Marsh platform dissection as a response to sea level rise: eco-physical mechanisms of sediment erosion

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Objectives: Salt marshes provide valuable ecosystem services to humanity, but are threatened by accelerating relative sea level rise (RSLR). How marsh functionality will be affected by RSLR depends on the morphological response of the marsh surface. A common paradigm is that marshes accrete vertically, keeping pace with moderate rates of RSLR until a threshold is reached, after which the marsh surface will submerge and disintegrate by a number of proceses. We propose that this paradigm applies only to certain conditions of tidal range and RSLR. In other cases, the marsh platform continues to accrete and is preserved by increasing drainage efficiency through expansion of its tidal creek network, thereby compensating for the increased tidal prism. We suggest that this alternate scenario applies to many regions in the U.S. and worldwide. ***Our objective is to identify the processes and conditions leading to increased channelization and drainage of the marsh platform as compared to submergence.***

Hypotheses: We will address three overarching hypotheses:

1. The geotechnical properties of marsh soil differ at creek head settings to the surrounding marsh platform.
2. Crab colonization enhances headward erosion of creeks through direct resuspension, alteration and weakening of the substrate, and through direct impacts on the hydrodynamics.
3. Plant dieback caused directly by crab activity enhances the headward erosion of creeks.

Location: Detailed field studies will be undertaken in the Santee Delta, South Carolina. Mesocosm studies will be undertaken at the University of Houston and aerial photograph analyses, performed at Boston University, will consider the Southeast of the US.

Approach: We will combine physical and biological approaches through field and mesocosm studies to understand the dissection of salt marsh platforms by headward-eroding channels. Our studies will integrate geomorphological and ecological fieldwork with historical assessments of channel growth and sea-level rise to examine the forcings responsible for driving the erosion and the mechanisms of the processes itself.

Devlierables: We will develop a new conceptual model for the response of marshes to relative sea-level rise using field measurements of physical and biological processes and rates of creek extension. This model will be broadly applicable to many salt marshes in the U.S. and globally. Our project will be one of the first to quantify biological feedbacks on marsh geomorphology and the results will be of interest to a wide range of scientists interested in salt marsh geomorphology, ecophysical processes, and basic salt marsh ecology.