An Overview of Extreme Storms in the U.S. Gulf of Mexico and Their Coastal Impacts

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During the past decade, the U.S. Gulf of Mexico coast has been subjected to the landfalls of 14 hurricanes. Each of these storms forced changes to the coast, some recovering naturally within months, others persisting to the present. The magnitudes of change can be scaled in terms of storm wave-runup elevation, R, and still-water elevation, η (which includes storm surge, wave setup, and astronomical tide), relative to the peak elevation of the foredune, Dhigh. As R/Dhigh and η/Dhigh increase, thresholds will be crossed that define regimes of increasing impact magnitude, progressing from runup colliding against the dune and eroding it landward, to runup overwashing the dune (R/Dhigh > 1), to still water level completely submerging the beach system (η/Dhigh > 1). The greatest coastal changes have been observed during this latter inundation regime, which can occur locally on a barrier island and cut an inlet, as occurred during Hurricanes Charley (2004), Ivan (2004), and Katrina (2005), or can submerge tens of kilometers of coast, as occurred on the Bolivar Peninsula, TX during Ike (2008) and on the Chandeleur Islands, LA during Katrina (2005). Airborne lidar surveys showed the inundated Chandeleurs lost 82% of their surface area and their Gulf-front shores eroded landward ~250 m. These islands line the Mississippi Delta, which is subsiding. This induced a relative sea-level rise that conditioned the coast for extreme storm changes. Should global sea-level rise accelerate in the future as predicted, barrier islands worldwide may respond similarly when inundated during storms.