

NOAA'S NATIONAL OCEAN SERVICE

Responding to Hurricane Sandy

In October 2012, the hybrid cyclone-nor'easter known as Hurricane Sandy roared toward the mid-Atlantic Coast. The reach of the storm was astonishing, with rain and high winds from the East Coast to the Great Lakes and snow across Appalachia. Even as the hurricane transitioned to a post-tropical cyclone, wind, waves, and storm surge wreaked havoc especially along the coasts of New York, New Jersey, and Connecticut. More than 100 lives were lost. Damage estimates are in the billions of dollars.

NOAA's National Ocean Service helps coastal communities prepare for and recover from storms like Hurricane Sandy.

Positioning America for the Future

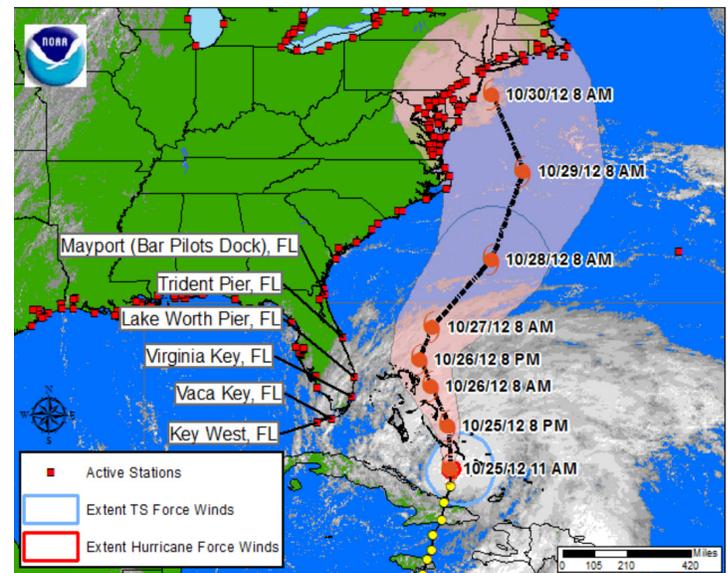
Preparing for the Historic Storm

Before, during, and after the storm, NOS monitored and disseminated observations of water levels, currents, and weather information in real time. This information helped coastal authorities prepare for, mitigate, and respond to the storm tides flooding our coast. The NOS's Center for Operational Oceanographic Products and Services (CO-OPS) operates a network of oceanographic and meteorological stations along U.S. coastlines and Great Lakes whose data is also integrated directly into NOAA's National Hurricane Center storm surge forecasts.

Throughout the storm, CO-OPS regularly posted and updated its Storm Quicklook, a synopsis of locations most affected by severe storm tides. Providing real time data to emergency responders when they most need it helps save lives and property.

NOS also coordinates the U.S. Integrated Ocean Observing System (IOOS®). IOOS partners along the East Coast provided vital information such as hourly updates from wind, wave, visibility, and air and water temperature sensors; high-frequency radar ocean current data; coastal wave forecasts; and even water temperature information from an ocean glider deployed off the New Jersey coast.

The entire East Coast needed to know, with as much precision as possible, what to expect from storm surge. NOS's Office of Coast Survey's Development Lab (CSDL) provided essential data and analysis to the National Hurricane Center, which used it to verify tidal data. Additionally, CSDL's physically realistic models captured previously unavailable storm parameters, which gave forecasters more realistic scenarios of the storm's devastation. Office of Coast Survey pre-staged regional navigation managers, embedding them into command centers and setting up coordination for rapid deployment of survey assets necessary for resumption of maritime traffic at ports and anchorages.



CO-OPS Storm QuickLook product integrating water level information with the National Hurricane Center projected storm path.

Immediately after the Storm Passed

I want to send my thanks to the NOAA staff who put together the Sandy Imagery Viewer so quickly. As with many other New Jersey and Mid Atlantic residents, my family has been worried about the shape our house and neighborhood was in after the storm. Finally seeing that the house is standing in one piece (along with neighboring houses) is a big relief.

