Tracking the fate of Arctic carbon: will shrub expansion result in a loss of soil carbon?

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Northern circumpolar soils cover 16% of the global land surface area, yet they account for nearly 50% of the estimated terrestrial organic carbon (C) pool. Unprecedented rates of warming may convert the Arctic from a net sink to net source of atmospheric C if temperature is the dominant mechanism of soil organic matter (SOM) accrual and retention. Additionally, climate projections indicate an increase in the abundance of woody shrubs, potentially increasing the total amount of labile C added to the system. Our ability to predict the response of Arctic C cycling is limited by uncertainties in our understanding of the processes that may counteract or enhance SOM loss. Our research objective is to improve our mechanistic understanding of the effects of labile C inputs into Arctic soils.

In July 2014 we added ^{13}C-glucose, simulating root exudates, to soils dominated by two dominant Arctic vegetation species: *Betula nana*, a vigorously expanding woody dwarf birch species, and *Eriophorum vaginatum*, a ubiquitous tussock-forming sedge. Stable isotopes allow us to partition the fate of ^{13}C-glucose among various pools. We measured $^{13}CO_2$ efflux in situ with a cavity ringdown spectrometer and analyzed a suite of biogeochemical variables on harvested soils. We also tracked ^{13}C-glucose incorporation into microbial biomass, transformation to DOM, and stabilization within the bulk soil. This experiment was repeated during senescence (September) and spring thaw (May 2015) to assess seasonal influences on substrate use dynamics. An additional subset of collars were labeled in July and measured in September and May to track long-term changes in soil C cycling following substrate input.

Our results indicate greater respiration and ^{13}C-glucose utilization under *E. vaginatum* with no short-term native SOM loss under either vegetation type. Overall, only ~10% of ^{13}C-glucose was measured in CO_2 efflux, and no priming of the microbial community was observed beneath either vegetation type. Low overall incorporation of ^{13}C in microbial biomass indicates either low substrate utilization or fast substrate cycling through the microbial loop and excretion of metabolic byproducts to the bulk soil. Particularly high ^{13}C enrichment of bulk soil beneath *B. nana*, combined with our $^{13}CO_2$ efflux results, suggest new inputs of labile carbon will not result in an immediate destabilization of native soil organic matter. Our findings indicate the Arctic may be more resilient to climate change than expected.