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Linking Transient Changes in Dissolved Organic Chemistry to Wetland Carbon Emissions

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At the interface of land and water, coastal wetlands store massive reservoirs of soil carbon (C) that are being impacted by sea level rise. As we seek the development of more accurate models to predict changes in wetland C cycling, there remain critical knowledge gaps due to the oversimplification of numerous C transformations in the wetland rhizosphere. A major challenge in measuring these transformations is that they occur over short spatiotemporal scales in a heterogeneous soil environment, which also undergoes diurnal and tidal perturbations. A multifaceted analytical approach is needed to better understand how the global C cycle is regulated by these fine-scale dynamics. To understand the role of plant-mediated oxygenation on these C transformations, soils have been collected before and after the active growing season across a *Phragmites australis*-dominated transect, within a coastal wetland that is part of the Smithsonian Environmental Research Center. The soils are being used in an incubation study where transformations in organic C, including exact mass and nominal oxidation state changes, are being investigated with Fourier transform ion cyclotron resonance mass spectrometry. Greenhouse gas production and meta-omics analysis are also being utilized to understand how the microbial communities and trophic cascade of carbon change over time. This quantitative approach will be used in conjunction with in-situ planar optode chemical imaging for fine-scale visualization of O_2 and CO_2 profiles in the rhizosphere to pinpoint biogeochemical hotspots. Our emerging conceptual framework is that short spatiotemporal dynamics in the wetland rhizosphere drive large-scale variability in wetland C storage and emissions. Our results can provide a deeper mechanistic understanding of the C cycle while increasing the accuracy of global C models and informing more effective climate mitigation policies.