



# EARTH SYSTEM MONITOR

## NOAA's Office of Oceanic and Atmospheric Research: A Vehicle for Improving NOAA Services

*A guide to  
NOAA's data and  
information  
services*

### INSIDE

2

Letter from the  
NODC Director

4

Ocean Acidification

5

The NOAA  
CoastWatch  
Program

6

NOOSS Optimization

7

Unmanned Aircraft  
Systems for  
Hurricane Research

8

News Briefs

10

Live from Seafloor to  
Scientists Ashore

12

Sant Ocean Hall



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

*Richard W. Spinrad, Ph.D., CMarSci, Assistant  
Administrator for Oceanic and Atmospheric  
Research*

In the decades and century to come, mankind will experience—and thus benefit and potentially suffer from—extraordinary changes in our world's climate, atmosphere, and oceans. These changes will impact our lives. NOAA's research to understand the interactions between the ocean, atmosphere, and land is critical for reducing uncertainty in climate forecasts, predicting severe weather, and sustainably managing ecosystems.

Research conducted through the Office of Oceanic and Atmospheric Research (OAR) will continue reducing the human costs—in both lives and dollars—of hazardous weather and other extreme events. OAR conducts research at seven laboratories around the country and with our partners (mostly in academia, at Cooperative/Joint Institutes and individual universities) through our sponsored research programs (e.g., the Climate Program Office, National Sea Grant College Program, and Ocean Exploration and Research Program). Through tools that observe, track, and predict the concentrations and movement of carbon, we are shrinking the probabilities of error in climate models. Ultimately, our preeminent research is a vehicle for improving products and services used by decision makers to prevent the loss of human life, manage natural resources, gain a greater understanding of the Earth-system, and maintain a strong economy.

### Ocean Exploration, Observation, and Monitoring

The ocean covers more than 70 percent of the Earth's surface, yet more than 90 percent remains unexplored. NOAA uses different ve-

hicles to explore the ocean and conduct research, including ships, buoys, high-tech remotely operated vehicles (ROVs), floats, gliders, and autonomous underwater vehicles (AUVs).

In August, NOAA launched the world's only vessel dedicated to ocean exploration and research, the NOAA Ship *Okeanos Explorer*. This ship will allow scientists and students real-time access to ocean exploration through the Internet. This technology will allow a "scientists on call" approach to ocean exploration and will bring the ocean into the classroom, allowing students to participate in undersea exploration. *Okeanos Explorer* is equipped with a variety of sensors and systems, including modern hull-mounted multibeam sonar for seafloor mapping. These maps will identify features for further investigation using tether-attached ROVs that can venture up to 6,000 meters below the surface.

NOAA uses buoys and satellites simultaneously to obtain a more complete picture of the ocean and gain faster access to data. OAR researchers designed, built, and

deployed Deep-ocean Assessment and Reporting of Tsunamis (DART<sup>®</sup>) buoys, a vital component of the recently-completed warning network for the United States. DART<sup>®</sup> buoys will dramatically increase warning times and decrease the loss of life. In October 2008, Dr. Eddie Bernard, Director of NOAA's Pacific Marine Environmental Laboratory, was honored with a Service to America Medal in Homeland Security for his leading work on DART<sup>®</sup>.

In 2003, just a month after the system was transferred from research to operational mode, the value of DART<sup>®</sup> was demonstrated when Hawaii cancelled a tsunami warning because real-time DART<sup>®</sup> data showed that the tsunami would not be damaging. This saved the state an estimated \$68 million. The latest generation of DART<sup>®</sup> has two-way satellite communications

*(continued on page 3)*



▲ Richard W. Spinrad, Ph.D.

## Letter from the NODC Director



▲ Margarita Conkright Gregg, Ph.D.

As we start a new fiscal year at NOAA, it is exciting to look back and see what the National Oceanographic Data Center (NODC) accomplished in the past year. This was an active, productive, and exciting year at the center. We initiated a series of activities to communicate to our customers the multitude of NODC products and services, at the same time receiving input on what ocean data and information are required by the community we serve. We also developed tools and services that will facilitate the exchange of ocean data and information. This is essential since understanding the oceans and coasts in a changing climate requires historical as well as real-time ocean data and information. NODC, in its role as the national steward for ocean data and information, is working with the national and international communities to provide products essential to addressing these issues.

In meeting our goal to provide access to the Nation's coastal and ocean data and information, NODC integrated disparate datasets through its Regional Ecosystem Data Management (REDM) portal; implemented the Coral Reef Information System (CoRIS) Regional Portal, which enables a broad audience of users to discover NOAA-funded coral ecosystems data and information products; and enhanced NODC's Coastal Water Temperature Guide to include an interactive Google Maps™ interface. An internal application known as World Ocean Database Select was enhanced by scientists at NODC to provide public access to ocean profiles every three months, a

considerable improvement over the previous multi-year updates.

Also, we acquired and archived over 11,600 datasets from over 70 oceanographic organizations and offices. We increased the number of users of the Global Ocean Data Assimilation Experiment High Resolution Sea Surface Temperature product by 20 percent, which translates to over a 300 percent increase in data distributed. NODC increased the amount of historical data as well as modern profile data in the World Ocean Database. Data from approximately 200,000 Ocean Station Data casts and approximately 200,000 Conductivity-Temperature-Depth casts were processed for inclusion into the upcoming World Ocean Database 2009. The number of visitors accessing the online Photo Library, Climate Data Modernization websites and collections, and our online legacy databases surpassed all previous records.

During 2009, we will continue to communicate NODC's mission and vision that reflects the core capabilities of the center and deals with the growing requirements for ocean data and information. We will also continue to plan for products and services our customers will require in the future. Our success relies on national and international partnerships, and we judge our accomplishments by the usefulness of our data and information products.

