

**STORM-TIDE STAGES PRODUCED BY HURRICANE HUGO ALONG THE SOUTH CAROLINA COAST**

Storm-tide stages resulting from Hurricane Hugo were the highest ever documented along the coast in South Carolina (Schuck-Kolben, 1990, plates 1-31). The contour lines presented in figures 4-6 represent maximum storm-tide stages resulting from the hurricane. The stages represented by these contour lines were probably exceeded in some areas as a result of wave action and run-up effects. The highest storm-tide stages in the study area occurred at Bulls Bay on the northeast side of the hurricane (figs. 4-5), where surveyed high-water marks indicate a peak storm-tide stage of about 20 feet above sea level. The maximum storm-tide stage at the northern study limit near the Little River Inlet was about 12 feet above sea level (fig. 6). At the southern boundary of the study area, at the mouth of the North Edisto River, the maximum storm-tide stage was about 10 feet above sea level (fig. 4).

Storm-tide stages were highest at the mouths of inlets and bays and decreased inland, except at Bulls Bay and Winyah Bay, where highest storm-tide stages occurred inland. The mouth of Bulls Bay is open to the southeast. The strongest winds blew directly into the inlet, causing a buildup of water in the northwestern part of the Bay. Contours of the storm-tide stage at Winyah Bay (fig. 5) indicate that the storm-tide stage was highest near the middle of the bay and lowest just inside the inlet. The inlet of Winyah Bay is confined by jetties that extend eastward from the inlet. Near its mouth, the bay is protected by a massive barrier island, which has dunes higher than 40 feet above sea level. The high storm-tide stage near the middle of the Winyah Bay was probably the result of the storm tide entering the bay in the vicinity of North Inlet, a former entrance to the bay, where the barrier island elevations are lower (Nelson, 1991).

Profiles of storm-tide stage along the outer and inner coast from North Edisto River to North Myrtle Beach are shown in figure 7. The outer coast is defined for this report as the part of the coast that directly contacts the Atlantic Ocean and is not protected by a barrier island or marshland. For example, Sullivan's Island and Garden City Beach are considered to be outer-coast locations. The inner coast is the part of the coast that is in contact with seawater (by way of a marsh, bay, or tidal river) but is protected by a barrier island or extensive marsh. One example of an inner-coast location that was protected by a barrier island is Cat Island (fig. 5).

The profiles in figure 7 also show that storm-tide stages generally were highest at the outer coast and decreased landward. The major exception was Bulls Bay where the stage was lowest at the outer coast and increased toward the inner coast.

Normal predicted tidal stage and observed tidal stage for September 21-23, 1989, are shown for five locations along the coast in figure 8; Wilmington, N.C. (about 150 mi north of the eye); South Island Plantation, S.C. (entrance to Winyah Bay, about 50 mi north of the eye); Charleston Harbor, S.C. (in the eye); Fort Pulaski, Ga. (about 80 mi south of the eye); and Fernandina Beach, Fla. (about 170 mi south of the eye).

The hydrographs in figure 8 indicate that the storm-tide stage was more than 10 feet above sea level within the eye (Charleston, S.C.) and that the storm-tide stages were higher north of the eye than south of the eye. The highest observed storm-tide stage at Fort Pulaski was similar to normal predicted tidal stage, but it occurred about 3 hours after the predicted high tide. The highest observed storm-tide stage at Charleston and South Island Plantation (Winyah Bay entrance) occurred prior to normal predicted high tide. At Wilmington, N.C., and Fernandina Beach, Fla., the observed high tide occurred at the same time as the normal predicted high tide.

**FREQUENCY OF COASTAL FLOODING**

Annual peak tidal stages (including storm-tide stage) at the Customs House Wharf gage in Charleston (data courtesy of National Oceanic and Atmospheric Administration, National Weather Service) are shown in the histogram in figure 9. This figure indicates that the storm-tide stage produced by Hurricane Hugo was the highest for the period on record (since 1922).

The maximum outer-coast storm-tide stages from Hurricane Hugo along the South Carolina coast between North Edisto River and Little River Inlet are shown along with storm-tide stages computed for various recurrence intervals by the Federal Emergency Management Agency (FEMA) for the counties of Charleston (FEMA, 1988), Georgetown (FEMA, 1989), and Horry (FEMA, 1988) in figure 10. The recurrence intervals in this figure are based on the percentage chance that a stage in figure 10 is the average time interval, in years, between stages that equal or exceed a given magnitude. For example, a stage with a 100-year recurrence interval may be expected to exceed an average of once in 100 years. Stated another way, it is a stage that has a 1-percent probability of being equal or exceeded in any given year. The chance that a stage will exceed the 100-year stage increases with time periods longer than 1 year. During any 50-year period there is about a 40-percent chance, and for any 90-year period there is about a 60-percent chance of one or more stages exceeding the 100-year or 1-percent probability magnitude. The maximum outer-coast storm-tide stage of 16 feet at Bulls Island had a recurrence interval in excess of 500 years (fig. 10). The 12-foot stage at Myrtle Beach area had a recurrence interval of about 50 years.

