facility in Fairmont, West Virginia. The antenna system will be designed to ensure continuity of operations during severe weather and other threat scenarios, including storms as severe as a Category 2 hurricane with winds ranging from 96 to 110 mph. Four existing receive-only antennas located at the NOAA Satellite Operations Facility in Suitland, Maryland, will also have their feed systems upgraded. The antenna system will include six new, large-aperture antennas capable of receiving and transmitting radio signals in multiple frequencies.

A collaborative development and acquisition effort between NOAA and NASA, the Geostationary Operational Environmental Satellite Series R (GOES-R) Program is developing the Nation's next generation of environmental satellites with faster, higher resolution imagery and new lightning mapping capabilities. GOES-R will improve support for the detection and observation of meteorological phenomena that directly affect public safety, protection of property, and, ultimately, economic health and development. The new weather products from GOES-R will significantly improve the ability of forecasters to more accurately predict dangerous weather and, in turn, warn the public faster. GOES-R continues to make steady progress in its instrument development and ground system programs as it approaches the scheduled launch of its first satellite in 2015.

Photo courtesy of Lockheed Martin.



Artist's rendering of GOES-R Spacecraft.

Harris Corporation will upgrade four existing antennas and integrate the entire antenna system into the overall GOES-R Ground System. NOAA will fund, manage, and operate the GOES-R satellites.

Tested New Aurora Model to Improve Air Travel Safety

As the number of airline passengers traveling on cross-polar routes from the United States to Asia increases so too does the overall concern regarding the risks of radiation exposure to travelers and flight crew. Forecasting the location and severity of the aurora is required by airline flight planners responsible for passenger and crew safety. This year NOAA's National Geophysical Data Center Space Weather Team successfully collaborated with partners from the NOAA National Weather Service Space Weather Prediction Center and the Johns Hopkins University Applied Physics Laboratory to test a new predictive model of the aurora based on upstream solar wind measurements. The Ovation Prime Real Time model will be transitioned to operations and used in conjunction with NOAA's future solar-wind sentinel to forecast space weather impacts on commercial air transportation.



Aurora Borealis, shown over Alaska.



Climate

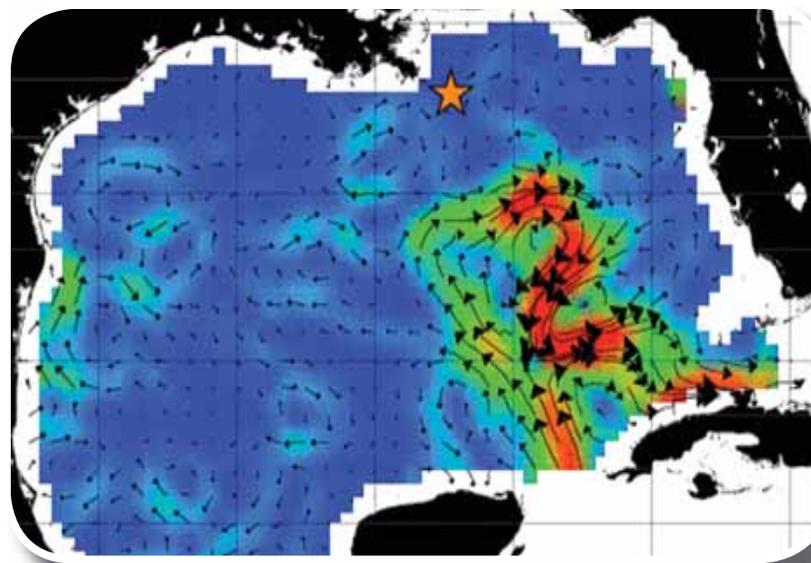


Extended Jason Series Satellite Ocean Altimetry Measurements

In July 2010, NESDIS negotiated and signed a four-party agreement with NASA, the European Organizations for the Exploitation of Meteorological Satellites, and the French Space Agency to cooperatively develop, launch, and operate the Jason-3 satellite. The Jason-3 ocean altimetry satellite will provide extraordinarily precise sea level height measurements that reveal upper level ocean heat content and patterns and indicate changes in water volume. Ocean altimetry data are essential to understanding our climate because ocean changes influence the weather. Predicted to launch in 2013 for a five-year run, Jason-3 will allow scientists to predict hurricane and other severe weather intensity. It will also give an accurate understanding of long-term climate change trends, including the Earth's heat gain. Ocean altimetry data show the location, width, and temperature differences in adjacent waters and detect and predict current eddies—temporary ocean features that can be of critical interest to ocean users such as drilling operators in the Gulf of Mexico.

Integrated Last Two Sensors on the NPOESS Preparatory Project

In fiscal year 2010, NOAA and NASA successfully integrated the last two sensors on the National Polar-orbiting Operational Environmental Satellite System Preparatory Project (NPP) at Ball Aerospace in Boulder, Colorado. This milestone is critical, as the two sensors—the Visible Infrared Imager Radiometer Suite and the Cross-track Infrared Sounder—are the backbone of NOAA's future polar satellite missions. With a projected launch date in the fall of 2011, NPP will ensure continuity of weather forecasting and climate monitoring and establish the sensor design baseline for additional NOAA weather satellite systems, especially the Joint Polar Satellite System (JPSS). NPP and JPSS will allow more timely and accurate weather warnings and forecasts as well as ensure continuity of crucial climate observations for the future.