In 2008, the *Earth System Monitor* focused on the NOAA mission goals "Weather and Water" and "Commerce and Transportation" and on the "Satellite" subgoal. This issue focuses on "Ships, Satellites, and Buoys." Dr. Richard Spinrad, Assistant Administrator of NOAA in the Office of Oceanic and Atmospheric Research (OAR), leads the issue with a description of how the research conducted at OAR is critical for "reducing uncertainty in climate forecasts, predicting severe weather, and sustainably managing ecosystems." Other articles in this issue support his views on the transition of research-to-operations, and the key role OAR plays in exploration and discovery that lay the foundation for NOAA's services of the future. ■

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/ESM](http://www.nodc.noaa.gov/ESM)

**Comments should be directed to Andrew Allegra, Managing Editor.**

Email: [esm@noaa.gov](mailto:esm@noaa.gov)  
Phone: 301-713-3277 x152  
Fax: 301-713-3302

#### Editing and Layout

Mindy Gaines, Tara Mairs,  
Marc Pulliam, Kelly Logan

The mailing address for the *Earth System Monitor* is:

National Oceanographic  
Data Center  
NOAA/NESDIS E/OC  
SSMC3, 4<sup>th</sup> Floor  
1315 East-West Highway  
Silver Spring, MD 20910-3282

#### Disclaimer

Mention in the *Earth System Monitor* of commercial companies or commercial products does not constitute an endorsement or recommendation by the National Oceanic and Atmospheric Administration or the U.S. Department of Commerce. Use for publicity or advertising purposes of information published in the *Earth System Monitor* concerning proprietary products or the tests of such products is not authorized.



**U.S. DEPARTMENT OF  
COMMERCE**

Carlos M. Gutierrez, Secretary

**National Oceanic and  
Atmospheric Administration**

William J. Brennan, Ph.D.,  
Acting Under Secretary  
and Administrator

*(Oceanic and Atmospheric Research continued from page 1)* between the anchored seafloor bottom pressure recorder, Tsunami Warning Centers (TWC), and the National Data Buoy Center. This allows TWCs to set stations in event mode in anticipation of possible tsunamis or retrieve the high-resolution (15-s intervals) data in one-hour blocks for detailed analysis.

NOAA researchers are also improving ocean observations through an innovative use of ocean “robots” called the Argo array. NOAA helped lead the international Argo effort in the year 2000 to deploy 3,000 free-drifting floats around the globe. There are now nearly 3,200 drifters throughout the world’s oceans. Argo floats spend most of their life collecting hydrographic data from the water-column as deep as 2,000 meters. In combination with satellite data, Argo provides a dynamic, more complete description of the upper ocean. With floats around the globe and data available within 24 hours via satellite, scientists no longer have to piece together data from multiple systems to get a worldwide profile of ocean variability.

### Weather Forecasts and Warnings

Americans enjoy the best weather services in the world. Many tools in today’s weather forecast office got their beginnings in OAR laboratories. One example is the Advanced Weather Interactive Processing System (AWIPS), a computer system that enables forecasters to view a variety of data sources in one place.

The NEXRAD Doppler radar system, developed by OAR researchers and used by NOAA’s Weather Forecast Offices throughout the Nation is credited for preventing over 330 fatalities and 7,800 injuries from tornadoes between 1992 and 2004. The next giant leap will be the multifunction phased array radar (MPAR), which will provide more detailed weather information and could significantly improve average warning times for tornadoes and flash floods. A single network of MPAR units could theoretically replace seven aging, single-function conventional radar networks that currently serve aviation, defense, homeland security, and weather forecasting needs.

We have made significant advances in understanding and modeling hurricanes and predicting when and where they will go, days in advance. These are capabilities we take for granted, but 20 years ago they were little more than a dream. Deploying dropsondes from NOAA’s hurricane hunter aircraft has provided NOAA researchers with a wealth of wind speed, temperature, humidity, and pressure data. This year during Hurricane Fay alone, 186 Global Positioning System (GPS) dropsondes were released, and the data were included in real-time model runs. NOAA is also beginning to use Unmanned Aircraft Systems (UAS) to obtain data (e.g., low level winds) currently unavailable using manned aircraft. This advance will improve hurricane landfall lead times and better determine the extent of hurricane evacuations needed,

saving \$640,000 per coastal mile when evacuations and other preparedness measures are not necessary.

### Changing Climate

Climate change is one of the most pressing issues of our time. NOAA researchers are working to improve our understanding and prediction of natural climate variability, as well as to identify and predict human-caused, or anthropogenic, climate change. Scores of NOAA scientists contributed to the Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report, which shared the 2007 Nobel Peace Prize and included over 20 numerical model runs for this historic assessment.

OAR researchers were measuring the Earth’s carbon footprint long before it became vogue. Precise measurements of carbon dioxide have been collected at the South Pole and NOAA’s Mauna Loa Observatory in Hawaii since 1958, which is the longest continuous carbon dioxide (CO<sub>2</sub>) record in the world. Expanding on this work, our researchers developed a new tool, CarbonTracker, which is a global visualization of CO<sub>2</sub> sources (areas of net CO<sub>2</sub> emission) and sinks (areas of net CO<sub>2</sub> absorption). This research has the potential to provide critical tools for validation in markets for carbon cap and trade and renewable energy.

Ocean acidification, another unwanted effect of CO<sub>2</sub>, threatens the health of marine organisms, including corals. To monitor these changes, our researchers developed the first buoy to directly monitor the ocean acidification in the Gulf of Alaska. Data from this buoy coupled with ongoing research will give us important insights into how changing ocean chemistry impacts ecosystems.

