Using New Technology

Hurricane Surge Models: A Primer

As a hurricane approaches the shore, several factors combine to cause a rise in sea level which can produce severe inundation and great destruction. This is the "hurricane storm surge." The storm surge is a dome of water, perhaps 50 miles wide and from four to 18 feet high, that sweeps across the coast near the point where the hurricane makes landfall. The storm surge is responsible for perhaps as many as 90 to 95 percent of hurricane-related deaths.

Through modern technology in computer applications, historical hurricane surge information has been used to develop numerical surge models to calculate storm innundation. These models take into account the intensity of the storm and the unique topography of the bay, estuary, or coastline shelf to predict the storm surge at the most hurricane-prone sections of our coastline. Using these models, meteorologists and emergency planners can now estimate the storm surge at a specific coastal location by simulating the approach of all possible sizes, intensities, and shapes of hurricanes along all relevant tracks and at all possible speeds. The simulations are also extremely valuable to emergency preparedness efforts, because the data allow planners to develop evacuation maps and plans in much greater detail than has ever been possible.

Three major surge models are used in the United States:

- SLOSH (Sea, Lake, and Overland Surge from Hurricanes), the newest model developed by the National Weather Service (NWS);
- SPLASH (Special Program to List the Amplitudes of Surges from Hurricanes), which is an earlier NWS model; and
- The FEMA Flood Insurance Storm Surge Model, used for the FEMA flood insurance program.

American Red Cross photo

SLOSH

The SLOSH model is used in basins that have irregular coastlines and contain large bays or estuaries such as in the New Orleans area, Tampa Bay, and Galveston/ Houston. Five storm intensities on the Saffir/Simpson Scale are provided by the SLOSH model. In addition to its intensity, any surge damage potential to a particular area depends on several other factors, including the track, size, and forward speed of the hurricane; and the nature of the area's coastline. Each hypothetical hurricane simulated by SLOSH would confront an area with hurricane force winds in one of five scenarios.

The output of the SLOSH model provides four major types of information on the effects of the simulated hurricanes. They are:

(1) Surface envelope of highest surges above mean sea level;
(2) Time histories of surges at selected gages or grid points;
(3) Computed windspeeds at selected gages or grid points; and
(4) Computed wind directions at selected gages or grid points.

SPLASH

To obtain open coast surge height data for a relatively smooth coastline, the numerical storm surge prediction model called SPLASH can be used. The SPLASH model predicts the height and duration of open coastline storm surge heights created by an approaching and landfalling hurricane. It assumes a generally smooth coastline and the absence of amplification of the surge by a bay or estuary. With the SPLASH model, inland routing techniques are used to delineate the innundation areas.

FEMA/FIA Model

A third storm surge model, the FEMA/ FIA model used by FEMA's Federal Insurance Administration, calculates coastal flooding due to hurricanes. This is also a computer model, which uses the same types of equations as SLOSH and SPLASH to set coastal flood insurance rates under the National Flood Insurance Program. The FEMA model is used to calculate the 100-year storm elevation—a value of surge height that has a probability of occurring within 100 years at a given location.

Developed by the Federal Emergency Management Agency with cooperation from the National Weather Service.