Title: Peatland porewater chemistry responses to deep peat and whole-ecosystem warming

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Abstract:
SPRUCE is a 10-year long, whole-ecosystem experiment that is evaluating the response of a northern black spruce-*Sphagnum* bog ecosystem to elevated temperatures and CO_2 concentrations. A total of ten 12-m diameter enclosures were built in the S1 bog in northern Minnesota. Across the 10 enclosures, five temperature treatments (+0, +2.25, +4.5, +6.75, and +9°C) are replicated at ambient and elevated CO_2 concentrations (+500 ppm). Heating occurs both above and belowground, while CO_2 is added via the aboveground blower system. In June 2014, only belowground warming (deep peat heating; DPH) was initiated, providing the unique opportunity to evaluate the responses of deep peat soils to warming. In August 2015, whole-ecosystem warming (WEW) was achieved with the addition of aboveground warming. CO_2 addition is planned for summer 2016.

Within SPRUCE, we are collecting porewater samples weekly to biweekly along the peat profile (from 0 to 3 m into the peat) in order to understand how solute concentrations respond to warming and elevated CO_2. Porewater sampling was initiated in summer 2013, and we have characterized depth profiles for one year pre-treatment, throughout DPH, and for 4 months of WEW thus far. We predicted that total organic carbon (TOC) concentrations will increase with warming in both near surface and deeper porewaters due to mineralization of recently produced TOC and deep peat, respectively. We also predict that increased mineralization rates will increase dissolved nutrient concentrations. During DPH, there were no substantial changes in solute chemistry at depth (2 m), suggesting that deep peats are resilient to warming in the short term. During WEW, there was an increase in the magnitude and variability of TOC and potassium concentrations in near surface porewater (0 m) with increasing temperature. Porewater TOC concentrations almost doubled during WEW in the +9°C enclosures (mean concentration in each enclosure = 129, 121 mg/L) compared to the pre-treatment period (means = 64, 77 mg/L). Nutrient analysis on samples collected in 2015 is ongoing, and the response of nutrients to WEW will also be presented. pH, and other anions and cations examined did not change with WEW. These initial results suggest that carbon cycling responses to warming will likely be more dynamic in surface than in deeper peats. Overall, understanding the response of porewater chemistry to warming and elevated CO_2 is critical to interpreting changes in nutrient cycling, decomposition, and vegetation.