### Research: The Vehicle for Meeting Future Needs

NOAA research creates a balance of near-term responsibility to enhance operational and regulatory roles of NOAA and our stakeholders, with a long-term commitment to conduct visionary, discovery-based research. This dual responsibility requires transferring research-to-operations, defining research requirements from mission needs, and continuing exploration and discovery in new areas that will lay the foundation for future NOAA services.

Continued investment in scientific research is essential. Every mission element, capability, product, and service in NOAA is science-based and a direct result of a sustained, sound investment in research. OAR research provides the basic understanding of Earth’s environment today, as well as the scientific insight needed to identify key challenges for the future. ■

## Ocean Acidification: Researching the *Other* CO<sub>2</sub> Side-Effect

*Rochelle Plutchak, Sea Grant Fellow, NOAA's Office of Oceanic and Atmospheric Research*

Anyone who has ever had pet fish knows that changes in pH levels can wreak havoc on life in an aquarium. The same is true in the ocean. It is estimated that the oceans have absorbed about 50 percent of the carbon dioxide (CO<sub>2</sub>) released from the burning of fossil fuels, lowering ocean pH. The result has been a 30 percent increase in hydrogen ions (acidity) since the start of the industrial age; this process is known as ocean acidification. In NOAA's Office of Oceanic and Atmospheric Research (OAR), scientists have been working to better understand this change in ocean chemistry. Just this year, researchers from the Pacific Marine Environmental Laboratory (PMEL) documented the first evidence that the western North American continental shelf is seasonally impacted by ocean acidification, which could already be impacting the near-shore environment.

Ocean acidification threatens marine organisms, including corals that support biodiversity and phytoplankton that are the base of the food web. Increasing acidity lowers carbonate ion concentration, a component of the calcium carbonate used by many organisms to build shells, skeletons, and coral reef structures. This threat to ecosystems may also impact the economy. Americans love their seafood—to the tune of approximately \$60 billion per year, making us the third largest consumer in the world. Coastal and marine commercial fishing generates as much as \$30 billion per year and nearly 70,000 jobs. Healthy coral reefs are the foundation of many of these fisheries, as well as the source of tourism and recreation revenues.

The ecological and economic implications of ocean acidification are far-reaching, and NOAA scientists are spearheading research and monitoring efforts to fully understand changes to vulnerable ecosystems. Results from a recent study from the Atlantic Oceanographic and Meteorological Laboratory could offer a glimpse into the future for coral reefs if atmospheric CO<sub>2</sub> continues to rise. Researchers studied seawater chemistry and the framework of coral reefs in the eastern tropical Pacific, a region exposed to high levels of CO<sub>2</sub>, and compared them with levels found in reefs in the Bahamas. They found that

this high-CO<sub>2</sub> environment causes a drastic reduction in the production of the cement that allows corals to create reefs capable of withstanding erosion. These results were published in the Proceedings of the National Academy of Sciences in July 2008.

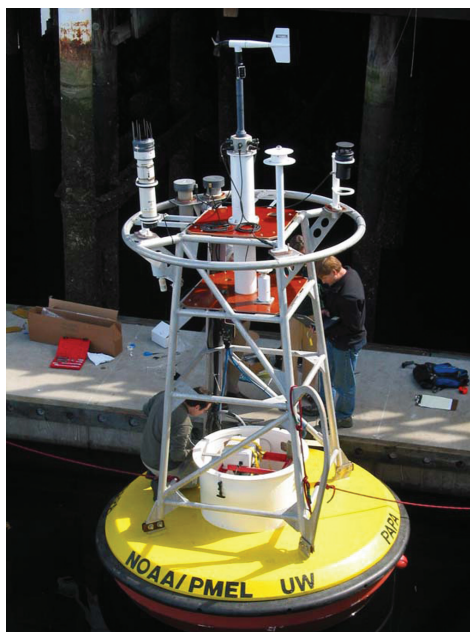
Over the next millennium, the ocean is expected to absorb around 90 percent of the CO<sub>2</sub> emitted into the atmosphere.

This expected increase in ocean acidification will create a need for additional and superior sensors, technologies for studying impacts on organisms and ecosystems, and ecological modeling efforts to help predict changes. OAR scientists have been on the leading edge of the effort to develop these technologies.

In 2007, scientists from PMEL launched the first buoy designed to specifically monitor ocean acidification in the Gulf of Alaska. The 10-foot diameter buoy measures air-sea exchange of CO<sub>2</sub>, oxygen, and nitrogen, as well as pH in surface waters. The buoy is part of a National Science Foundation project awarded to oceanographers at PMEL and the University of Washington in Seattle, in collaboration with Fisheries and Oceans Canada and the Institute of Ocean Sciences in Sidney, British Columbia. In addition to the lone buoy in the Gulf of Alaska, expanded monitoring is crucial. The Earth System Research Laboratory is now working with other NOAA labs

to develop a new technique to measure CO<sub>2</sub> fluxes over the open ocean, an important step in assessing the role of oceanic uptake in the global CO<sub>2</sub> budget.

Promoting further understanding of ocean acidification and preventing it from worsening is absolutely essential. OAR researchers are conducting preeminent research to “understand climate variability and change to enhance society’s ability to plan and respond”—one of NOAA’s four mission goals. OAR’s Climate Program Office and laboratories are improving our understanding of the global carbon cycle, connections to ocean acidification, and the potential impacts on marine life and the planet. This research will help society better understand how increasing atmospheric CO<sub>2</sub> will change the ocean and how these changes will impact our world. ■



▲ NOAA scientists and technicians make final adjustments on the first buoy designed to measure ocean acidification. The buoy was launched in the Gulf of Alaska.