The northern portion of the Gulf of Mexico's Loop Current, shown in red, appears about to detach a large ring of current, creating a separate eddy.

The transition of National Polar-orbiting Operational Environmental Satellite System (NPOESS) to the Joint Polar Satellite System (JPSS), a collaborative development and acquisition effort between NOAA and NASA, will continue in fiscal year (FY) 2011. JPSS will provide global environmental data used in numerical weather prediction models for forecasts, space weather observations, search and rescue detection capabilities, and direct read-out and data collection products and services to customers. Data and imagery obtained from JPSS will increase timeliness and accuracy of public warnings and forecasts of climate and weather events, thus reducing the potential loss of human life and property and advancing the national economy.

Timely transition of NPOESS to JPSS is critical to support the fall 2011 launch of NPP. In addition, NOAA will define a JPSS Program Review Plan and complete a number of readiness reviews to baseline the JPSS Program. Included will be an Independent Review Team review of the entire program by end of third quarter of FY 2011.

Led the Transition of Three Climate Data Records into Operation

During fiscal year 2010, NOAA's National Climatic Data Center (NCDC) led the transition of three Climate Data Records (CDRs) into operation: polar imager reflectance, geostationary imager thermal radiance, and polar thermal sounder radiance. CDRs provide authoritative, long-term climate reference sets and allow users to focus on specific issues such as drought, floods, and hurricanes. Consolidating this information can protect lives, property, and economic interests and can increase security. CDRs are required by industry, government, and research communities to detect, assess, model, and predict climate change. These records are also used by decision-makers to devise effective strategies to respond, adapt to, and mitigate the impacts of climate change. In addition, CDR production: removes and minimizes time dependent biases in satellite data; delivers long-term (50+ years), seamless homogeneous records characterizing climate change and variation; and reprocesses the entire period of record as new climate algorithms and sensor knowledge are developed.

In fiscal year 2011, NOAA's National Climatic Data Center will transition seven new satellite-based Climate Data Records (CDRs) into operations, bringing the total operational CDRs to 10. One key CDR will be using meteorological data from NOAA's polar satellite from 1982 to present to create the Global Sea Surface Temperature record. Since each satellite in the historical polar satellite series is different, NOAA's CDR program works to scientifically even out data across all the satellites to make a consistent and accurate record for long-term climate analysis.

On September 14, 2010, Secretary Gary Locke announced the selection of six new NOAA regional climate service directors who will build and strengthen partnerships to better assess and deliver regionally focused climate science and information products and services. Each director will be based at one of NOAA's six National Weather Service regional headquarters offices, ensuring close coordination between NOAA's weather and climate services. The directors will collaborate with partners from Federal agencies; State, local, and tribal governments; universities; the private sector; and non-governmental organizations. They will develop products and services to address issues such as local climate forecasts, drought plans, and flood risk mapping.

“By providing critical planning information that our businesses and our communities need, NOAA Climate Service will help tackle head-on the challenges of mitigating and adapting to climate change,” said Secretary Locke. “In the process, we'll discover new technologies, build new businesses and create new jobs.”

-Secretary of Commerce Gary Locke on formation of a National Climate Service



NOAA Administrator Dr. Jane Lubchenco, Secretary of Commerce Gary Locke, NOAA Satellite and Information Service Assistant Administrator Mary Kicza, and NOAA Satellite and Information Service Deputy Assistant Administrator Charlie Baker meet during Secretary Locke's visit to Silver Spring.

Spotlight on the Deepwater Horizon Oil Spill and Recovery

On April 20, 2010, an explosion on the Deepwater Horizon drilling rig led to a massive oil spill in the Gulf of Mexico. Approximately 180 million gallons of oil leaked out before the sea-floor well at Deepwater Horizon was capped on July 15, 2010, according to the Flow Rate Technical Group, a team of scientists and engineers formed to estimate the extent of the spill. The disaster not only caused long-lasting damage to the Gulf Coast's marine and wildlife habitats and its fishing and tourism industries, but also created a need for quality controlled ocean data. While directing recovery efforts for the spill, government officials and emergency responders needed detailed, up-to-date information to make important decisions. NESDIS aided officials by supplying the various data, products, and services they needed. NESDIS's data and services also helped officials determine the overall extent and impacts of the spill.

Data Distribution

NESDIS was well-prepared to react quickly to the spill. In late 2008, in response to a request from the National Ocean Service (NOS), the Office of Satellite Data Processing and Distribution's Satellite Analysis Branch (SAB) developed the capability to observe and report the location and extent of oil on ocean surfaces. In January 2010, SAB began issuing oil spill analysis products to the United States Coast Guard (USCG) and NOS on a limited, experimental basis. Minutes after the Deepwater Horizon rig began sinking, SAB began converting its experimental, unstaffed, pilot project in oil detection to a major disaster response effort.

