



NOAA



ACCOMPLISHMENTS 2013-2016

NOAA HIGHLIGHTS

2013

- April* NOAA completes Doppler radar upgrades
- July* NOAA upgrades supercomputers to improve weather and climate prediction
- November* Administration forms National Drought Resilience Partnership to increase drought preparedness
- December* NOAA dedicates Daniel K. Inouye Regional Center in Honolulu

2014

- April* NOAA releases Arctic Action Plan
- May* U.S. Global Change Research Program releases National Climate Assessment
- May* NOAA's www.climate.gov wins Webby Awards
- September* NOAA expands Thunder Bay National Marine Sanctuary and President expands Pacific Remote Islands Marine National Monument
- November* Climate Resilience Toolkit launches, helps communities prepare for a changing world

2015

- March* Presidential task force releases action plan to combat IUU fishing and seafood fraud
- May* National Water Center opens in Tuscaloosa, Alabama
- June* Cordell Bank and Gulf of Farallones national marine sanctuaries expand
- June* Science publishes NOAA analysis finding no recent slowdown in global warming
- November* NOAA issues Diversity and Inclusion Policy Statement

2016

- January* JASON 3 launches to monitor world's oceans
- February* NOAA launches DSCOVR, Deep Space Climate Observatory, satellite
- April* NOAA announces Big Data Project
- August* President announces expansion of Papahānaumokuākea Marine National Monument
- September* President announces first national marine monument in Atlantic Ocean
- October* NOAA releases agency-wide fleet plan
- October* White House honors innovators in sustainable seafood
- November* NOAA launches GOES-16
- December* National Ocean Council finalizes nation's first ocean plans for Northeast and Mid-Atlantic

Dear Friends and Colleagues,

Science. Service. Stewardship. These principles, the heart of NOAA's mission, have guided me over the past four years as Administrator. Every day, NOAA's employees and partners strive to understand how our planet works and find solutions to some of the world's most pressing challenges.

Our job is to build an understanding of the Earth, the atmosphere, and the oceans and to transform that understanding into critical environmental intelligence: timely, actionable information, developed from reliable and authoritative science, that gives us foresight about the future. Demand for these products and services continues to increase as decision makers look to NOAA for tools to help them plan wisely and better understand risk.

Four years ago we announced four priorities to sharpen our focus and set us up for an even brighter future. Working together, we achieved tremendous success:

- Smartly evolved operations in NOAA's National Weather Service to be more agile, efficient, and effective for the 21st Century.
- Launched three satellites and invested in satellites and other observational technologies to sustain the vital environmental intelligence our citizens and businesses rely upon.
- Equipped communities with information, products, services, and tools to assess severe weather and climate risk and plan for the future.
- Preserved and protected some of the world's most special marine landscapes by expanding and creating marine protected areas.
- Leveled the playing field for U.S. fishermen by ensuring imported fish are caught legally and more sustainably.
- Established research and restoration programs in the Gulf of Mexico following the Deepwater Horizon oil spill.
- Increased access to NOAA's data to expand scientific and economic opportunities and innovation.
- Funded research, education and outreach, and innovation projects across the country to better understand changes to our planet.
- Upheld world-class standards of scientific integrity and transparency to advance the public trust in NOAA science.
- Expanded opportunities for students to explore career opportunities and receive scholarships.
- Worked together to make NOAA a great place to work by increasing recruitment, retention, and reward opportunities, and making diversity and inclusion a priority.

I am so proud of the work we've done together. None of these achievements would have come to pass without the expertise, dedication, and passion of NOAA's employees. They are the true foundation of this agency. To each of them, I say Thank You. The work you do matters to people, businesses, communities, ecosystems, and governments around the country and the world, and directly impacts the future of society, the economy, and the planet. I applaud you for your achievements and thank you for your support these past four years.

It has been an honor and privilege to serve the country and be part of the NOAA family.



Dr. Kathryn D. Sullivan

Under Secretary of Commerce for Oceans & Atmosphere and NOAA Administrator



Evolution of the National Weather Service and Building a Weather-Ready Nation™



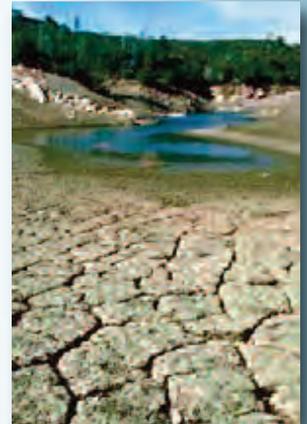
Over the past four years, the United States has experienced 50 weather and climate-related disasters totaling \$1 billion or more. From droughts and floods to tornadoes and hurricanes, NOAA's science and services are used by communities from coast to coast to prepare for, and recover from, extreme events.

NOAA's National Weather Service (NWS) is on the front line to ensure people and businesses have the information they need, when they need it, to prepare.

But, in today's world, it's not enough for people to receive only timely and accurate weather forecasts. People and decision-makers need clear information and resources that get them to act wisely and quickly.

In order to build a Weather-Ready Nation, where communities and our economy become ready, responsive, and resilient to the increasing vulnerability to extreme weather, water, and climate events, over the next several years, the NWS will evolve its operations to be more agile, efficient, and effective for the 21st Century.

The ultimate goal is to better capitalize on emerging technologies, increase capacity within its workforce, provide better products and services to decision-makers, and produce more accurate, consistent, and understandable products on which its customers can act.



*First ascension in America,
St. Louis, MO.
September 15, 1904*



*VORTEX2 field command vehicle
in vicinity of thunderstorm.*

Forecast Improvements

Providing accurate, timely, and reliable forecasts is at the heart of the NWS's work, and the demand for environmental data and analysis that informs decisions has never been greater. More reliable, timely, accurate, and consistent forecasts provide the basis for the critical decisions communities and businesses make to save lives and property.

Better Tropical and Hurricane Forecasting

That's why the NWS has taken steps over the past four years to make improvements. To better forecast tropical storm and hurricane track and intensity, NOAA's National Hurricane Center (NHC) implemented an enhanced Hurricane Weather Research and Forecasting (HWRF) model. The HWRF has become NWS's most skillful storm model in short term forecasts in the past three years.



When it comes to tropical storms and hurricanes, water is the most dangerous threat. The NHC took the next step toward creating separate information and warnings for people on storm surge. This new information provides communities with information on what areas have a significant risk of life-threatening storm surge from a tropical depression, storm, or hurricane.

Giving Communities More Time to Prepare

In 2015, South Carolina experienced devastating and historic flooding. Four NWS Weather Forecast Offices worked collaboratively to not only accurately forecast the storms, but to also communicate threats to communities across the region. Longer lead times provided communities with almost 30 additional minutes of warning, meaning people had the information they needed to act and more time to respond.

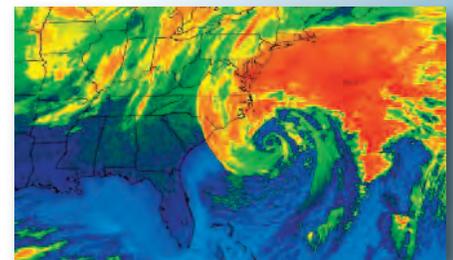


Working with Partners and Stakeholders

NWS released its service assessment for the January 2016 Nor'Easter, which affected more than 100 million people from New York to Philadelphia to Washington, D.C.

NWS meteorologists worked side by side with emergency managers, government leaders, and other critical decision makers to translate forecasts, watches, and warnings into action.

NWS staff briefed key partners, including FEMA, FAA, and six state and city Emergency Operations Centers, about the storm five days, or more, prior to its arrival. As a result of outreach from NWS, the National Guard activated 3,000 troops, states of emergency were declared in seven states and Washington, D.C., and approximately 12,000 flights were cancelled.



During the storm, forecasters were embedded with the FAA Command Center and were sheltered at local offices. Several forecasters spent up to three nights at their offices in order to ensure forecast services continued without interruption.

As a result of these efforts, people had the information they needed to get prepared ahead of the storm and stay safe during it.

A local meteorologist stated the performance of the Washington/Baltimore Weather Forecast Office was, "one of the best I've ever seen."



"During a crisis, communication is the key to protecting the public. It is critical that information is quickly and easily understood by those at risk. By gathering data and feedback from the public, social science projects regarding weather warnings can help to save lives."

Rachel Hogan Carr, Executive Director, Nurture Nature Center



Model Upgrades and Improvements



Leveraging new technologies and innovations is essential for NWS to evolve into a 21st century organization. In January 2016, NOAA's Weather and Climate Operational Supercomputer System began running at record speed with the capacity to process and analyze earth observations at quadrillions of calculations per second. These supercomputing upgrades significantly improve NOAA's ability to translate data into actionable information, which in turn will lead to more timely, accurate, and reliable forecasts.

Forecast Model Goes 4-D

For example, the upgrades allowed a significant boost to NOAA's primary operation model, the Global Forecast System, or GFS, which more than doubled its resolution from 27 kilometers to 13 kilometers. This resulted in higher resolution model output, more precise weather forecasts and warnings, and longer lead times.

Now, the model delivers hourly forecast guidance out to five days, instead of every three hours as before. Hourly forecasts help forecasters predict earlier and more accurately the onset of a storm and critical details of its evolution, which is helpful to decision-makers, emergency managers, and communities and businesses.

Modeling a Storm's Path and Intensity

NOAA's weather forecasts got hyper-local with the implementation of the High-Resolution Rapid Refresh model, which helps forecasters predict a storm's path, timing, and intensity. Forecasters can now pinpoint neighborhoods under threat of tornadoes and hail, heavy precipitation that could lead to flash flooding or heavy snowfall, and warn residents hours before a storm hits.

The model, which was developed over the last five years by NOAA's Earth System Research Laboratory, also provides valuable information to air traffic managers and pilots about hazards such as air turbulence and thunderstorms.

First National Water Model Launched

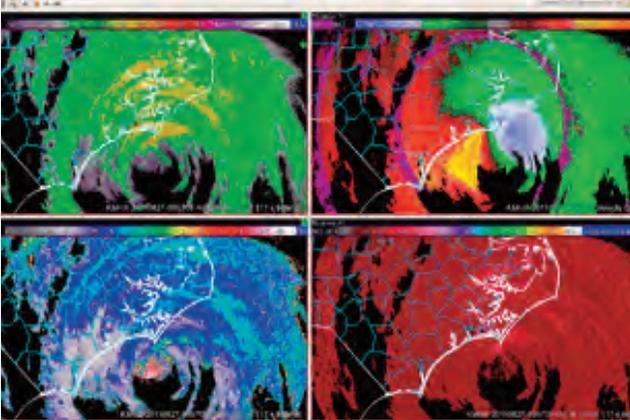
In 2016, NOAA and its partners launched the nation's first National Water Model, a game-changer for predicting floods and informing water-related decisions. This new forecasting tool simulates how water moves throughout the country's rivers and streams, paving the way for the biggest improvement in flood forecasting the country has ever seen.

The model uses data from more than 8,000 U.S. Geological Survey gauges to simulate conditions for 2.7 million locations throughout the contiguous U.S. NOAA can now better meet the needs of emergency managers, reservoir operators, first responders, recreationists, farmers, barge operators, and ecosystem and floodplain managers with more accurate, detailed, frequent, and expanded water information.



Observation Improvements

NOAA's network of satellites, radars, buoys, supercomputers, and other technologies are the foundation of the forecasts and services the agency provides.



Leveraging New Technologies for Better Forecasting

In order to produce its forecasts, NWS relies on immense amounts of data. As NOAA brings online more sophisticated and advanced technologies, the amount of data will only increase.

So that its forecasters can do their jobs more efficiently and effectively, the NWS needs to process that data more efficiently and effectively.

NWS recently completed the deployment of AWIPS-II, the next-generation Advanced Weather Interactive Processing System (AWIPS). This new software technology allows forecasters to better anticipate weather conditions and better accommodate incoming data.

Forecasters can create more accurate and timely forecasts and warnings during rapidly changing, high-impact weather.

Better Radar Technologies

In 2013, NOAA completed upgrades to its dual-polarization, or dual-pol, radar technology to help forecasters more accurately track, assess, and warn the public of approaching severe weather.

Dual-pol is the most significant enhancement made to the nation's federal weather radar system since Doppler technology was first installed in the early 1990s. Dual-pol radar sends and receives both horizontal and vertical pulses, which produces a much more informative picture of the size and shape of the objects in the sky.

This provides meteorologists the ability to distinguish between rain, snow, hail and non-weather items like wildfire smoke plumes, birds, and insects.



Shifting Customer Priorities and the OWA

Perhaps the most significant NWS accomplishment of the last decade is its transformation from a service-provider organization that largely generated forecasts and warnings to a customer-defined organization that connects forecasts and warnings to the potential impacts of an event. This new way of doing business provides decision makers at local, regional, and national levels with the information they need to make smart decisions to protect people, property, and businesses.



NWS forecasters have numerous operational tasks to perform during any given shift. NWS is dedicating to providing customers with the information they need, when they need it, and the use of advanced technology is stepping in to make some tasks quicker and some products even better.

The NWS is harnessing new technology that allows for more seamless forecasts. Previously, forecasts could only be created for a specific jurisdiction. To alleviate these patchwork forecasts, the NWS is implementing measures to create consistency across the entire country.

To provide field employees with the skills and tools they need for the future, NWS developed and delivered workforce training, and began conducting a comprehensive analysis of the organization

called the Operations and Workforce Analysis, or OWA.

The OWA project was designed to assess how service and operational needs have changed since the 1990s, identify operational gaps, and evaluate NWS' capacity to meet them.

Through the OWA, NWS confirmed the value of evolving its operations and recognized the need to provide consistent and enhanced levels of service to its partners, particularly emergency managers and the first responder community.

Partners will now expect standard products and services offered by different NWS offices across the country. Likewise, local NWS offices will know what partners need and tailor messages and services to support decision making.



On the Horizon



As a science-based services agency, NWS' focus on observational, forecasting, and service delivery improvements are rooted in mathematics and physical sciences. NWS recognizes that social sciences also play a key role in how audiences react to forecasts for potential extreme events.

Several projects are underway in which social science is taking the lead, the most visible of them the Hazard Simplification — or HazSimp — project.

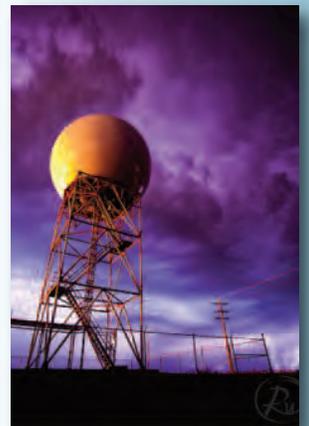
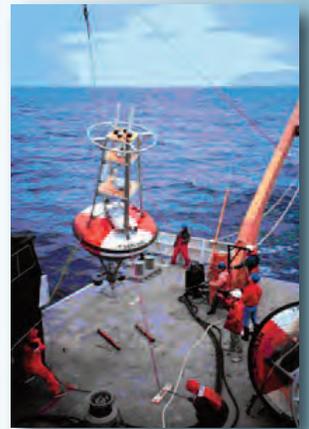
This multi-year project is seeking ways to make the watch/warning/advisory paradigm simpler to understand for the average user so that he/she knows the appropriate actions to take when this information is issued.

Another collaboration between NWS and NOAA Research is examining the “people side” of the equation, and investigating ways that weather experts can more effectively inform the general public when there is a need to act upon extreme weather forecasts.

Invest in Observational Infrastructure

NOAA's global observing systems are the foundation of the environmental intelligence we provide — without them we would be essentially “flying blind.” Our observing systems provide increasingly improved levels of certainty in our forecasts and products at a time when we desperately need more precision.

