EARTH SYSTEM MONITOR

A guide to NOAA's data and information services

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Critical Environmental Intelligence for a Climate-Smart Nation

Dr. Kathryn D. Sullivan
Acting Under Secretary of Commerce for Oceans and Atmosphere and NOAA Administrator

Each and every day NOAA provides people, communities, and businesses with information they need to help them make decisions: decisions about their daily lives; their town's and their own preparedness for hurricanes, floods, tornadoes, and storms; and their business' operations and long-term plans. I call this information *critical environmental intelligence*: timely, actionable information, developed from reliable and authoritative science. This information can give us foresight about future conditions, inform the myriad decisions that determine our comfort and our safety, and affect both the immediate profitability and long-term sustainability of communities and businesses. Just like the "intelligence" of the security world, this environmental intelligence is a combination of data, analysis, modeling, and assessment.

The need for environmental intelligence is growing. As I write this article, the country is in the grips of extended drought. Wildfires have ravaged western states. New York and New Jersey still are recovering from the impacts of Hurricane Sandy, most certainly made worse by sea level rise. Atmospheric CO_2 levels have reached 400 parts per million at the Mauna Loa Observatory. By 2050 or sooner, the Arctic will be nearly sea ice-free. Now is the time to anticipate, prepare for, and respond to a changing climate.

President Obama recognizes climate change as one of the major challenges of the 21st century. On June 26th, 2013, the president announced his Climate Action Plan. The plan emphasizes the nation's need to prepare for the impacts of climate change and to lead international efforts to strengthen global resilience to climate change.

Critical environmental intelligence is key to meeting the climate change challenge. NOAA's long-term investments in critical environmental intelligence infrastructure sit squarely at the center of the president's Climate Action Plan and are the foundation of our unique mission of science, service, and stewardship. From satellites in space, to Hurricane Hunter and other planes in the sky, to our ships, buoys, moorings, and gliders in the ocean, NOAA observes and monitors the Earth's oceans and atmosphere to keep citizens informed of the changing environment around them. NOAA transforms this information into the critical environmental intelligence used by our people, communities, and businesses, as well as by the global scientific community.

NOAA works in regions around the country to help deliver timely, actionable environmental intelligence to people, communities, and businesses. Our aim is to help them get what they need, not just what we want to give them. We could not accomplish this without the great support and dedication of NOAA's staff across the country, including the contributions of NOAA's Regional Collaboration Network. The Network's eight

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>
> ***- Dr. Kathryn D. Sullivan***

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From the NODC Director

Margarita Conkright Gregg, Ph.D.

It is my pleasure to contribute to this issue of the Earth System Monitor in which NOAA's Acting Administrator, Dr. Kathryn Sullivan, introduces us to our theme: *environmental intelligence*. In this series of articles, NOAA's Regional Collaboration Teams describe how NOAA's science, services, and stewardship mission translates into tools and technologies for improved decision-making by the public across the regions of the United States.

In my role of leading the ocean data stewardship effort here at NOAA's National Oceanographic Data Center (NODC), I am very familiar with how the different parts of NOAA tie-in to support the OneNOAA mentality. Working efficiently together is what makes our organization a success. For example, actionable environmental intelligence from NOAA's combined expertise in weather forecasting, sea ice analysis, and navigation services provide invaluable information for events in the harsh Arctic environment at times when it's needed most. This "intelligence" is supported by NODC and the rest of NOAA's data centers by creating baselines from our historical data archives and regional climatologies. Another example is NOAA's tsunami warning system and related emergency response and community education efforts, which represent a science-based and people-focused "end-to-end" program. The final result of which is to save lives by providing a baseline of tsunamis data at NOAA's National Geophysical Data Center that can be used well into the future by experts and the public. Also, the National Climatic Data Center readily helps sectors such as agriculture, civil infrastructure, energy, health, insurance, national security, and tourism by providing data and products such as climate normals and proactive drought information. In the Gulf of Mexico, NOAA's improved predictions of storm inundation combined with better understanding of the effects of sea level rise on habitat, provide a clearer picture of future storm impacts on the coastline and associated ecosystems. NODC's National Coastal Data Development Center (NCDDC) provides answers to questions related to the physical environment, marine resources, and economic activity in the Gulf of Mexico through its Gulf of Mexico Data Atlas.

These are only some of the examples of how NOAA's mission touches the livelihoods of our citizens, ranging from life and property to safety and recreation. This would not be possible alone. Across NOAA's Regional Collaboration Network located in Alaska, the Central U.S., Great Lakes, Gulf of Mexico, North Atlantic, Pacific Islands, Southeast/Caribbean, and the Western U.S., our teams work with federal, state, academic, non-governmental organizations, tribal, and international partners to translate observations and data into "actionable environmental intelligence". ■

Margarita

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regionally-based teams, located in Alaska, Central, Great Lakes, Gulf of Mexico, North Atlantic, Pacific Islands, Southeast/Caribbean, and Western regions, build and maintain relationships with our regional partners and decision makers to ensure that NOAA understands the needs of the region and collaborates with our partners to address them.

In this issue, you will see how NOAA works regionally to transform environmental intelligence into meaningful action. You also will see how the Regional Collaboration Network has enhanced NOAA's ability to integrate environmental intelligence from across the agency to identify key challenges and opportunities in the regions; to provide this intelligence to community leaders and the public so that they can make critical decisions; and ultimately, provide the foresight needed to build a nation better prepared to meet the climate change challenge. ■

1WH Climate Action Plan Fact Sheet

On the Frontier of Change - NOAA's Role in the Arctic

Amy Holman, Alaska Regional Coordinator; Gene Petrescu, Regional Scientist, National Weather Service Alaska Region HQ; Doug DeMaster, Alaska Fisheries Science Center Director; Molly McCammon, Executive Director, Alaska Ocean Observing System

How much do you know about the Arctic? You'll need more than one piece of information to create an accurate picture.