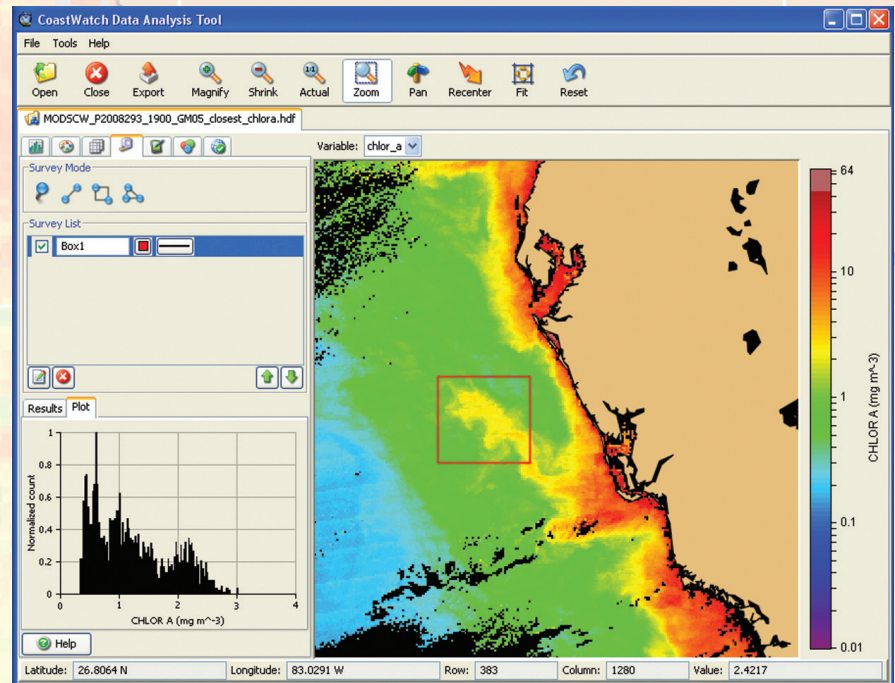
# The NOAA CoastWatch Program: Twenty Years and Counting

Michael Soracco, Senior Systems Engineer, SP Systems, Inc., and Paul M. DiGiacomo, NOAA CoastWatch Program Manager

The NOAA CoastWatch Program has come a long way since its start in 1987. What began as an *ad hoc* single product in response to a harmful algal bloom (HAB) event in North Carolina has evolved into a cross-NOAA effort that provides a wide range of oceanographic satellite remote sensing data, products, and services to a diverse group of users. Of particular note, CoastWatch was recently given an honorable mention in both the “Breakthroughs” and “Foundation Datasets and Products” categories for NOAA’s 200<sup>th</sup> Celebration.

The basic premise of NOAA CoastWatch has not changed very much since the beginning. The CoastWatch mission remains to “process near-real-time oceanographic satellite data and make it available to Federal, State, and local marine scientists, coastal resource managers, and the general public.” The early days of CoastWatch required users to register and use a modem to access government systems. Sea surface temperature data were distributed through eight regional nodes within the United States. Datasets are now significantly larger, and much faster networks have replaced modems in moving data from receiving stations, through central processing systems and/or regional nodes, and, ultimately, to end users. In addition to CoastWatch Central Operations in Camp Springs, Maryland, six regional nodes remain, situated in the various line offices of NOAA. These divisions continue developing unique products, in addition to distributing standard satellite data and products. Services provided by the regional nodes include online Geographical Information Systems, Thematic Real-Time Environmental Distributed Data Services (THREDDS), Live Access Servers (LAS), and a variety of applets and software tools.

There have also been improvements in data processing; specifically, reformatting datasets into a common program format called the CoastWatch Hierarchical Data Format (HDF). In addition, a Graphical User Interface program called the CoastWatch Data Analysis Tool (CDAT; see figure above) enables users to easily manipulate satellite data (HDF) depending upon their specific needs and applications. CDAT and other utilities can be downloaded from the CoastWatch website. Alternatively, users can import and use these data in their own software packages.



▲ Screenshot of the CoastWatch Data Analysis Tool (CDAT) using the survey function to generate a histogram based on a user-selected box.

CoastWatch produces and disseminates a wide variety of satellite remote sensing products, including ocean color (e.g., chlorophyll-a and reflectance), ocean surface winds, sea surface temperature, and other products from a variety of domestic and international platform/sensors. Additionally, CoastWatch facilitates and enhances product development and quality and supports their transition from research into applications, working with a broad group of scientists from NOAA line offices as well as other agencies, academic institutions, and other organizations. Collectively, these scientists develop products that can go through three phases of development: experimental, pre-operational, and operational. Although products may be posted on the CoastWatch website during any of these three developmental phases, operational products undergo a rigorous review and transition process through NOAA’s Satellite Products and Services Review Board (SPSRB).

