Coasts contain interrelated dynamic systems that continuously transform over different temporal and spatial scales as a result of geomorphic and oceanographic changes. Sea level rise (SLR) has the potential to affect coastal environments in a multitude of ways, including submergence, increased flooding, and increased shoreline erosion. Low-lying coastal environments such as the Northern Gulf of Mexico (NGOM) are particularly vulnerable to the effects of SLR, which may have serious consequences for coastal communities as well as ecologically and economically significant estuaries. The future of these coastal environments relies on substantial information regarding risks such as SLR to make informed decisions for managing human and natural communities. Evaluating potential changes in tidal hydrodynamics under SLR is essential for understanding impacts to navigation, ecological habitats, infrastructure and the morphologic evolution of the coastline; tidal hydrodynamics influence inundation, circulation and sediment transport processes. However, the complexities associated with coastal processes make this a difficult task.

The intent of this research is to evaluate the dynamic effects of SLR and coastal morphologic changes on tidal hydrodynamics along the NGOM and within three National Estuarine Research Reserves (NERRs), namely Grand Bay, MS, Weeks Bay, AL, and Apalachicola, FL. An extensive literature review revealed that many studies have neglected to consider the nonlinear effects of SLR by employing a simplistic bathtub approach (i.e., the existing mean sea level is elevated by the amount of SLR, causing the shoreline to be inundated). More recent efforts have begun to consider the dynamic effects of SLR (e.g., the nonlinear response of hydrodynamics under SLR); however, little research has considered the integrated feedback mechanisms and co-evolution of multiple interdependent systems (e.g., the nonlinear responses and interactions of hydrodynamics and coastal morphology under SLR). Using a large-domain hydrodynamic model, tidal hydrodynamics were simulated under past, present and future conditions to observe the tidal hydrodynamic response of the NGOM to SLR under a changing landscape. A sensitivity analysis indicated that estimates of morphological changes should be included in hydrodynamic assessments of SLR. Therefore, the model is modified with sea levels and morphology that represent the conditions at each time period. Tidal hydrodynamics circa 1848 were simulated using historic shoreline positions, topographic/bathymetric elevation data, and past sea levels. To simulate future tidal hydrodynamics, various methodologies to project future morphology were compared and contrasted. A novel statistical method was selected to make probabilistic projections of future shoreline change and dune heights under each SLR scenario. Future tidal hydrodynamics circa 2050 and 2100 were simulated and compared with present and past results. Results indicate changes in tidal velocities, amplitudes, and inundation areas. This provides insight as to how tidal hydrodynamics have changed historically and how they may be altered in the future.

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Approved for distribution by Scott Hagen, Committee Chair, on March 16, 2015.
The public is welcome to attend.