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Simulated net biospheric carbon emissions of managed peatlands, and implications for net-zero and net-zero targets.

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Peatlands have been disturbed throughout the Anthropocene. Peatland extraction and peat use results in a significant net emission of greenhouses gases over a relatively short time frame. However, not all carbon in extracted peat is lost to the atmosphere. To understand net-zero emissions, it is important to understand how emissions can be mitigated through management practices, and what offsets are required for irreducible emissions. Our research has the aims: (1) to develop an environmental systems model based on previous research, introduce land use change and management phases to the model runs, and consider the implications of the fate of peat; and (2) to ascertain net biospheric carbon emissions according to model phases and their variations.

The model approximates peat mass and accumulation in an undisturbed peatland system, then simulates the removal by extraction of horticulture peat. The model replicates typical accumulation rates and measured emissions due to extraction. The environmental systems model has been coupled with a basic hydrological sub-model, and the model was evaluated by comparing simulated outputs to peat core 14C, C:N and FTIR field measurements from Riviere-du-Loup, Qc, Canada.

We will present how management practices such as extraction duration, extraction intensity, and restoration delay impact simulated biospheric carbon emissions. Our simulations will also include the fate of extracted peat, demonstrating how peat use, storage and stabilised peat carbon impact net emissions. Based on our current restoration and extraction scenarios, we have deduced that it takes several thousand years to restore the biospheric carbon store of an extracted peatland. Preliminary work suggests that, depending on the assumed fate of the peat scenario, the biospheric restoration time can be reduced by 50-75% to recover carbon lost through peat extraction and use. Subsequently, offsets required for irreducible emissions to meet 2050 and 2100 targets can also be reduced.

Our results will allow the Canadian peat industry to employ a backwards induction approach to meeting its net-zero targets by enabling us to infer when net-zero biospheric carbon emissions and carbon neutral conditions will be met without offset mechanisms and the duration with offset mechanisms.