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How does simulated climate change affect the susceptibility of SOM to priming by LMWOS in the Subarctic?

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Soil organic matter (SOM) stabilization plays an important role in long-term storage of carbon (C). However, now many ecosystems are experiencing global climate change, which could change soil C balance through affecting the C input via plant community shifts, and C losses via SOM decomposition. In subarctic ecosystems, plant community composition and productivity are shifting because of climate change. This change of above-ground communities will affect rhizosphere input such as low molecular weight organic substances (LMWOS), which can affect microbial decomposer activities and subsequent contribution to SOM mineralization (priming effect). In the present study, we simulated climate change with N fertilization, to represent a warming enhanced nutrient cycling, and litter input, to simulate arctic greening, to evaluate the effect of a changing climate on subarctic ecosystems in Abisko, Sweden. The 6 sampled field treatments included three years of chronic N addition (5 g N m^{-2} y^{-1}), three years of chronic litter addition (90 g m^{-2} y^{-1}), three years of chronic N and litter additions, one year of high N addition (15 g N m^{-2} y^{-1}), one year of high litter addition (270 g m^{-2} y^{-1}) and a control treatment. All treatments were established in 1×1 m experimental squares and had 6 replicates. We resolved effects on plant community (NDVI), SOM mineralization, microbial composition, bacterial and fungal growth rates, and soil properties.

We found that N treatments changed plant community and stimulated productivity and that the associated increase in belowground LMWOS induced shifts in the soil microbial community. This coincided with a tendency for a shift towards bacterial dominated decomposition (low fungi/bacterial growth ratio) and a microbial community that had shifted from gram-positive bacteria to gram-negative bacteria; a shift often observed when comparing bulk with rhizosphere conditions. However, N treatments had no effect on SOC mineralization, but did increase soil gross N mineralization. This shift in the C/N of mineralisation might be because N treatments accelerated the growth of fast growing plant species with higher nutrient content, whose litter input provided microbes with fresh OM richer in N.

These responses in belowground community and processes driven by rhizosphere input prompted the next question: how did the simulated climate change affect the susceptibility of SOM to priming by LMWOS? To assess this question and explore the microbial mechanisms underpinning priming of SOM mineralization, we added a factorial set of additions including ^{13}C-glucose with and without mineral N, and ^{13}C-alanine semicontinously to simulate the effect of

belowground LMWOS input on SOM mineralization and microbial activity, and investigate how the SOM priming was linked to the actively growing microorganisms. Therefore, we incubated these samples for 7 days, treated with ^{13}C LMWOS, and measured SOC and SON mineralization to assess SOM priming, bacterial and fungal growth rates, microbial phospholipid fatty acids (PLFAs) and ^{13}C-PLFA enrichment, as well as the microbial C use efficiencies to assess microbial responses to LMWOS additions.