Measurement of Greenhouse Gas Flux Across a Hydrologic Gradient in Louisiana Coastal Freshwater Forested Wetlands

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Wetlands cover 3 to 8% of the global land surface but account for more than 20% of global methane emissions and store up to half of terrestrial soil carbon. Wetland carbon pools and greenhouse gas (GHG) fluxes are impacted by anthropogenic activities such as changes to hydrology and sediment transport. This research focuses on quantifying GHG emissions from freshwater forested wetlands (FFW) across a gradient from healthy to degrading to emergent wetlands or open water. By quantifying gas emissions from forested wetlands across a hydrologic and vegetation gradient in FFW, this study aims to provide critical data for the Coastal Master Plan (CMP) Integrated Compartment Model, which is the primary analytical tool for assessing potential CMP projects. Twelve FFW study sites were chosen at CRMS stations around Lake Maurepas, comprising four healthy wetlands, four degrading wetlands, and four transitioning to marsh or open water (degraded). Methane, carbon dioxide and nitrous oxide emissions were measured at each of the 12 sites using static chambers. We deployed five inverted 3.5-gallon buckets on sleeve bases positioned on floating Styrofoam rings, depending on water levels. Gas samples of chamber headspace were collected at intervals of 0, 15 minutes, 30 minutes, one hour, and two hours after deployment. Gas concentrations were measured using a gas chromatograph. Methane flux averaged 0.72±1.51, 1.82±1.83 and 3.41±2.43 mg/m^2/hr from degraded, degrading and healthy forested wetlands, respectively. Methane flux from healthy wetlands was significantly higher than from degraded wetlands ($F=2, 36$; $p=0.007$) and was positively correlated with percent time flooded ($r^2=0.482$). Carbon dioxide flux averaged 47.59±24.26, 54.96±19.12, and 43.28±21.10 mg/m^2/hr from degraded, degrading and healthy forested wetlands, respectively, and there was not a significantly difference detected among wetlands ($F=2, 20$; $p=0.513$). Nitrous oxide flux was negligible (>0.01 mg/m^2/hr) at all sites.