BEACH PLANFORM EQUILIBRIUM, APPLICATIONS AND METHODOLOGIES FOR CLIMATE CHANGE RESILIENCY CONSIDERATIONS

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BACKGROUND

Climate change and sea level rise (SLR) present a challenge and added uncertainty for managing coastal areas. Many coastal cities and developed coastal areas are assessing future vulnerabilities to SLR and developing adaptation plans for improved resiliency. Equilibrium conditions for beach planform can be critical to the long-term stability of beaches and dunes fronting coastal cities. In many cases, resiliency and adaptation programs for beachfront areas are based on assumptions of evaluating scenarios of higher water elevations and hydrodynamic forcing under present time topographic and bathymetric conditions. These evaluation parameters suggest that the coastline and existing morphological features are near equilibrium condition and are expected to remain near similar equilibrium over the SLR scenarios under consideration. Such assumptions may be limited to open coast conditions where the beach and the developed coastal planform follows theoretical open coast conditions or constant equilibrium planform.

EVOLUTION OF EQUILIBRIUM PLANFORM

Potential change in beach planform equilibrium should be considered in long-term planning in many cases. For example, cases where geomorphology is influenced by natural large-scale temporal and spatial changes or where development and coastal encroachment become more pronounced in response to SLR. Natural geomorphologic influences on equilibrium planforms may include coastal areas with barrier islands, inlets, river deltas, etc. Anthropogenic influences on equilibrium include areas where existing structures, bulkheads, seawalls or upland development are presently or expected to present an encroachment on the active beach system. Beach restoration in the form of nourishment and erosion control structures can also influence equilibrium planforms.

FLORIDA CASE STUDIES

This paper discusses factors influencing beach planform along the Florida Atlantic and Gulf of Mexico coastlines and proposes conceptual methodologies in various applications.

GULF COAST BARRIER ISLAND APPLICATIONS

The paper will include discussions on formation and evolution of the barrier island system of southwest and central Florida and time scale of the equilibrium condition change. Barrier islands and tidal inlets are dynamic in nature and their evolution occurs at larger time scale than typical coastal projects planning and design. The timing of early beachfront development relative to the barrier island or inlet evolution stage at that time, is a main factor of the potential long-term stability or level of sustainable equilibrium conditions. For example, the morphologic conditions for a given inlet of a barrier island 50 to100 years ago might not be necessarily close to the existing conditions. In several cases early development near inlets or headlands were developed along shoreline curvatures where vast ebb deltas supported the shoreline at one point of time. As morphological features evolve over decades the equilibrium planform deviated from what existed at time of early development. This long-term process resulted in areas of chronic erosion near upland development. The paper will discuss the application of various levels of 2DH process models, contour line model change models and schematic inlet models to provide schematic model of expected range of equilibrium conditions under such scenarios

FLORIDA ATLANTIC COASTLINE APPLICATIONS

Case studies along the Atlantic coast will also demonstrate the effects of early navigation and upland development over a century ago along the southeast region of Florida. The paper will discuss the combined effect of inlets, varying levels of exposed nearshore hardbottom, and beach restoration projects on altering equilibrium planforms. The paper will outline applied methodology of varying levels of detailed process modeling to parameterize long term trends and apply regional contour line change model for simulating large scale and long term expected equilibrium planform under varying scenarios. The coastal models used in this application were chosen to provide detailed and broad understanding of the site specific to regional factors governing the beach evolution. Regional trends that influence a local project area include regional offshore bathymetry orientation changes and offshore reef formations that may influence local wave transformation, sediment transport and the nearshore beach equilibrium planform. (Figure 1)

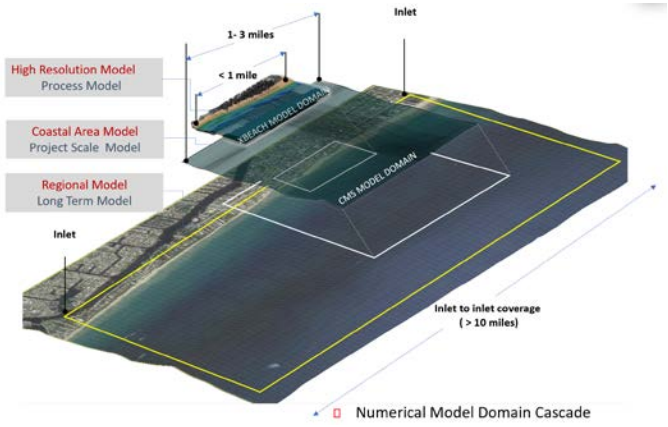

Figure 1 - Model cascade from process modeling to setup large scale contour line regional model and assess equilibrium planform