Within five hours of the rig sinking, SAB organized staffing for a 20-hour-per-day oil spill response desk, issued its first Deepwater Horizon oil spill analysis, and accepted the role of International Disaster Charter Project Manager. SAB issued regular near-real-time satellite-based analyses of surface oil location multiple times per day and a daily summary to NOS; USCG; and other Federal,

State, and local government personnel. This information made resource allocation, such as where to deploy oil containment booms, skimmers, and reconnaissance over flights, more efficient. NOS personnel also used the analyses as input to their trajectory forecasts, further enabling the public and government sectors to plan more effective actions to mitigate the spill damage.

Satellite Information

After several weeks it became evident that the spill region of impact was widening at an alarming rate and the dynamics of the Gulf of Mexico Loop Current system could carry oil to the coast of Florida and the Florida Keys. Officials decided broader scientific knowledge of the oceanographic situation in the Gulf would markedly reduce uncertainties associated with locating surface oil. It would also aid in predicting future movement and could even esti-



June 15, 2010, data from NOAA's Satellite Analysis Branch shows the extent of surface oil in the Gulf.

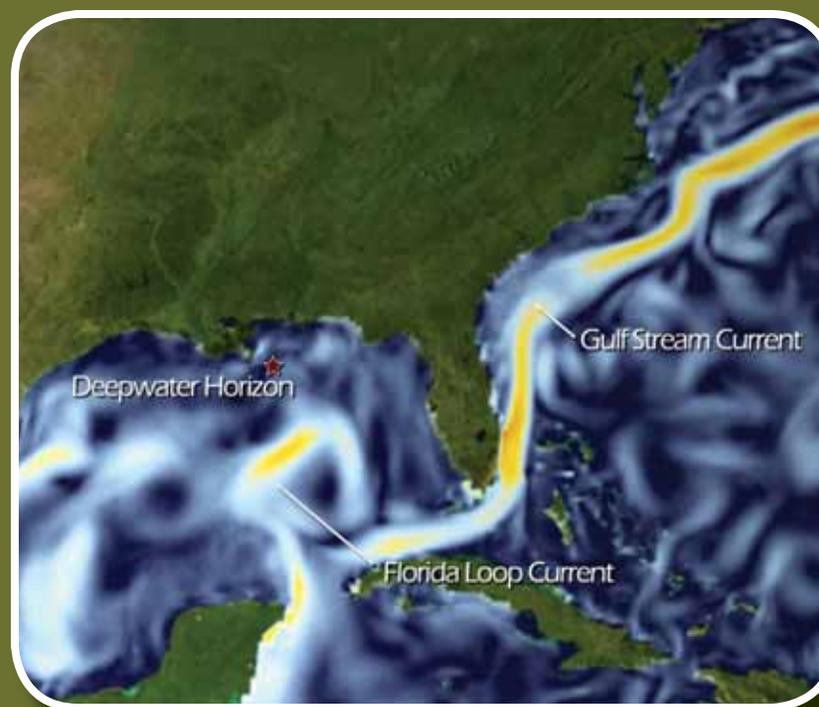
mate surface thickness and subsurface pathways. NOAA's Center for Satellite Applications and Research (STAR) and CoastWatch, collaborating with scientists at NOAA's Atlantic Oceanography and Meteorology Laboratory, prepared and acquired specialized satellite data such as sea surface temperature, ocean color, and sea surface height and ocean model products such as current fields, salinity, and subsurface trajectories. They began routine briefings for SAB personnel on the oceanographic conditions and forecasts for the eastern Gulf of Mexico.

STAR and CoastWatch obtained or facilitated the acquisition and distribution of a broad array of data from commercial, U.S. Government, and foreign environmental satellites for the broad NOAA and responder communities and the general public. STAR and CoastWatch officials also supported SAB's satellite-derived analyses with satellite products, scientific guidance, and oceanographic analyses. In addition, STAR and CoastWatch provided weekly tailored science briefings of the oceanographic conditions in the Gulf Coast and implemented or acquired specialized satellite and model products for the Gulf of Mexico to aid oil analysis. CoastWatch provided personnel with advanced satellite analytical experience to assist the National Marine Fisheries Service in the location, recovery, and rehabilitation of sea turtles. CoastWatch also made satellite imagery and products available to a broad audience through their Web site.

Web Support

The National Oceanographic Data Center (NODC) created a support Web site for Gulf of Mexico data and information after the oil spill. The site includes links to archived Deepwater Horizon data, climatologies, ocean currents data, coastal ecosystems maps, and ocean profile data. NODC also created a historical data page that highlights all of NODC's data and information from the Gulf of Mexico.

In June 2010, NOAA Central Library staff created a document titled "Resources on Oil Spills, Response, and Restoration: A Selected Bibliography" to help anyone seeking information concerning the Deepwater Horizon disaster or previous oil spills and associated remedial actions. The bibliography lists information sources concerned with the harmful effects of oil and chemical spills on marine habitats and their associated living marine resources and the cultural and economic impacts of such spills. It includes Web sites, videos, and printed



The Florida Loop Current was a special concern as the Deepwater Horizon Oil Spill was monitored. It was expected that oil would be entrained in the surface currents, possibly threatening areas in the eastern Gulf of Mexico, Caribbean, and Atlantic.

documents that were selected from resources available through the online NOAA Library and Information Network Catalog; many of these sources were produced by NOAA offices and programs. The bibliography, which was accessed over 12,000 times in June, can be found on NODC's Web site.

