



SSPEED GULF COAST CENTER

Rice University (Lead)
University of Houston
University of Texas - Austin
University of Texas – Brownsville
Texas A & M – College Station
Texas A&M – Galveston
Texas Southern University
Louisiana State University
Houston Galveston Area Council

SEVERE STORM PREDICTION, EDUCATION, AND EVACUATION FROM DISASTER (SSPEED CENTER)

A Proposal to Establish a Research and Operational Center

Mission. This center will organize leading universities, researchers, emergency managers, and private and public entities to better address severe storm impacts in the Gulf Coast area. The impact zone stretches from Texas to Louisiana and includes major cities such as New Orleans, Baton Rouge, Houston, and Brownsville. The Center will address (1) severe storm and hurricane research and storm surge prediction, (2) radar-based rainfall and flood warning systems for urban and coastal areas, (3) state-of-the-art educational programs for workforce training and public awareness, (4) infrastructure risks assessment, and (5) evacuation plans linked to the best warning and transportation systems, and societal needs. *The keys are to improve lead-time and accuracy of prediction and to deliver the information in real time to emergency managers for improved evacuations or sheltering in place.*

Background. The 2005 hurricane season clearly demonstrated the extreme and dire deficiencies that exist in storm prediction, disaster planning, and evacuation in the Gulf Coast region. Only through advanced innovation that links severe storm and real-time flood warnings with evacuation plans for vulnerable areas, and efficient communication of predicted impacts to decision makers can we improve the well being of our coastal communities in the face of severe storms and natural disasters. This is a very important Center concept that can only be accomplished through an academic, public, and private partnership of severe storm experts, emergency managers, and interested parties.

No Overlap with Existing Centers. There are no centers that address severe storm prediction and impacts in the Gulf Coast Area. The proposed Center directly responds to the five focus areas delineated by the Governor's Task Force on Evacuation, Transportation, and Logistics: (i) Command, Control, and Communication, (ii) Evacuation of People with Special Needs, (iii) Fuel Availability, (iv) Flow of Traffic, and (v) Public Awareness. By developing the proposed storm surge and flooding models, the

Center will serve the Governor's Division of Emergency Management (GDEM) needs and enhance their ability to produce sophisticated wind and surge models for coastal areas. By modeling evacuation scenarios and search-and-rescue operations, the Center will contribute invaluable information for evacuating people with special needs and on traffic flow issues. Quantifying infrastructure risks as proposed by the Center will allow planners to incorporate risk and hazard into their planning to prevent major failures from flooding and other shortages. Finally, the proposed education and outreach plan in the Center is directly aimed at increasing public awareness.

Methodology. Existing storm surge and inland flood models and methods will be expanded and applied to Texas-Louisiana coastal areas. A real-time **Regional Forecast Testbed** (RFT) will be developed and in place within two years of funding. This system will be able to compute flood inundation zones using radar rainfall; evaluate hurricane storm surges in real time; deliver the information to interested parties and emergency managers on an active web site; and, provide education and dynamic links to sheltering or evacuation plans in real time to assist managers and the public during severe events.

Organization. Rice University, located in Houston, Texas, will be the lead institution and the site for the proposed SSPEED Center. The other regional academic institutions include the University of Houston (UH), Louisiana State University (LSU), the University of Texas at Austin (UTA), Texas A& M University at Galveston, Texas Southern University, and the University of Texas at Brownsville (UTB) (Table 1). These universities were carefully chosen because each brings unique talent to the Center, and many of the involved faculty has worked together on related evacuation and flooding projects in the region. Other public and private agencies that will participate in the Center are listed in Table 2. HGAC will take on the lead governmental role for operations of the Center.

Objectives and tasks

1. Develop real-time storm surge forecasting ability for severe storms in the Houston-Galveston area of the Texas Gulf Coast, and deliver GIS-interoperable results as storms approach the coast (LSU and UTA).

The main drawback to the use of ADCIRC for operational forecasts has been the relatively long 4- to 6-hour computation times needed. Performance could improve substantially as the model is further adapted to use distributed computing resources. UTA working in concert with the LSU Hurricane Center along with consulting experts will improve ADCIRC to permit rapid forecasts using near real-time data inputs. This will assist in the pre-staging of response and rescue assets in areas near the focus of an impending disaster, yet safe from destructive forces.

2. Link storm surge predictions with inland radar-rainfall and GIS inundation maps for actual storm events for the Houston and Brownsville areas (Rice, UH and UTB).

