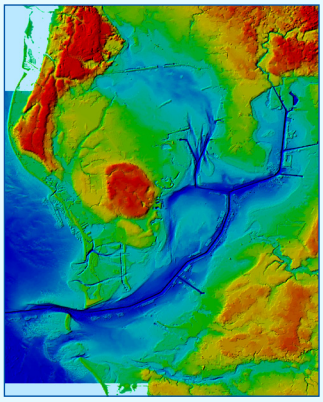
USGS
science for a changing world

USGS St. Petersburg Coastal and Marine Science Center

About Us

Extreme storms, sea-level rise, and the health of marine communities are some of the major societal and environmental issues impacting our Nation's marine and coastal realm. The U.S. Geological Survey (USGS) in St. Petersburg, Fla., investigates processes related to these ecosystems and the societal implications of natural hazards and resource sustainability. As one of three centers nationwide conducting research within the USGS Coastal and Marine Geology Program, the center is integral towards developing an understanding of physical processes that will contribute to rational decisions regarding the use and stewardship of national coastal and marine environments.



Topobathymetric map, Tampa Bay, Fla.

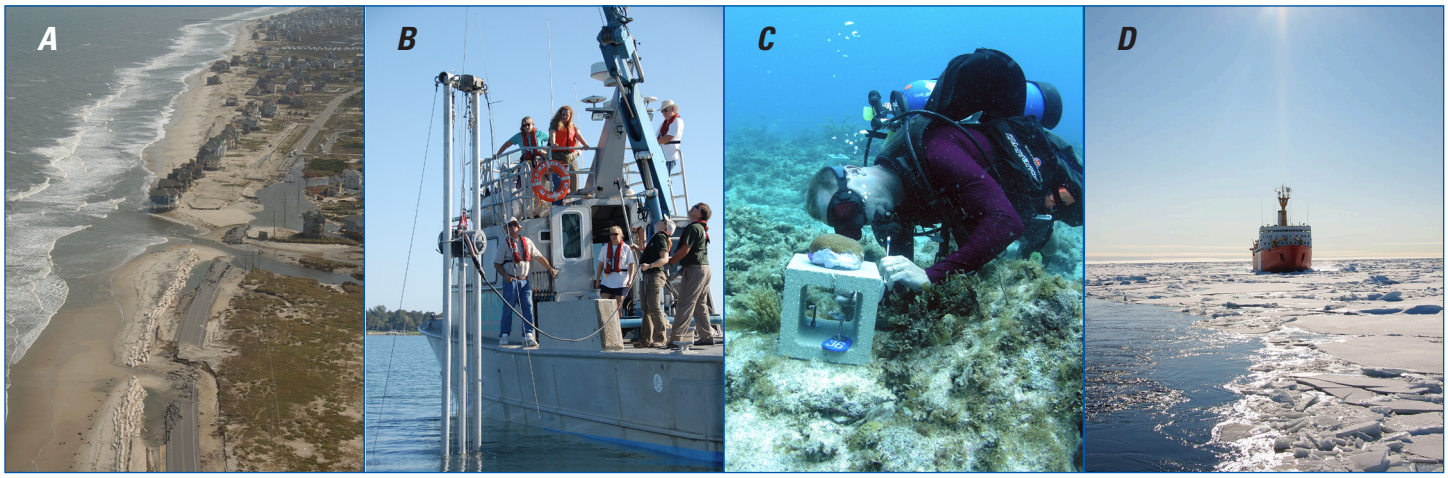


Figure 1. Scientists at the USGS in St. Petersburg, Fla., investigate hazards, geology, ecosystems, and climate change impacts to our coastal and marine environments. These include (*A*) studying and forecasting impacts of extreme storms on coastal environments, (*B*) obtaining geologic cores to understand Earth's history and predict future trends, (*C*) monitoring the health of coral reefs, and (*D*) conducting research on ocean acidification from the tropics to the Arctic.

Personnel

The USGS St. Peterburg Coastal and Marine Science Center (SPCMSC) is part of one of the largest marine science communities in the nation. The center is staffed with geologists, oceanographers, microbiologists, ecologists, biogeochemists, geographic information system (GIS) specialists, and scientific and administrative support staff who conduct research globally (fig. 1). Scientific field work is uncovering information and trends regarding coastal vulnerability to extreme storms, impacts from potential sea-level rise, coral reef health, and ocean acidification in the Gulf of Mexico, Florida, the Caribbean, and the Arctic.