During the Deepwater Horizon oil spill, NESDIS provided services and products based on its satellite information and databases to support government officials and emergency responders. NESDIS also used this data to support commercial and recreational fisheries, businesses, tourism, research, and the general public who live and work in the Gulf area. NESDIS continues to operate support Web sites that include coastal ecosystem maps and an online database that describes oil spill related research, monitoring, and restoration activities.

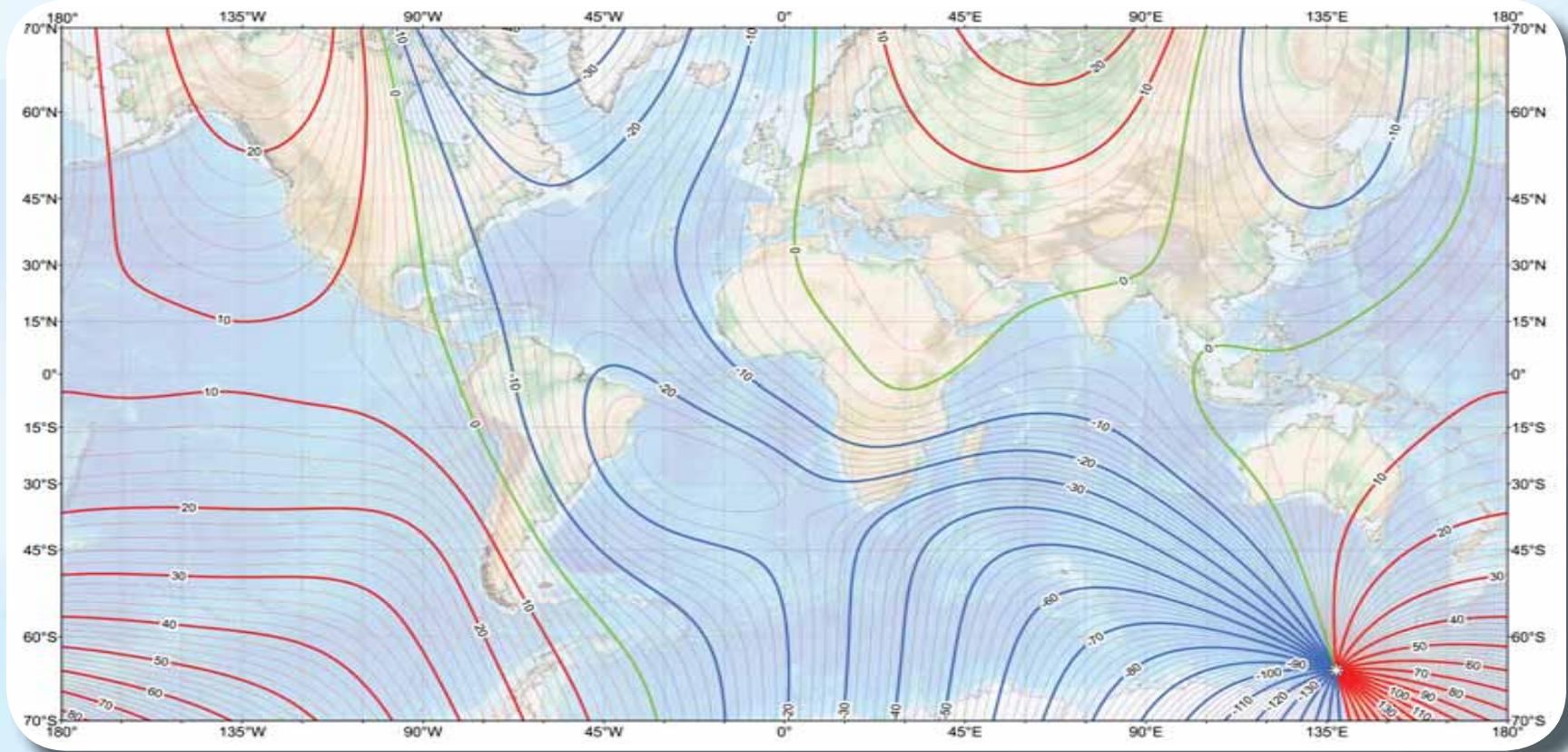
Oceans



Released World Magnetic Model for 2010 - 2015

In late 2009, NOAA's National Geophysical Data Center (NGDC) released a new World Magnetic Model for 2010-2015 (WMM2010). This updated model is essential not only to organizations that create nautical and land maps, but also to the proper functioning of high-end cell phones and cameras, which have generated a dramatically increased user base. WMM2010 incorporates the latest magnetic information from land, sea, and satellite observations to provide an accurate model of the Earth's magnetic field for use in both military and civilian nav-

igation systems. Devices such as high-end phones, internet devices, and cameras have NGDC's World Magnetic Model embedded in their firmware. These products determine the location of the device using the Global Positioning System while inferring the orientation of the device using an accelerometer with an electronic compass. In addition, NGDC's popular online calculators were migrated to the new WMM2010 on December 31, 2009. The accompanying supporting software permits users to compute both magnetic field strength and direction at any time during 2010-2015 at any location.



