Effects of Experimental Warming and Elevated CO_2 on Trace Gas Emissions from a Black Spruce Peatland [SPRUCE]

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Objective and Methods

The objective of this research is to quantify the fluxes and isotopic compositions of CO_2 and CH_4 from a black spruce peatland exposed to experimental warming and elevated concentrations of atmospheric CO_2. This research contributes to the DOE-funded SPRUCE project whose overarching goal is to determine how the C balance of high latitude ecosystems will change in response to climatic and atmospheric change. Our core research is comprised of autochamber measurements during the growing season. Alongside chamber-specific temperature, moisture and O2 concentrations this research will identify environmental drivers of these fluxes. The isotopic compositions of the C-based trace gasses will inform biotic regulation of trace gas emissions

Results and Conclusions

This project was funded in the spring of 2014. This past growing season we quantified the fluxes and isotopic compositions of CO_2 and CH_4 in response to peat warming at 2-m depth. During this growing season we made manual measurements in the early growing season before warming was initiated (June), in midsummer during the heat accumulation period (July), and at the end of the growing season after all treatments reached target temperature differentials (Sept). During this first year of partial treatments [see below], CH_4 flux was consistently higher in hollow compared to hummock microtopographic positions and increased in response to warming up to 9 ^{o}C. At present the isotopic composition of the CH_4 flux suggests a strongly hydrogenotrophic signature. CO_2 efflux was also higher in hummock compared to hollow microtopographic positions. CO_2 efflux also increased with increasing temperature but only late in the growing season once deep peat reach target temperature.

This past fall and winter we designed and built automatic soil respiration of CH_4 efflux chambers that will be deployed in May 2015 at the site. Two autochambers will be located in each experimental plot and will operate from May through September (N=20). These [beautiful] chambers will substantially increase temporal data density and enable us to assess diurnal to seasonal scale variations in fluxes in response to experimental treatments. Spring 2015 will not only have deep-peat heating but also surface heating and elevated CO_2; the replicated experiment will be fully operational. The data collected over the next several growing seasons will be used to calibrate a model of exoenzyme activity and microbial physiology [MCNiP, Finzi et al. 2015].