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Flooding Effect on Rhizosphere Processes in Salt Marsh Plants: Visualizing Spatio-temporal Dynamics of O2 and CO2 using Planar Optodes

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Tidal marshes are vegetated coastal ecosystems that are heavily influenced by estuarine gradients such as tidal inundation and salinity. The sequestration potential of these blue carbon ecosystems relies on the balance between the input and degradation of soil organic matter. At the root-soil interface, plant activity greatly impacts the physicochemical and biological properties of the surrounding soil through interactions with soil microbiota. The transport of oxygen into the anoxic sediments and exudation of metabolic substrates by wetland species demonstrate two key mechanisms by which plants can prime the microbial decomposition of organic matter. Previous studies have observed markedly distinct modulation of rhizosphere processes even amongst closely related species. Using planar optodes, these biogeochemical processes can be visualized and quantified as 2D images via dynamic quenching of O_2 and CO_2-sensitive fluorophores. This technique enables real-time spatial and temporal mapping of these analytes with minimal disturbance to the belowground biomass. Characterizing these profiles for marsh vegetation under hydrological stress may inform future predictions about species performance under the ongoing threat of accelerated sea level rise. In a microcosm experiment, three salt marsh species will be used in a transplant study to investigate the effect of inundation stress on O_2 and CO_2 dynamics in the rhizosphere over alternating light-dark cycles. By combining physiological measurements with morphological attributes, we aim to catalogue plant trait information that can used in scaled-up projections of long-term ecosystem functioning in wetlands.