Investigation of Salt Marsh Platform Vegetation Stress Indicators to Reveal Potential Marsh Loss Mechanisms

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In the Northeastern US, tidal salt marsh is being lost at rates 5-10% per decade, attributed to symptoms of sea-level rise, such as fragmentation, edge erosion, and tidal channel expansion. Unexpectedly, high-elevation plants are experiencing mortality, contributing to the development and expansion of ponds, pannes, and areas of bare peat on the marsh platform. These observations of high marsh mortality contrast strongly with conceptual models of salt marsh vulnerability to climate change, where generally low-elevation vegetation exposed to excessive inundation is considered more vulnerable to loss. However, observations of high marsh plant mortality are in strong accordance with the dominant paradigm of salt marsh ecohydrologic zonation, which identifies poorly drained conditions in the upper marsh, and sustained periods of continuous upward flow of saline water in these zones during neap tides. To help identify spatial patterns in plant stress, we conducted a study of soil redox, greenhouse gas exchange, and other plant stress indicators at three locations in Massachusetts, New York, and New Jersey, where excessive ponding is found on the marsh platform. We employed analysis of satellite imagery for band ratios, porewater sulfides, analysis of water levels and pressure gradients from nested piezometers, as well as greenhouse gas exchange. Our results reveal significant spatial patterns in plant stress, challenging the assumption that low marsh elevations are most vulnerable. These findings suggest a complex relationship between tidal flooding, soil redox, and plant health, emphasizing the need for nuanced models to accurately capture the dynamics of marsh disintegration.