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On the impact of bio-geomorphological gradients on salt marsh survival

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Coastal wetlands are among some of the most biologically productive ecosystems on the planet. Not only do they sequester large amounts of carbon and improve water quality, but they also provide a buffer between the ocean and coastal communities protecting them from effects of climate change such as accelerated sea level rise or increased storm frequency. Over the past century, increased salt marsh area loss was observed through the formation of internal open water bodies, so-called ponds, emerging in established wetlands such as temperate salt marshes fringing the US Mid-Atlantic coast. However, detailed causes leading to pond formation and their implications for salt marsh survival are still subject to debates. This study focused on disentangling the impact of bio-geomorphological gradients, governing sediment, and plant species composition on the formation of ponds. Marsh platforms are composed of a mosaic of plant species differing in growth properties related to tolerance in inundation stress and soil anoxia. Salt marsh sediment characteristics were shown to change with increasing distance from the open water sediment source creating specific spatial gradients. We carried out stratified field surveys on plant species distribution and sediment characteristics (e.g., organic matter content and compressibility) and compared results to a controlled mesocosm experiment identifying the plant-species growth response to differences in inundation time. The combination of field and laboratory measurements enables us to evaluate how bio-geomorphological gradients consisting of species-specific plant properties (plant growth and mortality) and sediment characteristics can explain pond formation and marsh degradation.