Recent news reports have highlighted that Arctic sea ice is both expanding and receding to an all-time low. Reportedly, marine commerce will jump at the chance to use Arctic Sea routes to shave 40 percent off their travel times, and yet we also hear that container ships are unlikely to use these routes because they will cost the shipping lines twice as much. Maybe you've heard there's concern about "opening" the Arctic to new oil and gas development, but did you know around 30 wells were drilled back in the 1980s?

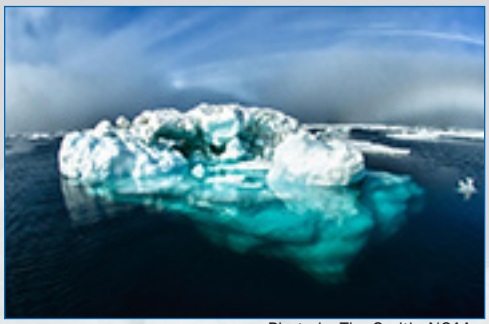

Photo by Tim Smith, NOAA

Figuring out what's really going on in the face of seemingly conflicting information is a difficult task. But it's imperative that we do so because a lot is on the line. The Arctic is a remote, complex, and rapidly changing environment. It is home to thousands of people and increasingly important to oil and gas exploration, fishing, tourism, and shipping.

Actionable intelligence in the harsh Arctic environment can literally be the difference between life and death. For example, in November 2012, an area the size of Pennsylvania in the Chukchi Sea froze solid in less than 36 hours. This phenomenon is known as a "flash freeze", and can be deadly for ships not prepared to operate in ice. In another case, a raging Category 3 strength storm in November 2011, followed by a rapid and intense cold event, thwarted the last fuel barge's attempt to deliver fuel to Nome from Dutch Harbor before the ice set in.

NOAA's combined expertise in weather forecasting, sea ice analysis, and navigation services provided invaluable information for these events. In these cases, NOAA worked with Shell Oil and the Bureau of Ocean Energy Management to ensure safe Arctic drilling and helped guide the USCG icebreaker Healy as it cut the ice, enabling an emergency fuel tanker to reach Nome.

As climate conditions change and the length of the navigation season in the Arctic increases, mariners will face more dynamic sea ice states. NOAA is working to improve our understanding of ice formation and provide for more accurate predictions of hazardous oceanic conditions. This requires leveraging internal NOAA capabilities as well as domestic and international partners, including the Distributed Biological Observatory; Alaska and Arctic Ocean Observing Systems; Voluntary Observing Ships; sea ice data, research, and analysis centers; federal and industry environmental studies programs; World Meteorological Organization committees; Arctic Council working groups; and many others.

The power of critical environmental intelligence is the ability to provide foresight we might not have otherwise. NOAA not only works on sea ice and weather in the Arctic, but on four other areas as well: Strengthening Foundational Science, Enhance International and National Partnerships, Improving Stewardship and Management of Ocean and Coastal Resources, and Advancing Resilient and Healthy Arctic Communities and Economies. The work we do to achieve our Arctic Vision and Strategy supports the National Strategy for the Arctic Region and plays a critical role in our collective understanding of a rapidly changing Arctic. From building data systems and common operational picture applications to permitting and analyzing the impacts of development on trust resources, NOAA staff from all parts of the agency come together to ensure the right information gets to the right people at the right time. ■

Southeast and Caribbean: Monitoring and Conservation of Corals

Dana Wusinich-Mendez, Atlantic and Caribbean Team lead, NOAA's Coral Reef Conservation Program; Geno Olmi, Southeast & Caribbean Regional Team Coordinator; Kurtis Gregg, Habitat Conservation Division, Southeast Regional Office, National Marine Fisheries Service

Coral reefs, like all ecosystems, change over time. Unfortunately, many coral reefs are changing for the worse due to an increasing array of natural and human generated threats—including global climate change, unsustainable fishing impacts, and land-based pollution. Observing changes to the reefs over time allows NOAA and its partners to better understand and manage the ecosystems that rely on healthy reefs. With support from the NOAA Coral Reef Conservation Program (http://coralreef.noaa.gov/), and consistent with NOAA's Caribbean Strategy, NOAA utilizes an array of tools and approaches to effectively monitor coral reefs.

Reef Visual Census sampling during June 2013 off Lake Worth, Inlet FL.

For example, NOAA's Integrated Coral Observing Network (ICON) is establishing a high quality in situ coral reef monitoring network, and integrating the near real-time data for ecological forecasting in coral reef ecosystems. The growing ICON network in the Caribbean is currently comprised of stations in St. Croix, U.S. Virgin Islands; La Parguera, Puerto Rico; Little Cayman Island, Cayman Islands; and Lee Stocking Island, Bahamas. The stations deliver hourly measurements of important meteorological and oceanographic variables and will establish long-term databases of the Earth's most threatened and important coral reef areas.

NOAA also collects imagery, bathymetry (ocean bottom depths), seafloor sediment types, and other oceanographic information for selected coral sites. Scuba drop cameras (cameras which are often tethered to the vessel and used for underwater imagery) and acoustic technology are used to map coral habitats and characterize the ecosystem. NOAA also measures contaminant levels in coral reef inhabitants to understand how land-based run-off affects coral health. The information, which is made available in mapping software, allows managers to assess the current status of natural resources and observe changes in the ecosystem.

