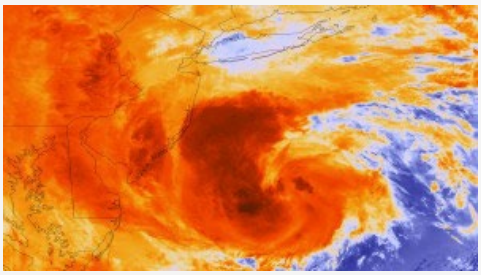
Sandy's Legacy – Improved Storm Surge Prediction Tools

On October 29, 2012, Hurricane/post-tropical storm Sandy smacked into the Mid-Atlantic, bringing 90 mph wind gusts and storm surges of up to 20 feet. When the water receded a week later, damage assessments exceeded $50 billion, making Sandy the second costliest storm in U.S. history. The National Hurricane Center estimated the death count from Hurricane Sandy at 147 direct deaths. Sandy damaged or destroyed at least 650,000 houses, impacted 24 states and left about 8.5 million customers without power. Storm surge from Sandy forced historically high coastal water levels from Georgia to Maine and created the indelible images of devastation we saw on television. One example was the record 14-foot storm surge into 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.



This image was taken on October 29, 2012 from NOAA/NASA's Suomi NPP polar-orbiting satellite. Using its Visible Infrared Imaging Radiometer Suite, or VIIRS, the satellite provides forecasters more information about the storm's cloud structure.

How did NOAA do?

As good as can be expected with such a momentous storm. Thanks to regular post-storm reviews – or service assessments – conducted by the National Weather Service, we've learned from past events and made significant improvements. Peyton Robertson, NOAA's North Atlantic Regional Team (NART) Lead and Director of the Chesapeake Bay Office for NOAA Fisheries, led the service assessment for Sandy. The assessment includes 23 recommendations for improvements, identifying better storm surge forecasts as the highest priority. Although surge forecasts for Sandy were available two days before the storm, the team found that officials in New York and New Jersey needed information sooner and in more user-friendly, unified formats, including GIS maps and warnings that provide specific local impacts.

What is the NART doing to help?

The NART is seeding cross-NOAA projects in our region 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 the Taunton, Caribou and Gray Weather Forecast Offices (WFOs), in cooperation with the National Center for Environmental Prediction and the National Ocean Service's Coastal Survey Development Laboratory. The NOAA team is testing and calibrating a new wave run-up prediction model developed by Dr. Hilary Stockdon of the U.S. Geological Survey for use in the North Atlantic.

What does this model predict?

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 shore line 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 or swash. This process is referred to as wave run-up. The Stockdon Model uses deep water wave height, wave period, and beach slope for input to predict these parameters.

Both storm surge and wave action are dependent on beach slope and near shore bathymetry, 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 WFO. "One foot of water traveling at 10 miles per hour will produce the force equivalent to 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 catastrophic damage on exposed beaches."

How will this new model help?

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.

"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."

With the support of NART funds, Dr. Stockdon will be visiting the North Atlantic region later this summer to meet NOAA principals. For more information about this project, contact Rich Okulski, National Weather Service, **Richard.Okulski@noaa.gov**.

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