*Resident of Lavallette, N.J.,
11/01/2012*

Within hours of the passing of the storm, NOS efforts focused on navigation surveys to restore maritime commerce; aerial surveys to assist in those efforts and to aid on-the-ground responders from FEMA and local authorities; and oil spill cleanup and damage assessment.

REOPENING PORTS—THE LIFELINE OF RECOVERY

NOS's Office of Coast Survey teams completed surveys of the Port of New York and New Jersey to help the port reopen, allowing emergency fuel and other supplies to move into the affected area. Over five days, Office of Coast Survey teams worked aboard NOAA hydrographic survey vessels, including two navigation response teams (NRTs) and the NOAA Ship *Thomas Jefferson* with her two survey launches, to search approximately 20 square nautical miles of shipping lanes, channels, and terminals to locate dangers to navigation.

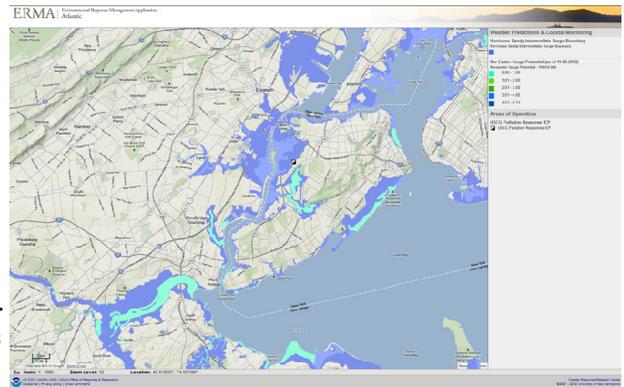
Surveys completed by NOAA Ship *Ferdinand R. Hassler* and R/V *Bay Hydro II* helped re-open the Port of Baltimore and the port complex at Hampton Roads where naval vessels and ships carrying coal exports were waiting for clearance. Surveys by NRTs and R/V *Potawaug* provided valuable data for ships transiting the Delaware River and ferry service that connects Lewes, Del., and Cape May, N.J.—an important access route to bring aid to stricken New Jersey and Delaware shore communities.

DAMAGE ASSESSMENT IMAGERY— CAPTURING THE DEVASTATION TO HELP RECOVERY AND REBUILDING
 As of November 7, 2012, National Geodetic Survey's remote sensing program continues to conduct aerial photographic surveys of the battered coast. Crews flying in NOAA's King Air and Twin Otter turboprop aircraft surveyed over 3,000 miles of coastline, and collected and processed over 10,000 images to document coastal damage and impacts to navigation. There have been more than 27 million visits to the storm emergency response website (<http://storms.ngs.noaa.gov/storms/sandy/>). FEMA uses NOAA's imagery to assess damages, expedite claims from the public, and project temporary housing needs.

The imagery provides emergency and coastal managers with the information they need to develop recovery strategies, facilitate search-and-rescue efforts, identify hazards to navigation and HAZMAT spills, locate errant vessels, and provide documentation necessary for damage assessment through the comparison of before-and-after imagery. It also provides a useful tool to private citizens for assessing damage to public and private properties in their community.

POLLUTION RESPONSE

NOS's Office of Response and Restoration (OR&R) is providing scientific support to the U.S. Coast Guard in responding to a significant spill at the Motiva Refinery in Sewarren, N.J., as well as support for cleanup and assessment of several small spills scattered throughout northern New Jersey's refinery areas. OR&R is also on-scene working with state and federal co-trustee agencies to lead a preliminary assessment of natural resource impacts from the spills for possible natural resource damage assessment claims and restoration. In addition, the U.S. Coast Guard and other responders are now using OR&R's Environmental Response Management Application (ERMA®) as the common operational application for pollution response.



NOAA's Environmental Response Management Application (ERMA) showing potential storm surge from the nor'easter layered over Sandy's storm surge actual boundaries.

