



Hazard Resilient Coastal Communities Hurricane Research, Outreach and Technical Support

Hurricanes and other coastal storms carry the threat of disaster, placing people and property at risk along the nation's coasts. These dynamic forces, combined with potential climate change impacts and population growth along our coastlines, have tremendous implications for the economic and environmental health of our coastal areas. Coastal residents must understand these risks, learn how to reduce their vulnerability, and understand how to respond quickly and effectively.

Sea Grant works to:

- Promote widespread understanding: Assess short and long-term risk for residents and businesses and ensure that forecast and other information is available and useful to help save lives.
- Prepare Communities: Help communities plan to reduce risk; pinpoint vulnerabilities and use technologies to prepare for and mitigate hazards.
- Respond to coastal catastrophes: Make products and services available to support crisis decision-making, mobilize the Sea Grant network to provide rapid response strategies, and partner with emergency responders.

Below is a sample of the work being done through NOAA Sea Grant programs.

[Florida Sea Grant](#)

Protecting homes from hurricane damage is a key focus for Florida Sea Grant. Through a variety of research investments and technical product development and support, Sea Grant works to prevent millions of dollars in annual damage in Florida. Examples of this work include:

- **Sea Grant research focuses on making homes safer and more hurricane resilient**
More than \$16 billion in damages occurred when Hurricane Wilma struck South Florida in October 2005. The majority of this damage was to roofs. Many older residential structures near the coast do not have roofs designed to survive the impact of major hurricanes. Sea Grant is investigating effective and economical ways of mitigating the effects of strong winds on roofs in order to reduce losses from hurricane events.
 - **Researchers use "Wall of Wind" facility to develop new design standards to protect structures from hurricanes**
Sea Grant researchers are using a new state-of-the art, Wall of Wind (WoW)

laboratory, the first major full-scale facility dedicated to hurricane research and damage mitigation.

- The facility makes it possible to estimate the amount of wind pressure a roof is able to sustain by taking into account roof elements such as tiles and shingles, the effect of which is otherwise neglected in conventional testing.
- Experimental studies are assessing the effectiveness of aerodynamic devices in reducing wind effects over the corners and edges of roofs. This research helped to develop a new product that can substantially reduce or prevent hurricane-induced damage to new and existing roofs. The aerodynamic edge product is now patented by industry partner Weather Predict Consulting Inc., and is estimated to create/sustain about 150 jobs when the product is commercialized. The product could help save \$5 billion in losses due to hurricane damage.
- Sea Grant researchers have also applied for a provisional patent for a new Fiber Reinforced Polymers (FRP) Tie System (an enhanced roof-to-wall fastening system that will help hold roofs in place during hurricanes). This product could save an estimated \$25 million in annual damage claims within Florida alone.

○ **Sea Grant develops enhanced modeling framework for storm surge and coastal inundation forecasting**

Technologies currently in use for hurricane and surge/inundation characterization, forecasting and protection are urgently in need of improvement. To meet the demand for more accurate storm surge models, Sea Grant demonstrated and validated a new storm surge and inundation forecasting system (CH3D-SSMS) in northeast Florida using data obtained during Tropical Cyclone Fay. This new system is expected to enhance storm surge and inundation forecasting and mapping in the U.S. and elsewhere.

- Sea Grant researchers are also developing an Education Virtual Appliance which offers advance modeling for emergency managers. The researchers have also developed a plan to engage stakeholders to help evaluate the Education Virtual Appliance modeling technology, and compare output scenarios from several commonly-used modeling applications. The researchers are developing a public education strategy on the topics of storm surge and coastal inundation hazards that will be posted on the web.

[University of Hawaii Sea Grant](#)

- **Handbook helps residents prepare for natural hazards**
Hawaii communities are exposed to multiple natural hazards that include hurricanes, tsunamis, earthquakes, and floods. Many homeowners are not prepared for dealing with these hazards and lack the necessary knowledge and information on emergency planning and preparedness. Sea Grant developed the [Homeowner's Handbook to Prepare for Natural Hazards](#), a guidebook that outlines effective ways to significantly lower serious risks to lives and property prior to a natural hazard event. Nearly 16,000 copies have been distributed directly to the community. Hawaii Sea Grant has also worked with other state Sea Grant programs (e.g., Mississippi-Alabama Sea Grant) to develop their own state-specific version(s) of the handbook.