Research

Research within the SPCMSC is organized around general mission areas that outline the major societal issues USGS science addresses. These research areas include the following: *Natural Hazards*–providing policymakers and the public with a clear understanding of hazards and assessments of their potential threats to society in order to develop strategies for preparedness and resilience; *Climate and Land-Use Change*–undertaking scientific research, monitoring, and forecasting to address the effects of climate and land-use change on the Nation's resources; *Ecosystems*–developing an understanding of ecosystem function and distributions as well as physical and biological components for freshwater, terrestrial, and marine ecosystems; and *Core Science Systems*–providing easy access to natural science information that

supports decisions to respond to risks and manage natural resources.

Some of the center's ongoing research projects and capabilities are listed below and provide critical data to policymakers, resource managers, and planners. Many of the projects are conducted with collaborators from Federal, State, and local agencies as well as academic institutions.

Natural Hazards

- *National Assessment of Coastal Change Hazards*–This project evaluates the vulnerability of U.S. coasts to hazards such as shoreline erosion caused by storms and sea-level rise (fig. 2). Researchers monitor the degree and variability of impacts from major storms on beaches. Such data can be used to improve the capability of predicting coastal change both locally and nationally.
- *Sea-Level Rise Hazards and Decision Support*–Sea-level rise and associated impacts are of significant importance to coastal planning and decision making. USGS scientists are assessing the relationships between a broad range of coastal factors such as beach erosion and groundwater supply using model simulations of coastal environments to predict long-term ecosystem change caused by sea-level rise and climate change.
- *Northern Gulf of Mexico Ecosystem Change and Hazard Susceptibility*–Investigating the geological, physical, and ecological processes of the northern Gulf of Mexico is of high national priority, especially after the devastating 2005 hurricane season. Scientists are determining hazard susceptibility in the region by understanding how these coastal ecosystems formed. They are also studying the impact of human activities on the environment and the vulnerability of ecosystems and human communities to more frequent and intense hurricanes.
- *Assessment of Coastal Vulnerability to Inundation*–More than 30 National Park Service units are vulnerable to hurricanes and Northeasters along the Gulf and Atlantic coasts. The National Park Service wants to improve visitor access and safety after storms.