The current World Magnetic Model for 2010 - 2015.



On October 22, 2010, Sunderland, now 17, visited NSOF with her younger brother Toby, also a sailing enthusiast, to applaud the rescue system and thank the staff that helped save her life.

Helped Rescue 281 People in Fiscal Year 2010

NOAA's fleet of satellites played a vital role in the rescues of 281 people in life-threatening situations throughout the United States and its surrounding waters during fiscal year 2010. In each incident, NOAA satellites pinpointed these downed pilots, shipwrecked mariners, or stranded hikers by detecting a distress signal from an emergency beacon, called an Emergency Position-Indicating Radio Beacon, and relaying the information to first responders on the ground. NOAA's polar-orbiting and geostationary satellites, along with Russia's Cospas spacecraft, are part of the international Search and Rescue Satellite Aided Tracking system (COSPAS-SARSAT). When a NOAA satellite locates a distress signal, the information is relayed to the COSPAS-SARSAT Mission Control Center based at NOAA's Satellite Operations Facility in Suitland, Maryland. From there, it is sent to a Rescue Coordination Center operated by either the U.S. Air Force for land rescues or to the U.S. Coast Guard for water rescues. Now in its 28th year, COSPAS-SARSAT has been credited with supporting more than 27,000 rescues worldwide, including 6,232 in the United States and its surrounding waters.

Not long after sailor Abby Sunderland reached the halfway point in her attempted solo voyage around the globe, rough seas and strong winds overturned her 40-foot boat in the Indian Ocean on June 20, 2010. An Indian geostationary satellite captured the distress signal from 16-year-old Sunderland's emergency beacons and relayed the information to the U.S. Mission Control Center at NOAA's Satellite Operations Facility (NSOF) in Suitland, Maryland.

NOAA alerted the U.S. Air Force and Coast Guard, who contacted Sunderland's family for specific details on her whereabouts. Then, a NOAA polar-orbiting satellite detected Sunderland's signal and was able to determine her precise location. The next day, an Australian search plane used this information to locate Sunderland about midway between Africa and Australia and established radio contact with her. A nearby French fishing vessel was redirected to her location, took her aboard, and delivered her to shore.

Enhanced Sea Ice Monitoring through New Datasets and Partnerships

The decline in Arctic sea ice raises both scientific and practical issues that may impact all of humanity. In fiscal year 2010, NESDIS increased its efforts to monitor and forecast Arctic sea ice. An ice-free Arctic Ocean will absorb more solar radiation that may, in turn, cause large changes in global weather patterns. In addition, accurate sea ice analysis and information are essential to safe travel for the more than 3,000 ships that travel the Great Circle Route between North America and Asia each year. Civilian and military vessels alike depend on this information to navigate this ever-changing region.

NESDIS also facilitated the signing of the National Ice Center (NIC) Memorandum of Agreement. This renewed agreement enables a continued partnership between the U.S. Navy, U.S. Coast Guard, and NOAA to provide timely and accurate snow and ice products. NESDIS also renegotiated and expanded the North American Ice Service (NAIS) agreement between the NIC, the Canadian Ice Service, and the International Ice Patrol that will allow NAIS to offer a single point-of-entry for ice information products. In addition, NESDIS teamed with the National Weather Service Alaska Region Ice Program to disseminate a five-day-per-week regional Alaska Sea Ice Analysis to users, replacing the previous three-day-per-week product.

Finally, NESDIS organized a critically important aircraft flight close to the North Pole and directly under the path of the European Space Agency's CryoSat-2 satellite on April 20, 2010, just 12 days after the satellite launched. This flight was an early opportunity to validate CryoSat-2's new radar technique for measuring the thinning of Arctic sea ice, a trend believed to be an early indicator of global warming.



Average Ice Extent

The sea ice in the Arctic has reached an abnormally low extent. Data from NOAA's POES, GOES, and the U.S. Air Force Defense Meteorological Satellite Program satellites shows the current extent of sea ice in the Arctic. The red line shows the average extent of sea ice for June 21st. Current Arctic sea ice extents are even lower than the record low year of 2007.

Coasts



Developed High-Resolution Digital Elevation Models for At-risk Coastal Communities

NOAA's National Geophysical Data Center (NGDC) developed high-resolution digital elevation models (DEMs) for 16 at-risk U.S. coastal communities. These models have many applications in planning, modeling, and forecasting efforts. NGDC develops DEMs that integrate ocean bathymetry and land topography and range from global scale to high-resolution local models of coastal communities. These DEMs are used in NOAA's Tsunami Warning System to enhance tsunami modeling, forecasting, and warnings. They can also be used for modeling of other coastal processes (such as hurricane storm surge, sea-level rise, contaminant dispersal, etc.), ecosystems management and habitat research, coastal and marine spatial planning, and hazard mitigation and community preparedness.