[Louisiana Sea Grant](#)

- **Sea Grant website provides residents with hurricane resources**
The [Louisiana Hurricane Resources](#) website, hosted by the Louisiana Sea Grant College Program, provides visitors with access to a wealth of data concerning storm preparedness and recovery, as well as archived information about Hurricanes Katrina and Rita.
- **Louisiana uses Hawaii product to help educate**
The Louisiana Sea Grant Law & Policy Program published the 250-page [Louisiana Hazard Mitigation Guidebook](#) to explain issues from zoning and structure siting to construction methods and legislation that can be employed to build more hazard-resistant communities. It is based on a similar guidebook published by Hawaii Sea Grant. Sea Grant representatives held workshops for Louisiana citizens and government officials to help them understand and implement the strategies outlined in the guidebook and to emphasize the importance of community planning. Videos of the workshops and copies of the guidebook are archived online and available free of charge. The guidebook is being used as a classroom text at Baton Rouge Community College and at Louisiana State University's Paul M. Herbert Law Center
- **Outreach program shows vulnerability to flooding**
"The Next Storm Surge" outreach series graphically demonstrates community and individual susceptibility to hurricane flooding. Louisiana Sea Grant Extension agents and disaster and GIS specialists conducted vulnerability assessments for eight of the state's coastal parishes. Using computer modeling and real-world data collected on the ground after hurricanes, they prepared maps showing the extent of potential flooding under various storm scenarios. They superimposed images of flood waters on photographs of local businesses and landmarks to help residents visualize predicted impacts. More than 2,000 people attended the program at local libraries, and most attendees viewed the presentations as a wake-up call. Maps and printed materials remained on display for library patrons after each program to extend the project's impact. One regional bank moved its electronic operations center further inland after bank officials viewed one "Next Storm Surge" presentation and realized their vulnerability.
- **Workshops help communities and local governments plan for increased tropical storms**
Sea level rise and other climatic changes are projected to increase the vulnerability of Louisiana's coastline to tropical storms by the end of this century. Because the cities and parishes with a wider array of armaments stand a better chance of combating and mitigating future natural hazards, a multi-disciplinary team from Louisiana Sea Grant is helping local policy makers fortify and prepare their communities through a series of workshops. Sea Grant Law &

Policy Program members, Marine Extension personnel, and other specialists are educating leaders about sea level rise, the use of Geographic Information Systems (GIS) data to evaluate storm surge and sea level rise risk, risk perception and communication, and best practices in preparedness. The program also addresses the legal liability of local governments if officials fail to act or act without consideration of pending hazards, and it emphasizes the importance of preparation and planning that increase community resilience while maintaining each community's cultural identity. In addition to workshops, the program provides a toolkit on CD to help policy makers incorporate what they learned into the development and decision making process.

Maine Sea Grant

- **Sea Grant wave forecast model predicts dangerous conditions**

On Maine's 3,000 mile coastline, surface waves can be the most energetic elements of the physical oceanography affecting coastal communities and habitats. Information about wave conditions has many applications, including the safety of boat or ship operations, the transport of pollutants in the water, the siting of aquaculture activities, and coastal engineering. Building on previous Maine Sea Grant-funded wave modeling studies, Texas A & M researcher Vijay Panchang developed a detailed atlas of fine-resolution wave climates in coastal Maine and a computerized wave prediction system for forecasting wave heights. Wave forecasts now cover all of coastal Maine, providing 48-hour forecasts of wave height, peak period, and wave direction. Areas of coastal Maine that hitherto had no wave information now have full coverage. Panchang recently added a module for wave-induced surface drift velocities, which NOAA oil spill forecasters requested and access as needed. In 2009, the system correctly predicted the conditions surrounding Hurricane Bill, including large waves near Thunder Hole in Acadia National Park, where several injuries and one fatality occurred. The complete dataset has been transferred to the US Geological Survey in Augusta.

Massachusetts Institute of Technology Sea Grant

- **Sea Grant assesses coastal wetlands to protect habitat**

Prevention of sudden wetland dieback (SWD) is key to maintaining and restoring vital wetland areas that form a protective barrier against hurricanes and tidal surges, and also provide essential habitat for marine species. Elmer Caruso led a team of researchers that surveyed and inspected tidal wetlands along Connecticut's Long Island Sound and along Cape Cod, Massachusetts, for overall health and for signs of SWD. Researchers also sampled and mapped sites with symptomatic and asymptomatic plants, attempting to identify organisms that contribute to SWD and to confirm pathogenicity on healthy *Spartina alterniflora*. They then tested how stressors, such as drought, flooding, and salinity, affect the susceptibility of *Spartina* to known pathogens, and implemented an outreach program through presentations, town meetings, publications and a website to inform the public of SWD.