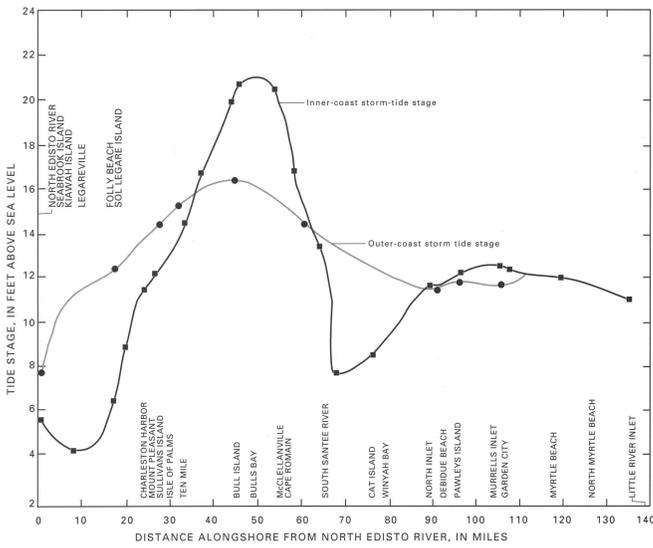


Figure 7. Outer-coast and inner-coast alongshore profiles of storm-tide stages produced by Hurricane Hugo, September 21-22, 1989.

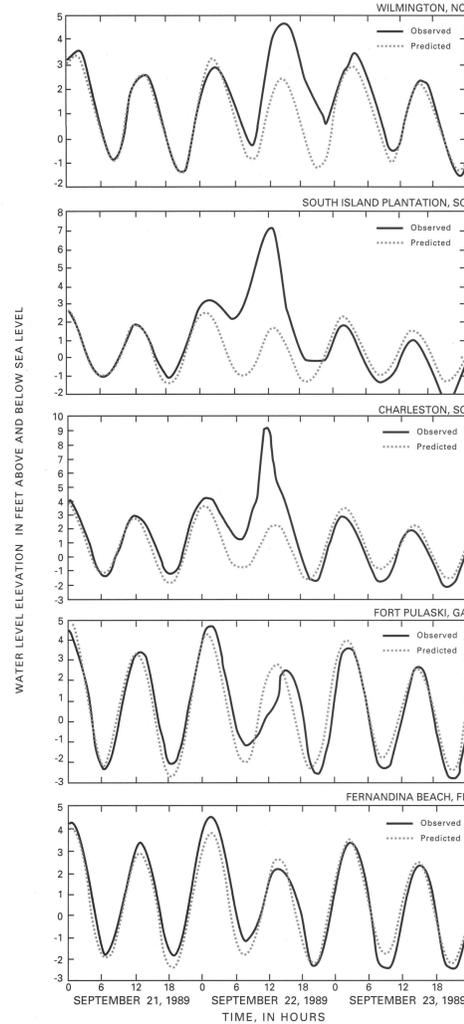


Figure 8. Stage hydrographs of observed tide and predicted normal tide stage for five stations from Fernandina Beach, Fla., to Wilmington, N.C., September 21-22, 1989. (Data Courtesy of National Oceanic and Atmospheric Administration, National Weather Service)

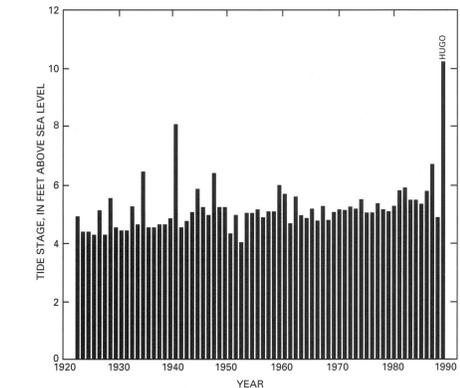


Figure 9. Annual peak tidal stages at Customs House Wharf, Charleston, S.C. (Data Courtesy of National Oceanic and Atmospheric Administration, National Weather Service)