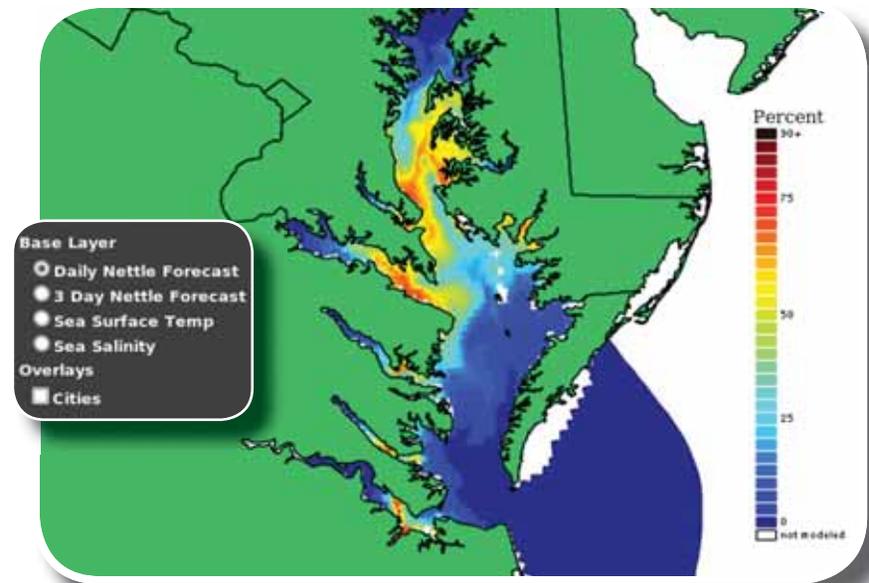
The response to the Deepwater Horizon disaster has generated a wealth of data that can inform research on Gulf of Mexico physical and biogeochemical systems for years to come. Data used to track the extent and fate of deep subsurface hydrocarbons have been assembled and archived at the National Oceanographic Data Center (NODC). This expanding dataset currently includes more than 1,500 conductivity-temperature-depth casts, corresponding physical sample data, and analyses of suspended particle size, distribution, and concentration. During fiscal year 2011, NODC will continue to add near-real-time datasets from the region, including from profiling floats, gliders, and satellites. The assembled dataset is available online at: www.nodc.noaa.gov/General/DeepwaterHorizon/support.html

Established an Ecological Sea Nettle Forecasting System

NOAA's Center for Satellite Applications and Research led a project to transition experimental ecological sea nettle forecasts for the Chesapeake Bay into operations with the aid of NOAA's Weather and Ocean Services. High concentrations of sea nettles, a species of stinging jellyfish, seasonally inhabit the Chesapeake Bay from late spring to early autumn. Their sting is painful, and knowing where and when to expect these jelly-

fish helps people avoid and prepare for this biotic nuisance. Over the past six years, experimental forecasts indicating the likelihood to encounter sea nettles in Chesapeake Bay have been generated by NOAA (<http://chesapeakebay.noaa.gov/forecasting-sea-nettles>). This "pathfinder project" is establishing a standard for transitioning ecological forecasts into operations that directly benefit the public. Daily and three-day forecasts are now generated by using real-time and forecast data that predict the probability of encountering sea nettles.

The prediction system used to forecast sea nettle presence can be easily modified to predict other important ecological variables in the Bay, such as the likelihood of waterborne pathogens and the concentration of dissolved oxygen. NOAA collaborated on this project with scientists from the University of Maryland Center for Environmental Science and Yale University. In the future, satellite-derived estimates of sea-surface temperature and chlorophyll concentration will be used in these and related forecasts.



Daily forecast of the likelihood of encountering a sea nettle in Chesapeake Bay on July 5, 2010.

Interview: Helen Wood, NESDIS Senior Advisor

Where did you grow up? Where did you go to school? And how did you get your start at NOAA?

I was born in Atlanta, Georgia. My father was in the Air Force, so we moved around a bit. I started school in Alabama, but I transferred to the University of Maryland to pursue mathematics.

Then my mother set me up with a friend who was a programmer and mathematician at the National Bureau of Standards. Her boss, a woman who was a retired Navy officer, asked me if I would like a job. So I started working in 1967 at the National Bureau of Standards as a GS-4 student and had a series of positions there until I graduated.

I was married by then. I had a daughter. When I came back from maternity leave, I started my full-time career job in late 1969 and stayed there for twenty years. In 1988, I was recruited to NOAA by a former boss from the National Bureau of Standards, Tom Pyke.

When you arrived here, what was your first position?

I was Director of the Office of Satellite Data Processing Distribution, OSDPD. I couldn't remember the acronym, so they told me to call it the "San Diego Police Department," that really helped. [The job] was in Suitland, Maryland, and I was promised that within two years, my office would be moved to Silver Spring. I was [in Suitland] for 15 years, until I took a position on staff here and got to Silver Spring.

What is your position now?

I'm a Senior Advisor for Special Projects, which means that I'm a Senior Advisor to the "stars." I can advise anyone, but no one has to take my advice. I've managed a number of special projects over the five years or so that I have been here at NESDIS headquarters, including working for the [previous NOAA] Administrator, Vice Admiral Conrad Lautenbacher. He asked me to be the first Secretariat Director for an intergovernmental body that ended

up being headquartered in Geneva, Switzerland. That was a very special, special project. I've also worked on helping to reduce losses from disasters using satellite data and better integration of data from earthquake monitoring, and stream gauges for flooding, and those sorts of things.