Mississippi-Alabama Sea Grant

- **Sea Grant increases communities' capacity to prepare for and respond to hazardous events**

As the number of people moving to the Gulf coast increases, so does the risk of exposure to flooding, hurricanes and other storm-related events. Although experience has shown that more homes and people located in the floodplain equals more exposure and potential for people to be in harm's way, many coastal residents are complacent when asked about their preparation

for the coming storm season. Recognizing that communities need support and assistance in determining their risk and resilience, Sea Grant created the [Resilience Index](#) as a self-assessment tool to provide community leaders with a simple and inexpensive method of predicting if their community will reach and maintain an acceptable level of functioning and structure after a disaster. The Resilience Index was completed by 16 coastal communities in Florida, Alabama, Mississippi, Louisiana and Texas. These communities assessed their strengths and vulnerabilities prior to future storm events. Two communities have applied for a grant to address one of the vulnerabilities they identified in the Index.

- **Parish saves \$1.3 million using financial health analysis coupled with storm cost predictions**

Local governments are typically unaware of how their financial condition has changed after paying the costs of emergency operations, clean-up and debris removal from tropical storm events. Poor financial health can inhibit a local community from investing in infrastructure, and can constrain its ability to prepare for the next tropical storm event. Measuring the expected cost of future natural disasters helps local decision makers anticipate the proper levels of emergency funding and other support their community may need in order to be more financially resilient during and after future natural disasters. Sea Grant measured the financial health of several Southeast Louisiana parish governments using common accounting financial indicators, and compared each community's financial health against accepted financially healthy "rules of thumb" levels before and after Hurricane Katrina. Next, an estimate of the one-, four-, 20-, and 50-year expected costs of a tropical storm and hurricane were estimated for a case study parish (Tangipahoa) and selected Southeast Louisiana parishes. The expected costs used historical cleanup debris removal costs for recent storms combined with parish-level probabilities of sustained winds from a tropical event. Coupling these results allowed researchers and parish decision makers to identify cost saving opportunities. The results of the analysis were used by Tangipahoa Parish to save \$1.3 million in interest expenses. Additional parishes will be provided similar assistance in year two of this project.

[New York Sea Grant](#)



Battery, southern tip of Manhattan Island. Photo courtesy of Battery Park Conservancy.

NYSG Research on "Fighting Back the Waves" in New York City

"Fighting Back the Waves," a story that appeared in the Wall Street Journal in May 2011, offers insight into what New York City and other major cities around the world are doing (and not doing) to prepare for future inundation threats from extreme storm events and climate change. Featured in the article is Malcom Bowman, Stony Brook University Oceanography professor and a storm surge expert. Bowman is also a member of The Stony Brook Storm Surge Research Group, which has been funded principally by New York Sea Grant since 2002 to work on storm surge science, coastal defense systems and policy issues related to regional protection of the City and Long Island. According to the Research Group, the New York Metropolitan region is vulnerable to coastal flooding and large-scale damage to city infrastructure from hurricanes and nor'easters. Much of this region - an area of about 100 square miles - lies less than three meters above mean sea level. Within this area lies critical infrastructure such as hospitals, airports, railroad and subway station entrances, highways, water treatment outfalls and combined sewer outfalls at or near sea level. In addition to being at risk for large, damaging storms that can produce unusually large storm surges resulting in severe flooding, the frequency and severity of these storms has the potential to be increased by the impact of global warming and sea level rise. Says Bowman, "The damage done by a 100 year storm now will equal the damage done by a 25 or 50 year storm later in the century if sea level rise accelerates." [More on Bowman's discussions on "Fighting Back the Waves" in New York City.](#)

North Carolina Sea Grant

- **Wind insurance mitigation credits reduce insurance costs, increase public safety**
Property owners pay high insurance premiums for coverage in wind zones near the oceanfront. Incentives for building owners to increase wind resistance would also increase overall safety on barrier islands during coastal storms because of less flying debris. In North Carolina, Sea Grant encouraged the State's Joint Underwriting Association to consider mitigation credits for property owners who construct more wind-resistant buildings, and provided written recommendations to the Joint Select Committee on the Potential Impact of Major Hurricanes on the North Carolina Insurance Industry. This work led to a 2009 decision by the North Carolina General Assembly to require that the Department of Insurance consider mitigation credits for wind-resistant features for coastal homeowners and commercial insurance coverage. The North Carolina Rate Bureau proposed mitigation credits in 2010. As a final step, the State's Insurance Commissioner implemented increased credits as an optional rating for all wind insurance coverage in the state and will offer 5 to 24 percent credits on 2011 policies. Potential savings would apply to wind coverage on approximately 200,000 coastal policies, with premiums of approximately \$300 million annually. Many existing buildings will be eligible for the lower wind insurance rates beginning in 2011. Sea Grant is a partner in plans to promote wind-mitigation upgrades of existing buildings so that the property owners can qualify for higher credits. Many new coastal buildings are expected to be designed for the highest credits. When state officials accepted Sea Grant's recommendations to establish wind-resistance mitigation credits on coastal insurance policies, the result was increased safety and lower premiums for property owners who took the recommended actions.
- **Flood warning information, maps help protect coastal communities**
Flooding is the number one weather-related killer in the US. For example, Hurricane Floyd produced catastrophic flooding in Eastern NC. Sometimes floodwaters cause long-lasting effects, including potentially high levels of fecal bacteria in drinking or bathing water. Outreach programming is essential to ensure researchers can provide needed information to weather

