Long Term Risks: Novel Barrier Island Retreat Behaviors Arising from Increasing Rates of Sea Level Rise

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Abstract

Recent studies have documented novel barrier island systems to the increased rate of sea level rise predicted over the coming century and beyond (Fairbanks, 1989; Mellet et al., 2012). In response to rising sea levels, barrier systems have been undergoing rapid and often extensive morphological change at rates that are unprecedented in historical records. These changes include coastal flooding and erosion, back-barrier saltwater intrusion, and barrier island retreat. These hazards have forced many coastal communities to adopt new management strategies and planning approaches. Yet, understanding the potential for future coastal flooding is challenging due to the lack of a well-documented record of rapid barrier island evolution. Here, using a novel three-dimensional model, we show that the internal dynamics of barrier systems can also result in significant deposition at back-barrier systems under a range of scenarios, from autogenic cycles of periodic retreat to allogenic forcing from sea level rise and aggradation. Our model is validated using the existing sea level curve, and suggests that the internal dynamics of barrier systems have also played a significant role in the evolution of coastal systems. The model also elucidates the potential for interactions between autogenic and allogenic forcing, showing that the internal dynamics of barrier systems might interact to produce novel barrier retreat behaviors. For the first time, a model is presented that can predict the evolution of barrier systems over the coming century and beyond. Consequently, we propose that future research should focus on the exploration of the sedimentological record to provide key insights into how barrier systems will evolve over the coming century and beyond.