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Water repellency diminishes peatland evaporation after wildfire

Nick Kettridge (1), Max Lukenbach (2,6), Kelly Hokanson (3), Kevin Devito (3), Chris Hopkinson (4), Rich Petrone (5), Carl Mendoza (6), and Mike Waddington (2)

(1) School of Geography, Earth and Environmental Sciences, University of Birmingham, Edgbaston, Birmingham, B15 2TT, UK, (2) School of Geography and Earth Sciences, McMaster University, Hamilton, ON, L8S 4K1, Canada, (3) Department of Biological Sciences, University of Alberta, Edmonton, AB, T6G 2E3, Canada. 4Department of Geography and Environmental Management, University of Waterloo, Waterloo, ON, N2L 3C5, Canada , (4) Department of Geography, University of Lethbridge, 4401 University Dr. Lethbridge, AB. Canada. T1K 3M4. , (5) Department of Earth and Atmospheric Science, University of Alberta, Edmonton, AB, T6G 2E3, Canada. , (6) Department of Geography and Environmental Management, University of Waterloo, Waterloo, ON, N2L 3C5, Canada

Peatlands are a critically important global carbon reserve. There is increasing concern that such ecosystems are vulnerable to projected increases in wildfire severity under a changing climate. Severe fires may exceed peatland ecological resilience resulting in the long term degradation of this carbon store. Evaporation provides the primary mechanisms of water loss from such environments and can regulate the ecological stress in the initial years after wildfire. We examine variations in evaporation within burned peatlands after wildfire through small scale chamber and large scale remote sensing measurements. We show that near-surface water repellency limits peatland evaporation in these initial years post fire. Water repellent peat produced by the fire restricts the supply of water to the surface, reducing evaporation and providing a strong negative feedback to disturbance. This previously unidentified feedback operates at the landscape scale. High surface temperatures that result from large reductions in evaporation within water repellent peat are observed across the 60,000 ha burn scar three months after the wildfire. This promotes high water table positions at a landscape scale which limit the rate of peat decomposition and supports the post fire ecohydrological recovery of the peatlands. However, severe burns are shown to exceed this negative feedback response. Deep burns at the peatland margins remove the hydrophobic layer, increasing post fire evaporation and leaving the peatland vulnerable to drying and associated ecological shifts.