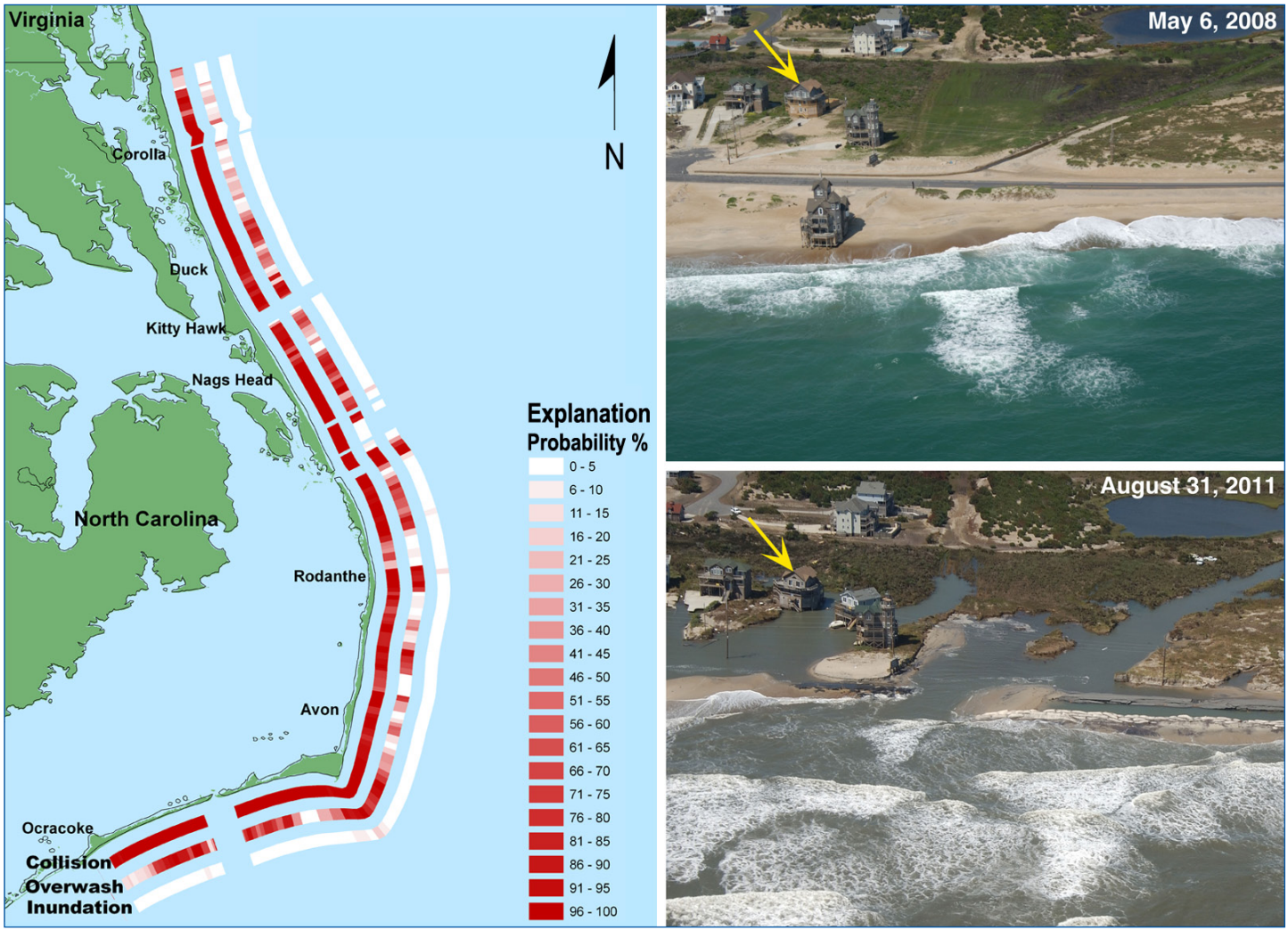


Figure 2. Prior to Hurrican Irene's landfall, researchers modeled and forecasted likely coastal impacts of the approaching hurricane by comparing measurements of dune elevations to potential hurricane-induced water levels. Obtaining before and after aerial photos highlights breaches, erosion, and flooding of barrier islands and coastlines from the storm.

Figure 3. A major undertaking of the Coastal and Marine Geology Program is monitoring the conditions of coral reefs and forecasting future impacts from ocean acidification and other environmental changes to guide proper management decisions.

Information generated by this project will lead to more resilient placement of infrastructure to support public and emergency access before, during, and after storms.

Climate and Land-Use Change

- *Gulf of Mexico Climate Change History*–By analyzing geologic cores and microfossils, scientists are determining cycles of natural climate and environmental change over the last 10,000 years in the Gulf of Mexico. This information is needed to establish possible causes of climate variation on human timescales and help distinguish between natural and human-related changes to produce better climate forecasts.
- *Ocean Acidification*–The over abundance of carbon dioxide in the atmosphere is leading to greater absorption of the greenhouse gas by oceans and resulting in an increase in seawater acidity, or ocean acidification. Ocean acidification lowers pH levels and decreases calcification rates in calcifying organisms like corals, clams, and oysters, reducing their ability to build shells or skeletons. Scientists are conducting research on ocean acidification in polar, temperate, and tropical regions to discern impacts, trends, and implications.

Ecosystems

- *Coral Reef Ecosystem Studies Team*–Coral reefs in the Caribbean and south Florida are undergoing significant transformations due to changing environmental conditions (fig. 3). This project researches areas relevant to understanding the health and resilience of shallow water reef environments. Goals include improving information about coral health, advancing the ability to forecast future changes in coral reef environments, and guiding management decisions.
- *Deep-Sea Coral Microbial Ecology*–Though corals notably inhabit the shallow, warm waters of tropical locations, they also exist hundreds to thousands of meters below the ocean's surface, where it is cold and completely dark. Researchers are now discovering and studying these unique and fragile ecosystems. These cold-water corals form critical habitat in the deep ocean, and studying coral-associated microbes gives key information about their health, biology, and overall resilience to environmental change.