forecasters, emergency managers and coastal residents. Several Sea Grant programs are working with the [NOAA National Severe Storms Laboratory \(NSSL\)](#) and other partners on a multi-faceted project focusing on the Tar-Pamlico and Neuse river basins affected by Floyd. The project — The [Coastal and Inland-Flooding Observation and Warning \(CI-FLOW\)](#) — provides a research and demonstration program to evaluate/test new technologies and techniques to produce accurate and timely identification of inland, coastal and flash floods. Sea Grant links CI-FLOW researchers with information providers and the coastal public. Sea Grant also participated in a team that updated state flood maps, with a focus on oceanfront counties with barrier islands. In concert with NSSL and National Weather Service forecast offices, Sea Grant has helped developed an interactive procedure to improve and enhance the usefulness of results from the CI-FLOW model. Utilizing web-based displays, the team has determined the most important variables and the optimum display methods for forecasters to use this information when predicting potential flood conditions in tropical storm event scenarios. Local governments likely will be adopting the updated flood maps in 2010 or 2011.

[Rhode Island Sea Grant](#)

- **Rhode Island adopts guidelines for hurricane-proof building**
Sea Grant, in collaboration with the Rhode Island Coastal Resources Management Council (the state's Coastal Zone Management agency), fostered adoption of policy and construction guidelines within the Rhode Island Builders Association, insurance, and real estate industries, to support the nation's first Coastal Zone Management Policy. The policy adapts construction guidelines to accommodate accelerated sea level rise resulting from climate change.
- **"Smart Growth" manual guides coastal development nationwide**
Sea Grant, in collaboration with NOAA and US EPA, published and disseminated nationally the manual, [Smart Growth for Coastal and Waterfront Communities](#). This document provides guidance to coastal communities for planning based on smart growth principles that will help hurricane-proof coastal areas as well as aid in adapting to the impacts of changing climate.

[South Carolina Sea Grant](#)

- **Beach Erosion and Research Monitoring (BERM) Program minimizes risk to people and property**
South Carolina's beaches and coastal areas drive the state's tourism economy and are vital to maintaining economic well-being and coastal heritage. Shorelines are ever-changing with potentially large impacts to private property owners and local/state government. To help provide sound scientific information about coastal sediment dynamics and shoreline change, Sea Grant partners with Coastal Carolina University and local, state, and federal coastal management organizations to: manage a research and monitoring program documenting coastal management and shoreline change; and, conduct Regional Sediment Management studies which aim to pool resources to solve engineering problems, improve the environment and save money. BERM Program information is utilized by the state's beachfront management agency to determine setback distances for shoreline development and about 4,000 habitable structures within and near setback zones. Data collected by the BERM Program is incorporated into the U.S. Army Corps of Engineer's eCoastal enterprise GIS to enable data-sharing across management agencies and disciplines. The successful partnerships developed by the BERM Program have resulted in a cost-effective solution to data acquisition and interpretation, and increased resource communication and sharing across agencies. The BERM Program is providing coastal decision-makers with scientific information documenting shoreline change and the

impacts of natural and anthropogenic forces. This information is critical to minimizing risks and reducing damage to people and property along the South Carolina coast.

- **Predicting residential building destruction from hurricane-borne debris**

A South Carolina Sea Grant researcher is studying the impacts of wind-borne debris from hurricanes to determine if stricter regulations on building code (such as Florida Building Code regulations) should apply in South Carolina coastal regions. The project will: characterize the hurricane wind hazard of the coastal South Carolina regions using a current state-of-the-art hurricane simulation procedure; develop a framework for predicting failures of the building envelope, which includes the foundation, roof, walls, doors, and windows, due to damage from wind-borne debris and ultimately to assist in designing a hurricane-resistant home.