Title: Warming Increases Plant-Available Nitrogen and Phosphorus in the SPRUCE Bog

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Project Abstract: Peatlands store nearly one-third of global soil carbon in deep deposits of peat that are shielded from decomposition by acidic conditions, waterlogged soils, and cold temperatures. Warming is expected to increase the release of carbon from highly-organic peatland soils, potentially leading to a positive feedback to future warming. This response is expected to be mediated by the response of peatland vegetation to rising atmospheric [CO_2], as well as the effects of warming on plant-available nutrients and water.
We quantified the effects of a range of ecosystem warming (from +0 °C to +9 °C), as well as elevated [CO_2], on plant-available nutrients in the SPRUCE (Spruce and Peatland Responses Under Changing Environments) experiment in an ombrotrophic bog in northern Minnesota. We used ion-exchange resin capsules to monitor monthly *in situ* changes in plant-available nutrients (i.e., NH_4-N, NO_3-N, and PO_4-P) throughout the peat profile across hummock-hollow microtopography in the experimental plots. NH_4-N was by far the most available N source, with NO_3-N making up a negligible fraction; PO_4-P availability was intermediate. Warming, combined with a longer frost-free period, increased the availability of NH_4-N and PO_4-P in the warmest treatment plots between two and twenty-fold. The increase in nutrients was much greater in deeper peat, beneath the rooting zone. There is thus far no clear effect of elevated [CO_2] on nutrient availability.
Interestingly, the same warming response was not apparent in the subset of porewater nutrients collected and measured at bi-weekly intervals at a comparable depth increment in the hollows. While porewater total organic carbon concentrations were increased by warming, indicating increased mineralization of organic matter, there was no difference in porewater NH_4-N, NO_3-N, or PO_4-P concentrations across the warmed plots.
Taken together, these lines of evidence indicate that warming has increased the mineralization of organic peat, leading to increased mineral nutrient availability. In turn, the increased nutrient uptake by the vegetation has depleted the availability of nutrients in the rooting zone and in porewater. The additional nutrients taken up by the plant community were detectable in *Sphagnum* mosses as well as vascular plant tissues; however, in recent years we observed a drastic increase in available NH_4-N and PO_4-P in shallow peat in the warmest plots where *Sphagnum* cover was decimated. The relative balance of peat accumulation will be affected by the interplay between vegetation dynamics and changing environmental conditions, mediated by nutrient and water availability.