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Interactive effects of wildfire and permafrost thaw on peatland carbon cycling

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Boreal peatland complexes in western Canada are fine-scale mosaics of permafrost affected peat plateaus interspersed with Sphagnum dominated thermokarst bogs where permafrost is absent. Wildfire further affects landscape patterning of peatland complexes, where virtually all peat plateaus are in a stage of secondary succession following wildfire. With climate change we expect both permafrost thaw and wildfire activity to increase in these landscapes, and to have important impacts on carbon cycling.
In a number of studies, we have used soil chamber techniques to assess the influence of both permafrost thaw and wildfire on soil respiration, net ecosystem exchange and methane emissions. We used chronosequences to assess the influence of time since both permafrost thaw (3 - 15 years) and wildfire (20 - 150 years). Radiocarbon signatures of soil respiration in both burned and thawed locations was used to determine the contribution of aged soil carbon to soil respiration. We furthermore characterized individual and interactive effects of fire and thaw on microbial and photochemical lability of dissolved organic matter. At many field sites it was clear that recent wildfire had accelerated permafrost thaw, and we combined field observations of soil thermal regimes with remote sensing approaches to assess the role of wildfire for accelerating permafrost thaw over the last 50 years at a regional scale. Overall, our results highlight the need to consider both individual and interacting effects of thaw and fire for projections of the future carbon cycling at the regional level.