NOAA's essential infrastructure includes: satellites, ships, buoys, computing systems, weather radars, and so much more. Investing in key observational platforms sustains the vital environmental intelligence our citizens and business rely upon.



Commercial Weather Data Project

NOAA has made substantial moves in the commercial space area. Through the Commercial Weather Data Pilot (CWDP) project, NOAA's National Environmental Satellite, Data, and Information Service (NESDIS) is opening the door to new kinds of environmental intelligence.

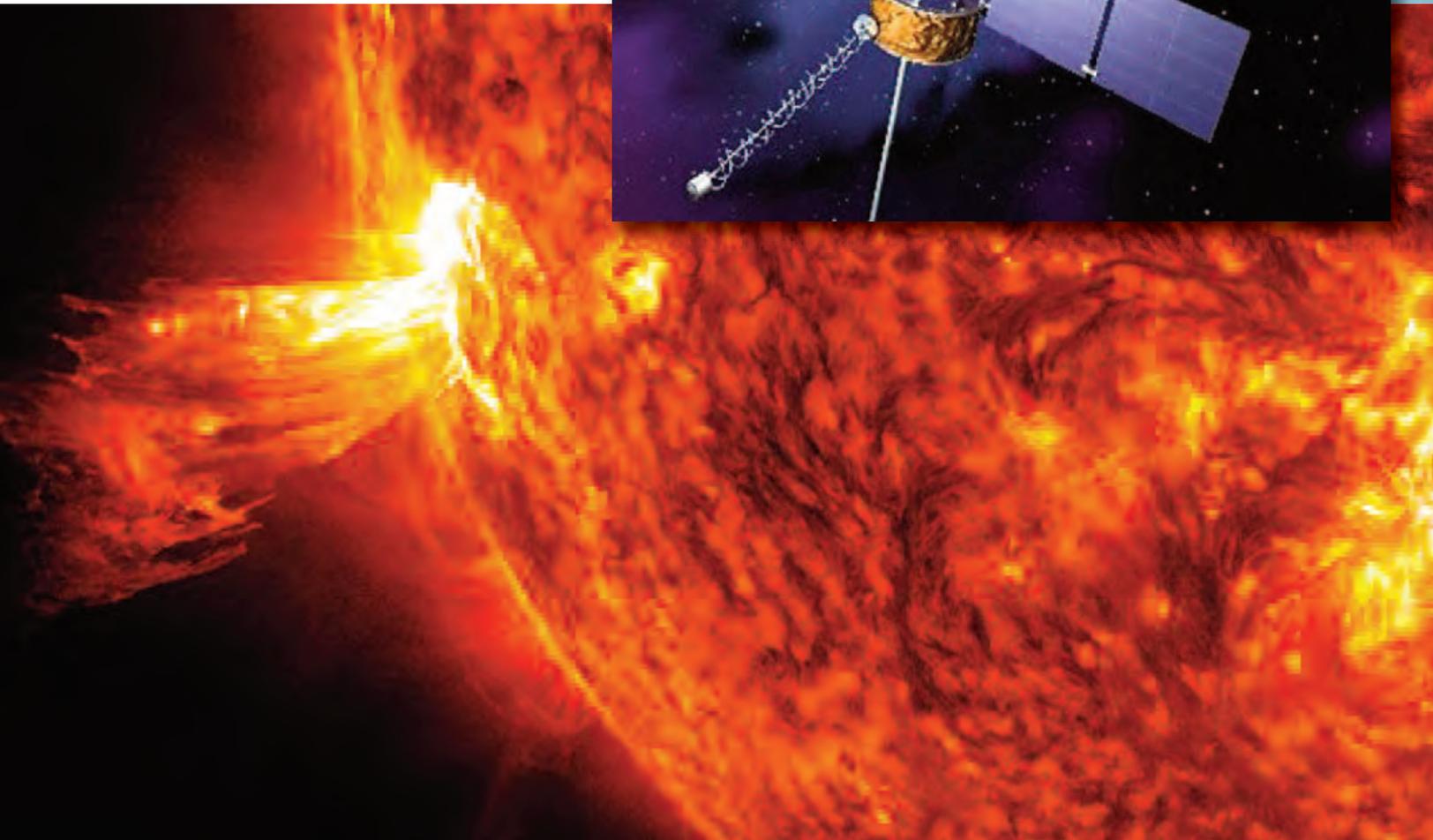
The CWDP paves the way for NOAA to acquire future data acquisitions from the private sector, which would then be used by the NWS for improved weather forecasts.



Keeping America Safe From a Million Miles Away



When it comes to keeping America's communities and businesses safe and secure, we can't take our eyes off the sun. On February 11, 2015, NOAA launched the Deep Space Climate Observatory (DSCOVR) satellite that alerts forecasters to large magnetic eruptions from the sun toward Earth. The need for DSCOVR is critical — protecting telecommunications and power grids to the countless GPS applications vital to our daily lives and national and local economies. In an increasingly wired world, space weather poses serious risk to essential, yet vulnerable, infrastructure.



Understanding the World's Ocean From High Above



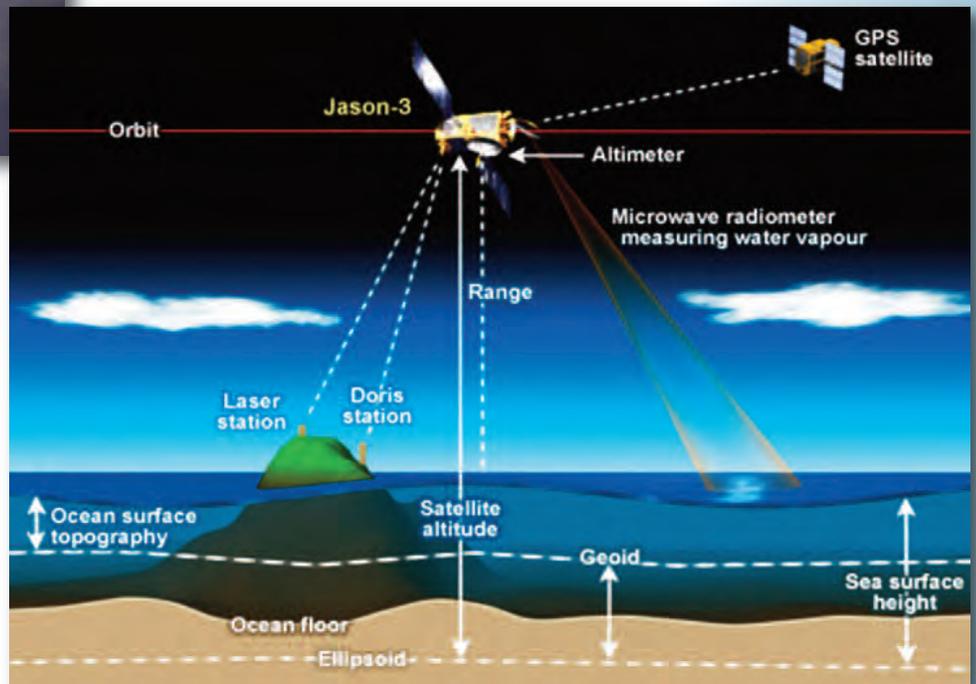
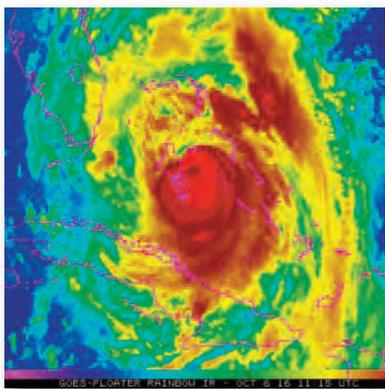
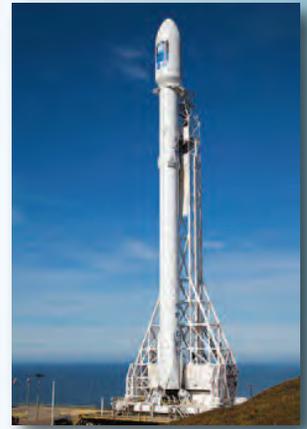
In early 2016, NOAA, NASA, and international partners launched JASON-3, the latest spacecraft to monitor the rate of global sea-level rise and help NOAA's National Weather Service forecasters more accurately forecast the strength of tropical cyclones.

JASON-3 will monitor the topography, or the hills and valleys, of the ocean surface, which affects the way waters transfer heat around the globe and tells scientists how much of the sun's energy is stored at sea.

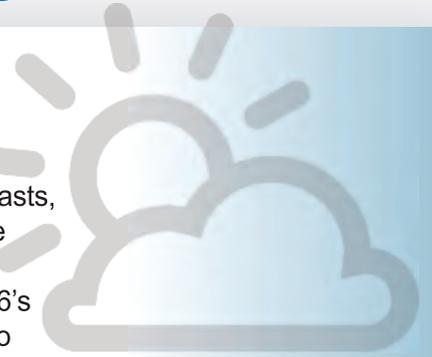
More than 90 percent of the heat being trapped in our planet goes into the sea, making the ocean perhaps the biggest player when it comes to climate change.

Besides the long-term observations, JASON-3 provides critical data in forecasting weather patterns, most notably hurricanes. NOAA's forecasters can better determine when and where hurricanes and severe weather may intensify before they hit shore. These longer lead times will help keep people and property out of harm's way.

In addition, new technologies onboard JASON-3 will improve El Niño and La Niña forecasting; assist efforts to respond to oil spills and harmful algal blooms; provide better information to commercial shipping; and, improve understanding of human impacts on our oceans.



Next-Generation Satellite Technologies



GOES-16

In November 2016, NOAA entered its next-generation of satellite weather observations with the launch of GOES-16. The satellite will revolutionize the nation's weather observation network and NOAA's prediction capabilities, leading to more accurate and timely forecasts, watches, and warnings.

GOES-16 will scan the skies five times faster than today's GOES spacecraft, with four times greater image resolution, and three times the spectral channels. It will provide high-resolution, rapidly refreshed satellite imagery as often as every 30 seconds, allowing for a more detailed analysis of a storm to determine whether it is growing or decaying.

GOES-16 will strengthen NOAA's ability to issue life-saving forecasts and warnings and make the United States an even stronger, more resilient Weather-Ready Nation.

The satellite's data will help improve hurricane tracking and intensity forecasts, the prediction and warnings of severe weather, including tornadoes and thunderstorms. Additionally, GOES-16's improved rainfall estimates will lead to more timely and accurate flood warnings.

For the aviation sector, GOES-16 will deliver clearer views of clouds at different atmospheric levels, generating better estimates of wind speed and direction and improved detection of fog, ice, and lightning. This will improve aviation forecasts and flight route planning to avoid hazardous conditions such as turbulence.

GOES-16 is flying six new instruments, including the first operational lightning mapper in geostationary orbit. This new technology will enable scientists to observe lightning, an important indicator of where and when a storm is likely to intensify.

Forecasters will use the mapper to hone in on storms that represent the biggest threat. Improved space weather sensors on GOES-16 will monitor the sun and relay crucial information to forecasters so they can issue space weather alerts and warnings. Data from GOES-16 will result in 34 new, or improved, meteorological, solar, and space weather products.



JPSS-1

The Joint Polar Satellite System (JPSS) is the country's next generation polar-orbiting operational environmental satellite system.

As the backbone of the global observing system, JPSS polar satellites circle the Earth from pole-to-pole and cross the equator about 14 times daily in the afternoon orbit — providing full global coverage twice a day.



Satellites in the JPSS constellation gather global measurements of atmospheric, terrestrial, and oceanic conditions, including sea and land surface temperatures, vegetation, clouds, rainfall, snow and ice cover, fire locations and smoke plumes, atmospheric temperature, water vapor, and ozone.



JPSS delivers key observations for essential products and services, including forecasting severe weather like hurricanes, tornadoes, and blizzards days in advance, and assessing environmental hazards such as droughts, forest fires, poor air quality and harmful coastal waters.

Further, JPSS will provide continuity of critical, global Earth observations — including our atmosphere, oceans, and land through 2038. JPSS-1, is scheduled for launch in 2017.



El Niño Rapid Response

To find out more about the phenomenon known as El Niño, NOAA scientists and partners conducted an unprecedented land, sea, and air campaign in early 2016. During the two strongest El Niños before this in 1983 and 1988, California was hit by intense rainstorms that caused flooding, landslides, and a large amount of property damage.

Researchers targeted a vast expanse of the tropical Pacific where El Niño-driven weather systems are spawned — the first link in the chain that produces atmospheric rivers, narrow bands of water vapor high in the atmosphere.

For the field campaign, NOAA and partners deployed research planes, a ship, and an unmanned aircraft equipped with specialized sensors to gather atmospheric data. Weather balloons were launched up to eight times a day.

On a rooftop in the southern part of the San Francisco Bay area, an X-Band scanning radar was also temporarily installed as an experimental system to provide additional rainfall estimates in complex terrain such as mountains and coasts during heavy precipitation events.

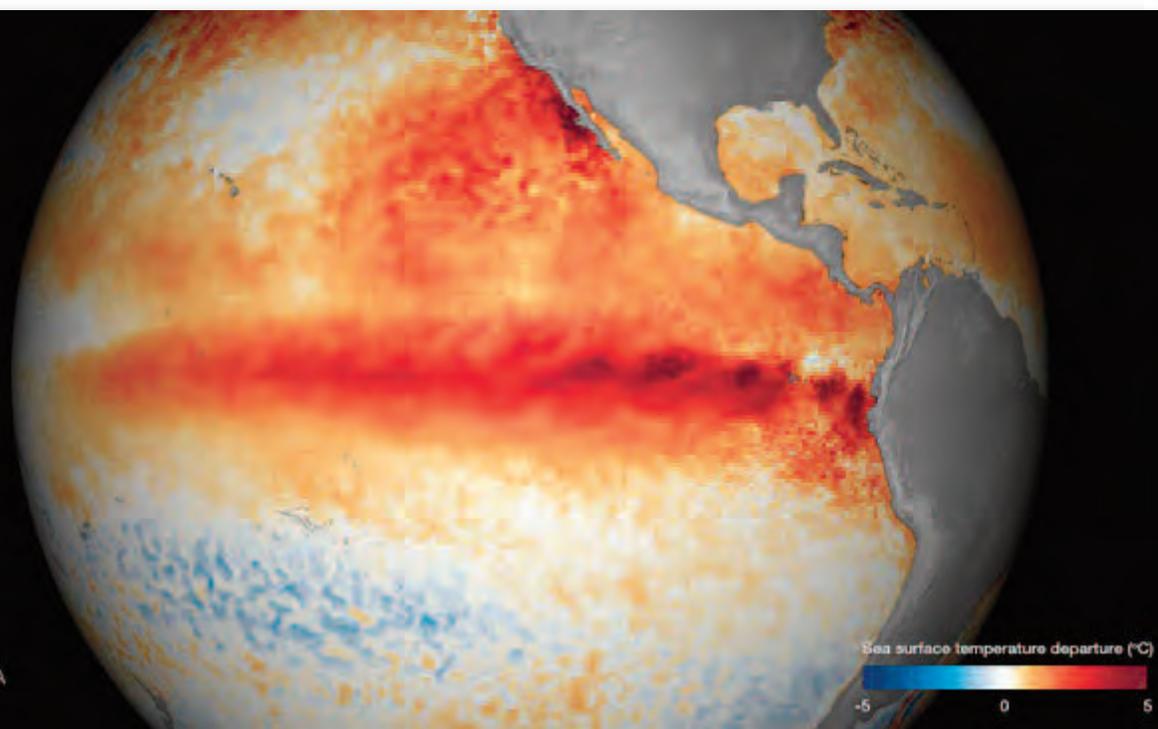
Preliminary observed data for the 2016 event show a much different impact on California rains than happened in 1983 and 1988. Perhaps most surprising is that Southern California became even drier despite high expectations for rain this time around.

