Cores for concern: Peatland carbon dynamics in a changing climate; a multidisciplinary approach.

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The effects of 21st century climate change are projected to be most severe in the northern hemisphere, where the majority of peatlands are located. Peatlands represent important long-term terrestrial stores of carbon (C), containing an estimated c.600-1055GT C, despite covering only 3% of total land area globally. In addition, pristine peatlands act as net sinks of atmospheric CO₂, imparting a negative feedback mechanism cooling global climate, whilst simultaneously acting as sources of CO₂ and CH₄. Peatlands remain net sinks of C as long as the rate of carbon sequestration exceeds that of decomposition. Projected changes in temperature, precipitation and other environmental variables threaten to disrupt this precarious balance, however, and the future direction of carbon feedback mechanisms are poorly understood, due to the complex nature of the peatland carbon cycle.

Two methods are used in order to help understand future the carbon dynamics of peat bogs under climate change. These are experimental studies, which measure greenhouse gas fluxes under manipulated climatic and environmental conditions (warmer, drier), and palaeoecological studies, which examine the effects of past climate change upon carbon sequestration throughout the peat profile. However, both methods fundamentally contradict each other. Palaeoecological studies suggest that carbon accumulation increases during warming periods, whereas warming experiments observe greater carbon loss with increased temperature.

The aim of this project is to link contemporary experimental and palaeoecological approaches to explain this discrepancy. This will be achieved by comparing greenhouse gas fluxes between plots which have been subjected to 10 years of passive warming and drought simulation at an experimental climate manipulation site on Cors Fochno, Ceredigion, Wales. Long term rates of carbon accumulation will be compared with net ecosystem contemporary carbon budgets from each plot. Surface samples from each plot will be analysed by a range of palaeoenvironmental
proxies to test how well the climate manipulations are represented by each proxy. Finally, a high-resolution multi-proxy palaeoenvironmental reconstruction spanning the past 1000 years will be compared with reconstructions derived from short-cores from each plot covering the duration of the experiment from each treatment, to see how faithfully climate manipulation mirrors real periods of climate change.

Understanding the future role of peatlands in future carbon sequestration and storage is of vital importance for modelling future climate change, in terms of both quantifying the potential ecosystem services peatlands may offer in mitigating the effects of climate change, as well as enhancing the predictive capabilities of global climate models. Currently, the uncertainty associated with peatland carbon cycling is such that peatlands are rarely included in global climate models.