Most recently, my focus has been integrated Earth observations for NOAA to help better plan, coordinate, and provide long-term access to our environmental data. Also, I've been co-chairing an interagency body under the White House Office of Science and Technology Policy.



Helen Wood, NESDIS Senior Advisor.

What is the most challenging part of your position?

When you're one person with an office consisting of one or two other people and a limited budget, the challenge is actually also an opportunity. You know, you can't buy your way into solutions; you have to build partnerships. My way of working has always been to focus on partnerships and finding common needs and a common way forward. [I find] ways to link good work with good opportunities and provide a little encouragement to facilitate a way forward. It's a challenge because there's no cookbook—there's no set of five steps that you follow. My work is probably the most satisfying because of that.

I've always viewed myself as a champion for the good efforts of others. In a broad sense, I feel like my accomplishment has been to always listen and engage those who really understand the mission and the job they're doing; I learn from them so I can help champion their efforts and provide more visibility and fight for resources.

What do you consider your most significant achievement in your time here at NOAA?

There are two things that I'm particularly proud of. First, around 1990 [at OSDPD], we were talking a lot with users of our satellite data around NOAA and those who wanted to use the data but didn't. Back then, our data were primarily used for weather forecasting. But the National Marine Fisheries, the Ocean Service folks, and the research folks were all interested in how they could collect more data in different ways around the world. NOAA satellites could help with a lot of these things, but not everything. So we began to explore and set up partnerships with the European, Japanese, and other foreign governments; with our sister agencies like NASA, U.S. Geological Survey, and Department of Defense; and with the private sector, which was beginning to build more capabilities for Earth observations. I had the opportunity to take a lead in forging a number of these partnerships and communicating back to NOAA management and our constituents the opportunities from having strong international partnerships and stronger interagency partnerships. It was kind of risky. It was really a bit of an uphill push. But now partnerships for satellite data are just the way we do business. And I can't take credit for all of that, but I can say it was a lot of fun and a wonderful opportunity to be there early on to begin to build some relationships that have yielded a lot of benefits for all the parties involved.



Helen Wood shown here with her Executive Assistant, Julia Tolbert.

Second, starting in 2003, Greg Withee, who was our Assistant Administrator, and Admiral Lautenbacher, who was our Administrator, asked me to help set up an intergovernmental group in Earth observations. We were trying to get governments to work together to share environmental data from all of our instruments and to plan together so that we wouldn't duplicate measurements and so that gaps could be filled. That wasn't as much a technical challenge as it was a challenge to build greater trust and commitment to collaborate.

When we had our first intergovernmental meeting and the United States invited about thirty nations to come and meet with us to see how we could work together, the reaction of many was, "Does the U.S. already have a plan they're trying to sell us?" And we didn't. And once the other governments



got here, their reaction was, “Oh, you actually don’t have a plan you’re going to lay on the table. You really do want to work together. All right. This is interesting. Let’s see if we can do it.” So everybody rolled up their sleeves, and I got to build the working level processes—the process for agreeing on what we’re going to do over the next 10 years and set up the staff office for that in Switzerland and set up agreements so that we had space and resources, and I’m very proud of that. It was exhausting, challenging—but I made so many friends and there’s so much goodwill that continues in this effort. I feel really good about it.

What is going to be NESDIS’s biggest challenge in the next five to ten years?

NESDIS has faced through the years the challenges of dealing with larger and larger volumes of data, of overseeing and bringing our users’ requirements in to guide the development of more capable operational environmental satellites to meet our needs and those of our partners for the future. Those budgets grow because the technology is, in fact, rocket science and more. It’s space science. It’s Earth science. And to get the measurements that we need to improve our weather forecasts, to improve our understanding of climate, to improve our ability to monitor ocean processes, and to help identify and monitor the condition of marine sanctuaries and marine ecosystems, we need to continue to bring in improved technology and improved science. So doing that on a manageable budget is a huge challenge. We have to take a very broad look, a very open look, at the best way to meet our measurement needs.

What advice would you give to young women in the science field?

Young women in the science field—young women in any field—should get their academic credentials and their training in place. And I would say in these fields, or just in our society, it’s important that we not be overly sensitive to the kinds of cultural interactions that may reflect awkwardness or discomfort. There are still people who are a little bit taken aback by a young woman who is very knowledgeable and educated or has authority or resources. And I always boost my chair up a little higher so I don’t look like a kid—I’m not young any more, but I’m short. That can help. Humor and an easy-going nature help regardless of who you are. Come in, be prepared, do the work, and don’t take things too seriously.

What enticed you to stay with NOAA NESDIS for as long as you have?

Twenty-two years in NOAA—the twenty-two years have just flown by. I never imagined I would work this long nor that I would stay in one agency this long. But NOAA is an amazing agency. Everything we do is relevant to life, to life on this planet, to making it a better place. And almost every day, I learn something new. It's all about our environment and making it safer and healthier for us. You know in your heart that you're part of an organization making a difference in so many ways. So in the end, leaving NOAA after 22 years is difficult because this is a truly remarkable place and the people are so dedicated, so impatient for improvement, for breakthroughs, for improved forecasting, for better measurements, for helping. Their passion is truly contagious. It's been a privilege and a joy to work here.

Outside of work, what is your favorite pastime?

