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# Methane dynamics and its relevance for carbon budgets in a temperate salt marsh

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Understanding the fate and cycling of carbon in coastal ecosystems is critical for understanding the global carbon budget. Salt marshes are considered large carbon reservoirs and are part of blue carbon ecosystems. This presentation will discuss recent findings on carbon sources, sinks, and fluxes across sediments, water, plants, and the atmosphere in a temperate salt marsh. Early studies suggested that the ecosystem acted as a net carbon sink, but this expectation has been revisited when complemented with information on vertical and lateral carbon fluxes of $CH_4$. The study site was an overall net carbon source to the atmosphere, with annual emissions of methane contributing to achieving this net source. Our results show that tidal creeks are potential hotspots for $CH_4$ emissions and could contribute to lateral transport of $CH_4$ to the coastal ocean due to supersaturation of $CH_4$ (>6,000 μmol/mol) in water. Furthermore, we found unexpectedly high $CH_4$ concentrations up to 145,000 μmol $mol^{-1}$ positively correlated with $S^{2-}$ (salinity range: 6.6–14.5 ppt). $CH_4$ and $CO_2$ within the soil pore water were produced from young carbon, with most $\Delta^{14}C\text{-}CH_4$ and $\Delta^{14}C\text{-}CO_2$ values at or above modern. We found evidence that $CH_4$ within soils was produced by methylotrophic and hydrogenotrophic methanogenesis. Several pathways exist after $CH_4$ is produced, including diffusion into the atmosphere, $CH_4$ oxidation, and lateral export to adjacent tidal creeks, the latter being the most likely dominant flux. Our results highlight the potential for high $CH_4$ production, the need to understand the underlying biogeochemical controls and the challenges of evaluating $CH_4$ to accurately account for carbon budgets in salt marshes.