NOAA researchers anticipate that the data gathered by weather balloons and instruments dropped from aircraft will help improve the models that are used to support weather forecasts.

The data will also provide insights that researchers hope will improve year-to-year El Niño forecasts, as well as the accuracy of models predicting longer-term effects of climate change.



A NOAA technician releases this dropsonde from the Gulfstream IV to measure weather data over the Pacific.



Ocean Observations

On the Forefront of HAB Research

Harmful algal blooms, or HABs, occur when colonies of algae — simple plants that live in the sea and freshwater — grow out of control and produce toxic or harmful effects on people, fish, shellfish, marine mammals, and birds. The human illnesses caused by HABs, though rare, can be debilitating or even fatal.



Improved Forecasts, New Sensors, and Event Response for Harmful Algal Blooms

In 2015, NOAA continued to improve the nation's ability to forecast, detect, and mitigate the impacts of harmful algal blooms (HABs).

The forecasts are part of a NOAA ecological forecasting initiative that aims to deliver accurate, relevant, timely, and reliable ecological forecasts directly to coastal resource managers and the public as part of its stewardship and scientific mandates for coastal, marine, and Great Lakes resources.



NOAA and its partners provide HAB forecasts for Lake Erie, the Gulf of Maine, and the Gulf of Mexico.

In FY15, NOAA's National Centers for Coastal Ocean Science (NCCOS) issued a new early seasonal projection of bloom severity in western Lake Erie, helped the California Water Board evaluate the state of HABs in waterbodies in California, and funded and participated in event response and monitoring from southern California to Alaska.

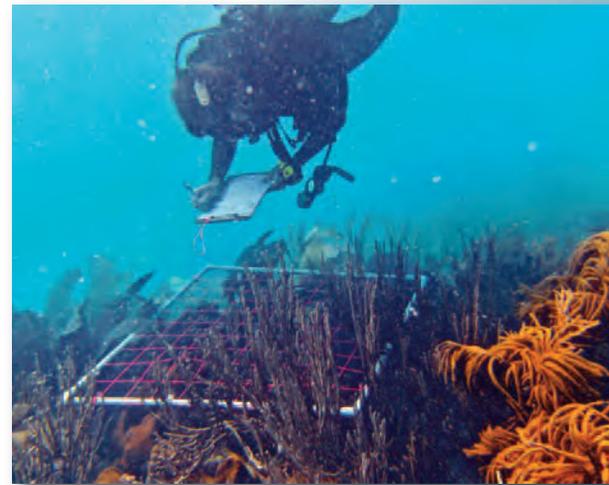
As part of the HAB toxin detection program, NCCOS delivered toxin sensors for deployment on autonomous environmental sample processors (ESPs) that can now report toxin levels in real time. Also in 2015, NCCOS engaged citizens in science to expand the Phytoplankton Monitoring Network to provide early warning for cyanobacteria in Lake Erie and for paralytic shellfish toxin with the Sitka tribes of Alaska.

In August 2014, NOAA supported the response to a harmful algal bloom that contaminated drinking water in Lake Erie, which left nearly 400,000 people in Toledo, Ohio, without drinking water for two days.

Ocean Acidification Data Portal

For more than 200 years, or since the industrial revolution, the concentration of carbon dioxide (CO_2) in the atmosphere has increased due to the burning of fossil fuels and land use change.

The ocean absorbs about 30 percent of the CO_2 that is released in the atmosphere, and as levels of atmospheric CO_2 increase, so do the levels in the ocean.





The Environmental Sample Processor (left) is an underwater robot that that can remotely measure paralytic shellfish toxins. The robot and a surface buoy with communication hardware (right) are readied for deployment in the Gulf of Maine. Photo credit: Woods Hole Oceanographic Institution

These changes in ocean chemistry can affect fish, oysters, clams, sea urchins, corals, plankton, and other marine life.

To better provide communities and businesses with information and data on ocean acidification, the United States Integrated Ocean Observing System (IOOS), supported by NOAA and other federal agencies, launched a new ocean acidification portal in 2014.

The portal provides shellfish growers, researchers, and others interested in ocean acidification with access to comprehensive, real-time ocean acidification data from Alaska, Hawaii, Oregon, California and Washington state.

Data from monitoring equipment enables shellfish growers to assess how the chemical makeup of the water will affect shellfish productivity and adapt their aquaculture practices to minimize impacts from ocean acidification to their operations.

The End of Traditional Paper Nautical Charts

For 200 years, NOAA has mapped and charted U.S. coastal waters. These traditional nautical charts, or lithographs, provided sailors and mariners with information they need to stay safe and keep commerce flowing in and out of America's ports.

Leveraging new technologies, NOAA increased its use of the increasingly popular Print-on-Demand charts and PDF nautical

charts. NOAA's Office of Coast Survey collaborated with the navigation electronics industry to create new, faster, and easier to use downloadable charts.

Physical Oceanographic Real Time System (PORTS®)

NOAA PORTS® is an integrated system of oceanographic and meteorological sensors that provides mariners with reliable real-time information about environmental conditions in a seaport, greatly enhancing the safety and efficiency of maritime commerce.



NOAA Ship Ferdinand R. Hassler's survey technicians were on duty 24/7 while the ship surveyed port areas after Hurricane Matthew.

Jacksonville, FL

In 2014, NOAA inaugurated a new PORTS®– the nation's 23rd and second largest – in the Port of Jacksonville, Florida.

Jacksonville ranks as the number-one vehicle export port in the nation, and is the top container port in Florida. Approximately 65,000 Floridians have jobs directly or indirectly related to the port, which channels around \$19 billion into the U.S. economy every year.

The system directly benefits commercial and recreational mariners in the dynamic St. Johns River. It includes a broad suite of operational sensors that measure water levels, currents, under-bridge clearance, visibility, salinity, and meteorological conditions.



Jacksonville PORTS® also supports hurricane response including storm-surge forecasts, real-time storm-surge monitoring, and evacuation planning, as well as studies of river ecology and health.

Southeast, LA



A new elevated tripod platform at the Atchafalaya Bar channel station is part of the Morgan City PORTS. It includes a horizontally-mounted current profiler, which collects and disseminates real-time currents every six minutes.

Two southeast Louisiana shipping hubs, critical to the U.S. economy, became part of PORTS® in 2015.

The new multi-sensor systems can increase navigation safety and allow for increased efficiency on ships transiting through the Port of Morgan City and Port Fourchon, LA.

Morgan City is a newly established foreign trade destination, while Port Fourchon is one of the nation's busiest energy ports, servicing 90 percent of the deep-water Gulf of Mexico oil and gas industry. Each day Port Fourchon handles more than

20 percent of the nation's energy supply.

Economic benefit studies from four PORTS® locations around the U.S. have shown a 50 percent reduction in groundings and over \$50 million in economic efficiency benefits every year.

Savannah, Cape Cod, Cuyahoga River

In 2016, PORTS® celebrated its 25th anniversary and added three new systems, for a total of 28 PORTS®. New systems were added in Savannah, Georgia; Cape Cod, Massachusetts and on the Cuyahoga River in Ohio.

CO-OPS Adds Four New Hurricane Hardened Stations in Gulf

In 2016, NOAA added four new water level stations in the Gulf that are specially reinforced to withstand hurricanes and other major storm events. The reinforced stations are better able to keep functioning during these events, providing critical information on water levels, winds and other meteorological information that can aid emergency response organizations.

This was made possible through CO-OPS' partnership with the Army Corps of Engineers in Galveston, Texas.

Most Technologically Advanced Research Ship Launched

The *NOAA Ship Reuben Lasker* — the fifth in a series of the most technologically advanced fisheries vessels in the world — was commissioned in April 2014. The *Lasker* will primarily support fish, marine mammals and turtle surveys off the U.S. West Coast and in the Eastern Tropical Pacific Ocean.

The new ship will improve NOAA's ability to more accurately manage fisheries stocks and recover protected species. Funding was provided under the American Recovery and Reinvestment Act.

The new vessel is named after the late Dr. Reuben Lasker, who served as the Director of Southwest Fisheries Science Center Coastal Fisheries Division and as adjunct professor at Scripps Institution of Oceanography, U.C. San Diego.

Dr. Lasker built a renowned research group that focused on the recruitment of young fish to the adult population — a topic with implications for fisheries management throughout the world.

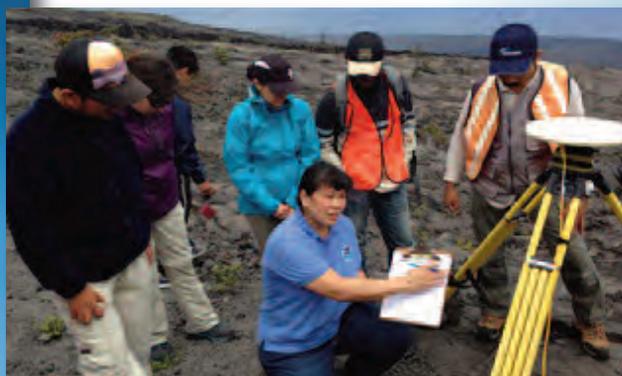




Provide Information and Services to Make Communities More Resilient



From droughts to floods, hurricanes to heat waves, and changing fish stocks to a changing climate, communities need insight and foresight to prepare more wisely for future events. NOAA's work directly addresses this need, providing the environmental intelligence communities need to prepare and build resilience – enabling infrastructure, institutions, economic sectors, and individuals to withstand and recover from ever increasing severe events. By providing the funding, tools, products, and services people need, we are taking the steps now to build resilient communities for the future.



Investing in Communities



In the last four years, NOAA has provided grant funding to target different facets of community resilience. Leveraging our funds with others, we invested in innovative solutions that increase the resilience of communities, businesses, and the environment.



NOAA's Regional Coastal Resilience Grants focus on regional-scale projects that enhance the resilience of coastal communities and economies to the effects of extreme weather, climate hazards, and changing ocean conditions.

The Regional Coastal Resilience Grants awarded \$9 million over two rounds in 2015 and 2016 to 200 coastal communities in 19 states to address growing economic, environmental, and social pressures. For example, in Massachusetts, the Cape Cod Commission received a grant to develop the economic, social, and environmental information needed to develop climate change adaptation plans.

The Town of Barnstable will serve as a pilot for implementing these plans, and information from this effort will be used as a model for other Cape Cod communities.

NOAA's Coastal Ecosystem Resilience Grants program is dedicated to helping communities by restoring natural coastal systems, like dunes and wetlands that provide protection for people, communities, and businesses while also providing natural habitats for a variety of species.

In 2016, NOAA announced \$8 million in recommended funding for 11 habitat restoration projects. For example, the Port Gamble S'Klallam Tribe in Washington state received a grant to restore a tidal connection in Kilisut Harbor by replacing a causeway with a bridge, allowing for safe passage of threatened species of salmon.

The project also serves to bolster the cultural fishing traditions of the tribe, while improving flood protection for approximately 400 households.

NOAA is also investing in the future through Environmental Literacy Grants for Community Resilience to Extreme Weather Events and Environmental Hazards.

In 2015 and 2016, NOAA awarded 11 grants to support K-12 and information education programs to build resilience through education. For example, The Science Museum of Virginia held its first major public event as part of its "Learn, Prepare, Act - Resilient Citizens Make Resilient Communities" funded by a NOAA grant.





The “Preparathon” was offered in August 2016, where nearly 3,000 people learned about Virginia’s particular vulnerabilities to climate-related threats from severe storms, flooding, and rising seas and how to prepare for them.

Emergency managers, firefighters, city planners and others from 29 local, state, federal, and nonprofit organizations were on site with equipment and vehicles providing opportunities for the public to learn about preparedness and resilience.

The Saltonstall-Kennedy Grant Program remains a cornerstone in NOAA’s portfolio to help fishing communities become more resilient. The goal of the S-K grant program is to fund projects that address the needs of fishing communities, optimize economic benefits by building and maintaining sustainable fisheries, and increase other opportunities to keep working waterfronts viable.



Biologists monitor a shellfish restoration project near Mobile, Alabama.

From FY2013-FY2016, NOAA awarded 178 projects valued at \$46M. In 2015 alone, the agency provided more than \$25 million in funding for 88 projects. This was the highest funding ever granted by NOAA under this decades-old program. These grants create jobs, increase economic opportunities for fishing communities, and improve the data and observations NOAA collects about the health of our nation’s fisheries and oceans.

Additionally, the Community-based Restoration Program invests funding and technical expertise in high-priority habitat restoration projects that instill strong conservation values and engage citizens in hands-on activities.

Through the program, NOAA, its partners, and thousands of volunteers are actively restoring coastal, marine, and migratory fish habitat across the nation. In the 20 years that the program has been in existence, NOAA has provided more than \$140 million to implement more than 2,000 habitat restoration projects, all through strong partnerships with more than 2,500 local organizations.

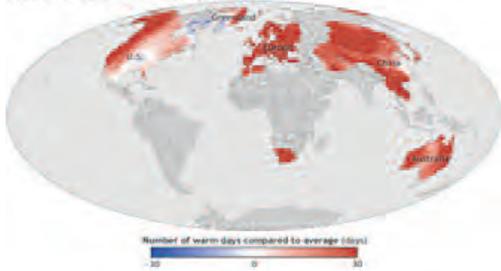
In 2013 alone, NOAA awarded \$10.8 million in funding for 19 coastal habitat restoration projects that restored up to 15,000 acres of habitat and open nearly 400 stream miles for fish passage.



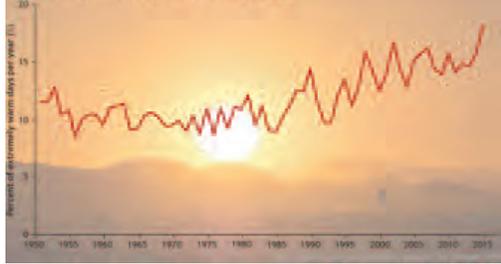
Providing Data and Tools to Enable Resilience



EXTREME HEAT WIDESPREAD IN 2015



2015 BREAKS RECORD FOR NUMBER OF WARM DAYS



Climate.gov

NOAA's primary website for easy public access to climate information, data, decision-support tools, and education resources is going strong in 2017. Public use of Climate.gov is growing rapidly, with a 232percent increase in visits over the last three years (averaging 580,000 visits per month in 2016) and 844 percent growth in subscribers to the site's weekly e-newsletter. This success is driven by the high-quality content and rapid publication rate.

In 2016, Climate.gov published 24 feature articles, 40 featured images, 29 Event Tracker posts, four new case studies, and 42 scientist blog posts. Climate.gov launched a new page in January 2016 dedicated to the El Niño weather phenomenon, which rose to the top of the Google search results for "El Niño." The site also expanded its collections of freely reusable climate maps and reviewed climate education resources.

Data visualizations have been widely republished by major media and education

outlets (print, online, and TV) — including the Associated Press, Reuters, the Weather Channel, The Washington Post, USA Today, The Chicago Tribune, U.S. News and World Report, and many others.

In 2014, Climate.gov won three Webby Awards, a worldwide best-of-the-Web competition sponsored by the International Academy of Digital Arts and Sciences, for being the best online site in the "Government," "Green," and "People's Voice" categories.

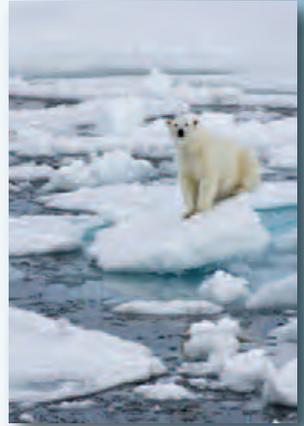
Digital Coast

The Digital Coast program, which contains more than 58 tools and more than 70 terabytes of data, is a NOAA-sponsored website that has become one of the most-used resources in the coastal management community.