NOAA works with partners throughout the Caribbean to monitor reef health, as shown in the following example from south Florida. The Reef Visual Census (RVC) uses trained divers following a rigorous sampling protocol to assess coral reef fish populations in the Florida Keys. The partnership between NOAA Fisheries, the Florida Keys National Marine Sanctuary (FKNMS), the State of Florida, the University of Miami, and the National Park Service has been providing managers in the Florida Keys with critical information on fish populations for over 30 years.

The RVC program informs managers about the condition of important species, and assesses the impacts of management actions, including the effectiveness of no-take marine reserves. What began in 1979 as a small number of samples on a few reefs has greatly expanded to thousands of samples spanning the entire Florida Keys. In 2011, the RVC approach to reef fish monitoring expanded to encompass the entire Florida Reef Tract and cover numerous jurisdictions.

RVC data currently is being applied to inform two pivotal management initiatives in Florida. The Florida Keys National Marine Sanctuary is considering the RVC data in their Marine Zoning and Regulatory Review process. In response to requests by the public, shifting environmental conditions, better scientific information, and legal requirements, Florida Keys National Marine Sanctuary Advisory Council is conducting a review of sanctuary regulations. Information from the RVC will help inform decisions about the rules and boundaries of marine zones to advance ecosystem protection in the sanctuary and surrounding national wildlife refuges (http://floridakeys.noaa.gov/review/welcome.html).

In a second example, the Florida Department of Environmental Protection, through the Southeast Florida Coral Reef Initiative, has initiated "Our Florida Reefs", a community planning process for southeast Florida's coral reefs (www.ourfloridareefs.org). This planning process brings together the community of local residents, reef users, business owners, visitors and the broader public in Miami-Dade, Broward, Palm Beach, and Martin counties to discuss the future of coral reefs in this region. RVC data, which is being collected by a network of partners in southeast Florida led by Nova Southeastern University and the State of Florida, will provide context for those discussions.

We rely on accurate and timely information about the

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location, integrity, and health of coral reef ecosystems for the prudent management of coral reefs. NOAA collaborates with partners throughout the region; providing critical information to managers and communities to understand and protect fragile coral reefs. ■

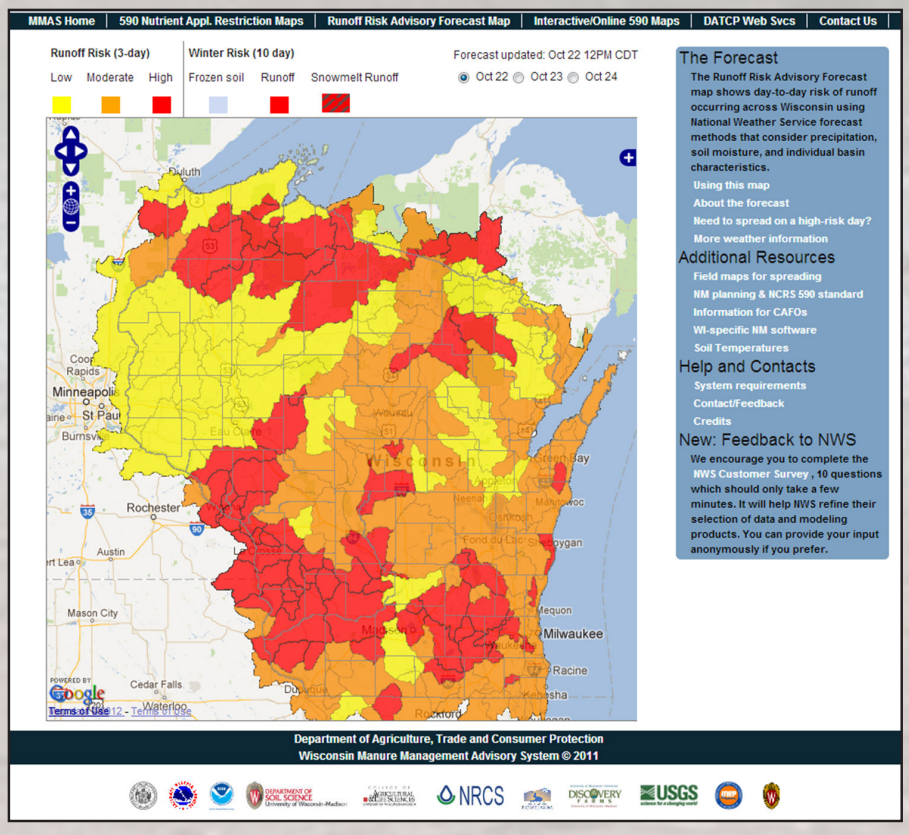
Central Region: Development and Production of a Decision Support Tool for Wisconsin Producers

Bethany Perry, Central Region Coordinator

Agriculture runoff is a key contributor to pollution in interior watersheds, lakes, rivers and groundwater, causing deteriorated water quality, potential health concerns, and ecosystem impacts far beyond the area of contamination. Runoff in the central U.S. contributes to the hypoxia "dead zone" of the Gulf of Mexico. While most producers carefully manage manure and nutrient application, spills and runoff still occur. The incidents can impact not only water sources, but can damage ecosystems by killing fish and the smaller animals that make up the food chain in these areas.

In order to assist Wisconsin producers in minimizing the occurrence of contaminated runoff, the National Weather Service (NWS) collaborated with multiple state and federal agencies to create the online Runoff Risk Advisory Forecast (RRAF). This decision support tool predicts runoff risks to water quality using existing NWS weather and watershed models. Before it was developed, producers received no real-time guidance on runoff risk. Initial assessment meetings were supported by the NOAA Central Region Collaboration Team.

