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The role of geologic inheritance on storm impacts along the south Texas Coast, USA

Bradley Weymer (1), Chris Houser (1,2), John Giardino (1), Patrick Barrineau (2), Mark Everett (1), and Michael Bishop (2)

(1) Department of Geology and Geophysics, Texas A&M University, College Station, Texas USA, (2) Department of Geography, Texas A&M University, College Station, Texas USA

The role of geologic inheritance on modern barrier island evolution is an often overlooked aspect of how barriers respond to and recover from extreme storms. For example, the position of coastal barriers is largely determined by antecedent geology/topography, which in turn affects overwash and inlet processes and subsequently influences the nature and extent of barrier transgression. Previous studies suggest that modern barrier island transgression is accomplished primarily by relative sea-level rise and extreme storms that are capable of breaching the dunes and depositing sediment to the back-barrier in the form of blowouts, washover fans and terraces. In areas where the dune heights are low, lateral dune erosion through the expansion of washover conduits can develop, whereas in areas where the dune heights are high, relative to the local base level, only the base of the dune is scarped and sediment is transported seaward. Unfortunately, the relationship between dune height and antecedent geology associated with storm impacts has not been investigated in detail. Thus, this study examines the utility of combining non-invasive Electro-Magnetic induction (EM), ground-penetrating radar (GPR), and DEM-derived surface parameters from LiDAR data to examine the influence of antecedent geology on the alongshore variability of modern storm impacts and barrier transgression. Our goal is to develop a multi-sensor toolbox to reveal linkages between pre-existing subsurface stratigraphy and surface morphology. For this study, we incorporated a series of shore-normal and alongshore geophysical surveys to investigate the 3-D subsurface stratigraphy to reconstruct the geologic history of the central portion of Padre Island National Seashore, Texas, USA. Additionally, airborne LiDAR-derived digital elevation models were used to generate geomorphometric parameters including slope, aspect, curvature, and roughness to classify the modern landscape according to surface characteristics. It is hypothesized that within the study area, higher dunes are located near a previously identified paleo-channel, which corresponds to a lower probability of overwash potential based on preliminary interpretations from EM, GPR, and topography data. These findings suggest that the paleo-channel acts as an internal sediment sink, which serves as source area for controlling local dune height (i.e. larger dunes). In other words, we suggest that the geologic framework controls dune height, which in turn governs modern barrier transgression in response to relative sea-level rise and extreme storms. Future work will determine the relationships between dune height and paleo-channels to make predictions for future storm impacts along the south Texas Coast, which can ultimately be used for coastal management and planning purposes.