The dynamic Digital Coast Partnership, whose members represent the website's primary user groups, keeps the effort focused on customer needs. Thousands of community planners, coastal managers, nonprofits, businesses, and academics view or download Digital Coast resources on an annual basis.

The number of communities within coastal states that accessed the Digital Coast website increased from 4,543 in the first quarter of Fiscal Year (FY) 2013 to 6,093 in the first quarter of FY 2017 — an increase of 34 percent. The site contains more than 120 "Stories from the Field," demonstrating uses of Digital Coast data, tools, and training from around the nation.

In FY2015 alone, more than 1,500 coastal professionals received training on a variety of technical and process-based topics through the Digital Coast.



Spotlight

New Tools to Protect People on the Coast

NOAA provides a wealth of tools that communities can use to assess risk. Below are two examples that help coastal communities understand their flood risk from hurricanes and sea level rise.

Sea Level Rise Viewer

The devastation caused by Hurricane Sandy in 2012 served as a stark reminder of the vulnerability of coastal communities to damage from storms and flooding. In 2013, to assist with rebuilding efforts, NOAA, FEMA, the Army Corps, and the U.S. Global Change Research Program developed the Sea Level Rise Viewer to look at and plan for future conditions. Interactive sea level rise maps show the inland extent and relative depth of inundation that would result from sea level rise up to six feet.

Additionally, the tool provides clickable visualizations, by superimposing rising water levels over existing photographs of various public locations, allowing the user to visualize the impact of various levels of sea level rise. The tool originally provided information for parts of New York and New Jersey impacted by Sandy, but by the end of 2015, we had expanded the tool to include all coastal U.S. states and territories, except for Alaska where gaps in the underlying geospatial and mapping data remain.

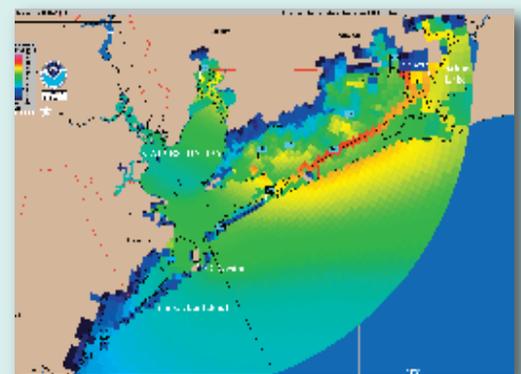


A companion tool, NOAA's Lake Level Viewer, provides coverage for the Great Lakes region. These data are resulting in real benefits for the future. The City of Charleston used the flood projection maps, digital elevation models, and realistic visualizations to show city planners and engineers how local streets, landmarks, and infrastructure would be affected if sea level were to rise an additional one to three feet. City planners incorporated the information into a proposed sea level rise strategy that was adopted by the Charleston City Council.

Potential Storm Surge Flooding Map

When hurricanes make land fall, storm surge is often the greatest threat to life and property and directly accounts for about half of the deaths associated with tropical cyclones in the United States. In 2014, NOAA introduced an experimental Potential Storm Surge Flooding Map to better communicate to the public the risk of injury and damage from storm-related flooding.

In 2016, NOAA made the Potential Storm Surge Flooding Map operational and it was used for the first time during Hurricane Matthew where 10-foot-plus surge levels were predicted in some areas, often much further inland than most would expect. These types of data are invaluable for emergency managers deciding whether and where evacuations are necessary. Now when NOAA issues a hurricane watch or warning, NOAA also issues a potential storm surge flood map for the area that is updated every six hours during the event.



Advancing Resilient Practices

Nuisance Flooding Becomes Part of National Dialogue on Sea Level Rise

In 2014, NOAA scientists coined a new phrase for a phenomenon that is affecting coastal cities nationwide: nuisance flooding.

Nuisance flooding is recurrent flooding that takes place at high tide. Because of sea level rise, nuisance flooding in the United States has become a “sunny day” event — not necessarily linked to storms or heavy rain — and causes public inconveniences such as frequent road closures, overwhelmed storm drains, and compromised infrastructure.



NOAA scientists found that these events have increased on all three U.S. coasts, between 300 and 925 percent since the 1960s. Of the 45 locations analyzed, eight of the top 10 U.S. cities that have seen an increase in nuisance flooding are on the East Coast.

Annapolis and Baltimore, Maryland, lead the list with an increase in number of flood days of more than 920 percent since 1960. Port Isabel, Texas, along the Gulf Coast, showed an increase of 547 percent, and nuisance flood days in San Francisco, California increased 364 percent.

NOAA now issues yearly outlooks for nuisance flooding. Nuisance flooding was also included as an indicator of climate

change for the first time in the 2016 Environmental Protection Agency report, Climate Change Indicators in the United States.

Carbon Credits for Wetlands Restoration Projects

Salt marshes, mangroves, and seagrass beds absorb and store large quantities of the greenhouse gas carbon dioxide from the atmosphere, thus decreasing the effects of global warming. These coastal systems are sequestering carbon at rates ten times higher than most forested systems.

In 2014, NOAA and partners developed the first methodology for calculating greenhouse gas reductions for tidal wetlands and seagrass restoration projects anywhere in the world.

This is an exciting achievement because it means that projects, such as removal of tidal barriers or increasing seagrass habitat, will be eligible to earn carbon credits in the voluntary carbon market, which can generate new sources of funding for coastal restoration.

NOAA is now working with partners on an initial demonstration project for how to apply the methodology in a wetland restoration. NOAA is also working to support the development of a similar methodology for carbon credits for the conservation of threatened coastal wetlands worldwide.





Supporting Green Infrastructure and Living Shoreline Solutions

Hardened erosion control techniques, such as bulkheads and seawalls, often accelerate shoreline erosion and destroy the habitat of economically important fisheries and other wildlife. Nature-based shoreline stabilization options, like marsh grass and oyster reefs, offer erosion control while maintaining normal ecosystem functions.

In 2015, NOAA developed three new green infrastructure products that are helping coastal communities use natural and nature-based systems to absorb and filter excess water and reduce flooding.

These new offerings include an interactive animation that illustrates how green infrastructure can help protect communities from storm impacts; a guide for spatial analysts who want to incorporate green infrastructure into mapping efforts; and a cost-benefits process that people can use to determine what green infrastructure strategies make the most sense for their community. These additions join other products featured on the green infrastructure section of the Digital Coast website.

Additionally, in 2016, NOAA released, “Guidance for Considering the Use of Living Shorelines,” which encourages nature-based shoreline stabilization techniques and highlights NOAA science, tools, and training that support such techniques.

The guidance also explains how to navigate NOAA’s potential regulatory (consultation and permitting) and programmatic roles in living shoreline project planning.

Better Decision Making Through Regional Planning

On December 7, 2016, the National Ocean Council (NOC) finalized the nation’s first “ocean plans” under the National Ocean Policy. The two regional plans, the Northeast Ocean Plan and the Mid-Atlantic Ocean Action Plan, promote the use of integrated ocean data and best practices to inform efficient management of the nation’s shared marine resources.

The Plans were developed collaboratively among states, tribes, federal agencies, and Fishery Management Councils and with extensive stakeholder participation to advance economic, environmental, and cultural priorities within each region. NOAA played an integral role in developing both plans, including serving as the federal co-lead for the Northeast Ocean Plan.

In order to improve access to ocean information, both Plans build on a foundation of thousands of new maps that are publically accessible through the Northeast and Mid-Atlantic Data Portals.

A new generation of data products were developed in consultation with scientists and marine industries to include a vast array of marine resources, including ecosystem information on 150 species of marine mammals, seabirds, and fish, and a wide range of information on human activities including fishing, recreation, shipping, and renewable energy.

The Northeast portal alone had more than 1 million page views in 2016 and was used to inform decisions about siting submarine cables, wind energy, and aquaculture.



Climate Action Plan



NOAA engaged in a number of Climate Action Plan efforts to provide environmental intelligence, tools, technical assistance, and other support to help both domestic and international communities better prepare and be more resilient to the impacts of climate change.

NOAA had varying roles in many actions within the plan, including developing several new tools to help inform and support decision makers, developing guidance for agencies to build ecosystem services into agency policies and practices, delivering science to support new Federal Flood Risk Management Standard (FFRMS), establishing a public-private partnership with the insurance and reinsurance industries to better share data about climate risk, and sharing data to build resilience capacity in other countries.

The projects listed below highlight some of NOAA most significant contributions to the Administration's plan to promote climate resilience throughout the United States and internationally.

U.S. Climate Resilience Toolkit

In 2014, NOAA and its partners launched the U.S. Climate Resilience Toolkit, an online repository of information, decision-support tools, and subject matter expertise to help communities, businesses, and individuals build resilience to climate-related impacts.

Users can find expertise and resources from 13 federal agencies on this single, easy-to-use website. People can use the site to understand climate-related threats to their local assets such as municipal infrastructure, natural resources, and economic vitality. The site's "Five Steps to Resilience" framework helps users engage stakeholders, find and use relevant climate data and tools, and see what others are doing to build resilience.

Users can also access climate projections for every county in the contiguous United States from 1950-2100, and download the information as graphs, maps, or raw data. Since its launch, the Toolkit has had more than 1.1 million total visits with a 72 percent growth in visits in 2016 over the previous year. In 2015, the Toolkit was nominated for a Webby Award by the International Academy of Digital Arts and Sciences.

National Drought Resilient Partnership and the National Integrated Drought Information System

NOAA co-chairs the National Drought Resilient Partnership (NDRP), which coordinates federal support for drought-related efforts, and helps communities reduce the impact of current drought events and prepare for the future.

The NDRP maintains a Long-Term Drought Resilience Federal Action Plan to advance agency action on six drought resilience goals.



The NDRP builds upon the National Integrated Drought Information System (NIDIS), an interagency program led by the NOAA.

In 2015, new NIDIS regional Drought Early Warning Systems (DEWS) were launched for the Pacific Northwest and the Midwest Agricultural belt. The DEWS are partnerships of federal, state, regional, local, and private entities that demonstrate a variety of early warning and drought risk reduction strategies.

In June 2015, NIDIS also announced the creation of the Drought Risk Management Research Center at the University of Nebraska-Lincoln. The Center focuses on innovative research and information delivery to improve drought risk management.

Resilience AmeriCorps

The Corporation for National Community Service, the Department of Energy, the Environmental Protection Agency, and NOAA — with guidance and technical and financial support from The Rockefeller Foundation and partnership from Cities of Service — announced the creation of the first-ever Resilience AmeriCorps in July 2015.

This pilot involved hiring 10-15 AmeriCorps VISTA volunteers for two years to work on a range of climate resilience projects in communities across the country to increase civic engagement and community resilience in low-income areas. NOAA served as the lead for providing resilience focused training and technical assistance to the volunteers.

Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources

Released in October 2014, the Priority Agenda for Enhancing the Climate Resilience of America's Natural Resources was a first-of-its-kind, comprehensive commitment across the federal government to support the resilience of America's vital natural resources.

NOAA led or participated in a number of activities under the Priority Agenda, including the Resilient Lands and Waters Initiative. NOAA led, in partnership with states, tribes, and other partners, three of the seven Resilient Lands and Waters partnerships that demonstrate the benefits of using existing collaborative, landscape-scale conservation approaches to address climate change and other resource management challenges.

The effort culminated in a report and companion website, which includes story maps, new decision support tools, and new interactive databases.

NOAA also helped develop the Climate Adaptation Leadership Award for Natural Resources, in partnership with several federal agencies and state fish and wildlife agencies, to recognize outstanding leadership in developing innovative approaches to prevent changes affecting valuable wildlife and natural resources.





Protecting Special Marine Places

National Marine Sanctuaries

For more than 40 years, our National Marine Sanctuaries have protected special places in America's ocean and Great Lakes waters.

The Sanctuary network of 13 undersea parks encompasses more than 600,000 square miles of marine and Great Lakes waters and is the source of about \$8 billion annually generated in local economies. Cordell Bank and Gulf of the Farallones National Marine Sanctuaries more than doubled in size in 2015.

The expansion was based on years of public comment and research by NOAA and its scientific partners on these special areas that support a vast array of sea life including whales, seals, dolphins, sea lions, seabirds, and white sharks. Two more expansions are underway.

In January 2016, an expansion was proposed for the Monitor National Marine Sanctuary which has served as a special place honoring the iconic Civil War ironclad, *USS Monitor*, and the memory and service of Civil War sailors. The expansion could protect historically significant shipwreck vessels, including vessels sunk during World War II's Battle of the Atlantic.

In June 2016, NOAA proposed to expand Flower Garden Bank National Marine Sanctuary, potentially covering an extra 383 square miles, including 15 reefs and banks that provide habitat for recreationally and commercially important fish, as well as 15 threatened or endangered species of whales, sea turtles, and corals.



In 2014, NOAA also re-established the Sanctuary Nomination Process for the first time in two decades. The updated process, developed with input from more than 18,000 public comments, allows the American people to nominate nationally significant marine and Great Lakes areas for potential designation as national marine sanctuaries.

In 2017, NOAA officially proposed two new sites: Mallows Bay on the Potomac River and an area of Lake Michigan in Wisconsin.

Marine National Monuments

President Obama designated 845,893 square miles of ocean as Marine National Monuments, expanding his commitment to conservation from the land to the sea. NOAA is a proud partner in managing and protecting these areas for future generations.

In 2014, he expanded the Pacific Remote Islands Marine National Monument from 86,888 square miles to 490,000 square miles, fully protecting the U.S. Exclusive Economic Zone around Jarvis Island, Wake Island, and Johnston Atoll.

Then in 2016, the President expanded the existing Papahānaumokuākea Marine National Monument, located in the Northwestern Hawaiian Islands, from 139,797 square miles to 582,578 square miles.

Papahānaumokuākea Marine National Monument hosts an amazing array of wildlife, including 14 million seabirds representing 22 species that breed and nest within its boundaries, and over 7,000 species of marine life, one quarter of which are found only in the Hawaiian Archipelago. The Monument is also of great importance to Native Hawaiians.





Finally, in 2016, he designated the Northeast Canyons and Seamounts National Marine Monument.

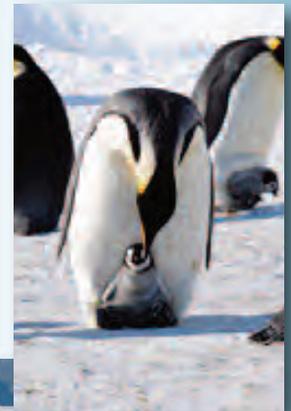
This 4,913 square mile area is the first marine monument in the Atlantic, and is home to undersea canyons and seamounts that comprise fragile and largely pristine deep marine ecosystems, including important deep sea corals, endangered whales and sea turtles, other marine mammals, and numerous fish species.

Ross Sea Region Marine Protected Area

Recent years have seen growing commitments from governments across the world to protect marine areas within their own EEZs. But a new milestone was reached in October 2016 when, after several years of negotiation, the Commission for the Conservation of Antarctic Marine Living Resources established the Ross Sea Region Marine Protected Area.

Now the world's largest MPA at 598,000 square miles, the Ross Sea MPA is significant because it transcends any national jurisdiction. Its establishment required the consensus agreement of 25 governments that are Members of CCAMLR, each with its own national interests.

The Ross Sea region is highly biodiverse and — relative to other less remote areas — is one of the most pristine ocean regions on our planet.