The Runoff Risk Advisory Forecast Working Group continues to refine the tool to deliver the best information to decision makers. RRAF now displays maps that show the likelihood of runoff from rainfall within the upcoming five days, or snowmelt within the upcoming ten days, for each of the 214 NWS basins in the state. These maps are updated twice daily, and indicate low, medium, or high risk for runoff within a ten-day forecast window. The success of this tool has raised awareness throughout the region. Iowa and Minnesota are now planning the development of similar tools. By helping producers reduce the amount of nutrients entering watersheds, these tools will have positive impacts that extend from the fields of Wisconsin down to the Gulf of Mexico. ■



A screen shot of the Runoff Risk Advisory Forecast map which shows the day-to-day risk of runoff occurring across Wisconsin.

Western Region: Tsunami Detection, Track Prediction, and Coastal Community Preparedness – Critical Environmental Intelligence When Moments Matter

Lauren Koellermeier, Office of Oceanic and Atmospheric Research (OAR)/ Pacific Marine Environmental Laboratory (PMEL)
Heather McCullough, National Environmental Satellite Data and Information Service (NESDIS)/ National Geophysical Data Center (NGDC)
Timi Vann, NOAA West Regional Coordinator

The ocean environment is dynamic, expansive, and difficult to observe. Powerful undersea earthquakes, volcanic eruptions, or underwater landslides can cause sudden motion and violent shifts of the ocean floor. These unpredictable events can sometimes produce a tsunami -- long sea waves capable of rapidly moving across the ocean and hitting our shores with powerful and destructive force. Our best protections against these unpredictable tsunami events are science-based early warning and community preparedness.

NOAA's tsunami warning system protects lives and property by detecting tsunami waves when they first occur, by delivering accurate, reliable, timely, and actionable information to coastal communities so they can act quickly for an effective emergency response. This warning system operates in partnership with coastal states, territories, and other federal partners through the National Tsunami Hazard Mitigation Program. The system is powered by NOAA's high-quality ocean observations that detect tsunamis when they first occur. These data are used by NOAA's scientists to predict tsunami arrival times, wave heights, and risks to coastal communities around the United States and U.S. territories – providing critical environmental intelligence to emergency managers when moments matter.

Tsunamis are one of the deadliest forms of natural disaster on record. In 2004, an estimated 230,000 people were killed in the Indian Ocean tsunami, and in 2011 the Great East Japan Earthquake and Tsunami is confirmed to have killed over 15,800 people. From 1900-2008, twenty confirmed tsunami events have directly impacted the U.S. coastal states and territories, killing over 700 people and causing more than $200 million (in 2008 dollars) in property damage [1]. NOAA's National Geophysical Data Center maintains a global historical tsunami database containing impact and socio-economic data, dating from 2000 B.C. to the present. The U.S. West Coast is especially vulnerable, as it sits on the Pacific Ring of Fire, a hot bed for earthquake and tsunami activity.

In June 2013, NOAA's Center for Tsunami Research at the Pacific Marine Environmental Laboratory successfully transitioned the NOAA tsunami forecast system for operational use by NOAA's National Weather Service Tsunami Warning Centers in Hawaii and Alaska. The forecast system includes 75 tsunami forecast models that provide high-resolution real-time tsunami predictions for selected U.S. coastal communities. Each tsunami forecast model relies on NOAA's National Geophysical Data Center's Digital Elevation Models developed from topographic and bathymetric data specific to each community. The tsunami forecast models are used in conjunction with a database of tsunami scenarios to refine the tsunami source and provide real-time wave height, current, and flooding forecasts for a particular community during a tsunami event.

Real-time data provided by the Deep-ocean Assessment and Reporting of Tsunami (DART®) network are critical to the accurate detection and forecast of a tsunami. Designed by NOAA engineers at the Pacific Marine Environmental Lab, and now maintained by NOAA's National Data Buoy Center, the DART® system includes a seafloor sensor capable of measuring a tsunami in the open ocean as small as 1 millimeter, and then transmitting that data in near-real time to an accompanying communication surface buoy and then onto the Tsunami Warning Center via satellite transmission.

Australian DART II buoy built by SAIC and deployed in the Tasman Sea. SAIC is NOAA's commercial partner licensed to build the DART buoys.
Photo credit: Damir Lenc, Australian Bureau of Meteorology.

The U.S. Tsunami Warning System was put to the test when a magnitude 9.0 earthquake struck off the coast of Japan in March 2011 and generated a tsunami with wave heights of over 40 meters. The tsunami waves were observed by multiple DART® systems providing measure-

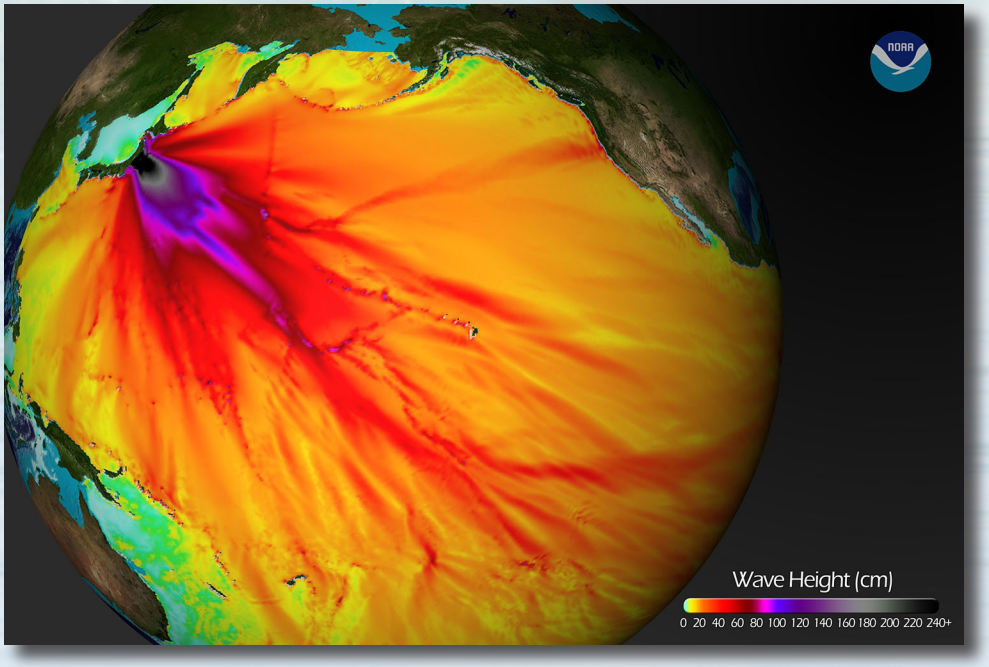
ments for model runs to predict the impact of waves on Alaska, Hawaii, and U.S. West Coast communities. Wave heights ranging from 0.5 to 1.5 meters were predicted for 32 U.S. and territorial communities, with overall accuracy of tsunami forecasts at each location confirmed by tide gauge stations operated by NOAA's Center for Operational Oceanographic Products and Services. The successful transition of the U.S. tsunami warning system from research to operations represents a milestone in protecting the lives and property of all U.S. coastal residents and visitors.

