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Prescribed burning as a natural, long-term experiment in biochar addition - Can prescribed burns contribute to carbon storage in peat soils?

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Prescribed burning is a common land management of UK peatlands where Calluna-vulgaris dominated vegetation is burnt on a cycle of 8 – 25 years. The burning of Calluna by prescribed burning does produce char and thus presents a long-term experiment in biochar addition to a soil. This study will discuss the impacts of biochar additions on soil structure, hydrology, water quality and carbon fluxes from a number of experiments including a study of a chronosequence of nine years. This study proposes that although prescribed burning of moorland dominated by Calluna represents a direct loss of carbon to the atmosphere during the burn itself and destruction of litter production after the burn this loss of carbon is outweighed by the production of both dead biomass and refractory black carbon (char) during the burn itself. The study has produced a model of carbon stock in a peatland under a range of burn frequencies (5- 25 years) and compared this to the carbon stocks of a Calluna-dominated peatland at steady-state biomass. The model was run stochastically with all input parameters being allowed to vary by 50% and run over a period of 51 years. The study shows that:
i) In the few years immediately following a burn, there is elevated water colour in soil pore water, but that this is not matched by a rise in dissolved organic carbon (DOC) concentration i.e. the composition varies rather than the absolute concentration.
ii) Whilst all the sites examined were net sources of carbon but burnt sites were smaller sources than unburnt sites, i.e. a relative sink was achieved by burning.
iii) The conditions under which burning results in a greater annual average sink of carbon than an unburnt site was controlled by the maturity of the Calluna and the extent of severe burning, i.e. the destruction of long term carbon reserves in litter and soil layers.
iv) The annual average C flux on an unburnt sink was -8.7 $\pm$ 2.6 gC/m2/yr compared to -13.3 $\pm$ 2.7 gC/m2/yr for a site burnt every 25 years (equivalent to 100% of the Calluna steady state biomass).
The study shows that significant carbon savings could be achieved not by bringing areas of Calluna dominated peatland under burn management but by changing the burn frequency on areas already under burn management and extending it to be as close as possible to the maximum steady-state biomass for the site.