Rice University has been actively involved in hydrologic analysis for flood

prediction and warning, and recently developed a real-time flood alert system (FAS2) for the Texas Medical Center. The FAS2 is based on converting NEXRAD radar directly to rainfall via a GIS system, which is then used in hydrologic models for predicting peak flows. The system is currently delivered real-time on a web site, and has been tested on major flood events in Houston, including T.S. Allison in 2001. Dr. P. Bedient, in partnership Dr. J. Benavides and Dr. B. Vieux, is developing flood alert systems for other areas in Texas, including Austin and Brownsville. The SSPEED researchers at UH, Rice and UTB will develop automated linkages to GIS maps of the affected Gulf Coast areas to illustrate inundation zones and water levels at the street/house scale. More importantly, a detailed mapping effort to evaluate coastal risk areas and critical facilities will be undertaken with the latest storm surge data linked with floodplain data in the SSPEED Center.

3. Incorporate the innovative technology developed for the Regional Forecast Testbed (RTF1) in objectives 1 and 2 to emergency planning and transportation systems (Rice, UTA, TAMUG, and LSU with HGAC).

The Houston-Galveston Area Council (HGAC) is the voluntary association of 133 local governments and local elected officials in the 13-county Gulf Coast Planning region of Texas (a service area of approximately 12,500 square miles containing almost 5.4 million people). HGAC is responsible for disseminating information to help the region and local governments enhance disaster preparedness, hazard mitigation, and storm debris management plans, as well as completing regional forecasts for population, employment, and land use. Coordination of local evacuation plans is also managed by HGAC. The advances in forecasting technologies and mapped inundation zones from the Center will be disseminated via HGAC.

4. Develop a disaster-trained workforce (DTWF) through an education center at UH involving internships between the partner universities, the private companies, and the Houston-Galveston Area Council (UH and Rice).

The need for a workforce that is better educated and trained to deal with disasters, such as hurricanes Rita and Katrina, has never been more apparent. The SSPEED Center will establish a severe storm and hurricane education center (SSHEC) to fill this gap. The primary mission of SSHEC will be to serve as a bridge between the technical experts, emergency managers and the public. In particular, SSHEC will conduct on-line and conference seminars to educate emergency responders including those at Independent School Districts on the use of available resources and information technologies. Additionally, the educational center will develop innovative educational programs to increase awareness among a targeted public and high school audience.

To begin to develop a capable workforce as a major outcome of this Center, students at the participating universities will be trained in severe storm modeling, flood warning systems, risk analysis and disaster mitigation and planning. SSHEC

will support a summer student exchange program to exchange students to the other campuses for immersion in the multidisciplinary areas encompassed within the Center Universities. Additionally, internship opportunities will be developed with the private sector, including HGAC and the Texas Medical Center (TMC).

Finally, SSHEC will establish an annual severe storm and hurricane workshop (prior to hurricane season) open to students, emergency responders, and the public to promote awareness and readiness.

5. Develop and implement a public education program for informing and motivating the public's compliance with government initiated evacuation orders (Rice, UH, TAMU, and TSU).

An increasing and ever present problem associated with mass evacuations in anticipation of natural disasters (e.g., hurricanes) is for the evacuation itself to become an emergency and public health disaster. Congestion on roadways made worse by stalled vehicles, inclement weather, a scarcity of gasoline, water and, food produces a condition in which individuals are at risk well before the natural disaster they are fleeing strikes. Worse, is the potential for evacuees to be stranded in traffic when the natural disaster strikes.

The development of public information campaigns to lessen the effects of traffic congestion on the timely and safe evacuation of large residential populations pending a natural disaster requires considerable research. We do not understand the choices evacuees make that impact traffic congestion and related problems. These include the timing of the evacuation, roadways used, evacuation destination and, vehicle usage (i.e., number of vehicles and persons per vehicle). Who the public trusts and relies upon for timely information and instructions is also unknown. The sources of information that influence these decisions are studied as determinants of when, how and where households evacuate. Researchers at Rice University and the University of Houston take the lead in studying and devising public information campaigns. They will work with HGAC, and first responders to educate and monitor the public's knowledge of and likelihood to respond to government directives during natural disasters.

