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Investigating the carbon cycling implications of changing microbial leaf litter decomposition across a permafrost thaw gradient.

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Abstract: Thawing arctic permafrost (which contains 30-50% of global soil carbon) is expected to drive substantial alterations to carbon (C) cycling that will accelerate climate change. As permafrost thaws, old C may decompose more rapidly and be released as methane (CH4) and carbon dioxide (CO2), but thawing soil can also increase plant productivity as perennial shrub communities transition to faster growing annual wetland plants. The effect of new C input from plants on the C cycle is not yet well understood. It could mitigate C loss if C input rates are high enough, or it could increase contributions to CH4 emission (a more potent greenhouse gas than CO2) if it decomposes anaerobically. This project will examine (1) the ways in which fresh plant litter deposition influences microbial activity, (2) the differences between these dynamics across three stages of permafrost thaw, and (3) the overall impact of these changes on greenhouse gas emissions. It make use of a lab experiment tracing 13C labeled plant material through decomposition incubations to identify (through stable isotope probing and mass spectrometry) which members of the microbial community are active in transforming plant litter into different organic matter compounds and greenhouse gases. This project will increase our understanding of the importance of species-specific interactions on biogeochemical cycling and the complex factors that control arctic greenhouse gas emissions. Such understanding is needed to predict the timing and magnitude of climate change impacts on humans and ecosystems.