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Smart Observations of Management Impacts on Peatland Function (SmartBog)

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What did the research aim to address?

Peatlands in Ireland have been significantly impacted by land use change and are vulnerable to both long-term climate change and extreme weather events. These factors impact the ability of peatlands to support key ecosystem services and, in particular, to store carbon and minimise greenhouse gas (GHG) emissions, a key aspect of our national climate mitigation strategy.

The SmartBog project aimed to assess the extent, condition and use of raised bog ecosystems in Ireland and to enhance our understanding of the impact of management and climatic variability on the climate mitigation potential of these systems. The project used an innovative and interdisciplinary approach, integrating remote sensing data, machine learning and object-based image analysis to better understand the spatial extent and condition of raised bogs and to identify drainage status and habitat change over time. This work was combined with in situ and published studies of gaseous and fluvial carbon and GHG emissions to better inform peatland GHG reporting and to understand the efficacy of land-based mitigation strategies such as rewetting. Low-cost internet-of-things sensors were used to further validate and inform the remote sensing and in situ GHG measurements, and a web-based interactive data visualisation dashboard was developed to support decision-making to enhance the sustainable management of peatlands.

What did the research find?

The SmartBog project developed a new land use classification system and map for Irish peatlands, which, when combined with default emission factors from the Intergovernmental Panel on Climate Change wetlands supplement and literature-based emission factors for key land use classes of raised bog, highlighted a difference in estimated total CO2 emissions of ~1.2 Mt CO_2-C y^{-1} using these respective approaches.

The in situ measurements showed that our wetlands are both vulnerable and resilient to climatic variability, with changing hydrological conditions influencing the carbon source or sink strength of these ecosystems. This work also highlighted the time-dependent benefits of peatland rehabilitation in reducing carbon emissions, and that carbon losses through the fluvial pathway can constitute up to 10% of the annual net ecosystem carbon sink.

This research is highly relevant for policy-related and land management decisions on peatland rehabilitation; however, the work also highlights the need for further measurements to capture the variability in emissions between sites and, in the long term, to better understand site-specific drivers of emissions and the influence of the interaction between management and climate on the source/sink emission dynamics of these systems.

How can the research findings be used?

The Smartbog project provided a framework to inform the assessment of peatland use and management and how this can be further integrated into our national GHG emission reporting framework and land-based climate mitigation strategies.

This work needs to be expanded to other peatland types and supported by long-term monitoring and experimental activities to reduce uncertainties surrounding the site-specific variability in drivers of emissions and the impacts of exceptional and extreme climatic events, and to better assess the time-dependent impact of a variety of peatland rehabilitation strategies.

This work should align with other national and international observational networks such as the National Agricultural Soil Carbon Observatory and the Integrated Carbon Observing System, and the outputs from such work need to be harmonised and compiled in a national data repository that will provide information to the extensive array of stakeholder groups working with peatland systems.

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