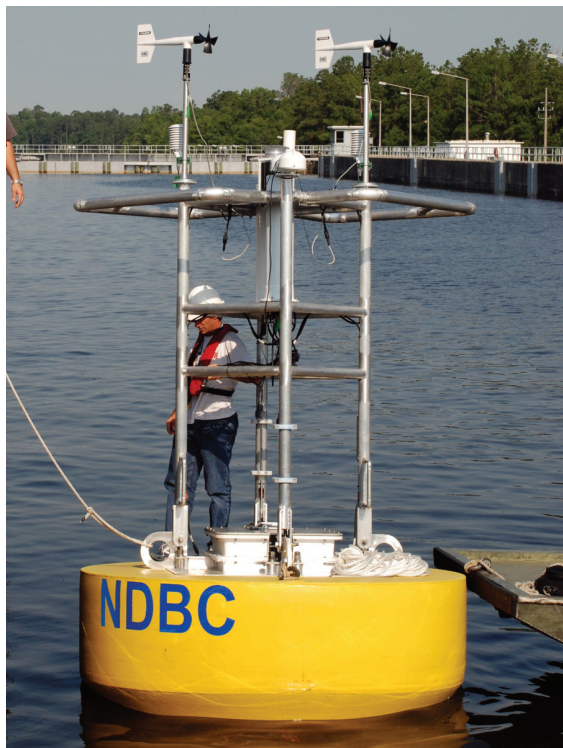
Ocean color is one of CoastWatch’s most used datasets, particularly in support of HAB monitoring. CoastWatch initially used ocean color data from the Ocean Color and Temperature Scanner (OCTS) onboard the National Space Development Agency of Japan’s (NASDA, now the Japan

(continued on page 6)

## NOOSS Optimization: The Multi-Purpose Buoy

Michael Burdette, *Oceanographer, National Data Buoy Center*

Special Thanks to Brett Taft, Engineer; Rodney Riley, Engineer; William Hansen, Engineer; and LTJG William Wells, NOAA Corps., for helping with this article.



▲ Testing the Multi-Purpose Buoy.

Recently, the Tropical Atmosphere Ocean (TAO) and Deep-ocean Assessment and Reporting of Tsunamis (DART<sup>®</sup>) systems were assimilated into the National Data Buoy Center (NDBC) Ocean Observation System of Systems (NOOSS). This transition highlighted the need to develop a strategy to manage three independent observation systems as one integrated observation system of nearly 200 buoys. To accomplish this, NDBC first developed a multi-purpose buoy, a standard platform with baseline form factors to meet the individual and combined needs of a TAO, DART<sup>®</sup>, and Coastal Weather Buoy. This new buoy will allow for more combined and coordinated operations that take advantage of a common platform, provide an opportunity to mix observation schemes where advantageous, and reduce overall logistics and maintenance costs.

The design, development, fabrication, and deployment of the prototype multi-purpose systems for long-term field testing were completed in June 2008. As with any system that is intended for multiple applications, there were major design conflicts that had to be resolved. These issues included individual power system requirements for each application; payload packaging; and the placement of a wave sensor relative to magnetic interference. In addition, NDBC created a configurable mooring bridle to accommodate various hardware and program requirements and a configurable Acoustic Doppler Current Profiler (ADCP) well to protect the sensor from environmental damage and increase reliability. NDBC also made sure to design this buoy so that it is easy for a field technician to service or reconfigure at sea.

To date, all field testing has proven successful. In 2009, NDBC plans to conduct one last short-term test to prove interoperability. During at-sea service, each of the buoys will be reconfigured on-deck to support different program requirements before being redeployed for a 30-day monitoring period. ■

*(The NOAA CoastWatch Program continued from page 5)*  
Aerospace Exploration Agency, JAXA) Advanced Earth Observing Satellite (ADEOS) (1996-1997). This initial effort paved the way for implementing NOAA's first operational ocean color products, starting in 2006. Today, data from GeoEye's Sea-viewing Wide Field-of-view Sensor (SeaWiFS) and the National Aeronautics and Space Administration's (NASA's) Moderate Resolution Imaging Spectroradiometer (MODIS) aboard the OrbView-2 and Aqua spacecraft, respectively, are processed into daily, mean, and anomaly chlorophyll-a and reflectance products. These products are then made available to NOAA's Center for Operational Oceanographic Products and Services (CO-OPS) for analysis and are used to issue HAB bulletins for the Gulf of Mexico. To maintain operational ocean color continuity, CoastWatch is now obtaining and processing MEdium Resolution Imaging Spectrometer (MERIS) data

from the European Space Agency's (ESA's) Envisat platform and is likewise preparing for the Visible/Infrared Imager/Radiometer Suite (VIIRS) to be flown aboard the National Polar-orbiting Operational Environmental Satellite System (NPOESS) platforms.

New developments and improvements scheduled in the coming year for CoastWatch include completing the redesign of the CoastWatch Central website; further developing a complementary OceanWatch website that supports global climate applications; supporting the network Common Data Form (netCDF) format; and implementing a THREDDS server to support NOAA Integrated Ocean Observing System (IOOS) activities, among many other efforts. ■

For additional information on CoastWatch, visit <http://coast-watch.noaa.gov/> or contact Paul DiGiacomo, the CoastWatch Program Manager, at [Paul.DiGiacomo@noaa.gov](mailto:Paul.DiGiacomo@noaa.gov).

## Unmanned Aircraft Systems for Hurricane Research

Erica Rule, Outreach Coordinator, NOAA's Atlantic Oceanographic and Meteorological Laboratory

**N**OAA has been sending manned aircraft into hurricanes for over 50 years to collect information vital to understanding hurricane dynamics and accurately measuring storm strength. To improve intensity forecasts, scientists need to collect information in the environment where the air meets the sea—called the hurricane boundary layer.

Since 2005, NOAA has been studying the unique capability of unmanned aircraft for use in understanding hurricanes. NOAA uses the Aerosonde®, unmanned aircraft system (UAS) as an instrument platform capable of transmitting data, from within hurricanes, at flight levels at or below 500 feet of altitude where it is too dangerous to send manned aircraft. During a flight into a hurricane, the UAS spirals into the eye of the storm, riding the waves of air turbulence while its pilot controls the aircraft from anywhere in the world. The aircraft

can be used again for future missions once recovered back on land.