Helping Communities Recover and Prepare for the Future

For weeks, months, even years after a hurricane has ravaged a coastal community, NOS continues its work.

PROVIDING WATER LEVEL AND METEOROLOGICAL DATA REPORTS AND TOOLS

CO-OPS provides storm tide and meteorological data reports following extreme weather events. For Hurricane Sandy, the coast from the Florida Keys to Maine was the area monitored, with the most significant storm tides observed from New Jersey to Connecticut. The storm set a number of record storm tide levels. CO-OPS also provides online tools for extreme water levels and frequency of inundation. Coastal planners use these reports and tools to design coastal communities, infrastructure and shoreline protection to safe elevations above storm tides.



Before-and-after images of the storm's destruction along the New Jersey coastline.

ASSESSING THE ENVIRONMENTAL IMPACT OF CONTAMINANTS
NOS's National Centers for Coastal Ocean Science and its partners have assessed the state of contamination along America's coasts for decades. When disasters like hurricanes strike, federal and state officials use NOS's historical records of contaminants in oyster tissue and samples of sediment and water to evaluate whether restoration efforts are on track. NCCOS also models how coastal ecosystems respond to climate change and evaluates approaches for preserving and protecting fragile coastal habitats.

ASSESSING THE DAMAGE TO COASTAL MARSHES
NOS's Office of Ocean and Coastal Resource Management is working with state partners to measure the storm's impacts on coastal marshes and provide baseline data needed to support future assessments.

MAPS AND DATA ANALYSIS
NOAA's Coastal Services Center is providing access to the satellite and aerial images needed to generate the maps used to understand the long-term effects of the storm. These data products include pre-hurricane imagery and digital elevation data from a variety of sources and maps depicting wetlands loss along the coast. Much of the data, tools, and training needed by the nation's coastal communities are provided through NOAA's Digital Coast for the express purpose of helping communities protect themselves from coastal hazards. Special guidance was posted to make users aware of the available recovery-related resources. As the recovery progresses, resources accessible via the Digital Coast will help coastal communities envision and obtain a new future.

HELPING COMMUNITIES RECOVER
NOS's Office of Ocean and Coastal Resource Management is helping communities recover. Through the National Coastal Zone Management Program, NOS's state coastal management program partners are on the ground surveying storm damage; issuing emergency permits to enable debris removal, rebuilding, and habitat restoration; and meeting with local communities and property owners to begin to discuss recovery and long-term resilience strategies.

The National Coastal Zone Management Program and National Estuarine Research Reserves are also coordinating closely with federal and other partners to bring the latest information, technical assistance, and geospatial and monitoring data to the recovery efforts.

Integrated Coastal Management: Promoting Safe, Resilient and Sustainable Communities

We can't thank you enough for all the work and coordination you have provided to minimize the impact to the maritime community and economy in the port of Hampton Roads. You have been key contributors/partners in this critical effort.

*U.S. Coast Guard Chief for
Waterways Management
Sector Hampton Roads,
11/01/2012*

Storms like this highlight the fact that coastal America is more than beautiful beaches. Millions of Americans live in heavily populated coastal areas that are increasingly threatened by change. NOS's coastal management programs provide national leadership to state and territory coastal management programs and estuarine research reserves to keep America's coasts healthy and resilient. Bringing expertise across the range of biological, physical and social sciences, NOS works with state partners to preserve, protect, develop and, where possible, restore and enhance the nation's coastal zone resources.

As the communities impacted by the storm begin long-term planning, NOS stands ready to carry out additional activities including navigational surveys; coastal inundation modeling; assistance with planning for sea level rise; and providing communities with a range of technical expertise as they plan for future storms.



*NOAA Coast Survey's
Navigation Response
Team 5 starts their
surveys from Sandy
Hook Pilot base.*

Getting the surveys done, quickly but thoroughly, is extremely important to the nation's economy. Over \$200 billion of imports and exports moved through the Port of New York and New Jersey in 2011. It is the country's third largest port, by value of cargo.

*Maritime news site gCaptain,
11/02/2012*