Protecting Species

Focus on Species in the Spotlight Gains Momentum

Of all the species NOAA protects under the Endangered Species Act, the agency considers eight species among the most at risk of extinction in the near future.

As a result, the agency launched its “Species in the Spotlight: Survive to Thrive” initiative in 2015 as a concerted agency-wide effort to spotlight and save these highly at-risk species: Atlantic Salmon Gulf of Maine; Central California Coast Coho; Cook Inlet Beluga Whale; Hawaiian Monk Seal; Pacific Leatherback Sea Turtle; Sacramento River Winter-run Chinook; Southern Resident Killer Whale; and White Abalone.



In 2016, the agency released 5-Year Action Plans outlining efforts vital for stabilizing these populations. So far, it has led to innovative partnerships with interested stakeholders who will help prevent these species’ extinction and set them on the road to recovery.

For example, in 2016 the Navy committed to provide more than \$2.1 million in funding to NOAA Fisheries to support core research and survey needs for White Abalone recovery at Tanner and Cortes Banks.

White Abalone is a highly endangered marine mollusk that has been depleted by past decades of overharvest along the U.S.

West Coast. Two of the last known White Abalone populations in the wild persist on Tanner and Cortes Banks, which are part of the Navy’s Southern California Range Complex, an area essential for U.S. security and defense at-sea testing and training.

Research made possible through this agreement will allow us to better understand the status and life history of wild populations of White Abalone and to design an effective strategy for monitoring both wild and transplanted abalone.



Species Recovering from the Brink of Extinction

In 2015, for the first time in 19 years and only the second time ever, NOAA removed a species from the list of threatened species under the Endangered Species Act. The Eastern Steller sea lion was delisted due to recovery.

Scientific assessments indicate the Eastern Steller sea lion has increased from an estimated 18,040 animals in 1979 to an approximately 70,174 in 2010, the most recent year for which data are available. Working with affected states and other partners, NOAA has developed a post-delisting monitoring plan for this population. If implemented as intended, this plan takes the important steps necessary to maintain the recovered status of the eastern Steller sea lion.

When most people think of endangered species, Humpback Whales are usually high on the list. These creatures were hunted over centuries to near extinction.



But international conservation efforts to protect and conserve whales over the past 40 years have proved successful for most populations.

In 2016, NOAA reported that nine out of 14 known populations of Humpbacks worldwide have recovered to the point where they no longer qualify to be on the U.S. list of endangered and threatened wildlife. Humpbacks native to the southern hemisphere, in particular, seem to be flourishing.

New Protections Extended to Species at Risk

Several marine species are facing new and worsening impacts to their survival. For example, coral reefs are one of the most biologically diverse ecosystems on Earth, providing habitat for many marine species and shoreline protection for coastal communities. Yet coral reefs worldwide have declined significantly — some individual species have declined by at least 90 percent.

In August 2014, NOAA listed 20 coral species as threatened under the Endangered Species Act. The final decision to list these corals was the result of the most extensive rulemaking ever undertaken by NOAA.

NOAA identified a number of threats to coral ecosystems, some of the most serious threats include impacts related to climate change (rising ocean temperatures, ocean acidification, and disease), ecological effects of fishing, and poor land-use practices. NOAA is working with partners on mitigation measures and recovery plans for the newly listed corals.

In July 2014, NOAA Fisheries listed four Distinct Populations Segments of scalloped hammerhead sharks. Scalloped hammerhead sharks are found worldwide in coastal warm waters. Yet, this species



was not listed in the majority of U.S. waters due to steps fisheries managers and fishermen have already taken to help protect these species.

For the other populations, science shows threats to the species from overfishing and inadequate management of foreign fisheries, with illegal, unreported and unregulated fishing, also known as IUU fishing, as a significant problem. In addition, the sharks are killed for their fins, which has significantly contributed to their decline.

NOAA and the Department of Interior took a significant step in July 2014 to protect the threatened loggerhead sea turtle by designated critical habitat in the Atlantic Ocean and on coastal beach habitat along the Atlantic and Gulf coasts.

The NOAA rule put in place new protections for 38 specific areas that contain one or a combination of: nearshore reproductive habitat, wintering area, breeding areas, migratory corridors, and Sargassum habitat. The DOI rule addresses approximately 685 miles of nesting beaches in North Carolina, South Carolina, Georgia, Florida, Alabama, and Mississippi.



Sustainable Fishing

Celebrating 40 Years of the Magnuson-Stevens Act

The Magnuson-Stevens Fishery Conservation Act, signed 40 years ago, recognizes that a “one-size-fits-all” approach does not work for managing the numerous fisheries of our nation’s vast and diverse ocean territories.

Since the 1970s, this landmark legislation has evolved to balance economic fishing goals with long-term environmental sustainability. Today, the United States is on track to end overfishing for good.

As a result of the combined efforts of NOAA Fisheries, the regional fishery management councils, and all our partners, we have largely ended unsustainable fishing practices and returned many fish stocks to healthy levels that will provide fish and fishing opportunities for generations to come.

Champions of Change

On October 7, 2016, the White House recognized 12 individuals from across the country as “White House Champions of Change for Sustainable Seafood.” This event highlighted that after decades of decline, the United States is witnessing the economic and ecological recovery of America’s fishing industry and that this shift required hard work, collaboration, and sacrifice by many across the country.

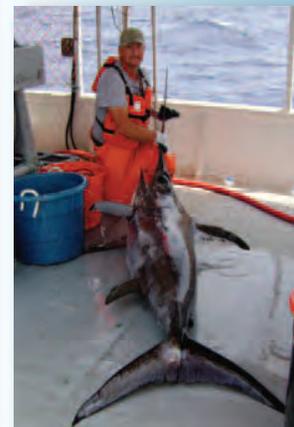
The Champions included fishermen, seafood processors and wholesalers, chefs, entrepreneurs, and scientists representing every region of the country as well as every step in the seafood supply chain. The event also highlighted innovative ways to catch fish and other seafood sustainably, to connect fishers with their customers, and to ensure science and management work together.

Fishing is a proud livelihood that is the backbone of many coastal communities nationwide, and NOAA was pleased to be able to recognize the innovators throughout the country that are helping to ensure a healthy, sustainable future for this industry.

Promoting the Sustainable Management of Global Fisheries

NOAA and other federal agencies have collaborated to export to the rest of the world U.S. successes on how to manage fisheries sustainably. Some of this has been accomplished by ensuring that seafood that enters the U.S. market has been harvested legally and is not mislabeled.

Other efforts have focused on establishing or improving existing regional fisheries management organizations (RFMOs) to ensure that decisions about shared fisheries are science-based and harvest is sustainable.



Overfishing and Overfished Numbers Hit All-Time Lows

NOAA announced in 2015 that the number of domestic fish stocks listed as overfished or subject to overfishing dropped to historic lows when compared to 1997 when NOAA began tracking stock status. Since 2000, 40 U.S. marine fish stocks have been rebuilt.

Another important focus of collaboration has been on combatting illegal, unreported and unregulated (IUU) fishing and seafood fraud, including misrepresented seafood products. Those that engage in IUU fishing and seafood fraud undermine the environmental sustainability of fisheries worldwide by ignoring the management measures adopted by governments and RFMOs.



These actions also weaken profitability for legally caught seafood and fuel illegal trafficking operations. To address these issues, on June 17, 2014, the President created the Task Force to Combat Illegal, Unreported, and Unregulated Fishing and Seafood Fraud, which was co-chaired by the Departments of Commerce and State with 12 other participating federal departments, agencies, and offices.

This partnership and other NOAA-related actions have resulted in a number of significant milestones both through domestic actions that impact international behaviors and through international engagements.

Domestic Actions

Seafood Traceability

In December of 2016, NOAA established the Seafood Import Monitoring Program (SIMP). This groundbreaking program establishes reporting and recordkeeping requirements for imported seafood products.

These data prevent IUU-caught and/or misrepresented seafood from entering U.S. commerce, thereby providing additional protections for our national economy, global food security, and the sustainability

of our shared ocean resources. Initially, the SIMP will only apply to certain species. However, the goal is to eventually apply the SIMP to all seafood.

Enforcement Coordination

NOAA Fisheries Office of Law Enforcement has also been a leader in efforts to better support information sharing among the multitude of U.S. enforcement agencies that are engaged in combatting IUU.

Relevant agencies have developed a new strategy for information sharing that is currently being used to coordinate domestic law enforcement operations targeting IUU fishing and seafood fraud.

The strategy also examines the various federal laboratories that conduct relevant forensic analyses, catalogues their capabilities, and identifies ways to improve the use of these resources, such as through the development of a communication portal to more efficiently share information among agencies.

Marine Mammal Protections for Imported Seafood

In August 2016, NOAA implemented the fish and fish product import provisions of the Marine Mammal Protection Act (MMPA), requiring nations exporting fish and fish products to the United States to be held to the same standards as U.S. commercial fishing operations in terms of their interactions with marine mammals.

The rule also establishes the criteria for evaluating a harvesting nation's regulatory program for reducing marine mammal bycatch and the procedures required to receive authorization to import fish and fish products into the United States.

NOAA Fisheries has a long history of working collaboratively with other nations to address international marine mammal conservation, and has provided technical assistance to other countries in support of their marine mammal conservation efforts.





This rule marks a significant step forward in the global conservation of marine mammals and expanding international collaboration for best stewardship.

International Engagements

Cooperation with Other Governments

Regional Fisheries Management Organizations (RFMOs), such as the newly created North Pacific Fisheries Commission and South Pacific Regional Fisheries Management Organization, are responsible for ensuring the long-term conservation and sustainable management of shared fisheries resources and the protection of the marine ecosystem of the portions of the ocean in which those resources occur.

NOAA played a significant role in the negotiation of the treaties creating these RFMOs and worked to ensure that the fisheries management measures that these RFMOs develop are based on modern principles of fisheries management — the same principles that guide U.S. management of domestic fisheries.

The United States also led international efforts to update two older RFMO treaties to reflect these principles, and NOAA worked with other agencies to support Congressional efforts to ratify the new and amended agreements and adopt implementing legislation. The United States is now better able to ensure that stocks that are fished both in U.S. waters and in adjacent areas of the high seas are subject to the compatible management rules.

NOAA has also enhanced bilateral cooperation with fisheries officials across the globe. For example, a signed

statement with the European Union has been the springboard for collaboration on combatting IUU.

Coordinated efforts resulting from this collaboration have had significant impacts including decisions by the governments of Ghana and the Republic of Korea to modify their laws and the management of their fishing vessels in the face of a pending exclusion of their seafood from two of the largest markets in the world because of the IUU fishing activities of their vessels.

Port Entry Requirements

In 2015, President Obama signed the Illegal, Unreported and Unregulated (IUU) Fishing Enforcement Act, which enabled the U.S. to become a party to the Port State Measures Agreement (PSMA) and marked another critical step in the Administration’s efforts to combat IUU fishing and seafood fraud.

In June 2016, thanks in large part to the efforts of the United States to get other countries to join the agreement, the PSMA entered into force globally. The treaty requires foreign flagged vessels to share information with port officials and permit inspection of log books, licenses, cargo, and fishing gear.

Significantly, the agreement mandates that countries deny entry to their ports by, or ensure the inspection of, vessels known to have been involved in IUU fishing. NOAA’s education efforts internationally, as well as commitments to build capacity in developing nations, were instrumental in getting other nations to sign onto the agreement.

The United States has also pushed for the adoption of port inspection measures by a number of RFMOs. These measures generally consist of a subset of the obligations included in the PSMA and are intended as a bridge for countries not yet ready to join the PSMA.



NOAA is as the lead agency for enforcement of the PSMA and quickly developed an enforcement plan and created 15 training modules for state, territorial, and international partners. In the second half of 2016, NOAA completed PSMA trainings workshops with local enforcement agents in American Samoa, Guam, and Indonesia.

Due to the success of those trainings, NOAA has plans for at least two additional trainings in Asia in 2017 and is in discussions with four other interested organizations.

Monitoring and Enforcement

The Safe Ocean Network is a network of governmental, non-governmental and tech industry groups who share knowledge and technology to better enforce fisheries rules around the globe — providing insight into vessel activities in very remote locations of our oceans.

More than 40 counter-illegal fishing projects worth over \$82 million are currently affiliated with the Safe Ocean Network. These projects include the innovative use of data from NOAA's Suomi National Polar-orbiting Partnership (SNPP) satellite for illegal fishing detection.

NOAA developed algorithms uses data from the satellite's Visible Infrared Imaging Radiometer Suite (VIIRS) to identify vessels that may be illegally fishing at night. NOAA currently provides near real-time alerts for VIIRS boat detections in 86 marine protected areas in Indonesia and in areas closed to commercial fishing in the Philippines.



As part of the Safe Ocean Network, the United States has agreed to develop a fishing boat detection service for Asia and the Pacific also using VIIRS data. NOAA and other U.S. agencies are also partnering with southern African governments and academics to test improved methods for using the VIIRS data for boat detection in that region as well.

Enforcement Successes

Strong, progressive regulations result in sustainable fisheries and protected species only if everyone is playing by the rules, so that the work of NOAA's law enforcement investigative and legal teams is an essential component of our overall management approach.

NOAA staff working in the field, undercover, and in enforcement proceedings resulted in a number of significant cases that ultimately protect the rights and livelihoods of law-abiding fishermen. the following are a small number of these cases.

- When NOAA Fisheries observers on vessels in Alaska identified discrepancies in the weight of their samples vs. those reported by a seafood company, the Office of Law Enforcement (OLE) investigated and found that by manipulating their scales, the company was able to catch more pollock than allowed. The legal team brought a case, and the company paid \$1.75 million in civil penalties.



Commercial and Recreational Fishing Benefit the Economy

In 2014, U.S. fishermen landed 9.5 billion pounds of fish and shellfish, valued at \$5.4 billion. This same year, 10.4 million anglers took 68 million trips, and caught nearly 392 million fish. Commercial and recreational saltwater fishing in the United States generated nearly \$214 billion in sales in 2014.

- A New England fish company and its president pled guilty to federal felonies stemming from their role in systematically covering up purchases of illegal fluke, scup, and black sea bass. The individual directed unwitting company personnel to prepare and file at least 78 false dealer reports to OLE, which omitted or misidentified approximately 203,000 pounds of fluke, 50,000 pounds of scup, and 12,000 pounds of black sea bass with a wholesale value of \$481,000. The two defendants agreed to pay \$932,000 in combined fines and restitution. The defendants also agreed to make a \$110,000 community service payment for the enhancement of seagrass and fluke habitat around Long Island.
- In the Gulf region, a company pled guilty to a one count felony violation for mislabeling more than 35,000 pounds of imported Mexican shrimp as product of the United States. The company purchased the imported shrimp and removed the labels identifying it as product of Mexico. It then created false bills of lading and unloading tickets to make the shrimp appear harvested aboard a U.S. flagged vessel. The guilty party paid a criminal fine of \$150,000 and the 35,000 pounds of shrimp previously seized was later sold in a forfeiture auction for \$120,800.
- In California, an investigation and undercover buy operation determined that an overseas individual and his company conspired with a U.S. company to ship marine mammal products falsely declared as antiques and household goods to the United

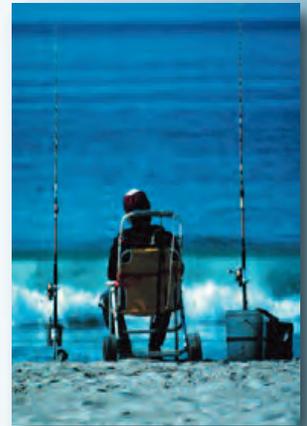
States, evading the required permits. The parties pled guilty to a single count of smuggling wildlife (specifically, sea turtle shells and a giant clam shell) into the United States resulting in a \$75,000 criminal penalty, and a \$25,000 community service payment that will be transferred to the National Wildlife Fund. The U.S. corporation was sentenced to three years' probation and was ordered to pay \$100,000 in fines and community service payments.

