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Reactive transport modelling of subsurface carbon dynamics in a pristine salt marsh on the Pacific coast

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Conservation and restoration of salt marshes are increasingly recognized as climate mitigation and adaptation actions, due to the high carbon sequestration capacity and flood protection. However, we lack the quantitative understanding of subsurface carbon cycling in salt marshes that is required to implement effective management practice.

The amount of organic carbon sequestered in soils is determined by the rate of its decomposition versus the rate of burial. Burial rates are relatively straightforward to quantify using isotope dating of soil accumulation, but decomposition occurs via a complex network of chemical reactions and a myriad of environmental factors govern the reaction rates. The scientific community does not have a good handle on the environmental factors that govern reaction rates in such hydrologically dynamic systems. Previous studies suggest that saline wetlands have negligible methane emissions due to substantial bacterial sulfate reduction which outcompetes acetoclastic methanogenesis, and high rates of anaerobic methane oxidation by sulfate. However, studies along the Pacific coast of the USA are relatively limited when compared to studies on the East and Gulf coasts, and those marshes are typically dominated by different vegetation and climate conditions. Vegetation cover and type, and seasonality are increasingly identified as important drivers of carbon sequestration, highlighting the importance of studying Pacific wetlands.

To address this knowledge gap, a combination of data collection and modelling is used to quantify relevant biogeochemical processes within one marsh, across a number of environmental conditions: vegetation versus mudflat, high tide versus low tide, dry season versus wet season. Field data from an undisturbed salt marsh in Elkhorn Slough National Estuarine Research Reserve in Monterey Bay (Yampah Marsh) will be used for demonstration of the model output. This marsh is densely vegetated with *Salicornia Pacifica*. Subsurface carbon decomposition rates will be quantified using a biogeochemical 1D reactive transport model that is constrained using pore water concentration profiles of sulfate, phosphate, chloride, methane, ammonium, total alkalinity, and dissolved inorganic carbon. Reaction rates will be quantified and compared to explore how environmental conditions affect reaction rates.