B028-05 - Subjecting permafrost microorganisms to short-term warming

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Arctic environments are a prime example for ecosystems facing manifold vast and rapid changes in the wake of climate change, outpacing the global rate of temperature increases. The risk of thawing permafrost soils raises concerns about a positive feedback process being mediated by increased microbial activity that does not acclimate over time freeing greenhouse gases. However, the mechanistic understanding of the controls on microbial carbon cycling upon warming is still vague. In the following study we investigate microbial growth and soil organic matter decomposition in different soil horizons of the active layer and upper permafrost, covering different polygonial landscape units in two small catchments at the Canadian Yukon Coast.

81 soil samples were subjected to a short-term warming experiment under controlled temperature (4 °C and 14 °C) and moisture conditions. Microbial respiration was measured weekly whereas microbial biomass and physiological parameters were determined at the end of the incubation period and used to assess temperature responses. Microbial growth was estimated by measuring the incorporation of ^{18}O from labelled water into DNA and used to calculate CUE. Microbial biomass was determined via chloroform fumigation. Potential activities of extracellular enzymes were measured using microplate fluorometric assays.

Microbial biomass carbon was not affected by warming except for permafrost layers where it either increased or decreased depending on the examined catchment. Microbial respiration strongly responded to warming following the pattern organic layers > upper frozen permafrost > cryoturbated material > mineral layers. Mass specific growth and extracellular enzymatic activities were also enhanced with short-term warming in all soil horizons. This led to rather variable CUE being unaffected in mineral and cryoturbated layers whereas we could observe a minor reduction in organic and permafrost layers where the response of respiration outpaced the one of microbial growth.

Our results are not indicative for any physiological acclimatization of permafrost microbes when subjected to 8 weeks of experimental warming and hence support the current concern for potential prolonged carbon losses from warming tundra soils.

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