- And finally, in Hawaii, a NOAA investigation led to an administrative law judge assessing the owner of a longline fishing vessel \$54,366 for three counts of removing and harvesting fish within the Papahānaumokuākea Marine National Monument.

New National Policy Gives a Voice to America's Saltwater Recreational Anglers

Recreational fishing is an important national pastime. In February 2015, NOAA announced a new national policy to better serve America's 11 million recreational saltwater anglers and the companies and communities that rely on them.

The policy — crafted with input from recreational fishing and boating communities, conservation organizations, and managers across the nation — institutionalized NOAA's commitment to healthy recreational fisheries and recognizes the benefits they provide to the nation.



“This policy represents a milestone in NOAA Fisheries’ relationship with the recreational fishing community,” said American Sportfishing Association President and CEO Mike Nussman. “This new policy sets forth a path for how the agency will elevate recreational fishing in a way that benefits both fisheries resources and public access to them.”

The policy covers a number of existing and emerging concerns, including public access, resource stewardship, regulatory education, science innovation, and better lines of communication between state and federal rule-makers with the community.

Expanding Opportunities for U.S. Aquaculture

In 2016, NOAA implemented the nation’s first comprehensive regulatory program for ocean aquaculture in federal waters. The groundbreaking rule creates a coordinated permitting system for the Gulf of Mexico, opening the door for the region to expand seafood production and create new jobs in an environmentally sustainable manner.

The action is expected to increase and diversify the U.S. seafood supply by supplementing wild fisheries harvest with up to 64 million pounds of farm raised seafood per year.

This represents a 70 percent increase in marine aquaculture production nationwide, and will help to address the \$12 billion seafood trade deficit while promoting economic growth and job creation.

Additionally, in 2015, NOAA issued a permit for the first shellfish aquaculture project in federal waters off the East Coast in Nantucket Sound. The partners hope to create new jobs in the region and satisfy consumer demand for local seafood.

NOAA develops Tools and Strategies for Addressing Fisheries in a Changing Climate

In 2014, NOAA announced a new Fish Species Climate Vulnerability Assessment Methodology to provide decision-makers with information on the relative vulnerability of fish species with expected changes in climate and ocean conditions. The methodology helps fisheries managers and scientists identify risks and reduce impacts to fish stocks, and consequently fishermen.

In 2015, NOAA released the first-ever Fisheries Climate Science Strategy as a proactive approach to increase the production, delivery, and use of climate-related information needed to fulfill NOAA’s fisheries mandates. The Strategy identifies seven objectives that will provide decision-makers with the information they need to reduce impacts and increase resilience with changing climate and ocean conditions.

In December 2016, NOAA released five draft Regional Action Plans designed to guide implementation of the NOAA Fisheries Climate Science Strategy. The plans were developed by NOAA Fisheries Science Centers and Regional Offices with input from internal and external partners.





The plans identify priority needs and specific actions NOAA and partners will take over the next five years.

Finally, in 2016 NOAA completed the new OCEANADAPT web site in partnership with Rutgers University to assess climate-related shifts in the distribution of major commercial and recreational fish stocks in U.S. marine ecosystems.

This unique site provides information on distributions for over 650 species of fish

over the past 40-50 years. The information is updated annually allowing decision makers to track and assess shifts in distribution of individual species or entire fish communities in a region over time.

This indicator was recently chosen to be added to the suite of indicators in the EPA's Climate Change Indicators in the United States report.



Restoring Habitats

Prioritizing Habitat Science and Conservation Efforts

Over the last five years, NOAA has established 10 Habitat Focus Areas. These are diverse environments where NOAA is prioritizing resources and demonstrating how its science, service, and stewardship can come together to improve habitat conditions and create more resilient communities.

For example, in California's Russian River, NOAA is applying its expertise in flood and weather forecasting, as well as habitat restoration, to help inform water management in streams to better balance the needs of agriculture, municipalities, and fish.

Bringing expertise from the National Weather Service to better understand and forecast "atmospheric rivers" — a long line of rain storms that stream in from the Pacific Ocean and often cause flooding — has allowed water managers to provide more informed flood control and water storage reliability that benefits both people and threatened and endangered salmon populations.

NOAA's other HFAs are: the Penobscot River in Maine; the St. Louis Estuary in Wisconsin and Minnesota; the Choptank River in Maryland and Delaware; West Hawaii on the island of Kona in Hawaii; Biscayne Bay in Florida; Kachemak Bay in Alaska; Manell-Geus in Guam; Muskegon Lake in Michigan; and Culebra Island in Puerto Rico.

Restoring our Rivers

The 106-foot-high San Clemente Dam on the Carmel River in Monterey, California, was removed in 2015 as part of a three-year restoration project. The dam was the largest dam to be removed in California to date, and was accomplished through a unique public/private partnership of state

and federal agencies including NOAA and the dam owner. Removal of the dam will allow unimpeded access to 25 miles of spawning and rearing habitat for threatened South-Central California Coast steelhead.

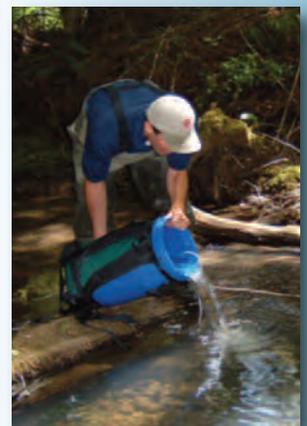
In 2015, as the next step in the Penobscot River Restoration Project in Maine following the removal of the Great Works Dam and Veazie Dam, the large nature-like bypass channel fishway was constructed around the Howland Dam. As a result of these collective actions, 13 miles of river has been reopened providing access to 454 miles of the upstream river network and 39 lakes.

Blueback Herring will have improved access to 93 percent of its historical spawning habitat, while Alewife is now afforded improved access to 31 percent of its historical-use habitat in the Penobscot River watershed.

In April 2016, federal, state and Tribal representatives, along with PacifiCorp, signed amendments to the Klamath Basin Restoration Agreement and the Klamath Hydroelectric Settlement Agreement. The project is expected to remove four dams on the Klamath River by 2020, amounting to one of the largest river restoration efforts in the nation. For the first time in more than 100 years, endangered salmon will have access to more than 400 miles of previously blocked habitat.



Robert Webb and Dr. Kathryn Sullivan join California Department of Fish and Wildlife personnel for a "fish squeeze" at the Don Clausen Fish Hatchery during a tour of the Russian River watershed.



Gulf Restoration



The Deepwater Horizon oil spill (DWH) — the largest offshore oil spill in U.S. history — released well over 134 million gallons of oil into the Gulf over 87 days. The oil caused an array of toxic effects to marine ecosystems and living marine resources, including death, disease, reduced growth, and impaired reproduction across broad geographic regions.

As the lead science agency for oil spills in coastal and marine environments, NOAA was on the scene of the DWH oil spill from the earliest moments of the crisis. We continue to be engaged in the restoration and recovery over six years later, and will be for the next 15 years.

NOAA, working closely with the other natural resource Trustees, was the leader in assessing the impacts of DWH to benthic resources, nearshore marine ecosystems, and recreational use. This ecosystem scale injury assessment looked at everything from phytoplankton to sperm whales.

The DWH assessment generated major advances in oil spill science. Investing some \$700 million into the scientific studies, NOAA and its researchers now better understand injury mechanisms for important resources like deep-sea coral, fish and shellfish, wetlands, sea turtles, and marine mammals. More than

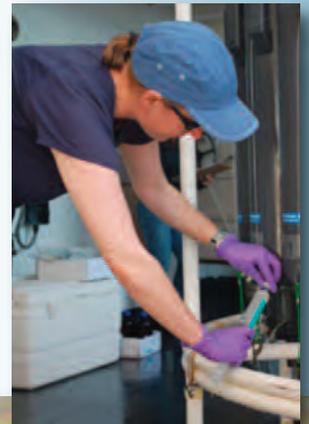
20 species were identified for the first time during these assessments.

NOAA also provided significant leadership in the development of a natural resource restoration plan that employs a comprehensive, integrated approach to best address the ecosystem-level injuries that occurred as a result of the spill.

Over a roughly three-month period, NOAA synthesized vast amounts of scientific and restoration information, gathered and developed since the April 2010 incident, and along with the other Trustees, after public hearings and comment, adopted a capstone Programmatic Damage Assessment and Restoration Plan/Environmental Impact Statement (PDARP/EIS).

This NOAA science assessment and restoration planning work supported the U.S. Department of Justice's historic \$20 billion settlement with BP to resolve natural resource damages and federal civil penalties and other injuries as a result of DWH.

The restoration plan will guide \$8.8 billion for natural resource damages in the Gulf of Mexico for the next 15 years. The Trustees have already approved 66 projects for a total of \$866M in BP "early restoration" funds. NOAA is implementing or co-implementing a number of these projects, totaling approximately \$353M, that will benefit many of the resources injured by the spill including coastal habitats, sea turtles, oysters, marine mammals and fish.





Oil spills can have indirect effects that don't necessarily kill animals and plants, at least, not right away, but those impacts can lead to death and health and reproductive problems months or years later. (Credit: Louisiana Department of Fisheries and Wildlife)

The settlement with BP also provided \$5.5 billion, plus interest, as a civil penalty under the Clean Water Act. The RESTORE Act, which Congress enacted in 2012 in response to the spill, divvies up these funds to the five Gulf states, the RESTORE Council, and the NOAA Science Program.

NOAA, through the Department of Commerce, actively participates in the Gulf Coast Ecosystem Restoration Council (RESTORE Council) which oversees approximately \$3.2 B of the RESTORE funds.

In December 2015, the Council approved its initial round of projects that included up to \$17M for NOAA to create a Conservation Corps; restore of over 2,200 acres of critical wetlands in Florida, Alabama, and Texas to improve water quality and restore habitat; and develop a monitoring and assessment program for the Council.

Additionally, in late 2016, the RESTORE Council adopted its updated Comprehensive Plan, which sets the stage for a coordinated and collaborative approach to Gulf-wide restoration.

NOAA was also charged with creating the NOAA RESTORE Science Program with approximately \$133M of RESTORE funds. The mission is to carry out research, observation, and monitoring to support the long-term sustainability of the Gulf ecosystem and the communities that depend on it.

NOAA has already awarded \$2.7M to projects to synthesize current scientific understanding and management needs within three priority areas: modeling, monitoring, and ecosystem and health indicators.

The Program has also announced \$17 million in grant funding to support proposals focused on living coastal and marine resources and their habitats in the Gulf of Mexico.



Achieve Organizational Excellence



Each day, NOAA's employees strive to promote organizational excellence and execute our mission with discipline and consistency. We have worked to recruit, retain, reward, and develop the best talent possible and ensure that our customers — both internally and externally — receive the best service possible. Our employees are the backbone of our agency, and we will look to put "Mission First, People Always."



Increasing Opportunities for Diversity and Inclusion



As a mission driven agency, NOAA is committed to balancing the mantra of “Mission First, People Always.” The agency has placed a priority on increasing diversity and inclusion in its workforce.

In September 2015, more than 100 NOAA leaders met at the Senior Executive Service (SES) Summit to discuss the topics of employee engagement and diversity and inclusion. This group collectively committed to ensuring each and every NOAA employee feels safe, welcomed, and professionally challenged.

We set in place a plan to create a more diverse and inclusive culture at NOAA, using the Federal Employee Viewpoint Survey (FEVS) results as the primary means to track progress.

In July 2016, NOAA released the NOAA Diversity and Inclusion Toolkit that includes talking points, communication tips, and educational resources related to diversity and inclusion. We also implemented D&I principles in hiring of SES and performance evaluations for supervisors.

In October 2016, NOAA hosted a Diversity and Inclusion Summit with more than 400 employees attending from across the nation and released the NOAA Diversity and Inclusion Strategic Plan in November 2016. This work has been integrated throughout the organization, with many of NOAA’s Line Offices releasing their own diversity and inclusion strategic plans targeted to their specific culture and organizations.

NOAA has also realigned its Civil Rights office to assume responsibility of the agency’s overall D&I program, and hired a new Director for the office with years of experience in the field. This office, along with NOAA’s Diversity and Inclusion Management Advisory Council, is crafting a strategy to carry this work into the future.



NCCOS’s Dr. Terry McTigue receives an Equal Employment Opportunity and Diversity Award.



NOAA’s Partnership Education Program increases diversity in the marine sciences.



OR&R Diveristy Committee.

Creating a Safe Working Environment



To provide a safe working environment for all NOAA employees, NOAA and the Office of Marine and Aviation Operations (OMAO) took aggressive action to establish a comprehensive program to prevent sexual assault and harassment and provide a safe, professional working environment across the fleet and the agency.

We have provided support to victims, set up a long-term structure to swiftly and thoroughly address allegations, and are implementing cultural changes across the organization to prevent and minimize future issues.

NOAA, in conjunction with RAINN (Rape Abuse Incest National Network), has established a helpline service available to all NOAA employees and will offer counseling and NOAA specific information regarding options for reporting, support, and other available resources.

NOAA has also strengthened implementation of cultural changes across the organization. In June 2016, the OMAO Director issued a new policy statement on Workplace Violence and Threatening Behavior to all NOAA Corps and civilian employees. All NOAA vessels had a mandatory safety briefing as part of a “safety stand down” in which all vessels ceased operations.

OMAO is implementing a post cruise survey for all visitors who sail on NOAA ships. This survey will allow for anonymous feedback to help gauge the climate of the work environment on NOAA ships and help improve safety policies for all employees.

NOAA is committed to continuing to implement and develop programs to address and prevent aggressive and destructive behaviors and to provide a safe, professional working environment across the fleet and the agency.



The Scientific Enterprise

Research to Operations, Applications, Commercialization, and Utilization (R2X)

It is essential to ensure that NOAA's world class research and technology development is transitioned effectively out of the laboratory and into our operational services.

In the FY2017 President's Budget, NOAA proposed the creation of the Research Transition Acceleration Program (RTAP). RTAP is designed to support the acceleration of mature R&D activities to the "mission-qualified" level in one to three years. This pace is significantly reduced from historically longer transition times, which have taken decades in some cases.

NOAA's RTAP will improve the process and provide the needed resources to accelerate the transition of NOAA's R&D outputs into operations, applications, commercialization, and other uses for societal benefits, which we call R2X. The full description of NOAA's re-engineered transition process is defined in NAO 216-105B. In the end, these process and resource improvements will continue to strengthen the culture of transitioning R&D at NOAA.

Strategic Research Guidance

Meeting NOAA's evolving mission needs requires careful and strategic planning to ensure that NOAA's research and development (R&D) portfolio remains vigorous, forward-looking, and capable of meeting mission needs.

Building upon existing best practices to promote scientific and technological excellence, NOAA began issuing annual Strategic Research Guidance in 2015. The NOAA Strategic Research Guidance Memorandum (SRGM) serves as the critical guidepost for regularly reviewing, evaluating, and rebalancing NOAA's R&D

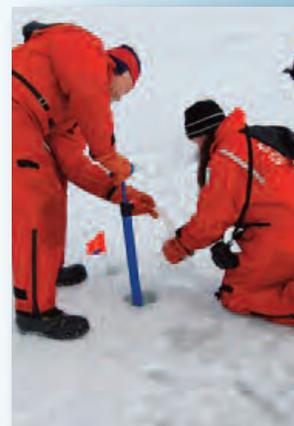
enterprise in light of mission requirements, stakeholder needs, and emerging priorities.

