Short- and long-term hydrologic controls on smouldering fire in wetland soils

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Abstract

Smouldering fire vulnerability in organic-rich, wetland soils is regulated by hydrologic regimes over short (by antecedent wetness) and long (through influences on soil properties) timescales. An integrative understanding of these controls is needed to inform fire predictions and hydrologic management to reduce fire vulnerability. The Great Dismal Swamp, a drained peatland (Virginia and North Carolina, USA), recently experienced large wildfires, motivating hydrologic restoration efforts. To inform those efforts, we combined continuous water levels, soil properties, moisture holding capacity and smouldering probability at four sites along a hydrologic gradient. For each site, we estimated gravimetric soil moisture content associated with a 50% smouldering probability (soil moisture smoulder threshold) and the water tension required to create this moisture threshold (tension smoulder threshold). Soil properties influenced both thresholds. Soils with lower bulk density smouldered at higher moisture content but also had higher moisture holding capacity, indicating that higher tensions (e.g. deeper water tables) are required to reach smouldering thresholds. By combining thresholds with water level data, we assessed smouldering vulnerability over time, providing a framework to guide fire prediction and hydrologic restoration. This work is among the first to integrate soil moisture thresholds, moisture holding capacities and water level dynamics to explore spatiotemporal variation in smouldering fire vulnerability.

Read the article in International Journal of Wildland Fire [1].

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