Title: Using Optical Oxygen Sensors and Targeted Microbial Analyses to Examine Methane Dynamics in the Boreal Rhizosphere

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Abstract: Methane is responsible for 15-19% of total greenhouse gas radiative forcing, and natural wetlands are responsible for 20 to 50% of methane emissions. In wetlands, methane is produced in anoxic, saturated soils by anaerobic methanogens from acetate and/or hydrogen produced by fermenters. The anaerobic fermenting microbes must compete with aerobic heterotrophs for organic substrates. These aerobic heterotrophs also compete with aerobic methanotrophs for oxygen. These complicated microbial interactions control the rates of methane production, oxidation, and emission. Spatially, the most interesting region for these processes is the rhizosphere: the region in which soil and groundwater chemistry are significantly impacted by plant roots. Up to 90% of wetland methane is emitted to the atmosphere through plants, and thus, rhizosphere processes can notably influence total methane emissions. As atmospheric carbon dioxide concentrations continue to rise the physiological response of plants, primarily an increase in root carbon exudation, will lead to changes in the rhizosphere and therefore in methane dynamics of the entire wetland system.

This study will examine microbial interactions and methane dynamics in the rhizosphere of *Carex aquatilis*, a wetland sedge, grown under both an ambient and elevated (800 ppm) concentrations of atmospheric carbon dioxide. Ten sedges will be grown under each condition. Oxygen concentrations surrounding the roots of the plants will be monitored throughout the experiment using optical oxygen sensors, and the data from sensors will be used to target fine scale microbial and chemical sampling. Prior to these sampling events we will expose plants to $^{13}C\text{-}CO_2$ and track the labeled carbon into microbial DNA and various peat carbon pools to quantify the fate of photosynthesized carbon. We hypothesize that plants in the elevated carbon dioxide condition will have increased rates of root carbon exudation, which in turn will stimulate heterotroph activity, causing heterotrophs to outcompete methanotrophs for rhizosphere oxygen and significantly decreasing the percentage of methane oxidized before release to the atmosphere.