Shallow ponds affect carbon storage in temperate salt marsh ecosystems

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Salt marshes have some of the highest rates of organic matter production and storage in coastal environments. Refining the role of marshes in carbon budgets requires developing biogeochemical assessments that integrate spatial and temporal heterogeneity. This is becoming increasingly important because disturbances that reduce the productivity of emergent grasses and drainage of marsh soils will likely contribute to an expansion of shallow ponds. These permanently-inundated depressions can be prominent features of the landscape that exist for decades, yet little is known about how ponds may affect marsh ecosystems. We characterized the metabolism of 3 ponds in a temperate salt marsh (MA, USA) and evaluated the effects of pond formation and expansion on sediment organic matter composition and preservation. Sediment cores (20 cm) were collected over 11 weeks in the summer and fall, during periods of tidal isolation and flushing. Fluxes of dissolved inorganic carbon (DIC), sulfate, and ammonium were estimated from pore water profiles. Additional cores (50 cm) were collected for organic matter characterization and to estimate accretion rates. Pond sediments were heterotrophic and sulfate reduction was the primary metabolic pathway. Sediment fluxes were similar between seasons but were faster during periods of tidal isolation. Sediment accretion rates were much slower in the ponds compared to the marsh. High rates of sediment respiration could largely account for differences in accretion rates between ponds and the marsh, thereby providing a mechanism for pond formation and development. Consequently, future expansion of pond spatial extent may reduce the ability of marshes to store carbon.