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Start with Science to Build Safer Communities

Hurricane Sandy Science Plan—Impacts of Storm Surge, Including Disturbed Estuarine and Bay Hydrology

"The understanding we gain from these studies will set the stage for better models addressing future hazard scenarios and will help coastal communities be better prepared to withstand and respond to catastrophic storms."—*Suzette Kimball, U.S. Geological Survey Acting Director*

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

Hurricane Sandy devastated some of the most heavily populated eastern coastal areas of the Nation. With a storm surge peaking at more than 19 feet, the powerful landscape-altering destruction of Hurricane Sandy is a stark reminder of why the Nation must become more resilient to coastal hazards. In response to this natural disaster, 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. These funds support a science plan (Buxton and others, 2013) that will provide critical scientific information necessary to inform management decisions for recovery of coastal communities, and aid in preparation for future natural hazards. This science plan is designed to coordinate continuing USGS activities with stakeholders and other agencies to improve data collection and analysis that will guide recovery and restoration efforts. The science plan is split into five distinct themes:

- Coastal topography and bathymetry
- Impacts to coastal beaches and barriers
- Impacts of storm surge, including disturbed estuarine and bay hydrology
- Impacts on environmental quality and persisting contaminant exposures
- Impacts to coastal ecosystems, habitats, and fish and wildlife

This fact sheet focuses on assessing impacts of storm surge, including disturbed estuarine and bay hydrology.

U.S. Geological Survey scientists prepare an acoustic doppler current profiler to measure water velocity profiles in a new inlet formed during Hurricane Sandy on Fire Island, New York.

Theme Stakeholders

Storm-tide monitoring data are essential for informing Federal and local emergency responders before, during, and after natural hazards such as hurricanes. Storm-tide data include information such as rises in water levels and changes in water quality. It is important for agencies such as the Federal Emergency Management Agency (FEMA), the U.S. Army Corps of Engineers (USACE), the National Weather Service (NWS), and State and local agencies to receive and collect these real-time data for present and future emergency response situations. Quality-assured storm-surge data improve community planning essential to rebuilding efforts, as coastal areas can better assess flooding risks and mitigation strategies. In addition, these data can improve resources for engineers and ocean scientists working to better calibrate storm-surge and water-circulation models.

U.S. Geological Survey scientist deploys an acoustic doppler current profiler to measure water velocity profiles in a new inlet formed during Hurricane Sandy on Fire Island, New York.

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U.S. Geological Survey hydrologic technician surveying a high-water mark on Liberty Island, New York, following Hurricane Sandy.

Storm Surge Impact Projects

The storm surge created by the winds and waves of Hurricane Sandy was the primary driver of coastal community destruction and dramatic changes in the coastal and near-coastal environment. The energy of the surge caused physical changes of the landscape, and the landward extent of the surge transported saline waters, sediment, and debris to ecologically sensitive environments that are rarely impacted by ocean effects. Upon approach to the coast, the combination of the surge's arrival with the tide of a full moon created a storm tide (the combined rise in water elevation from both tide and storm surge) that attained a peak of more than 19 feet, an elevation not observed in the last 100 years. Although models predicting the level of the storm tide at the coast generally were accurate, predictions of the extent, depth, and severity of the storm tide across the land surface were not uniform. In several instances, the impacts of the storm tide were higher than expected, illustrating the critical need of a better understanding of how storm surge and landscape features interact to dissipate or increase storm impacts. The USGS intends to provide coastal communities with a better means to respond and recover from the next coastal storm by focusing efforts on storm-tide data collection, data delivery, data networks, and data analysis.

Storm-Surge Response and Data Collection

The main goal of storm-surge response and data collection is to ensure that coastal regions are prepared for upcoming natural hazards by gathering necessary information on storm-tide water levels and storm surge that can aid in future emergency response situations. The combination of storm-tide, storm-surge, and wave-height water-level data is referred to as storm-tide data. To accomplish this, the USGS can improve USGS storm-surge response activities in the Northeast and Mid-Atlantic States, and increase the amount of storm-tide data transmitted in real time. This information is an important resource for emergency responders by providing a realistic scope of the magnitude of the storm. Since the data are delivered in real time and stored for future use and analysis, this information will be an important resource before, during, and after future storms in addition to supporting current applications such as coastal change and storm-surge forecasting models.

Storm-Surge Data Recovery and Delivery

The USGS can increase the efficiency of data recovery and processing by modifying software, procuring rugged data-retrieval hardware, using Real-Time Network Global Positioning System (RTN GPS) surveying equipment, and acquiring wireless connectivity. Storm-surge data will be linked with GIS tools and web display permitting rapid analysis and display of storm-surge data. Making use of this information will allow emergency responders, community planners, forecasters, modelers, and the public to identify high vulnerability areas in real time and the data analysis will contribute to a better understanding of coastal science.

Storm-Tide Monitoring Networks and Data Analysis

This study aims to refurbish and enhance the distribution of fixed-place and mobile storm-tide monitoring networks. The data gathered by these networks helps to better understand impacts of rising water levels caused by coastal storms. In addition to water-level and water-quality data, the USGS will gather water velocity and directional data to aid in determining the possible water-induced effects on land features and built structures. These monitoring locations have been requested by State and local emergency responders, and USGS hydrologists will take their input into account when selecting them. This work will reduce uncertainty in forecast modeling by using a combination of long-term tide gages and rapid-deployment sensors in predetermined locations to measure the extent and magnitude of storm tides and wave heights and possibly aid in future evacuation efforts. In addition to being a valuable resource for responders, this information also contributes to scientific understanding and USGS studies of bay, estuary, and river channel flows as they relate to coastal change and storm impacts.

Storm-Tide Data Analysis and Scientific Understanding

Storm-tide data analyses are intended to improve the storm-surge models maintained by other agencies and used to assist with response, recovery, and rebuilding of coastal communities in relation to natural hazards and contribute to USGS coastal storm science understanding efforts. This project will allow USGS to collect data on water level, bathymetry, flow direction, velocity, and sediment transport in damaged coastal communities. Such information will contribute to model improvement and future research as well as restoration plans. In addition, the USGS can develop maps of flood levels and storm-surge inundation using these data that show potential risk around important infrastructure and evacuation routes.

For more information:

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/*.

- *http://coastal.er.usgs.gov/hazards-events/sandy/*