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Emission factors for smouldering peat megafires

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Smouldering wildfires occur in large deposits of peat across the globe in boreal and temperate regions. These fires are the most persistent fires on earth and consume large quantities of biomass which can take centuries or longer to regenerate. Recently large peat fires in Indonesia have caused significant health issues across a large geographic area in south east Asia. A similar event that occurred in 1997 was estimated to have released up to 13.7Gt of carbon to the atmosphere.

Globally, the carbon stored in peatlands is greater than that stored in vegetation and is similar to that stored in the atmosphere. One of the major threats to these ecosystems is smouldering megafires which can be ignited easily in peat with the resulting fire persisting for extended periods of time (often many weeks or months).

Given the potential impact on global carbon balances, it is essential to have accurate estimates of carbon emitted from these fires. Is is established that the emissions from any combustion process are strongly dependent on the combustion conditions these include the temperature (energy balance), availability of oxygen and the fuel composition. Because smouldering is a persistent form of combustion, it can occur over a wide range of conditions. This necessitates an understanding of emission factors linked to the burning dynamics.

To allow for controlled, repeatable burning conditions across this range of conditions, a series of laboratory scale experiments were undertaken to identify the carbon dioxide, carbon monoxide and methane flux from samples of smouldering sphagnum moss peat. This peat is used as it has been extensively studied experimentally and numerically. By using repeatable experimental conditions delivered by the FM Global Fire Propagation Apparatus, the flux of CO, CO_2 and methane can be linked to the smouldering fire dynamics. Smouldering in shallow fronts is represented by burning in ambient oxygen concentration while deep fronts are simulated using reduced oxygen environments. Conditioning of the peat allows for consideration of the effect of fuel bulk density and moisture content on the emissions.

Consequently, the emission factors from smouldering peat are found for a broad range of conditions that may be experienced in real peat fires. This provides valuable, well characterised data that can be applied in fire-climate interaction models and the potential for improved estimates of carbon release during smouldering wildfires.