Poster #1-3

Inter-annual Variation in Radiocarbon Age of Ecosystem Respiration over Ten Years of Permafrost Warming

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Permafrost carbon (C) has accumulated in northern latitudes throughout the Holocene because of frozen and waterlogged conditions. As air temperatures increase with climate warming, we expect to see an increase in permafrost thaw and a decrease in environmental constraints on microbial decomposition. Over decadal timescales, highly thawed permafrost areas can release more old C than minimally thawed areas. Since the bulk of permafrost C is old, we anticipate that long-term C losses will largely originate from both old and slowly decomposing C pools. Our study was conducted in a moist acidic tundra site near Eight Mile Lake, Alaska where we have experimentally warmed permafrost for a decade, and tripled the rate of thaw relative to control. We utilized natural abundance $\Delta^{14}C$ as a tool to estimate the age of ecosystem respiration (Reco) during the peak of the growing season, from 2009 to 2018. My contributions to this long-term dataset included the collection of CO_2 samples in 2011, 2013, 2014, 2017 and 2018, and data analyses. We found that Reco $\Delta^{14}C$ decreased at a rate of 12‰ per year (CI: -23 to -0.4‰ year-1) in both control and soil warmed plots. However, soil temperatures at 40 cm induced a slower rate of decrease in Reco $\Delta^{14}C$ in soil warmed plots relative to control by 3‰ over time (CI: 0.3 to 6‰). This phenomenon may be attributed to warmer temperatures increasing plant activity and C input to soil with contemporary (more enriched) $\Delta^{14}C$ values, which can dilute the isotopic signal of old C, even when its contribution to Reco increases. In some years, we observed substantially more negative Reco $\Delta^{14}C$ values across all treatments, indicating high rates of old soil C loss to the atmosphere. Since permafrost regions have historically been C sinks, an increase in soil C flux to the atmosphere has large implications for the net ecosystem C balance in the Arctic. If permafrost regions become a C source to the atmosphere, the effects of climate warming could be exacerbated.