In September 2005, NOAA, its partners, and the National Aeronautics and Space Administration (NASA) successfully flew an unmanned aircraft into Tropical Storm Ophelia. The UAS was first flown in hurricane strength winds during Hurricane Noel in 2007. In both instances, the Aerosonde® UAS provided critical near-surface wind observations to the National Hurricane Center in real time.

This year, NOAA plans to test the capability of UAS aircraft to obtain continuous observations of temperature, moisture, and wind close to the ocean surface in a mature, major hurricane (category 3 or stronger). In coming years, NOAA hopes UAS data will be used to help initialize and verify operational and research-oriented numerical experiments of tropical cyclones. ■

## WISDOM (Weather *In Situ* Deployment Optimization Method)

Justyna Nicinska, WISDOM Program Manager, NOAA's Office of Oceanic and Atmospheric Research, and Russell B. Chadwick, Senior Engineer, Global Systems Division

**S**evere hurricanes have a devastating impact on the southern coast of the United States, Caribbean Countries, and eastern Central America. More accurate predictions of landfall and of hurricane intensity at landfall are of increasing importance for public safety. Improvements, such as highly accurate track and intensity forecasts can moderate potentially unnecessary large-scale evacuations and enhance public security by providing additional time to prepare.

The Weather *In Situ* Deployment Optimization Method (WISDOM) project seeks to improve the three to seven day predictions of Atlantic hurricane track and intensity by deploying specialized balloons into critical data-sparse regions of the atmosphere. An interagency effort, sponsored by the Department of Homeland Security and managed by NOAA, is underway to test this concept during the 2008 hurricane season. This system consists of ground-based release points for “super-pressure” balloons in a large area around a weather disturbance. These balloons will travel through the atmosphere and communicate pertinent measurements (altitude and location, used to derive wind data) via a small Global Positioning System (GPS) unit to the Earth Systems Research

Laboratory in Boulder, Colorado. The long-term goal is to measurably improve hurricane forecasts by saturating the data void for every major storm with several hundred balloons and include these data in global forecast models.

A significant source of hurricane forecast error is the lack of *in situ* wind data over large areas, up to thousands of miles, around the storms. WISDOM will use advanced modeling techniques first, to identify the high forecast-value regions for data collection and second, to identify the optimal balloon launch sites. Upon release, balloons will rise rapidly to a specified altitude and drift along the previously estimated trajectory into the targeted region. The wind data from the balloon/GPS system will be distributed to operational forecasting centers.

The WISDOM 2008 proof of concept test is underway. Nineteen balloons were successfully launched from Mississippi, Florida, Puerto Rico, and Barbados by students from Mississippi State University, University of Miami, the Caribbean Institute for Meteorology and Hydrology, and by NOAA employees. There will be additional deployments this season, targeting the next approaching storm. ■

## News Briefs

### Great Lakes Environmental Research Laboratory

NOAA's Great Lakes Environmental Research Laboratory (GLERL) conducts high quality research and provides scientific leadership on important issues in both the Great Lakes and marine coastal environments. This work leads to new knowledge, tools, approaches, awareness, and services. GLERL has embarked on development of ecosystem forecasting capabilities that predict the effects of biological, chemical, physical, and human-induced changes on ecosystems.

### Invasive Shrimp Species Discovered in Great Lakes

Biologists at GLERL's Lake Michigan Field Station in Muskegon, Michigan, collected an invasive Mysid shrimp species that was previously not found in the Great Lakes. The full impact of this new invasive species is not yet known. Aquatic invasive species are a global problem, threatening the economic security of the United States. They reduce the beneficial uses of coastal ecosystems and resources and increase costs for commerce and trade-related coastal industries.



▲ *Hemimysis anomala* invasive shrimp.

### NOAA Great Lakes Lab Recognized for 'Green' Research Vessels

GLERL converted a fleet of research vessels from petroleum-based to 100 percent bio-based fuel and lubricants, earning a White House Closing-the-Circle Award in the green purchasing category. This initiative reduced costs and positively impacts the work environment for the vessels' crews and researchers. GLERL's approach to the 1998 Executive Order that called for the "greening" of government agencies was to focus on the use of bio-products on research vessels and to demonstrate environmental and operational benefits.



▲ *R/V Laurentian* was one of the first NOAA research vessels converted to operate on bio-based fuel and lubricants.

### International Field Years on Lake Erie

GLERL, in collaboration with researchers in the U.S. and Canada, is nearing the end of an extensive Lake Erie research endeavor. The project, International Field Years on Lake Erie, has become the largest international multidisciplinary research effort of its kind in Lake Erie's history, involving approximately 40 scientists from NOAA, 17 different universities, and private institutions spread across 7 states and 4 countries. Fourteen observation moorings were deployed in the lake to continuously collect data. The project is expected to yield an improved understanding of processes

leading to the development of Harmful Algal Blooms (HABs) and forecast anoxic "dead zones" in the central and western basins of Lake Erie.

### Research Finds Vaccine against Common Deadly Fish Virus

Ohio Sea Grant researchers have found that a unicellular alga, *Chlamydomonas reinhardtii*, can be used to vaccinate fish against the Infectious Hematopoietic Necrosis Virus (IHNV), which kills 30 percent of the U.S. trout population. The IHNV antigen is attached to the alga cells, which are then fed to fish, inducing an immune response to the virus. Successful trials of this vaccination process could lead to a major decrease in U.S. trout population deaths.

For more information on the GLERL, visit [www.glerl.noaa.gov](http://www.glerl.noaa.gov).

