Title: **Increased Plant-Mediate Oxygen Transport in Response to Elevated CO_2 But Not Warming in the Salt Marsh Accretion Response to Temperature eXperiment (SMARTX)**

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Project Abstract:

Coastal wetlands are hotspots of carbon sequestration, cycling, and export that regulate the biogeochemistry of coastal rivers, estuaries, and continental shelves, but are poorly represented in Earth System Models. The Salt Marsh Accretion Response to Temperature eXperiment was established at the Global Change Research Wetland in 2016 to advance model representations of the complex interactions between plants, microbes, and hydrology in forecasts of coastal wetland responses to global climate change. We actively manipulate whole-ecosystem temperature and atmospheric CO_2 concentration through feedback-controlled heating from the plant canopy to 1.5 m soil depth and CO_2 addition (eCO_2).

Complexity in tidal wetland responses to global change arises from the fact that wetland plants simultaneously regulate supplies of electron donors (organic carbon) and electron acceptors (molecular oxygen). We found that warming and eCO_2 generally increase aboveground net primary productivity (NPP) but have more complex and non-linear effects on belowground NPP. These non-linear belowground plant responses are driving key soil biogeochemical processes such as redox potential, soil carbon sequestration, and methane emissions. A custom-designed automated redox system in a subset of the plots shows that eCO_2 increases redox potential by up to 150 mV, presumably by increasing O_2 transport through plant biomass. Warming dramatically

increases CH_4 emissions through increased labile carbon supply but warming crossed with *e*CO_2 caused CH_4 emissions to decline dramatically because of increased CH_4 oxidation. Plots with the highest belowground NPP tended to have the highest rates of soil carbon sequestration, except when warming was crossed with *e*CO_2, suggesting that increased plant O_2 transport has enhanced soil organic matter decomposition. FTCIR of porewater dissolved organic carbon indicates that *e*CO_2 may cause a loss of aromatic compounds, consistent with an increase in plant O_2 transport. Collectively, our results show that plant O_2 transport must be represented in numerical models to forecast key coastal wetland biogeochemical phenomena.

The Coastal Carbon Ecosystem Model (CCEM) is a point-based model with plant-sediment feedbacks to forecast changes in soil elevation and soil carbon stocks over decade to century timescales. We modified the CCEM to include semi-empirically derived relationships between belowground biomass and soil organic matter decomposition. Model results indicated that *e*CO_2 and SLR interact synergistically to increase soil carbon burial, but feedbacks between plant biomass and decomposition (priming by plant O_2 transport) reduced the impact of *e*CO_2 on soil carbon accumulation. Such feedbacks are being incorporated into the land component of the Energy Exascale Earth System Model.