Poster #36

Peatland Carbon Cycle Responses to Warming and Elevated CO_2: Early CO_2 and CH_4 Flux Responses and Status of Tree and Shrub Net Primary Production

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Spruce and Peatland Responses Under Climatic and Environmental Change experiment (SPRUCE) is an *in situ* warming by elevated CO_2 manipulation located in a high-carbon, ombrotrophic peatland in northern Minnesota. Methods for warming at large plot scales (12-m diameter) were used. We combined aboveground enclosure walls that create an internally recirculating warm air envelope with soil deep heating to simulate a broad range of future warming treatments of as much as +9 °C. Deep belowground warming was initiated in June 2014 followed by air warming in August 2015. In June 2016, elevated CO_2 atmospheres (eCO_2 at + 500 ppm) were added to half the warming treatments in a regression design.
Post-treatment net surface C flux estimates in the form of CO_2 or CH_4, measured from 1.2 m diameter *in situ* collars associated with both deep and shallow warming were exponentially correlated with whole-ecosystem warming, but the magnitude of the CO_2 flux remained greater than CH_4. The CO_2:CH_4 ratio of evolved gases was reduced. After a lag period of several months, eCO2 treatments also led to enhanced net CO_2 emissions in September 2016 and enhanced CH_4 emissions just before the onset of winter. The ^{14}C-signatures of dissolved organic carbon (DOC) and evolved gases suggest C substrate origins reflect recent rather than ancient C sources, and indicate that active microbial respiration at depth is fueled by surface inputs of DOC.

Annual assessments of tree and shrub-level vegetation growth characteristics and aboveground net primary production following a full year of warming treatments (plus 5 months of elevated CO_2 exposures), have not yet shown clear warming or eCO_2 responses above the pretreatment variation present across the plots. Various measures of growth (circumference at dbh, mass accumulation, mass accumulation per live stem, and terrestrial LIDAR based measurements) are being used to track long-term vegetation response.

Plot-level carbon budgets were highly variable across the S1-Bog during the pre-treatment period, and the net C flux ranged from a source of 71 g C m^{-2} y^{-1} to a sink of 34 g C m^{-2} y^{-1} (95% confidence interval). Varying the assumptions regarding the fraction of CO_2 leaving the bog from autotrophic sources (rapidly cycling current year photosynthate), can produce alternate conclusions regarding the sink-source nature of the bog. However, such changes remain within the confidence interval. Future model-data intercomparisons will help resolve the sink-source nature of the bog with warming.