Tracking the fate of Arctic carbon in a rapidly changing ecosystem

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Northern circumpolar soils cover 16% of the total land surface area yet account for nearly 50% of the estimated global organic carbon (C) pool. Unprecedented rates of warming and vegetation shifts (e.g. shrub expansion) may alter ecosystem C dynamics. However, our ability to predict the response of arctic C cycling is limited by significant uncertainties in our understanding of processes that may counteract or enhance SOM loss. One of our research objectives is to improve our mechanistic understanding of belowground C cycling in Arctic tundra soils. We utilize experiments with isotopically enriched (^{13}C and ^{15}N) plant litter and enriched ^{13}C-glucose to track the fate of C and N through the soils. In a field experiment, we added isotopically enriched ^{13}C-glucose to soils dominated by two dominant arctic vegetation: *Betula nana,* a woody dwarf birch species, and *Eriophorum vaginatum,* a ubiquitous tussock-forming sedge. We hypothesized labile C additions would stimulate loss of native SOM from soils under *Betula nana* vegetation more than *Eriophorum vaginatum*. We measured $^{13}CO_2$ efflux following C additions and are tracking the fate of this C into microbial biomass and soil C pools. We are incorporating data from these experiments into a microbe-explicit soil carbon model (MEM) to improve our ability to predict Arctic soil carbon-climate feedbacks. The MEM includes a detailed component network (soil organic C, dissolved organic C, microbes, extracellular enzymes, and mineral surfaces) to explicitly represent biotic and abiotic components and their competitive interactions. As an initial effort, we tested the model behavior using lab soil incubation data from previous publications. We will apply data from our experiments to perform model parameterization and evaluation. We will also further develop the model to be able to simulate soil C dynamics in a real Arctic soil environment. Preliminary results from our field experiments indicate greater respiration and ^{13}C-glucose utilization by soil microbes associated with *E. vaginatum* and no stimulation of native SOM loss under either vegetation type. Our $^{13}CO_2$ efflux results suggest new inputs of labile C will not result in an immediate destabilization of native SOM. Preliminary results from our model testing and evaluations indicate that the model is able to accurately track the dynamics of each modeled soil C pool, and that microbe-mineral competitive interactions play a key role in controlling soil organic C turnover.