The SRGM is to be used by all who have equity in NOAA's R&D enterprise: researchers, technology developers, and program managers as well as our partners in academia, other government agencies, non-governmental organizations, and the private sector.

Building upon the concepts and priorities laid forth in the SRGM issued in 2015, the 2016 SRGM highlights noteworthy R&D successes achieved by NOAA scientists and supports aggressive decision making by identifying areas where additional focus is warranted in the development of R&D priorities for NOAA.

Prospectus for Cooperative Institutes in the 21st Century

This year NOAA took a careful look at how the agency was constructing, using, and assessing the NOAA Cooperative Institutes. As a result of working with the CI Directors, the CI Committee, NOAA and DOC General Counsels and various external stakeholders a summary report was produced, which we call "Prospectus for Cooperative Institutes in the 21st Century," which provides a vision and recommendations that seek to strengthen and advance the research and development enterprise of NOAA and its partners.





The recommendations included within the prospectus, when fully executed, will elevate the capacity and capability of the CIs and strengthen NOAA's research enterprise. CIs will benefit from clearer direction on where to aim their resources and intellectual capital.

NOAA program managers will benefit from sharing and capitalizing on best management practices to advance the agency's mission. In addition, the important dialogue about creation of new CIs will benefit from clarity of vision for where the enterprise will go.

A Unified and Regionally Integrated NOAA

NOAA's science, services, data, and programs are present in every part of the country. NOAA confronts complex challenges head on developing tailored solutions for communities and businesses. NOAA's Regional Collaboration Teams across eight regions are positioned to facilitate collaboration at the regional level, and tap into local resources and capabilities.

Reducing Nutrient Runoff

Many of the nation's waterways suffer from water quality degradation, often caused by excess nutrient loading. The Central Region Collaboration Team recognized the need to better connect expertise and resources between teams in an effort to provide decision support tools to reduce the impacts of nutrient loading.

Exploring Public Private Partnerships

The Great Lakes Regional Collaboration Team is exploring public-private partnerships with key regional organizations to provide the best available science and high-quality environmental information.

The team has supported graduate students in developing an analysis that evaluates NOAA's priorities and how they might align with organization across the Great Lakes region.

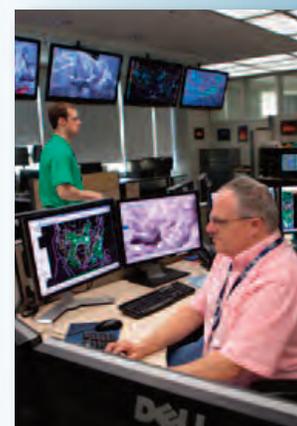
Collaboration with Fishermen

Accurate marine forecasts are critical to the safety and success of the fishing industry. The North Atlantic Regional Team saw an opportunity to partner a long-standing Northeast Fisheries Science Center program with other local NOAA offices.

Several meteorological instruments were purchased for the Science Center's cooperative fishing fleet and provided 1,000 hourly weather reports.

Ensuring Storm Readiness

Spreading the word about how people can prepare for hurricane season requires using a variety of methods to reach people. Webinars have become a useful tool across NOAA to respond to regional needs through information sharing.



The Southeast and Caribbean Regional Team and the Gulf of Mexico Regional Team stepped up to host webinars to increase storm readiness in their communities. Hundreds of people received the information they needed to prepare.

Providing Data to Meet Users Needs

Knowing what data are available and having the ability to access, understand, and use it is an underlying need for addressing priorities in the Gulf of Mexico. To help tackle this issue, the Gulf of Mexico Regional Team organized a workshop to improve user access and dissemination. The group suggested potential portals for connecting and sharing information and ways to publicize available data.

Supporting the World Conservation Congress

In September 2016, Hawaii hosted the World Conservation Congress — the world's largest conservation event organized by the International Union for the Conservation of Nature. The Pacific Islands Regional Collaboration Team was at the center of showcasing NOAA's mission to more than 8,000 delegates from around the world.

Team members learned about the best practices in science and marine resource management from other countries and share best practices to promote conservation.

Increasing Coastal Resilience

Alaska's vast and remote shorelines are some of the most critically under-instrumented coastal and nearshore areas in the United States. Yet, accurate water level observations, both static and real-time, are fundamental for flood forecasting, ecosystem management, and safe navigation.

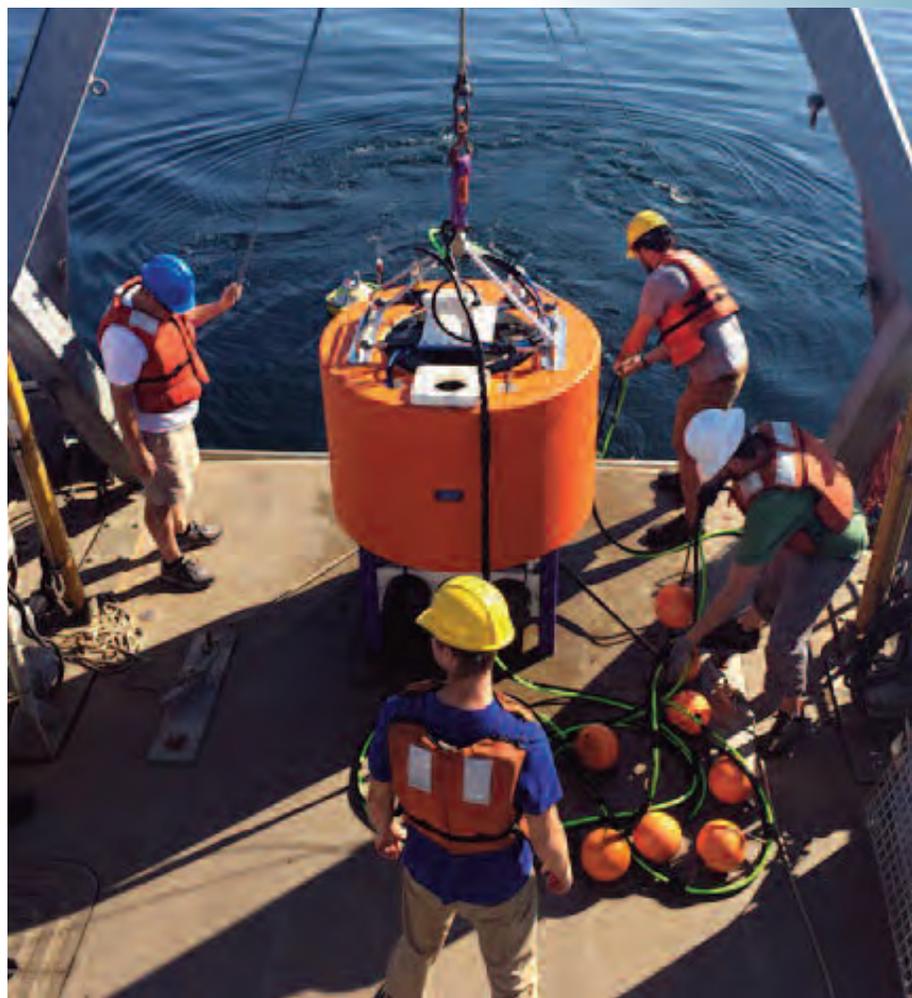
The Alaska Regional Collaboration Team created a roadmap and established an Alaska-wide Integrated Water Level Observing Network. This plan is part of the team's effort with regional partners to

increase coastal resilience by creating the foundation for planning and resource management tools.

Documenting Changing Conditions

In recent years, the western United States has experienced a number of unusual environmental conditions, including warm ocean waters in the eastern Pacific Ocean; an unprecedented harmful algal bloom spanning the entire West Coast; and persistent and historic drought conditions.

The Western Regional Team recognized there was a gap in how environmental data is compiled, synthesized, and communicated. They initiated a 10-month effort to calculate and communicate changing conditions and impacts. Now, the region has a more complete picture of current conditions and potential impacts to communities and businesses.



Big Data

NOAA generates tens of terabytes of data a day from satellites, radars, ships, weather models, and other sources. While these data are publicly available, it is difficult to download and work with such high volumes. NOAA's vast wealth of data therefore represents a substantial untapped scientific and economic opportunity.

The NOAA Big Data Project (BDP) was created to explore the potential benefits of storing copies of key observations and model outputs in the Cloud to allow computing directly on the data without requiring further distribution. Such an approach could help form new lines of business and economic growth while making NOAA's data more easily accessible to the American public.

The BDP seeks to combine three incredibly powerful resources: NOAA's expansive collection of high-quality environmental data and expertise, the vast infrastructure and scalable computing capabilities of our industry collaborators, and the innovative energy of the U.S. economy.

The BDP, through Cooperative Research and Development Agreements (CRADAs), currently works with five infrastructure-as-a-service (IaaS) providers to broaden access to NOAA's data resources. This collaboration is designed to facilitate full and open data access at no net cost to the taxpayer, and to foster innovation by bringing together the tools necessary to make NOAA's data more readily accessible.

The Big Data Project's collaborators — Amazon Web Services, Microsoft, Google, IBM, and the Open Cloud Consortium — work together to identify, extract, and develop NOAA's data to develop new business and research opportunities.

Methods for making data from weather satellites, weather prediction models, fisheries, and climate observations more accessible to industry, academia, and others are in different stages of development,

but show promise in terms of fostering new ideas and spurring economic growth.

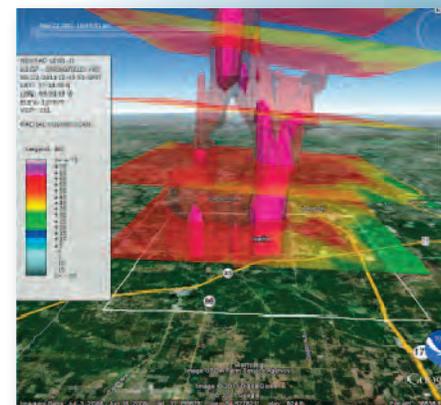
Earlier this year, climate data records from satellites, ocean- and ground-based observations and coastal laser-based elevation measurements were moved from NOAA to Google and Amazon Web Services in support President Obama's new Climate Partnership for Resilience and Preparedness.

Communities, businesses, and federal, state, and local government agencies now have access to these data in a modern cloud-based system and in a format that supports decision-making processes.

The most mature Big Data Project activity to date involves NOAA's Next Generation weather radar (NEXRAD) data. After one year on Amazon's Web Services platform, the utilization of NOAA's NEXRAD data had increased by 130 percent, and loads on NOAA's data infrastructure had been reduced by over 50 percent.

Big data analyses that had previously taken scientists several years to accomplish now take only days, and new uses for NEXRAD weather radar have been spawned on Amazon's platform, including new bird migration and insect studies.

These early project successes, and ongoing data transfer activities, are creating new opportunities for the public and private sectors and have the potential to positively affect millions around the country.



Visualization of NEXRAD Reflectivity sweeps and derived isosurfaces in Google Earth for the May 22, 2011 Joplin, MO tornado. The image was generated with the NOAA Weather and Climate Toolkit and Google Earth

Education



NOAA takes an “all hands on deck” approach to education. Our educators and partners work in different offices, programs, states, and countries, covering topics that span from the surface of the sun to the depth of the ocean floor. We educate audiences from preschoolers through postgraduates and provide learning opportunities outside of the classroom for people of all ages.

NOAA’s 2016 common measures are collected from programs across NOAA and are one way we communicate the reach of our investments to the public, students, and educators.

Partners such as academic institutions, educational organizations, and other federal, state, and local agencies extend our ability to reach our target audiences.

- Over 58 million people visited informal education institutions hosting NOAA supported exhibits or programs that enhance stewardship and promote decision making.
- Nearly 450 institutions increased educational capacity through NOAA funded interpretive/educational centers, exhibits or programs.
- Over 2.6 million youth and adults participated in NOAA supported informal education programs that enhance stewardship and promote informed decision making.
- Over 440,000 preK-12 students participated in NOAA supported formal education programs that enhance understanding and use of NOAA science and other resources.
- Over 23,000 educators participated in NOAA supported professional development programs that enhance understanding and use of NOAA science and other resources.

- Over 40 million people visited NOAA Education websites that support a broad spectrum of educational activities and provide critical information to the nation.
- Over 3,700 postsecondary students trained in NOAA mission related sciences through NOAA funded higher education programs that prepare students for career paths at NOAA and related organizations.
- Nearly 750 postsecondary degrees in NOAA related disciplines awarded to students who were supported by NOAA in higher education programs.

NOAA’s education programs provide opportunities for students and the public to learn science and engage in our mission. We strive to make these opportunities accessible, relevant, and useful.

NOAA and Partners Advance Federal Citizen Science Efforts

NOAA is an active member of the Federal Community of Practice for Crowdsourcing and Citizen Science. From working with the White House Office of Science and Technology Policy, to launching its own Citizen Science Community of Practice, NOAA has been at the forefront of advancing Citizen Science within the federal government.



In FY16, NOAA assisted with the creation of a government-wide website, www.citizenscience.gov. This website was designed to accelerate the use of crowdsourcing and citizen science across government agencies and will aid in developing, implementing, and improving citizen science and crowdsourcing projects across the country.

Diversity and Professional Advancement

Understanding the perspective and challenges of underrepresented groups in NOAA's workforce will aid in developing recruitment, retention, and advancement strategies to promote diversity and inclusion.

With that in mind, the Diversity and Professional Advancement Working Group (DPAWG) developed and disseminated a NOAA wide survey, which gathered perspectives about diversity, inclusion, and opportunities for professional advancement. DPAWG identified disparities between the minority and majority NOAA workforce perceptions on job satisfaction, mentorship, career advancement and diversity, and obtained individual commitments from NOAA Leadership to increase efforts to promote inclusion and embrace diversity among employees.

Every Kid in a Park

Eighty percent of U.S. families live in cities today, creating a disconnect with the natural world. Today's children spend more time on computers and smartphones than exploring nature.

This disconnect to nature was the impetus for the *Every Kid in a Park* program, which provides an opportunity for every fourth grade student across the country (approximately four million) to experience federal lands and waters first hand at no cost.

Several offices across NOAA came together to offer hands on experiences for fourth grade students to introduce them to the vast places NOAA protects including national marine sanctuaries, national

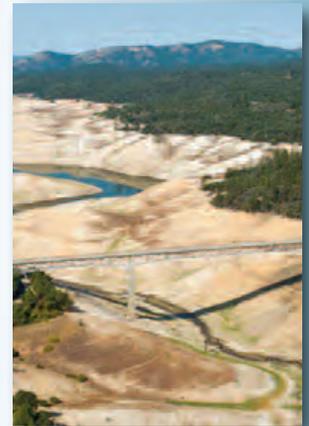
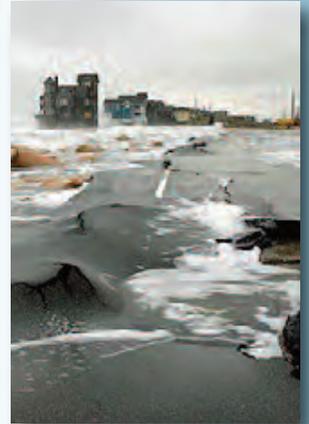
estuarine research reserves and a national marine fisheries laboratory. In total, more than 3,200 fourth grade students experienced NOAA programs during 51 events around the country.

Regional Climate Workshops Reach More than 400

In 2015, NOAA conducted a series of five regional workshops for more than 400 formal and informal educators. The workshops were developed with federal, state, and NGO partners in Chicago; Seattle; St. Petersburg; Boulder; and Silver Spring, Maryland.

Each workshop focused on regional and/or topical impacts of climate change to connect educators and their audiences to the best-available, science-based information and resources about climate change. Attendees interacted with climate science, education and communication experts, participated in hands-on education activities and explored innovations in Earth-system research.

