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Mitigating wildfire carbon loss in managed northern peatlands through restoration

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Wildfire frequency and severity are expected to increase in forested temperate and boreal ecosystems. Recent research indicates that northern peatlands are no exceptions to these risks and may be particularly vulnerable. These ecosystems represent a major component of the global carbon cycle and serve as contemporary and long-term net carbon sink. However, severe, deep burning, fires on these organic soils may not only compromise long-term carbon storage by releasing large amounts of carbon but also impose a real threat to human health and economies through smoke pollution and large costs in fire suppression, respectively. As research in tropical peatlands has revealed, these risks are likely enhanced when northern peatlands are drained and/or mined. Here we examine whether peatland restoration (re-wetting) practices can mitigate the risk of deep burns (>20 cm) and provide management recommendations. We synthesize the effects of drainage on peat moisture content and show how drainage and mining can weaken ecohydrological feedbacks in peatlands, making drained peatlands vulnerable to deep burns and carbon loss. We use bulk density and moisture data from burned, unburned and restored peatlands to evaluate the risk of deep burns under various conditions (differences in peat properties, extent of water table drop) using a new peat smouldering model. Climate change scenarios are shown to explore future risks of deep peat burning in extensively drained areas such as northern Europe. Combining modeling and experimental data we conclude that restoration can successfully lower the risk of deep burns if, for example, a new peat moss layer is established which will ensure a higher moisture content. Considering the large areas of drained and mined peatlands in the northern hemisphere, we will argue that restoration efforts are important to mitigate deep burns and carbon loss in peatlands.