A tsunami can also leave in its wake an expansive debris field, posing hazards to navigation and public health and safety. The 2011 Japan tsunami, mentioned above, generated an estimated 1.5 million tons of floating debris. In response to this threat, NOAA's Office of Response and Restoration collected at-sea observations of floating debris from aircraft, satellites, and vessels to begin modeling debris movement. This work is ongoing and complements NOAA's collaborations with impacted states to develop response plans and protocols and conduct extensive community outreach, and also complements partnerships with federal agencies, states, and non-governmental organizations to monitor baseline debris accumulations.

The Japan earthquake and tsunami provides a glimpse of what the U.S. West Coast might face with a rupture along the Cascadia subduction zone, where fault features are strikingly similar. Warnings are only effective if people understand the risks and know how to respond. The ever-present threat of tsunamis and the continued growth of our coastal communities make community preparedness a central element of the tsunami hazard mitigation program. NOAA's National Weather Service, through the TsunamiReady™ program, provides community leaders and emergency managers with a way to strengthen their local tsunami warning operations. To date, 145 communities have met TsunamiReady™ standards by establishing 24-hour emergency operations centers, developing a formal tsunami plan, and promoting public readiness through education and information dissemination. If a large earthquake occurs along the Cascadia subduction zone, preparations conducted under the TsunamiReady™ and community outreach and education programs will prove essential, since tsunami waves could arrive minutes after an earthquake.

Together, NOAA's tsunami warning system and related emergency response, and community education efforts, represent a science-based and people-focused "end-to-end" program, demonstrating "observations-to-data-to-information-to-action". It is a good example of the need for, and power of, "environmental intelligence," and of how NOAA works to keep citizens informed of our changing environment. ■

Dunbar, Paula K.; Weaver, Craig S. " U.S. States and Territories National Tsunami Hazard Assessment: Historical Record and Sources for Waves", National Tsunami Hazard Mitigation Program, August, 2008. <http://nthmp.tsunami.gov/documents/Tsunami_Assessment_Final.pdf>

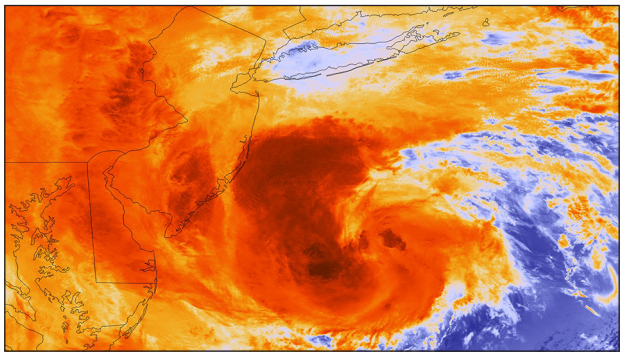


March 11, 2011 Japan tsunami event maximum wave amplitude map. Filled colors show maximum computed tsunami amplitude in cm during 24 hours of wave propagation.

Sandy's Legacy in the North Atlantic – Improved Tools for Predicting Storm Surge

Nicole Bartlett, North Atlantic Regional Coordinator

On October 29th, 2012, Hurricane/post-tropical storm Sandy hit the Mid-Atlantic region, bringing 90 mph wind gusts and storm surges of up to 20 feet. When the water receded a week later, damages exceeded $65 billion, making Sandy the second costliest storm in U.S. history. NOAA's National Climatic Data Center estimates that Sandy directly caused 159 deaths. Sandy damaged or destroyed at least 650,000 houses, impacted 24 states, and left about 8.5 million customers without power.



This image of Superstorm Sandy was taken on October 29, 2012 from NOAA/NASA's Suomi NPP polar-orbiting satellite using its Visible Infrared Imaging Radiometer Suite, or VIIRS.

Storm surge from Sandy forced historically high coastal water levels from Georgia to Maine and created unforgettable images of devastation. One example was the record 14-foot storm surge that hit New York Harbor, flooding subway tunnels and airports and closing the stock market for two days—the first time that's happened for weather-related reasons since 1888.

Thanks to regular post-storm reviews conducted by the National Weather Service, we've learned from past events and have significantly improved NOAA's environmental intelligence on the impacts of severe storms.

NWS conducts service assessments to evaluate its performance after significant hydrometeorological, oceanographic, or geological events, with the goal of helping NWS continuously improve its services to the nation. Assessment teams of experts from within and outside NWS evaluate activities before, during, and after events to determine the usefulness of NWS products and services. The team generates a report, which serves as an evaluative tool to identify and share best practices in operations and procedures, and identify and address service deficiencies.

