Poster #9-19

How do Whole-Ecosystem Warming and Elevated Atmospheric Carbon Dioxide Concentrations Affect Peatland Methane Production

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Peatlands contain one-third of the world's soil carbon (C). Much of this C is stored deep in the soil profile, where water-logged and anaerobic conditions have allowed C to accumulate for thousands of years. It is currently unknown if these vast C stores will remain belowground or if they will be respired as carbon dioxide (CO_2) and/or methane (CH_4) in the face of ongoing global change. Understanding, and modeling, the future fate of this soil C remains a pressing issue in global biogeochemistry. We assessed the response of CO_2 and CH_4 production in a boreal peatland following 13 months of deep-peat warming (DPW), 16 months of subsequent whole- ecosystem warming (surface and deep warming; WEW), and 4 months of elevated atmospheric CO_2 concentrations as part of the Spruce and Peatland Responses Under Changing Environments (SPRUCE) project in northern Minnesota, USA. This project includes 5 temperature treatments that warmed the entire 2 m peat profile from 0 to +9 °C above ambient temperature with and without elevated atmospheric CO_2 concentrations (~850 ppm). Soil cores were collected at multiple depths beneath the peatland surface (-20 to -200 cm) from each experimental enclosure at SPRUCE and anaerobically incubated at in situ temperatures for 1-2 weeks. Following DPW, only CH4 production from surface depths (e.g., -30 cm) was positively correlated with elevated temperature. However, during WEW, both surface and deep peat CH_4 production increased with rising temperature. There was little indication that elevated CO_2 influenced CH_4 production. Surface peat had greater CH_4 production than deeper peat, implying that increased CH_4 emissions in response to warming observed in the field were largely driven by surface peat dynamics. Radiocarbon analyses suggest that CO_2 and CH_4 are produced from the decomposition of both young and ancient C sources. The CO_2:CH_4 ratio was inversely correlated with temperature across all depths during WEW, indicating that the entire peat profile is becoming more methanogenic with warming. This result was supported by *in situ* measurements of porewater CO_2 and CH_4 concentrations which displayed the same trend. Thus, our results suggest that the vast C stores at depth in peatlands are responsive to warming only after a significant lag period, but that ecosystem responses remain largely driven by surface peat.