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The importance of savanna fires in the global carbon cycle: beyond direct emissions

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Abstract

Wildfires in African savannas are one of the main contributors of global fire activity, accounting for around 30% of global carbon (C) emissions from fires. They are, therefore, pivotal to understand the impact of fire on the global C budget. The immediate effects of fire on C budgets not only depend on direct emissions from burning of vegetation, but also on pyrogenic carbon (PyC) production. PyC is overall more resistant to degradation than unburnt biomass and can therefore act as an additional carbon offset mechanism. The ability of PyC to compensate C emissions will depend on the amount produced and, also, on its environmental recalcitrance. In addition, together with ash, it may also affect postfire respiration of soils. No PyC production data for African savanna ecosystems have been available to date. To address this research gap, we quantified PyC produced in four experimental savanna fires, with behaviour typical of dry-season wildfires, along a climatic N-S gradient in Kruger National Park in South Africa. This involved detailed pre-fire fuel and soil inventories, in-fire temperature monitoring and post-fire collection of PyC and remaining unburnt fuel. In addition to pre- and post-fire C stocks estimation, and associated emissions, the environmental recalcitrance of the PyC generated was quantified by means of thermogravimetry-differential scanning calorimetry and hydropyrolysis. Furthermore, the effect of PyC on post-fire soil CO2 fluxes was also assessed via short-term laboratory experiments. In this presentation, we will summarise our findings and discuss their implications in the wider context of grassland fires worldwide, which account for ~80% of the global area burned.

Keywords: carbon emissions, pyrogenic carbon, fuel consumption, prescribed burn