Methane Oxidation in the Rhizosphere of Wetland Plants

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Methane is a potent greenhouse gas, with a global warming potential 20-times larger than that of carbon dioxide. The objective of this project is to improve predictions of future methane emissions. The project will examine the conversion of methane to carbon dioxide, i.e., methane oxidation, within the soil zone surrounding roots (the rhizosphere) of wetland plants. Wetlands are the largest natural source of methane to the atmosphere, and a majority of methane emitted by wetlands travels from soil through plants to the atmosphere. Plants also support the movement of atmospheric oxygen into the soil where it can oxidize methane; up to 90% of the methane produced in wetlands can be converted to carbon dioxide in this way. However, the process is not well captured by most computer models where oxidation of methane is simply set to a constant percentage. In reality, the percentage of methane oxidized in the rhizosphere is dynamic, responding to soil and water chemistry and to plant traits and behavior. As the climate changes, plant species composition, plant behavior, and subsurface chemistry will change, altering the fraction of methane oxidized within wetlands. Thus, understanding the dynamic response of methane oxidation to these expected climate-induced changes is key to accurately predicting future methane emissions. This project will study the potential for future changes in methane oxidation using a combination of field measurements, laboratory experiments and modeling investigations informed by field and laboratory results. Outcomes include a quantitative and predictive understanding of the interaction between plant behavior and methane oxidation in wetlands, an improved representation of methane oxidation in computer models, and an enhanced appreciation of how changes to the climate system will impact methane emissions from wetlands. These outcomes address one of the scientific drivers for the Biological and Environmental Research program at DOE: "discovering the physical, chemical, and biological drivers and environmental impacts of climate change."

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