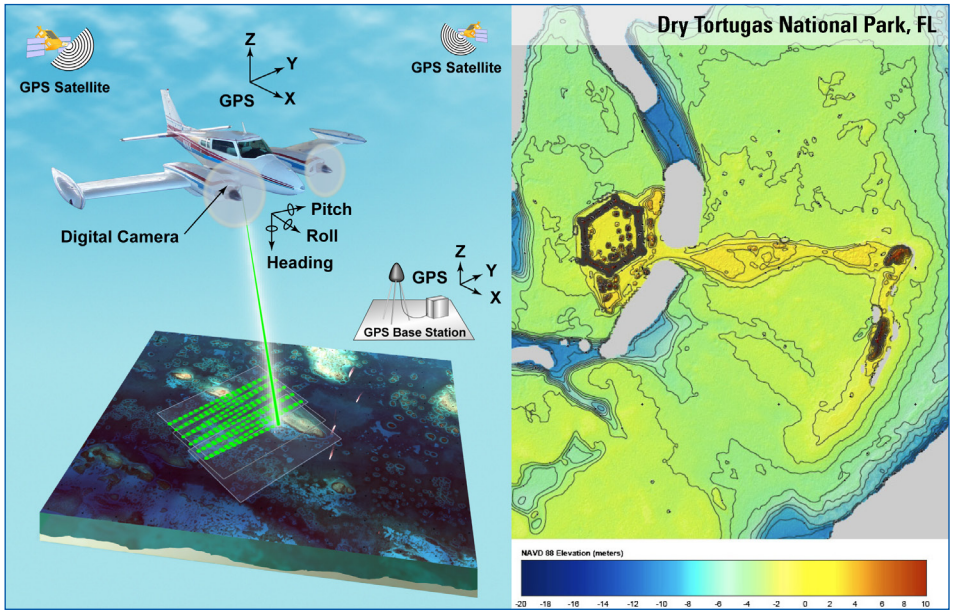


Figure 4. LIDAR (light detection and ranging) technology uses laser pulses to collect detailed elevation information that is the baseline for high-resolution maps, such as this map of Dry Tortugas National Park.

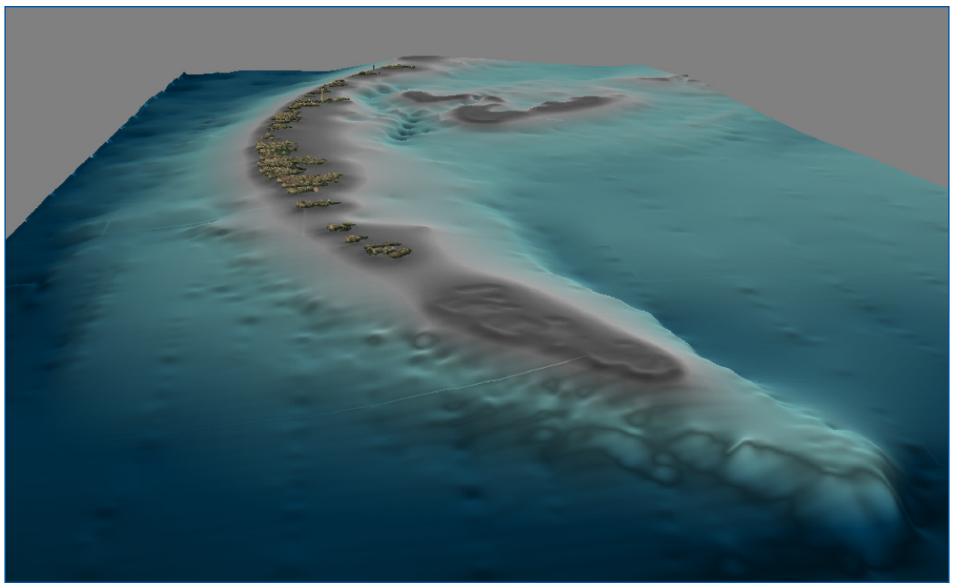


Figure 5. Island shape derived from LIDAR is overlain on water-depth data to show the Chandeleur Islands in the Northern Gulf of Mexico.

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Core Science Systems

- *Decision Support for Coastal Science and Management*–Scientific research increasingly relies on technology and new capabilities to unlock information. The development and use of specialized technology like LIDAR (light detection and ranging) allows for the remote sensing of coastal marine and terrestrial environments to build high-resolution maps (figs. 4, 5). Coastal remote sensing, mapping, and other tools can be deployed in support of zoning decisions and serve as a baseline for evaluating resources and tracking the effectiveness of management decisions.
- *South Florida Information Access (SOFIA) and the Everglades Depth Estimation Network*–SOFIA is a service that provides the documentation, dissemination, and storage of information in support of research for the Comprehensive Everglades Restoration Plan. The Everglades Depth Estimation Network is a real-time monitoring and modeling service that provides current on-line water-depth information for the entire freshwater portion of the Greater Everglades. Scientists and managers can use these services to help guide field operations and support assessments that measure ecosystem responses to restoration implementation.
- *Seafloor Mapping*–Identifying the composition and features of the seafloor is an integral component of many coastal and marine geology studies, both as stand-alone science and for providing support and critical baseline data for other projects (fig. 6). Not only can interpretive maps of the sea floor provide a framework for research and management in the coastal ocean, they can help locate deep-sea coral mounds and shipwrecks. They also illustrate areas of present and past dumping of sediments, contaminants, and impacts from other human activities. Information derived can be used to develop predictive models to guide and monitor habitat and resource management strategies.

Figure 6. USGS scientists operate a hydraulic rotary drill to collect cores that will help them better understand the geology and formation of the Florida Middle Grounds.