In 2016, NOAA sponsored six additional workshops in Long Beach; Detroit; Salt Lake City; Boulder; New Orleans; and Charleston. In addition, six mini-workshops were held at the National Science Teachers Association (NSTA) national conference in Nashville. Nearly 500 formal and informal educators attended and post-workshop assessments indicated that educators planned to share the resources with a potential of well over 40,000 people.



Addressing the Nation's Water Challenges with Data



Water Initiative

In the United States and around the world, water security is increasingly in jeopardy. Too much water, too little water, or water of poor quality can endanger life, property, economies, and ecosystems.

Following a series of national meetings held in 2016, NOAA developed a comprehensive NOAA Water Initiative. The Initiative is designed to advance the science and improve the information products that can help people and governments better understand their particular weather, water, and climate challenges, take appropriate actions and make sound plans for the future.

Guided by the Initiative, NOAA will work closely with its public and private sector partners to develop and deliver timely, accurate, and actionable water information services, based on next-generation water prediction capabilities and a deep understanding of user needs.

On the education front, NOAA strives to incorporate authentic research practices into learning experiences to inspire the next generation of experts in the entire range of disciplines that underpin the agency's mission.

California Drought

For the last five years, NOAA has been deeply embedded in decision-making on California reservoir and river operations necessary to protect threatened and endangered salmon and steelhead populations that depend on specific river temperature and flow conditions for survival.

Since 2011, the agency has worked with federal and state partners to manage the state's limited water supply as efficiently and effectively as possible — meeting competing demands for human health, agricultural production, and protected salmon and steelhead to ensure these listed species do not succumb to the state's water shortages.

One of the major results of these efforts was the 2015 Interagency Drought Strategy. As part of the strategy, the government created innovative partnerships with private landowners and water users who want assistance in making decisions to protect the Endangered Species Act-listed runs during critical times.

NOAA continues to work with partners to monitor conditions for fish in real time, assessing how listed salmon and steelhead are responding to operational changes and taking action to minimize adverse effects — accounting for both the needs of listed fish and water users.



Arctic



The Arctic is rapidly changing. These changes, which are expected to intensify, impact weather patterns, ecosystems, and human activities. NOAA is at the forefront of understanding how these changes will affect both local communities and global forecasts.

Increased observation and improved data sets are vital to improving forecasts and informing decision makers. NOAA's improvements in observational capacity are leading to better understanding of Arctic ecosystems, the atmosphere, climate, and their dynamic interconnections.

Our new Distributed Biological Observatory (DBO) identifies ecologically important areas to focus our observational efforts. NOAA will monitor both physical and biological changes in these areas and assess how these changes could affect local communities, fisheries, and marine mammals.

Sea ice conditions and changes affect almost all aspects of the Arctic from commercial uses to ecosystem impacts. NOAA has advanced sea ice forecasting services by increasing our observational data and refining and improving our models.

Accurate and timely sea ice forecasts are critically important for those operating in the harsh conditions of the Arctic environment including the U.S. Coast Guard and commercial fishing operations as well as ensuring safe navigation and successful search and rescue operations.

NOAA has also expanded our research to better understand the widespread impacts of shrinking sea ice coverage. As a result of this monitoring, the complicated linkages among melting sea ice, changing climate, and weather patterns in the Arctic and around the globe are becoming clearer. This clarity allows better planning to cope with accelerating Arctic change.

In 2014, NOAA released its first comprehensive Arctic Action Plan. The Action Plan establishes priorities and

identifies more than 80 actions across NOAA to help the U.S. respond effectively to the challenges from a changing Arctic environment. Many of these actions have been executed leading to improved forecasting, increased observational capacity, and strengthened international cooperation.

The Arctic is a unique ecosystem and the U.S. cannot act alone to protect this resource. All of NOAA's Arctic activities are united in one aspect leveraging national and international partnerships and collaborating to support common Arctic goals.

NOAA strengthens international cooperation through the Arctic Council, joint research opportunities, and provision of services. NOAA also has many successful Arctic national partnerships, within and outside the federal government.

NOAA played a significant role in the development of the nation's first Arctic Science Ministerial convened in September 2016. Twenty-five countries met to identify and discuss effective strategies to deal with the environmental challenges facing Arctic nations in rapidly changing environments.

The Ministerial provided an unprecedented opportunity to coordinate international activities and make investments in monitoring and understanding the impacts of Arctic change on global climate.

As the Arctic continues to change, NOAA is prepared and positioned to provide vital information to help advance U.S. economic interests and protect this unique environment.



Opening Doors With Cuba

NOAA Navigation Services and Cuba Agree on Efforts to Improve Maritime Navigation Safety

NOAA's navigation services directors and subject experts traveled to Havana to meet with their counterparts in Cuba's National Office of Hydrography and Geography. The U.S. and Cuba have expressed their joint commitment to pursuing the improvement of maritime safety through the exchange of modern hydrographic data and products.

A Memorandum of Understanding (MOU) was signed in March 2016 to improve maritime navigation safety and related areas of mutual interest to protect lives and property at sea. In the MOU, both agencies agreed to "develop annual work plans to identify specific priority activities for cooperation."

Among a range of activities, the U.S. looks forward to coordinating electronic navigational charts production and facilitating international charts; improving tides and currents monitoring and forecasting; and collaborating on geodetic challenges. This agreement is the first step in what is expected to be a long-term collaboration between the two countries.

U.S. and Cuba to Cooperate on Sister Sanctuaries

Less than a hundred miles south of the reefs and mangrove forests of Florida Keys National Marine Sanctuary are the marine ecosystems of our neighboring nation, Cuba.

In November 2015, a Memorandum of Understanding (MOU) was signed by NOAA, the National Park Service, and Cuba's Ministry of Science, Technology, and Environment. This new MOU includes the establishment of sister-sanctuary relationships between Guanahacabibes National Park in Cuba, including its offshore Bank of San Antonio, and Florida Keys and Flower Garden Banks national marine sanctuaries in the United States.

Recognizing that these protected areas are all inextricably linked by ocean currents and animal migrations, and threatened by some of the same environmental stressors (such as ocean acidification), this MOU is an opportunity for marine protected area managers and scientists in the U.S. and Cuba to learn from one another's experiences, benefiting and improving the health of coral reef resources in both countries.

Innovative Science



NOAA Tide Tables Turn 150

NOAA completed the 2016 Tide Tables and Tidal Current Tables, which marks the 150th edition since NOAA began publishing them. These predictions are the cornerstone of the services NOAA provides the nation.

They provide information for safe navigation for mariners, inform climate change research, help coastal communities understand when they may experience high or low water, and help commercial and recreational fishermen improve their catches.

The Coast and Geodetic Survey, NOAA's ancestor agency, published the first edition in December 1866 for the year 1867. The manuscripts have been shipped to publishers, and should be available in a few weeks.

The NOAA RESTORE Act Science Program

In 2016, NOAA announced nearly \$17 million in grant funding to support proposals focused on living coastal and marine resources and their habitats in the Gulf of Mexico.

In 2015, approximately \$2.7M in projects were awarded by the NOAA RESTORE Act Science Program to synthesize current scientific understanding and management needs within three priority areas: modeling, monitoring, and ecosystem and health indicators.



The NOAA RESTORE Act Science Program was established to support the science and coordination necessary for better understanding and management of the Gulf of Mexico ecosystem and its resources. The science plan includes 10 long-term research priorities that will guide how the program invests its funds.

The NOAA RESTORE Act Science Program will work closely with the research and resource management communities to address the priorities outlined in the plan.



NOAA Launches New Tool for Deepwater Horizon Data

In 2015, NOAA launched a flexible new data management tool known as DIVER to support the Natural Resource Damage Assessment for the 2010 Deepwater Horizon oil spill. DIVER stands for "Data Integration, Visualization, Exploration and Reporting," and provides unprecedented flexibility for filtering and downloading validated data collected as part of the damage assessment efforts for the Gulf of Mexico.

DIVER was developed as a digital data warehouse during the Deepwater Horizon oil spill response effort and related damage assessment process, which has required collecting and organizing massive amounts of scientific data on the environmental impacts of the spill.

The tool serves as a centralized data repository that integrates diverse environmental data sets collected from across the Gulf of Mexico ecosystem.

It allows scientists from different organizations and laboratories located across the country to upload field data, analyses, photographs, and other key information related to their studies in a standardized format. DIVER thus brings together all of that validated information into a single, web-based tool.

NOAA Research Confirms Crude Oil Causes Developmental Abnormalities in Large Marine Fish

In a landmark study released in 2014, NOAA researchers confirmed that that crude oil from the Deepwater Horizon oil spill in the Gulf of Mexico in 2010 causes severe defects in the developing hearts of bluefin and yellowfin tuna.

In 2010, their spawning season directly coincided with the Deepwater Horizon spill. Their embryos, which float near the ocean surface, were potentially in harm's way as crude oil rose from the damaged wellhead to form large surface slicks. Based on findings from the 1989 Exxon Valdez spill in Prince William Sound researchers knew that recently spawned fish are especially vulnerable to crude oil toxicity.



That spill taught them to pay close attention to the formation and function of the heart. Severely affected fish with heart failure and deformed jaws are likely to have died soon after hatching.

New Genetic Technique Helps Unravel the Mystery of Sea Turtle Science

In 2013, thanks to a breakthrough in the genetics lab, a NOAA Southwest Fishery Science Center researcher and his colleagues learned that hidden in a sea turtle hatchling's DNA is its entire family history, including who its mother is, who its father is, and to what nesting population it belongs.

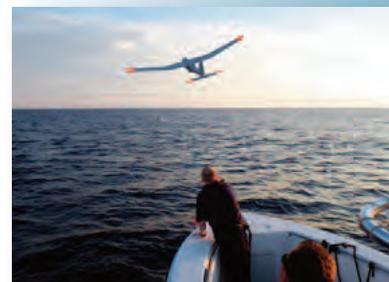


The discovery of these 'fingerprints' helped solve a genetic puzzle. For decades, most sea turtle studies and conservation efforts focused on nesting females and hatchlings, because they're easiest for humans to access. Male sea turtles, which don't come ashore, are elusive characters.

The NOAA team pioneered a technique that allows them to fill in the blanks using tiny DNA samples from nesting females and hatchlings. This innovative tool is opening up new avenues in marine turtle conservation. Population recovery goals are based on how long turtles take to reach maturity, and genetic fingerprinting can help reveal this key piece of information, which may be different for each population.

UAS is a Whale of a Pioneering Technology

The digital revolution has moved consumer technology to the cutting edge. Unmanned aerial systems — also known as UAS — have opened the door for NOAA to conduct research in a wider range of environments more safely and cost efficiently.

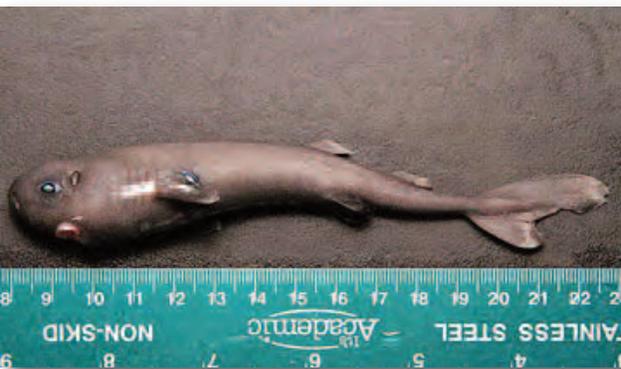


Recently, NOAA's Southwest Fisheries Science Center successfully initiated a UAS program that collected hard-to-get measurements of individuals and populations of endangered whales in their habitat. Using a small remote-controlled hexacopter, scientists for the first time collected breath samples from the whales' spouts to obtain information about DNA, hormones, and bacteria.

These samples, combined with aerial photos of the whales' bodies, are being used to assess family history, stress levels, and overall health and condition. The technique has also been shown to work in the study and assessment of populations of pinnipeds and of penguin colonies. NOAA's growing UAS program includes deployments in the field in the United States, Canada, Chile, and the Antarctic.

NOAA Reveals one of the World's Rarest Finds — a Pocket Shark

In 2015, a very small and rare species of shark discovered by NOAA and Tulane University researchers captured the world's attention. The species' common name is the "pocket shark" because of the distinctive orifice above the pectoral fin — one of many physiological features scientists hope to better understand.



Researchers found a five-and-a-half inch long male pocket shark that had been recently born in the Gulf of Mexico. The only other known specimen was found off Peru 36 years ago. The rare, tiny shark was an important reminder that we still have much to learn about the creatures that inhabit our oceans.

Saildrone Charting New Course for Ocean Research

The summer of 2016 saw an odd craft making its way across San Francisco Bay and other areas.

It was one of two unmanned wind/solar powered Saildrones, which were launched to learn more about critically endangered North Pacific right whales, to track the feeding behavior and the relationship between northern fur seals and their prey species in the Bering Sea, and to determine the effectiveness of Saildrone acoustic equipment (echo sounder) in monitoring fish populations.

To announce the start of the survey, NOAA Fisheries hosted the first-ever live YouTube broadcast.

NOAA Scientists Document Huge New Walrus Haul out in Alaskan Arctic

Tipped off by reports from the local community, NOAA scientists were the first to photograph from the air and document thousands of burly, mustachioed mammals lounging on the shore near Pt. Lay, Alaska, in the summer of 2013.

The team's small airplane carried digital cameras for documenting whale sightings, so they took aerial photos of the crowded beach and shared them with colleagues at partner agencies. It turned out those photos were evidence of a relatively new phenomenon.

Due to loss of sea ice in offshore areas, Pacific walrus are foraging in more coastal areas and using beaches for resting, or hauling out. The number of walrus at the Pt. Lay haul out keeps growing. Estimates from the photos are 1,500 to 4,000 animals when first seen in September, and 5,500 to 8,000 a little later in September.

By the end of the month, biologists reported that there were approximately 10,000 walrus.



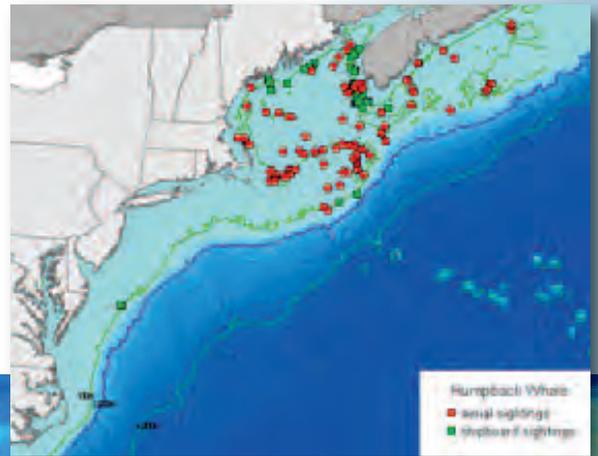
Long-term, Real-time Acoustic Monitoring of Whales Underway

A collaboration with the Woods Hole Oceanographic Institution, Naval Facilities Engineering Command Atlantic, and U.S. Coast Guard is assessing a promising way to use new tools to monitor baleen whales in real time.

The project is assessing the capability of autonomous platforms to conduct long-term, large-scale, real-time monitoring for endangered baleen whales throughout the Gulf of Maine. Different platforms are being used to achieve comprehensive monitoring over a variety of spatial (tens to hundreds of kilometers) and temporal scales (from hours to years).

The project seeks to provide year-round acoustic surveillance, real-time detection data to supply target areas for follow-up visual observations, and numerous opportunities to assess performance by validating real-time acoustic detections with ship- and land-based visual observations.

This project is leveraging the visual survey capacity at the Northeast Fisheries Science Center — aerial and shipboard — to validate the new technology being developed, in part, by the Center's acoustics group.





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