Sandy's service assessment includes 23 recommendations for improvements, with "identifying better storm surge forecasts" as the highest priority. Although surge forecasts for Sandy were available two days before the storm, the review found that officials in New York and New Jersey needed information sooner and in more user-friendly, unified formats, such as GIS maps and warnings that provide specific local impacts.

In response, members of NOAA's North Atlantic Regional Collaboration Team are taking steps to improve predictions of local impacts for high-impact coastal storms such as Sandy. One such project is the development of a wave run-up model led by regional National Weather Service Forecast Offices (WFOs) in cooperation with the National Center for Environmental Prediction and the National Ocean Service's Coastal Survey Development Laboratory. The cross-line office NOAA team is testing and calibrating the model, which was developed by Dr. Hilary Stockdon of the U.S. Geological Survey for use in the North Atlantic.

The Stockdon Model predicts two primary effects of wave action: wave setup and wave run-up. Wave setup is the additional rise of water along the shoreline resulting from breaking waves piling up water faster than it can retreat back to the ocean. After a wave breaks, the broken wave continues to travel shoreward, then up the beach as a turbulent wave bore (high, dangerous wave) or swash (turbulent layer of water). This process is referred to as wave run-up. The Stockdon Model uses data on deep-water wave height, wave period, and beach slope to help predict storm effects. Both storm surge and wave action are dependent on beach slope and near-shore bathymetry (measurement of depth), but in opposite ways. The steeper bathymetry, characteristic of the North Atlantic coastline, tends to minimize storm surge, while increasing wave action.

"Wave run-up and storm surge pack a powerful one-two punch," said Rich Okulski, Meteorologist-in-Charge for the Caribou, Maine WFO. "One foot of water traveling at 10 miles per hour will produce the force equivalent to a 280 mph wind. While storm surge brings wave action higher onto the beach, it is the wave load on structures that is responsible for most of the damage on exposed beaches."

While National Weather Service warning products predict storm surge levels, the additional increase in water level due to wave setup and the effects of wave run-up are not yet included. So, how will this new model help?

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"We are at high risk due to our reliance on sand dunes as natural barriers in many parts of the region," says Okulski. "Coupling Dr. Stockdon's model with a method developed by her U.S. Geological Survey colleague, A.H. Sallenger, we can actually predict erosion or failure of the dune structure. This provides actionable information to emergency managers before an event."

It is the kind of environmental intelligence that will make all the difference to residents, NOAA customers and partners when a storm like Sandy hits again. ■

Central Region: Real Time Weather App Involves Citizen Scientists

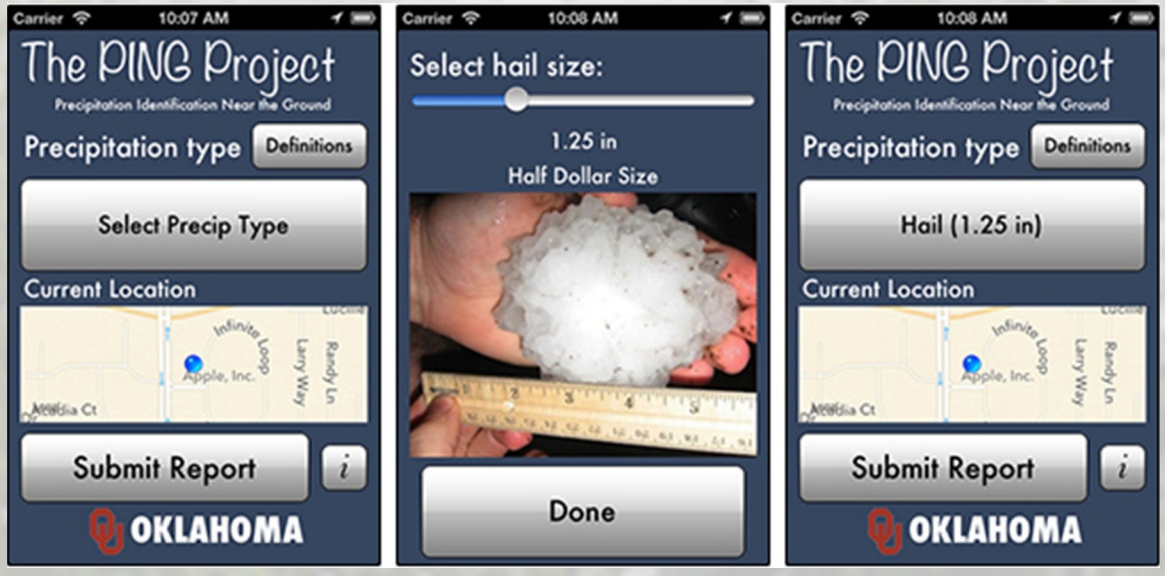
Bethany Perry, Central Region Coordinator

NOAA continues to explore new ways to gather data and information. One way is to collect weather information from the public through their smart phone or mobile device. The Meteorological Phenomena Identification Near the Ground (mPING), was recently released as a free mobile app. The app uses crowdsourcing to collect local weather conditions by asking users to record what they're actually experiencing. It was developed through a partnership between NOAA's National Severe Storms Laboratory (NSSL), the University of Oklahoma, and the Cooperative Institute for Mesoscale Meteorological Studies.

So how does mPING work? Once users download the free app, they select the type of weather they are experiencing, and send an anonymous report. The phone records the GPS location of the observation, and transmits the information. The purpose of mPING is to obtain ground observations of precipitation types that automatic systems do not detect well. All reports in the mPING database, both past and real-time, can be viewed on the mPING website. This allows anyone to see all observations in time and space, to better identify the locations where hazardous weather may exist.

