Poster #29

Tracking the Fate of C Inputs to Arctic Tundra Soils from Roots to Rivers

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Rapid climate warming may already be driving enhanced decomposition of vast carbon (C) stocks in Arctic tundra soils. However, stimulated decomposition may also release nitrogen (N) and support increased plant productivity, potentially counteracting soil C losses. At the same time, additional plant C inputs may prime microbes to attack soil organic matter (SOM) to acquire N, resulting in net C losses. Since N acquisition strategies and traits differ among plant species, they may have different potentials to mediate climate-carbon feedbacks. We used field and laboratory experiments to quantify the interactions of biological, chemical, and physical controls on soil C stability.

Using isotope-tracing techniques, we found the magnitude of SOM priming depends on vegetation type and soil N concentrations. Under non-limiting N conditions, labile C inputs primed SOM decomposition in tussock soils, but did not prime shrub soils. If warming enhances decomposition and N availability, increasing shrub abundance may dampen soil C losses. This hypothesis was supported by results from a field tracer experiment, where labile C inputs reduced loss of native SOM stocks by increasing microbial substrate use efficiencies. The quality and mobility of C remaining in the soil solution will determine overall strength of the soil C sink. To quantify soluble C transport, we used bromide as a conservative tracer, and assessed DOM chemistry using a combination of fluorescence and solution-state nuclear magnetic resonance spectroscopy. Permafrost-inluenced soils were significantly enriched in aromatic C, soluble microbial byproducts, and humic-type materials, while organic soils had higher proportions of fulvic acids. Rates of solute transport along the permafrost interface were similar to those through porous organic soils, suggesting permafrost thaw could mobilize SOM across the landscape.