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Scaling greenhouse gas fluxes in a natural and restored wetland from microsites to ecosystem level

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Current methane emission models are employing a top down approach in which methane emissions are estimated. However, meteorological, hydrological and ecological drivers of methane and carbon dioxide fluxes in wetlands operate on different spatial and temporal scales, thus necessitating bottom-up and top down assessments to refine model outcomes. Fast methane (CH4) gas analyzers such as the LI7700 are now enabling continuous ecosystem scale (eddy flux) measurements and assessment in conjunction with traditional chamber measurements and localized belowground measurements for microsite contribution (bottom-up) analysis. Here, we have set up two locations, one in a natural and one in a restored tidal salt marsh in the Meadowlands of New Jersey (MNJ) USA, in order to compare ecosystem level methane fluxes with scaled microscale measurements. Continuous methane fluxes were measured at the ecosystem level with the Licor7700 using eddy flux measurements over three growing seasons at the restored site and two growing seasons at the natural wetland site. Concurrently, measurements were collected from chambers and subsurface dialysis samplers, at several microsites in each site as well. Methane and carbon dioxide emissions, and their belowground pools, were highly variable in space and time over the two growing seasons. The temporal dynamics of methane and carbon dioxide fluxes in each of the locations suggest small-scale site-specific controls on methane emissions, but ubiquitous, non-specific controls on carbon dioxide uptake and release. Methane emissions as measured at the ecosystem scale, and confirmed by chamber measurements, increased at the restored site from 2012 to 2013, despite no corresponding increases in dissolved organic carbon or belowground pool measurements. Scaled belowground pool measurements from non-vegetated microsites can estimate the measured chamber methane fluxes, but this is not possible in vegetated microsites. Additionally, methane emissions from chamber measurements matched ecosystem level measurements better in the restored than in the natural wetland site. This presentation examines the relationships between controls on carbon dioxide fluxes, belowground methane pools, and scaling methane emissions from chamber measurements to ecosystem level measurements.