User reports from mPING get sent to NOAA's National Severe Storms Laboratory (NSSL) in Norman, Oklahoma. These ground observations will assist efforts to build algorithms for the newly upgraded dual pole radars deployed across the United States. Researchers will compare the reports from users with what radars detect, and will use that comparison to develop new radar and forecasting technologies and techniques. Researchers hope to record tens of thousands of observations from across the United States in their database. NOAA Central Region Collaboration Team contributions will allow further refinement for the underlying database to more effectively utilize the tool on a national stage.

The apps are available on iTunes and Google Play for use on both phones and tablets. Follow this project and others on the NSSL Facebook page. To see a short video on mPING, visit http://www.youtube.com/watch?v=h6UM5Xg3C3s&feature=youtu.be. ■



The new mPing app for Apple and Android mobile devices lets users report rain, hail, sleet, and snow to NOAA's National Severe Storms Laboratory. Weather researchers there will compare these citizen scientists reports to local radar images - radars have a tough time seeing precipiation near the ground. The results are expected to lead to new radar technologies and techniques to determine the type of precipitation falling at ground level. Credit: NOAA

Informing Disaster Risk Reduction and Resilience in the Pacific Islands Region: 2013 Drought in the Republic of the Marshall Islands

Eileen Shea, Pacific Islands Regional Coordinator; Charles P (Chip) Guard, NWS Guam; Ed Young, NWS Pacific Region; John Marra, Pacific Regional Climate Services Director, Reginald White, RMI Meteorological Service

NOAA helps communities around the nation become more resilient to and prepared for weather and climate extremes, such as drought. In January 2013, the National Weather Service (NWS) in Guam warned of a potential drought in the Republic of the Marshall Islands (RMI) using the seasonal drought predictions of NOAA's Climate Prediction Center, supplemented with region-specific analyses produced by NOAA and other colleagues in the region.

This initial warning, continued drought information statements, and consultation with government officials were instrumental in the RMI decision to set a National State of Emergency on February 5th. The prediction proved accurate. Harsh and persistent drought conditions since April 2013, have emptied water storage facilities, contaminated underground water sources with saltwater, facilitated an increase in water-borne diseases, and devastated food crops including breadfruit, banana, coconuts and taro. The impacts on the 13 northern and western Pacific atoll islands of the RMI were severe. A formal RMI National Declaration of Disaster was declared on May 8th. These steps, supported by information from NOAA and other Federal agencies, prompted further action to prepare for the drought, well in advance of its most significant impacts.

On June 14th, 2013, President Obama issued a Disaster Declaration associated with ongoing drought conditions. This declaration launched an immediate federal-wide response effort from a diverse array of agencies including: NOAA, Federal Emergency Management Agency, U.S. Agency for International Development/Office of the U.S. Foreign Disaster Assistance, Centers for Disease Control, the U.S. Army Corps of Engineers, Small Business Administration, U.S. Department of Agriculture, and the U.S. Embassy in Majuro, RMI. NOAA's technical support provided critical information to secure relief throughout the drought and laid the foundation for ongoing response and recovery activities.

More than simply providing timely and trusted information, what enabled this response was the more than 15 years of cross-NOAA efforts spent developing climate services in the region.

Since 1994, a multitude of partners have joined forces in a NOAA-sponsored collaborative climate risk management endeavor known as the Pacific ENSO Applications Climate Center (PEAC). These include: the NWS Weather Forecast Office in Guam, the NWS Pacific Region Headquarters, the NOAA Pacific Islands Regional Climate Services Director, the University of Guam Water and Environmental Research Institute, the University of Hawaii School of Ocean and Earth Sciences and Technology, Social Sciences Research Institute, and others. Initially focused on anticipating and preparing for regional impacts of the El Niño-Southern Oscillation (ENSO) cycle, the PEAC partners are now part of a broader Pacific Climate Information System. Led by NOAA, this collaboration seeks to understand, anticipate, respond, and adapt to changing climate conditions to support resilient and sustainable communities in the Pacific Region. On June 20th, 2013, Jerry Valazquez, UN Office of Disaster Risk Reduction Head for the Asia Pacific, noted that "the worsening situation of the Republic of the Marshall Islands is a strong warning for the whole of the Pacific of the potential suffering that drought brings, particularly as many islands in the Pacific have limited water supplies." NOAA is there, working with the array of decision-makers to provide new and emerging climate information products related to water resources, coastal inundation, and coastal ecosystems. Only through such long-standing partnerships, and the critical environmental intelligence they provide, are we able to meet the needs of the people affected by severe drought such as those in the RMI. ■

Taro, a root, is a main food for people on atolls. Here the taro leaf is dying due to the drought, causing the root to rot and be inedible.

The Gulf of Mexico: Essential Ecosystems, Storms, and Sea Level Rise

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If current population trends continue, the already crowded U.S. coast will see its population grow from over 123 million people in 2010 to over 134 million by 2020, according to the latest NOAA figures[1]. This puts more of the population at increased risk from extreme coastal storms such as Sandy and Isaac, which severely damaged infrastructure and property in 2012. Over time, the effects of sea level rise can intensify the impacts from such storms.

Improved storm predictions and reliable forecast models are increasingly important tools for protecting coastal residents' lives, livelihoods, and property. Such information helps coastal zone managers evaluate ways to reduce future ecological and community impacts from sea level rise and storms.

Installing a "marsh organ" to study how plants respond to different water levels, which can be related to potential sea level rise. Credit: Scott Hagen, University of Central Florida.

