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Start with Science to Address Vulnerable Coastal Communities

Hurricane Sandy Science Plan—New York

"USGS efforts to measure pre- and post-storm Sandy water levels in the bays and water velocity in the breach at Old Inlet have been a help in answering questions regarding the impact of breaches through the barrier islands. The USGS has also been helpful in flying lidar to demonstrate storm impacts and measuring high water marks on the mainland, which will allow us to understand the flooding impact…so that we can use [this information] to help define the areas that were compromised and follow with identification of assets at risk and options for risk reduction."—*Fred Anders, New York Department of State, Division of Coastal Resources*

Hurricane Sandy is a stark reminder of why the Nation must become more resilient to coastal hazards. More than one-half of the U.S. population lives within 50 miles of a coast, and this number is increasing.

The U.S. Geological Survey (USGS) is one of the largest providers of geologic and hydrologic information in the world. Federal, State, and local partners depend on USGS science to know how to prepare for hurricane hazards and reduce losses from future hurricanes. The USGS works closely with other bureaus within the Department of the Interior, the Federal Emergency Management Agency (FEMA), the National Oceanic Atmospheric Administration, the U.S. Army Corps of Engineers (USACE), the Environmental Protection Agency, and many State and local agencies to identify their information needs before, during, and after hurricanes.

Before and during Hurricane Sandy, USGS scientists from all over the country worked continuously to create and issue forecasts of coastal impacts, to deploy a large number of storm-tide sensors that recorded the height of the water surface along the coast and the inland movement of water, and to collect data documenting the impact of the storm to built and natural environments. The storm-tide data supplement the extensive network of the USGS real-time tide-gaging stations in the region, many of which form the backbone of flood-warning systems, to provide the critical data needed for emergency response before, during, and after the storm.

Long Island, N.Y., including Fire Island, was impacted extensively. The USGS has a long-standing collaborative research program with the National Park Service (NPS) to understand the drivers of coastal change along Fire Island and to assess the vulnerability of the barrier system to storms, long-term erosion, and sea-level rise. In addition, the USGS and NPS maintain a long-term vegetation and surface monitoring site near the Old Inlet breach in Fire Island. Before Hurricane Sandy's landfall, a USGS team surveyed the pre-storm state of the beaches and dunes, and the team remained nearby to conduct rapid post-storm surveys. The USGS also collected post-storm topographic data using airborne light detection and ranging (lidar) sensors.

Photos of Fire Island 2 to 4 days after Sandy made landfall. *A*, Leveled beaches and scarped dunes in central Fire Island. *B*, Houses undermined and destroyed at Davis Park. *C*, Leveled dunes and large overwash sheets near Fire Island Lighthouse. *D*, The island breach at Old Inlet.

Most oceanfront homes in the communities within Fire Island National Seashore were damaged or destroyed, and the island was breached in three locations. Measurements of dune and beach erosion indicate that 50 percent of the coastline of Fire Island was overwashed, and dunes were eroded landward by as much as 43 meters. Surveys of beach and dune volume indicate that more than 60 percent of pre-storm volume was lost, elevation decreased by as much as 5 meters, and stabilizing vegetation was damaged (Hapke and others, 2013).

By using observations of beach changes and models of waves and storm surge, scientists can forecast how the coast will respond to hurricanes and can identify vulnerable areas. Following Hurricane Sandy, USGS predictions of vulnerable areas of the coast allowed limited resources to be targeted to areas most at risk. These vital datasets also can lead to a better understanding of hurricane impacts on coastal regions and can aid decision-makers in their deliberations concerning restoration efforts.

According to NOAA's Sandy Eslinger, who served as a temporary Field Coordinator for the Natural and Cultural Resources Recovery Support Function at FEMA's New York Joint Field Office, "The coastal impact assessment products provided by the USGS have been a critical resource for us on the Federal team to help identify and prioritize impact-related data collection, issue identification and resource evaluation."

To provide scientific expertise in the post-Sandy recovery efforts in New York, a USGS coastal scientist was deployed to FEMA's New York Joint Field Office. In this role, the USGS helped to coordinate recovery efforts and develop strategies, working closely with New York State Department of Environmental Conservation and Department of State; New York City Department of Planning and Department of Parks and Recreation; the USACE, NPS, and Fish and Wildlife Service; and local agencies and other stakeholders.

Following Hurricane Sandy, the USGS developed a science plan, which is presented in detail in, "Meeting the Science Needs of the Nation in the Wake of Hurricane Sandy—A U.S. Geological Survey Science Plan for Support of Restoration and Recovery," (Buxton and others, 2013) to coordinate USGS science activities with other agencies and to guide continued data collection and analysis to ensure support for recovery and restoration efforts. Science activities are organized in five themes: coastal topography and bathymetry; impacts to coastal beaches and barriers; impacts of storm surge and estuarine and bay hydrology; impacts on environmental quality and persisting contaminant exposures; and impacts to coastal ecosystems, habitats, and fish and wildlife. This science plan is a reminder that a clear vision leads to great accomplishments.

For more information:

http://coastal.er.usgs.gov/hazard-events/sandy/

USGS Hurricane Sandy Science in New York

In response to Hurricane Sandy, the U.S. Geological Survey (USGS) received a total of $41.2 million in supplemental appropriations from the Department of the Interior (DOI) to support response, recovery, and rebuilding efforts. Some examples of New York projects include the following:

- Topographic lidar (airborne elevation mapping) is scheduled to be collected in late 2013 for the New York City area and north along the Hudson River to provide improved elevation information. Coastal elevation datasets with enhanced vertical accuracy will be created for New York City. This information is critical to improving the ability to predict flooding of urban areas.
- The USGS is studying the impact of Hurricane Sandy on wetlands, marshes, and scrub forests on Fire Island, New York; the role vegetation may have played in the breach formation; and how the sand that is distributed around the breach may be further impacting vegetation and the stability of the island.
- Recent and historical USGS storm-surge data will assist resource managers with rebuilding infrastructure and with future storm response plans. The USGS will increase capacity to deploy storm-surge equipment in the northeast and develop a fixed-place storm monitoring network.
- The USGS will continue to assess the impacts to human health and aquatic organisms from failed and damaged infrastructure, such as wastewater treatment facilities, flooded tunnels, and combined sewer overflows. These results will help identify the coastal infrastructure of New York that is most vulnerable, with the goal of avoiding toxic releases in the future.
- The USGS is working with the City of New York Parks and Recreation to study and model the impact of Hurricane Sandy on the wetlands of Jamaica Bay. Wetlands are critical habitat areas and also can dampen the impact of coastal storms.

References Cited

Buxton, H.T., Andersen, M.E., Focazio, M.J., Haines, J.W., Hainly, R.A., Hippe, D.J., and Sugarbaker, L.J., 2013, Meeting the science needs of the Nation in the wake of Hurricane Sandy—A U.S. Geological Survey science plan for support of restoration and recovery: U.S. Geological Survey Circular 1390, 26 p., *http://pubs.usgs.gov/circ/1390/*.

Hapke, C.J., Brenner, Owen, Hehre, Rachel, and Reynolds, B.J., 2013, Coastal change from Hurricane Sandy and the 2012–13 winter storm season—Fire Island, New York: U.S. Geological Survey Open-File Report 2013–1231, 37 p., *http://pubs.usgs.gov/of/2013/1231/*.