Impact of Short-term Warming on Carbon and Nitrogen Cycling Along the Plant-Soil Continuum

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The majority of plant biomass is located belowground in Arctic ecosystems, and plant roots are responsible for the uptake of nutrients that limit plant growth in these ecosystems. Despite performing a crucial role connecting primary producers to the soil, plant roots are relatively understudied in the Arctic and their functional response to rapidly warming climate is unknown. We therefore decided to assess whether one growing season of elevated temperature would have an impact on belowground carbon (C) and nitrogen (N) dynamics in the tundra. We conducted two field campaigns in Utqiaġvik, AK where we were able to sample Zero Power Warming Chambers deployed by NGEE Arctic. These chambers elevate air temperatures by around 4°C and surface soil temperatures by around 1°C during the peak growing season. To understand the impact of the warming treatment on both C and N dynamics, in 2018 we quantified the uptake of $^{15}N\text{-}NH_4$ from the soil by the arctic grass *Arctagrostis latifolia*. In 2021, we looked at the aboveground uptake of $^{13}C\text{-}CO_2$ by the sedge *Carex aquatilis*. Together, these experiments allow us to trace the path of N up from the soils through plant tissues as well the path of C downward from plant leaves, through roots, and into the rhizosphere. In 2018, we found that soil N and P availability increases significantly with warming, but biomass N and P pools of *A. latifolia* do not. Uptake of N by this grass species was not significantly impacted by warming, but we did see a strong relationship between soil NH_4 availability and uptake provided these variables were expressed in spatially explicit units (NH_4 per cm^3 soil & uptake per m fine root). In 2021, in addition to sampling plant tissues, our team also collected daily leaf samples, daily soil porewater samples, and measured soil microbial biomass at the end of a one-week incubation period. Preliminary observations from the 2021 campaign include the formation of iron-oxide plaques on root surfaces, indicating that oxygen (O) is flowing from the plant roots to the rhizosphere. Future analyses will quantify the transfer of recent photosynthate to soil porewater and the soil microbial community as well as allocation of this photosynthate within plant tissue. This research highlights the important role that interactions between plants, soils, and microbes play in determining local biogeochemistry.