To facilitate the implementation of a public information campaign, researchers at Rice University will conduct an annual survey of residents in risk prone areas regarding their preparedness for evacuations and alternative responses to natural emergencies. The annual survey will be used to educate the public about alternative ways to prepare for and respond to natural emergencies. These surveys will be used to assist HGAC and other emergency planners in designing emergency response plans. Specific attention will be paid to the relative costs and benefits (e.g., movement of individuals) of alternative responses to natural emergencies. Rice researchers have teamed with their colleagues at the Texas Transportation Institute are examining ways to utilize existing incidence management programs (i.e., SafeClear) in the City of Houston to support emergency evacuations. Future plans

include identifying ways to coordinate these on-going traffic management programs with new plans for emergency evacuations.

6. Deploy a prototype system, or Regional Forecast Testbed (RFT2), to Brownsville during year 3 of the project (UTB, UTA, and Rice).

Located near the Gulf of Mexico and the U.S./Mexico border, Brownsville has one of the fastest growing populations in the United States. The area is characterized by a large Hispanic population, and has relatively poor infrastructure systems for flood warning and evacuation to be successful. A cost-effective and comprehensive flood protection plan addressing storm surge, localized flooding due to intense rainfalls, and the persistent threat of river flooding from the Rio Grande has yet to be developed for the area. The recent major hurricanes that impacted the Gulf Coast, including Hurricanes Katrina and Rita and the closer to home near miss of Hurricane Emily earlier in the 2005 season, have alerted federal, state and local emphasis to this important issue. Moreover, the previous hurricane season has highlighted the need for enhanced severe storm prediction in this region, coupling of storm surge and severe storm runoff, as well as the development of educational and outreach programs to increase awareness of this persistent seasonal threat.

Advantages of the Center. An overarching theme unifying the above Center components is a proposed Regional Forecast Testbed (RFT) that will provide operational forecast tools for the Gulf Coast region. The RFT will be located in Houston and will be implemented in the coastal area that connects Houston and New Orleans within the first two years and be expanded to Brownsville in years 3-4.

The SSPEED center will create synergism between various experts at the main university campuses, and the private and public sectors, and educate students in disaster prediction and management areas where there is a shortage of professionals. The Center would provide a physical location for developmental research, education, public outreach, and emergency information delivery to be organized under one entity. This research Center would be located at Rice University, under the direction of Dr. Philip Bédient, with emergency operations located at one other secure site in Houston, and would provide redundant around the clock predictive service, after a severe storm warning has been issued by the National Weather Service. This will help strengthen our scientific, engineering, research, education, and human resource base within the region. Therefore, this center will play a crucial role in finding a path to sustainability for communities along the Gulf Coast, just as major funded earthquake centers across the U.S. have greatly advanced our ability to build safer buildings in earthquake zones.

The Houston Galveston Area Council will be actively involved in the Center as the Governor's appointed local agency for hurricane planning and evacuation. They will help provide operational management for evacuation planning for the Center. In addition, the Texas Medical Center and the City of Houston will play major roles in terms of organization of talents, operations, emergency response, and advisory roles in times of disaster. Individual researchers are listed below along with proposed activity.

Table 1. University Roles

University and Main Investigators	Proposed Activity
Rice University P.B. Bedient, Center Director R. Stein	Flood prediction and warning; Urban hydrologic models; Web integration of real time data; Regional Forecast Testbed 1, Public policy and response.
University of Houston H.S. Rifai, Co-Director	Educational outreach for public and high schools; Infrastructure risk assessment.
Louisiana State University Hurricane Center M. Levitan, B. Wolshon	Storm surge model prediction; Evacuation and transportation planning.
University of Texas-Austin G. Wells, Center for Space Research	Disaster planning; Storm surge modeling; Remotely sensed data; Evacuation and transportation systems.
TAMU and TAMU Galveston S. Brody, B. Merrell, B. Seitz	Coastal flood evaluation; Storm surge impacts. Land use in coastal zone, community response.
Texas Southern University, C. Lewis	Transportation systems and evacuation planning.
Univ. of Texas - Brownsville J. Benavides	Coastal flood response; Regional Forecast Testbed International border issues.
Houston Galveston Area Council	Evacuation planning and transportation management lead governmental unit for operations and response

Table 2. Academic and Private Sector Partners in SSPEED

University Partners	Private/Gov Partners
Rice University - Lead	Houston Galveston Area Council
University of Houston	Texas Medical Center
Louisiana State University	Vieux and Assoc., Inc.
University of Texas at Austin	Walter P. Moore Eng.
TAMU & TAMU Galveston	Dodson and Assoc., Inc
Texas Southern University	TC&B
University of Texas - Brownsville	

BUDGET INFORMATION

Approximate Annual Budget -- \$ 3.0 million per year for five years.