The AUGER Project

PeAtland properties influencing greenhouse Gas Emissions and Removals

The climate footprint of peatlands has been found to be strongly dependent on their management (Petrescu et al. 2015). Greenhouse (GHG) dynamics are significantly altered when peatland undergoes a change in land use, which usually involves drainage and leads to lowered water table levels that directly affect its ecohydrology.

Increased emissions of carbon dioxide (CO_2) and nitrous oxide (N_2O), together with a reduction in methane (CH_4) emissions, have been widely reported for drained grasslands on organic soils (Klemedtsson et al. 2009, Renou-Wilson et al. 2014), for industrial peatlands (Wilson et al. 2007, Wilson et al. 2012, Wilson et al. 2015) and forested peat soils (Byrne and Farrell 2005, Minkkinen et al. 2008).

Rewetted/restored peatlands have increasingly become the focus of GHG studies, which show that the effect of rewetting

Kilian Walz using the Russian auger at Croaghonagh Bog, Co. Donegal, November 2016. Photo: D. Wilson

on GHG dynamics in these new ecosystems can be somewhat unpredictable.

Furthermore, some studies have reported high CO_2 and CH_4 emissions post-rewetting (Wilson et al. 2007, Wilson et al. 2009, Vanselow-Algan et al. 2015), while others have shown that the CO_2 sink function can be re-established relatively quickly (Tuittila et al. 1999, Wilson et al. 2013). In addition, climate change may result in higher CO_2 and CH_4 losses from peatlands, thereby acting as positive feedbacks on climate change (Frolking et al. 2011).

Natural peatlands in Ireland currently comprise a small C sink (absorbing CO_2 while emitting CH_4), but represent less than 15% of the current national resource. Anthropogenic disturbances, mainly in the form of drainage (for agriculture and forestry) and peat extraction, result in increased CO_2 and N_2O emissions, as well as reduced CH_4 emissions.

There are two options for mitigating GHG emissions from peatlands: avoiding new or recurrent drainage and reducing emissions on the existing drained areas by rewetting/restoration. Climate policy instruments involving mitigation on peat soils are not being implemented in Ireland due to a lack of basic information on the peatland resource and, in particular, its properties. Peatland properties that can influence emissions and removals include water table position, vegetation composition and peat soil edaphic properties, such as peat type (pH), soil temperature, nutrient status, microbial composition.

A considerable amount of peat soil data (bulk density, carbon (C) content, peat depth, degree of decomposition (von Post), pH and vegetation composition data) has already been gathered by various organizations countrywide over the last few decades, while efforts to combine these are now critical in order to identify the gaps in the coverage of the various peatland land use categories (LUCs).

However, three major uncertainties exist: (1) the C density of peat soils remains largely unknown, as soil bulk density and C content have only been measured at a relatively small number of sites across the whole country; (2) regional peat volumes (and therefore the national peatland C stock) are highly uncertain, as peat depth and peatland basin morphology have not been assessed across all peatland types (very few studies consider the full profile or even sub-peat soils, which are estimated to contain between 4 and 28% of the total C stored in peatlands in the UK, for example (Fyfe et al. 2013)), and (3) the absence of accurate mapping of peatland land use change (to be addressed in a sister project funded by the Irish Environmental Protection Agency, EPA). These knowledge gaps should be addressed in order to fully quantify the role of

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Blanket bog, Co. Donegal. Photo: Florence Renou-Wilson

human activities on the climate footprint of Irish peatlands.

The AUGER project is funded by the Irish Environmental Protection Agency (2016-2019) with the aim of carrying out a nationwide survey to document the properties of various types of peatlands and peat soils, how they are affected by various management options, and how this influences the C and GHG dynamics of these systems, thereby quantifying the role of human activities on the climate footprint of Irish peatlands.

The key objectives of the project are as follows:

1. To review Ireland's need for C stock and GHG flux monitoring capacities on peatland sites; to identify priority site types; to assess potential candidate sites for such a network, including the collection of detailed information on current monitoring sites and a proposed programme of monitoring activities.
2. To review current models and tools used to assess peatland conditions and growth; to review the significance of peatland properties and management in modelling GHG emissions.
3. To characterize peatland LUCs and their associated edaphic and ecosystem properties: This will build on existing data to identify potential gaps to be filled and be further informed by a nationwide peatland survey of the physical, chemical and ecological parameters of peatlands and peat soils (and overall assessment condition). It is intended to compile a database regrouping all types of peatlands under existing land use (including 'natural' or 'near pristine') and management.
4. To support ongoing field observations and modelling of GHG emission/removals at two core peatland sites: Moyarwood Bog (Co. Galway) and Clara Bog (Co. Offaly).
5. To model anthropogenic impacts (in the form of land use impacts) on GHG emissions and removals: The development of the process-

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based ECOSSE (Estimation of Carbon in Organic Soils – Sequestration and Emissions) model will allow Ireland to move to the Tier 3 level of NI-reporting.

The sustainable management of Ireland's peat soils is an environmental challenge, but represents a significant opportunity as these soils can be managed to their strengths, which in turn will benefit society at large. Are Irish peatlands a boon or a burden? Society can decide, but this will require full cognisance of the extent, location and condition of peat soils and peatlands, vegetation, land cover, land use, management and a range of environmental influences.

As part of the international drive to understand and quantify the GHG impacts of wetland management, Ireland needs to address the existing knowledge gaps by first establishing a robust and representative database of the characteristics of peatlands types and LUCs, as well as associated biogeochemical and ecohydrological properties.

How land use and management (options) affect these properties is important in order to understand the indirect impact on the climate footprint of these large areas; such an evaluation forms the main objective of the AUGER project.

Building on the expertise from site-specific GHG investigations in this country, and by developing the capacity to model the response of peatlands to changes in management, land use and climate, the AUGER project will allow for a more accurate estimation of GHG emissions/removals from peat soils, which cover a fifth of the land area of Ireland.

In addition, by reviewing the national need for monitoring GHG emissions/removals and the C stocks within peatland sites, this project will help Ireland, which is closely engaged with the Integrated Carbon Observation System (ICOS), to prioritize long-term investment in peatland observation platforms that are, thus far, lacking.

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