### NOAA's Oldest Ship, *John N. Cobb*, to be Retired

NOAA ship *John N. Cobb*, the oldest and only wooden hulled ship in the NOAA fleet, was decommissioned on August 13, 2008, in Seattle after 58 years of service. The 93-foot fisheries research vessel began service in 1950 with the Bureau of Fisheries, predecessor to NOAA's Fisheries Service, conducting albacore tuna surveys in Oregon, Washington, and Alaska. Homeported in Seattle, *Cobb* has operated primarily in Alaskan waters for much of her service life, most recently in support of the fisheries service's Auke Bay Laboratories in Juneau.

"The *John N. Cobb* has been an extremely productive platform for NOAA. She has been operating with her original 1931-design Fairbanks-Morse engine until this year," said Rear Admiral Jonathan W. Bailey, director of the NOAA Corps, one of the Nation's seven uniformed services, and NOAA's Office of Marine and Aviation Operations. "We are sad





▲ *John N. Cobb* in Glacier Bay, Alaska.

to see *Cobb* go, but it would not be the best use of NOAA's resources to perform the maintenance and repairs required to keep her in service."

*John N. Cobb* was designed as a purse-seiner, but added capabilities enabled her to utilize almost every fishing method, including trawling and long-lining. The ship has conducted various types of data acquisition and research, including juvenile salmon marine ecology evaluations, juvenile rockfish habitat assessments, sablefish tagging and telemetry, marine mammal surveys, coral and sponge benthic habitat research, near-shore estuaries' habitat mapping, and oceanographic sampling and long-term coastal monitoring.

*Cobb's* career has included some interesting and unusual missions such as:

- *Cobb* helped pioneer the use of surface rope trawls, which led to the development of an important long-term dataset on the biological and physical factors affecting annual fluctuations in the population strength of specific groups of salmon.
- The *Exxon Valdez* disaster in 1989 kept *Cobb* busy for several years supporting evaluations of the effects of the oil spill on the Prince William Sound ecosystem.
- *Cobb* came to the assistance of two vessels in distress in Alaska

— the purse seine vessel *Karen Rae* in the mid 1990s and the Alaska state ferry *Le Conte* in 2004.

NOAA is investigating the use of other NOAA ships or chartered vessels to carry on *Cobb's* work in Alaska.

### NOAA Deploys "Smart Buoy" at Mouth of Susquehanna River

NOAA's Chesapeake Bay Office deployed a new edition of its series of "smart buoys" at the mouth of the Susquehanna River on September 13, 2008, to monitor the bay's changing conditions. U.S. Senator Barbara Mikulski, U.S. Senator Benjamin L. Cardin, and U.S. Rep. C.A. "Dutch" Ruppersberger, along with retired Navy Vice Admiral Conrad C. Lautenbacher, Jr., Ph.D., Under Secretary of Commerce for Oceans and Atmosphere, commemorated the deployment at Concord Point in Havre de Grace, Maryland.

As part of the Chesapeake Bay Interpretive Buoy System, this is the fifth interpretative buoy to mark the Capt. John Smith Chesapeake National Historic Trail. The new buoy will feature a sensor to track nutrient levels as they enter the bay from the river.

The buoy, like others in the system, will collect weather, oceanographic, and water-quality observations, and transmit this data wirelessly in near-real-time. The Susquehanna

buoy will also feature a new sensor, designed to track levels of nitrogen in the water. High levels of nutrients, including nitrogen, have a strong connection to deterioration of the bay's health, and can contribute to low dissolved oxygen levels in bay waters, which create areas known as "dead zones."

"The Susquehanna buoy is more than just an important addition to the Capt. John Smith Chesapeake National Historic Trail," said Senator Cardin. "This innovative buoy system will provide real-time data to boaters, help scientists gather critical information about the nutrient and ecological health of the Chesapeake Bay's watershed, while also providing visitors with information about Capt. Smith's historic voyages of discovery."

The system's buoys have been deployed at the mouths of the Potomac, Patapsco, and Rappahannock rivers, and in the James River off Jamestown, Virginia.

For more information on these "Smart Buoys," visit [www.buoybay.org/site/public](http://www.buoybay.org/site/public).



▲ Smart Buoy in the Susquehanna River.

## Live from Seafloor to Scientists Ashore

*Christine Patrick, Knauss Marine Policy Fellow, NOAA Office of Ocean Exploration and Research, and Fred Gorell, Public Affairs Officer, NOAA Office of Ocean Exploration and Research*

**W**ith *Okeanos Explorer*, NOAA has a ship on course to be “America’s Ship for Ocean Exploration,”—the only Federal ship dedicated solely to exploring our largely unknown ocean for the purpose of discovery and the advancement of knowledge. The ship will explore in new ways, sending images and other data live from the seafloor to scientists ashore.

Why explore? All life relies on the ocean, which covers more than 70 percent of our planet. The ocean drives weather, regulates temperature, and provides half of the oxygen we breathe, food, medicines, energy, and avenues for commerce. Yet, the ocean is 95 percent unexplored. The *Okeanos Explorer*

has great potential to help NOAA understand, manage, and protect the ocean and its resources. And with images of ocean discoveries delivered live to a variety of audiences ashore, we expect ocean literacy to rise, allowing stakeholders to make better-informed decisions on ocean issues.

