Title: **Ecosystem Warming Accelerates Peatland Carbon Loss: Findings from the First Three Years of SPRUCE**

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Project Abstract: One-third of the Earth's terrestrial C is found in peatland ecosystems, and the majority of this C has accumulated belowground over millennia. Because of the disproportionate importance of peatlands to the global terrestrial C budget, it is critical to understand how peatland C responds to warming and elevated atmospheric CO_2. The Spruce and Peatland Responses Under Changing Environments (SPRUCE) project is evaluating the effects of warming and elevated CO_2 on an ombrotrophic bog in northern Minnesota using a novel ecosystem-scale experiment: 10 enclosures (12-m diameter, 8-m tall) that span a range of warming conditions (+0 ºC, +2.25 ºC, +4.5 ºC, +6.75 ºC, +9 ºC) at ambient CO_2, and replicated at elevated CO_2 (+500 ppm). The experiment began in August 2015 and is planned to run for a decade. Here, we examined the response of peatland net C flux to warming and elevated CO_2 during the first three full years of the experiment (2016-2018). Net C flux was calculated from measurements of tree and shrub net primary production (NPP; above and belowground), *Sphagnum* NPP, CO_2 and CH_4 efflux from the bog surface, and total organic carbon (TOC) and dissolved inorganic carbon (DIC) efflux in lateral outflow. Overall, there was a strong linear response of C flux to warming with a net C loss of 34.5 g C m^{-2} y^{-1} $°C^{-1}$. Peatland C loss was primarily driven by decreased *Sphagnum* NPP and increased losses of CO_2 and CH_4. *Sphagnum* was the predominant contributor to aboveground NPP in this peatland, and production decreased drastically in 2017 and 2018 with warming due to reduced growth and loss of ground cover. Both CO_2 and CH_4 losses increased with warming in all years, and while the magnitude of CO_2 efflux was much larger than that of CH_4, the response of CH_4 efflux to warming was stronger. In summary, we found that the bog switched from a net C sink under ambient conditions to a net C source with warming. Evaluation of peatland net C flux will continue for the duration of SPRUCE to examine if: 1) the peatland continues to be a source of C under warming, 2) the response continues to be linear, and 3) effects of elevated CO_2 begin to emerge.