A joint initiative – the Ecological Effects of Sea Level Rise in the Northern Gulf of Mexico (EESLR-NGOM) project – examines the effects of sea level rise and storm inundation. NOAA's National Centers for Coastal Ocean Science, the University of Central Florida, and many partners are working with the three National Estuarine Research Reserves (NERRs) in the Northern Gulf of Mexico (Grand Bay, Weeks Bay, and Apalachicola) to develop and apply new predictive models and communicate that information to coastal managers.

The project involves conducting field observations and developing models to predict the effects of sea level rise, tides, and storm surge. This critical environmental intelligence will better enable coastal zone managers to evaluate ways to reduce future ecological and community impacts from sea level rise and storms.

Following the philosophy that "in order to look forward we have to look to the past", one part of the project uses storm inundation data recorded for Hurricane Katrina to compare what the surge would have looked like with the shoreline and land use patterns of 1960 with the projected shore line for 2050. Such comparisons aid understanding of the long-term effects of sea level rise, since changes are hard to see on a year-to-year basis. They also improve the forecasts of possible future storm impacts. Showing the value of this information, this study was suggested by a management applications committee of federal, state, and local coastal managers, who advise on what sort of information they need and how to share it in a useful way.

Another aspect of this collaborative project investigates the effect of sea level rise on critical habitats like marshes, seagrass beds, and oyster beds. Using improved predictions of the expected sea level rise and resultant effects at different locations around the Northern Gulf, combined with tidal and hydrodynamic information and with data from field experiments on plants and oysters, scientists can predict how these resources may respond to different amounts of sea level rise. This information helps show how well these habitats may support economically important species under changing conditions.

Improved predictions of storm inundation, combined with better understanding of the effects of sea level rise on habitat, provide a clearer picture of future storm impacts on the coastline and associated ecosystems. This kind of information helps managers set priorities to reduce risk and plan projects to ensure natural systems and the communities that rely on them, will remain able to recover from major storms in the future.

The Gulf of Mexico Regional Team of NOAA's Regional Collaboration Network connects this project with other climate-related and coastal restoration efforts in the Gulf, ensuring that these related efforts coordinate effectively to assess the impacts of sea level rise and inundation. Due to the risk of major storms in the northern Gulf of Mexico, and because the area is already experiencing sea level rise caused by a number of factors, such research is increasingly valuable for managing the natural treasures of the region and sustaining the vibrant culture and communities that depend on them. ■

1 Ache, B., Crossett, K., Habe, K., Pacheo, P. "National Coastal Population Report Population Trends from 1970 to 2020".National Ocean Service., March, 2013. <http://stateofthecoast.noaa.gov/coastal-population-report.pdf>

Great Lakes: Let's Go to the Beach!

Jennifer Day, Great Lakes Regional Coordinator

The mantra of Great Lakes protection and restoration asks for the answers to three basic questions: Can I drink the water? Can I eat the fish? Can I safely swim at the beach? Answering these basic questions requires some very advanced science presented in a way that allows the Great Lakes community to make better decisions about these often daily choices.

NOAA's broad mission extends from the surface of the sun to the bottom of the ocean, but also includes a critical freshwater mission in the Laurentian Great Lakes of North America. With over 10,000 miles of coastline and broad expanses of white sand beaches, the Great Lakes draw tens of millions of residents and visitors each year. But, can we safely swim in the water?

NOAA's collection of data, modeling expertise, and the development of publically available decision-support tools, can help forecast water quality and other dangerous conditions. These tools enable beach managers and public health officials to notify the public of expected problems one or two days in advance. This allows for beach closings when necessary and also prevents beach closures when conditions are safe, thereby avoiding negative economic impacts on the local community.

Great Lakes beaches occasionally close due to degraded water quality, caused by the presence of harmful algal blooms (HABs) or elevated concentrations of a dangerous bacterium known as E. coli. In addition, local weather and geographic conditions can aid in the formation of dangerous rip currents and deaths from drowning.

NOAA scientists regularly collect data through observation, field sampling and remote sensing. These data are used to improve identification and understanding of the environmental factors that contribute to the formation and growth of HABs.

The data are also used to create tools and technologies for improved decision-making by the public. NOAA has developed an experimental HAB bulletin to provide a weekly forecast for HABs in western Lake Erie. When a harmful bloom is detected, scientists issue a bulletin that reports the HAB's current location, forecasts future movement, and categorizes its intensity. This allows local decision makers, coastal community residents, and visitors to better monitor and plan around the presence of HABs and ensure a safe beach-going experience.

Many sources of E. coli and other non-point source pollution are known, but their effect on beaches can depend on daily conditions attributed to weather and currents. NOAA scientists have developed predictive models to provide beach managers with software that helps predict when conditions are right for the development of potential water quality problems, instead of the current testing methods that provide information days after the occurrence.

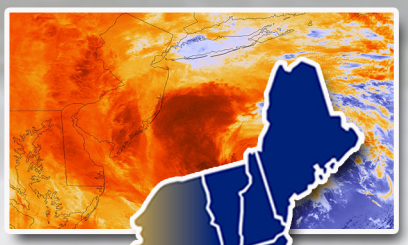
The satellite photo of the record breaking 2011 HAB in Lake Erie.

More swimmers are killed by rip currents in the Great Lakes than by severe weather. NOAA now includes recreational beach forecasts, including warnings of potential rip currents in its daily weather forecast information distributed to local officials, the media, and though public broadcast over NOAA Weather Radio.

NOAA's job is to build an understanding of the Great Lakes in a way that enhances public knowledge of these potential dangers. NOAA's contributions to environmental intelligence - sound science and data at the foundation of publically available decision support tools – helps answer the question, "Can we safely swim at the beach today"? ■

“Environmental Intelligence at NOAA: Working Together to Solve Regional Problems”

Stories Told by NOAA’s Regional Collaboration Network



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