Poster #51

Effects of Experimental Warming & Elevated CO_2 on Trace Gas Emissions from a Northern Minnesota Black Spruce Peatland

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High latitude peatlands contain nearly half of Earth's soil carbon pool and represent a particularly significant terrestrial carbon sink. As result of their anoxic conditions, peatlands are simultaneously a large C sink but also a major source of CH_4 to the atmosphere. The greatest rates of warming are occurring at high latitudes and warming is predicted to accelerate the loss of the C stored in peat as a result of faster rates of decomposition.

At present the magnitude and forms of C loss (i.e., CO_2 & CH_4) from boreal peatlands remain highly uncertain. In particular, to what extent will potential increases in forest productivity owing to rising atmospheric CO_2 concentration [herein eCO_2,ATM] offset potential losses of peat C owing to warming? To address this and other uncertainties we began measurement of CO_2 and CH_4 fluxes at the DOE-funded *Spruce and Peatland Response Under Climatic and Environmental Change* (SPRUCE) experiment in the Marcell Experimental Forest, MN. At the SPRUCE site, plants now grow at ambient & $eCO_{2,ATM}$ [ambient, 900 ppmv] across a gradient of experimental warming (0 to +9 ^oC in 2.25 ^oC increments).
Across the previous three seasons of measurement [2014-2016], we find that experimental warming increases both CO_2 and CH_4 emissions. CH_4 production is more sensitive to warming and results in a declining peat efflux CO_2:CH_4 with increasing temperature. Experimental and seasonal warming increases the $\delta^{13}C$ ratio of the respired CH_4 implying an increasing contribution by acetoclastic methanogens. Although the total quantity of CH_4 emitted from the S1 Bog is small, CH_4 accounts for >50% of the greenhouse gas emissions in the highest-warming treatments when adjusted for warming on a 100-year timescale.

Experimental CO_2 fumigation began in 2016. Despite the short duration of treatment, there is a clear fingerprint of the ^{13}C-depleted CO_2 gas in the efflux of CH_4 and CO_2 at $eCO_{2,ATM}$. The isotopic detection is evident within ~1 week of gas initiation. Plant photosynthate is thus rapidly transferred belowground resulting in plant and microbial respiration, fermentation or decomposition of root exudations and the production of CH_4.

The results to date indicate belowground C in boreal peatlands is vulnerable to atmospheric loss with climate warming. The net radiative effect of these C emissions will depend an offset imposed by enhanced uptake and storage of C as atmospheric CO_2 concentrations continue to rise.