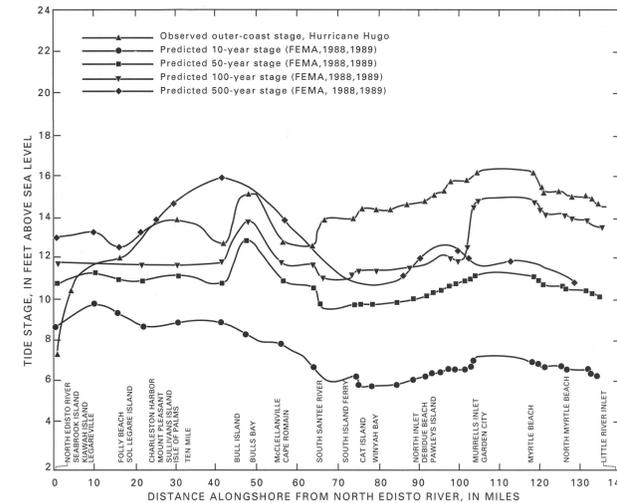


Figure 10. Outer-coast observed and predicted tidal stages for selected recurrence intervals along the South Carolina coast.

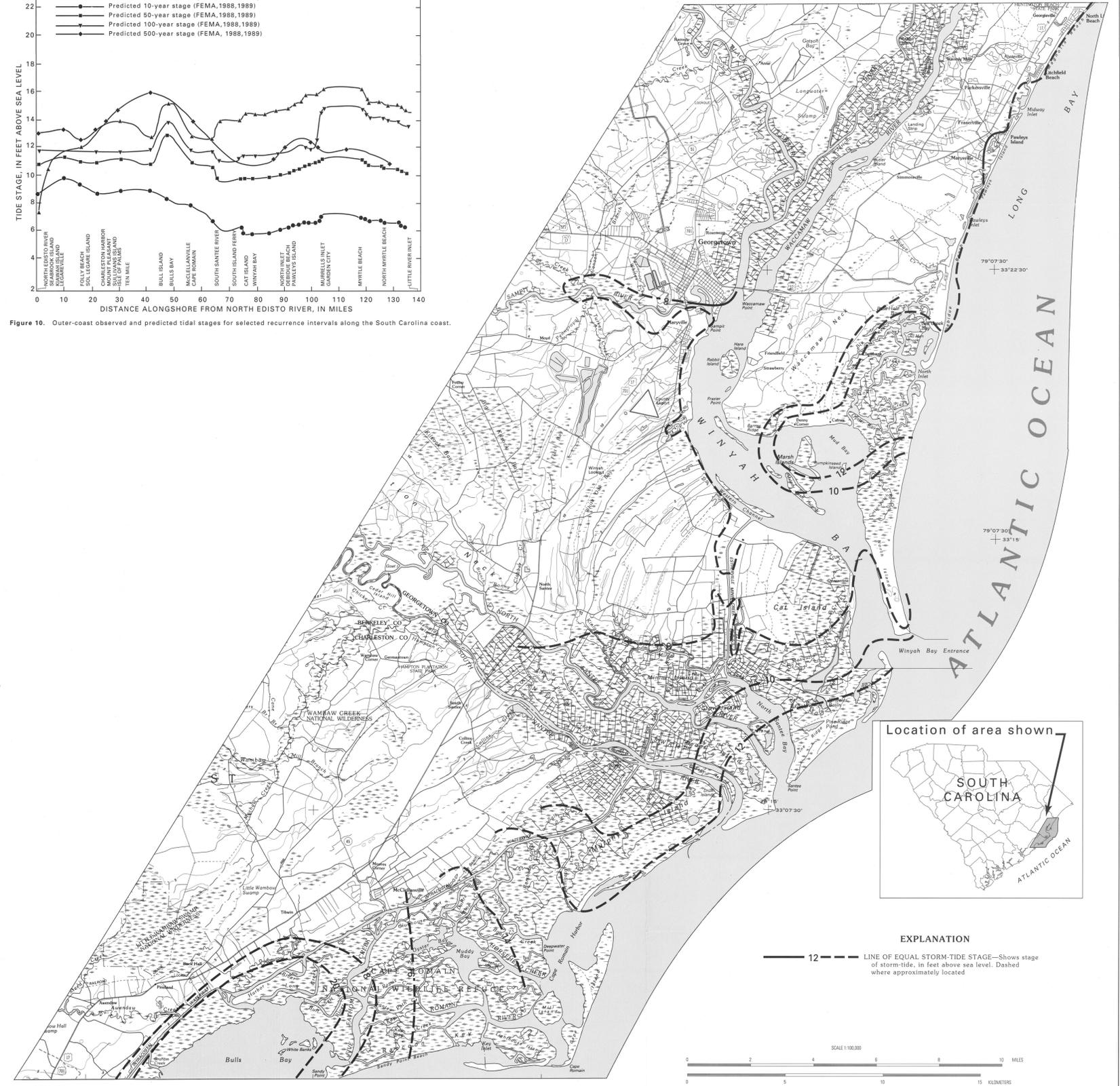


Figure 5. Storm-tide stages from Bulls Bay to North Litchfield Beach.