Poster #9-26

Building Coastal Models with the Salt Marsh Accretion Response to Temperature eXperiment (SMARTX)

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The Energy Exascale Earth System Model (E3SM) simulates fully coupled processes and interactions between water, energy, carbon and nutrient cycles. E3SM connects vegetation and soil dynamics through nutrient uptake, plant production, litterfall and decomposition as a function of abiotic parameters (i.e. temperature and moisture). However, E3SM is designed to characterize terrestrial and freshwater habitats and connects terrestrial and open ocean ecosystems using a single transport term, ignoring coastal dynamics. The goals of our project were to: 1) Parameterize a point version of E3SM to mimic coastal wetland habitats and 2) Determine C_3 and C_4 marsh community responses to the interacting effects of sea level rise, increased temperature, and elevated CO_2 (eCO_2) demonstrated in the Salt Marsh Accretion Response to Temperature eXperiment (SMARTX). We adapted E3SM to a coastal ecosystem using long-term data sets from field experiments conducted at the Global Change Research Wetland (GCReW). Tidal forcing was mimicked using a 2-column system. Column 1 simulated interactions between vegetation and soil while column 2 simulated water level (both tidal and sea level rise). Parameters for generic C_3 and C_4 plant functional types were adapted to represent saltmarsh C_3 and C_4 communities. We also altered biogeochemical processes to incorporate salinity, methane, and sulfur dynamics.

Plant community responses to environmental change were non-linear, non-additive and inconsistent between C_3 and C_4 plants. We were able to characterize the following shifts observed in SMARTX results: alterations to above:below ground biomass ratios with eCO_2 in C_3, but not C_4 communities; peak biomass responses to moderate temperature rise and decline with further warming; synergistic effects of warming and eCO_2 on biomass allocation in C_3 communities.