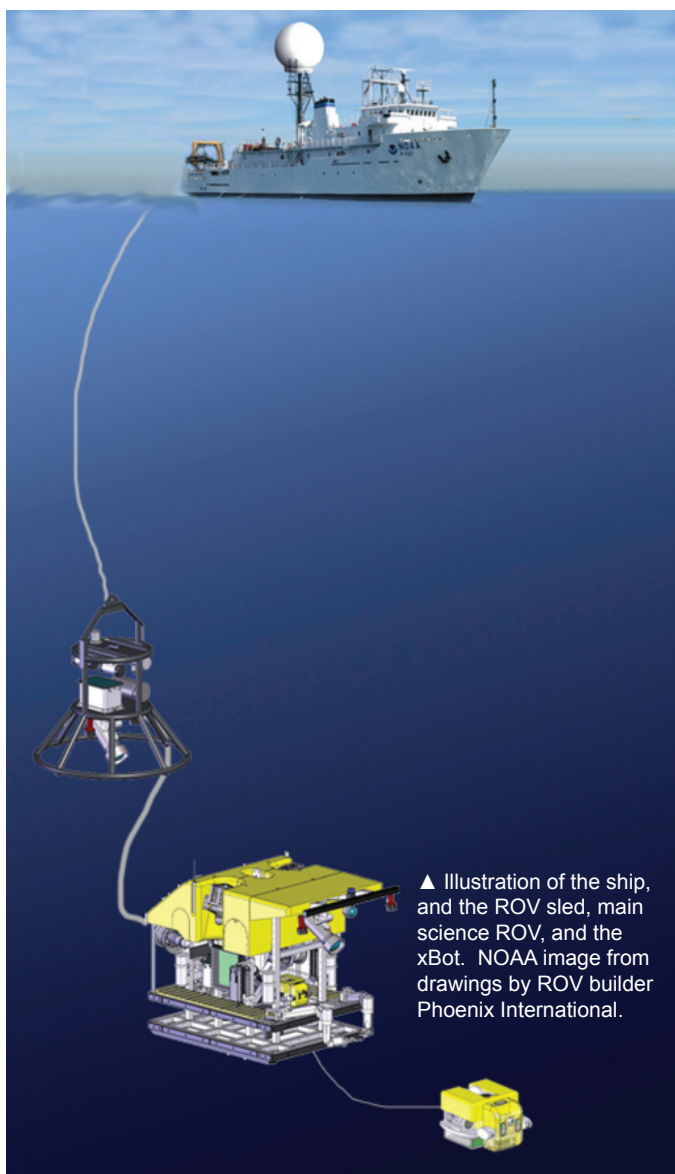
Unlike many ocean expeditions, this ship’s missions will have most scientists remaining ashore. Using telepresence technology, live images from the seafloor and other data will flow over satellite and high-speed Internet pathways to scientists standing watch in any of five Exploration Command Centers ashore. This allows those scientists to add their expertise and even take control of missions, no matter where the ship may be.

Ship missions include exploration mapping and site characterization, reconnaissance, education, and outreach. If an anomaly is discovered, more “on-call” scientists ashore may join the team as the ship deploys remotely operated vehicles (ROVs) and other sensors and systems to conduct a preliminary investigation. When enough data is generated to energize the ocean research community to pursue follow-on investigations, the ship will move on to explore other parts of the unknown ocean.

The ship’s most visible feature is a large dome for high-bandwidth satellite communications between explorers ashore and afloat. A modern hull-mounted multibeam sonar produces high-resolution maps of the seafloor as deep as 6,000 meters, and the vessel’s tethered ROVs can operate down to 6,000 meters. When ROVs are deployed, *Okeanos Explorer* remains on station using dynamic positioning, a sort of automatic pilot that integrates satellite positioning data with the ship’s engines and thrusters.

*Okeanos Explorer* is operated by NOAA’s Office of Marine and Aviation Operations, with NOAA’s Office of Ocean Exploration and Research operating mission-related equipment. The ship and crew are conducting training and field tests off the U.S. West Coast with the first full field season planned for 2009. The *Okeanos Explorer* will spend its first two years in the Pacific before homeporting in Rhode Island. ■

Many of the ship’s adventures will stream to NOAA’s award-winning website, [oceanexplorer.noaa.gov](http://oceanexplorer.noaa.gov), bringing the excitement of ocean exploration and discovery live into classrooms, newsrooms, and living rooms.



▲ Illustration of the ship, and the ROV sled, main science ROV, and the xBot. NOAA image from drawings by ROV builder Phoenix International.

# Ships, Satellites, and Buoys



NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Poster Designed By: Marc Pulliam

## Sant Ocean Hall

*Joanne Flanders, NOAA Ocean Hall Coordinator and Deputy for Program Development, Office of Ocean Exploration and Research*

The Sant Ocean Hall opened on September 27<sup>th</sup> at the National Museum of Natural History to reveal a 23,000 square foot exhibit designed around the message: *The ocean is a global system essential to all life*. Five years in the making, this exhibit weaves more than 600 specimens and models—and a 1,500 gallon Indo-Pacific coral reef aquarium—with high definition imagery, innovative computer interactives, and a virtual submersible expedition to the seafloor.

The 30-year “permanent” exhibit responds to the calls of the U.S. Commission on Ocean Policy and U.S. Ocean Action Plan to manage the ocean wisely and build public support for a healthy ocean. It will be kept current through updateable exhibits such as NOAA’s Science On a Sphere®, an animated globe that displays Earth’s environmental processes, the NOAA designed Ocean Today Kiosk, which allows visitors to access data and recent discoveries through multi-media offerings, and a “Where in the World we do Science” station, which highlights novel research and the people behind it.

The Smithsonian-NOAA partnership to create a national exhibition on the ocean began in 2003 and was made possible through financial support from Congress. Sant Ocean Hall received more than 42,000 visitors on its first day, and the museum entertains and informs seven million people annually. The hall’s information and stewardship messages are carried through shared content to kiosks at Coastal Ecosystem Learning Centers nationwide and via the museum’s public programming. This exhibit will also be leveraged further through a national ocean science education collaborative being developed by NOAA, the museum, and the Centers for Ocean Science Education Excellence. ■