Being with my twin grandchildren, who are in the area and are 6 years old, is a joy. I like to help them see life differently—how things work, how things can work differently, taking gadgets apart, putting things together. My greatest joy as a [mother is] watching my daughter and her family develop. Also, I love to travel. My desire is now to continue to see the world, to experience the cultures, to see the beauty, and to celebrate being a part of the world.

What's next for Helen Wood?

After I retire from NOAA, my interest in the work of environmental monitoring, my passion for that, will be with me for the rest of my life. So I certainly hope to be able to communicate that through lectures. I hope to be able to communicate to kids the opportunities and the joy there for pursuing a career in science and technology. There are many, many ways to be part of this—but just to capture the kids' imaginations, to continue in this area. Those are among the things I would like to do.

Follow-up footnote: Helen retired from NOAA in early July, 2010, after 42 years of U.S. government Service. In mid-August, she returned to NOAA as a part-time, temporary, government employee, for up to one year.



Helen Wood at her desk in the GEO Secretariat offices in Geneva, Switzerland (2006).

Awards

GOLD MEDALS

Leadership

Mary E. Kicza, W. Stan Wilson, D. Brent Smith, Linda V. Moodie, Kerry A. Sawyer, Mitchell D. Goldberg, Changyong Cao, Kenneth R. McDonald

For leading change in the international space community and securing strong commitments from 28 space agencies to address gaps in Earth observation.

Scientific/Engineering Achievement

Shobha Kondragunta

For her contributions to NOAA's air quality program by developing a suite of new products from NOAA satellites.

Customer Service

Thomas C. Peterson, Sara Veasey, David M. Anderson, Chris Miller (OAR), Eileen Shea, Susan Solomon (OAR), Jay Lawrimore, Roger Pulwarty (OAR)

For producing a major scientific report detailing the impacts of global climate change in the United States.

SILVER MEDALS

Scientific/Engineering Achievement

Matthew Menne, Claude Williams

For major innovations in climate data preservation and providing the authoritative source of data for understanding the Nation's changing climate.

David Levinson, Kenneth Knapp, Howard J. Diamond

For major innovations in climate stewardship, providing the authoritative source of historical hurricane track data to the global climate community.

ADMINISTRATOR'S AWARDS

Peter Steurer

For leading the development of a NOAA procedure that determines what scientific records to archive, a procedure that received best practice recognition by the National Archives Records Administration.

Mitchell D. Goldberg

For organizing and leading an international program to ensure the accuracy and comparability of measurements from earth observing satellites.





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 MARY ADKINS JR, ANDREW ALLEGRA, ANDREW ALLEN, DONALD AM-
 BURGEY, KEITH ANDERS, DAWN ANDERSON, DAVID ANDERSON, DONNA ANDERSON,
 GLORIA ANDERSON, MICHAEL ANGEL, WILLIAM ANSARI, STEVEN ANZELC, JIMI APPERSON, CHARLENE
 APPLEQUIST, SCOTT ARGUEZ, ANTHONY ARNDT, DEREK ARNFIELD, JEFFREY ATKINS, STEVEN AUNE, ROBERT AUSTIN,
 CAROL AUSTIN, MATTHEW AVERSANO, GLORIA BAGLEY ARMSTRONG, DARRAH BAJPAI, SHYAM BAKER, CHARLES BAKER, ED-
 WARD BALDWIN, RICHARD BALL, ERIN BALLOU, JAMES BANANA, LISA BANAS, JOSEPH BANNOURA, WALID BANZON, PATRIA VIVA
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 PATRICK BENNER, DAVID BERBERICH, KEVIN BERRY, EUGENE BERRY, PAULA BLACKWELL JR, FREEMAN BLOEDEL, BRIAN BOSCH, JULIE BOTLUK, LISA BOUK-
 ABARA, SID BOWMAN, DAVID BOYD, THOMAS BOYER, TIMOTHY BRADY, JAMES BRANCH, TIMOTHY BRANDON, TESS BRAUER, DOUGLAS BRAUN, DEBRA BREGER,
 CAROL BREWER, MICHAEL BRIDGETT, DARBBIE BRIELE, MARK BRINEGAR, DANNY BRINKER, RANDAL BRISCOE, ROBERT BROOKS, BARBARA BROOKS, DONNISE BROOKS, TODD
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 SHARON CAREY, THOMAS CARPINO, CHRISTINE CARR, LILA CARROLL, DONALD CARTER, EMILY CARTER, LILLIAN CARTER, PRESTON CARTER, WILLIAM CARTWRIGHT, JOHN CASEY, KENNETH
 CATALAN, JOSEPH CECIL, LEWIS CHALFANT, MICHAEL CHAMBERLAIN, KIMBERLY CHANG, CHOL CHANG, PAUL CHAPMAN, LAURA CHARNOCK JR, DOUGLAS CHEN, SAM CHENG, ZHAOHUI CHERRIX,
 HOMER CHERRY, TROY CHIEDI, ROSA CHOE, JAE CHOLID, LUKMAN CLAPP, JENNIFER CLARK, CRAIG CLARK JR, JOHNNY CLARK, NATHAN CLEMENTE COLON, PABLO CLEVENSTINE, SETH COHEE, DONNA
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