Title: Responses of peat porewater chemistry to deep peat warming in a northern peatland

Authors: Natalie A. Griffiths[1] and Stephen D. Sebestyen[2]
[1]Oak Ridge National Laboratory, Oak Ridge, TN, griffithsna@ornl.gov
[2]USDA Forest Service, Northern Research Station, Grand Rapids, MN, ssebestyen@fs.fed.us

Abstract

Northern peatlands store over 30% of the world's terrestrial carbon, and evaluating the responses of these peatland ecosystems to warming is critical for understanding carbon cycle feedbacks and effects on associated biogeochemical cycles. The Spruce and Peatland Responses Under Climatic and Environmental change (SPRUCE) experiment is assessing the response of a black spruce-*Sphagnum* bog ecosystem (S1 bog at the Marcell Experimental Forest in northern Minnesota) to warming (+0, +2.25, +4.5, +6.75, and +9°C) and elevated CO_2 concentrations (800-900 ppm). The treatments will be imposed within ten 12-m diameter, open-topped chambers for 10 years, using infrastructure that warms both above and belowground to achieve whole-ecosystem warming. Within the SPRUCE experiment, we are characterizing the depth profiles of porewater chemistry (0 to 3 m into the peat) with the goal of understanding how solute concentrations and yields, particularly total organic carbon (TOC), respond to warming and elevated CO_2. This information will aid in assessing nutrient cycling, decomposition, and organismal responses and will be critical to interpreting the sources, cycling, and transport of organic matter from the peatland.

In June 2014, belowground warming ('deep peat heating') was initiated to evaluate the responses of deep peat soils (warming targeted at 2 m depth; 4000-7000 year old peat). We measured the chemistry of porewater every 2 weeks both before and during warming in all 10 plots. We predicted that TOC concentrations would increase with warming due to mineralization of deep peat at 2 m, with potential cascading effects to coupled biogeochemical cycles (i.e., increased ammonium concentrations due to mineralization). Plots reached their target heating levels between July and mid-September 2014. Total organic carbon concentrations increased by approximately 15% in the +6.75°C and +9°C treatments by the end of the sampling period (October/November 2014). In comparison, TOC concentrations in the lower temperature treatments (+0°C, +2.25°C, +4.5°C) only increased by 2%. Similar responses of porewater TOC were not observed at 1 m suggesting that elevated TOC may be a response to deep peat heating rather than a natural temporal pattern that occurred in the warmer temperature treatment plots. There were no changes in porewater pH and specific conductivity (at 2 m) with deep peat heating. Analysis of porewater samples for nutrients (ammonium, nitrate, phosphate), cations, and anions is ongoing, and responses of these solutes to deep peat heating will also be presented.