CELTICFLUX: Measurement & Modelling of GHG Fluxes from Grasslands and a Peatland in Ireland

Summary of Findings

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As a signatory to the United Nations Convention on Climate Change (UNFCCC), Ireland is obliged to produce inventories of Greenhouse Gases (CO_2, N_2O and CH_4) emissions and sinks. Internationally, the carbon cycles in forests have been studied more extensively than grasslands or peatlands. The magnitude of the CO_2 sink for forests in temperate humid climates has been found to range from ~ -5 to -15 tC-CO_2 ha^{-1} yr^{-1} (negative sign indicates a sink). By comparison with forests, grasslands and peatlands in temperate climates have been reported to be either small sinks or small sources for CO_2. The small annual sink of CO_2 and high interannual variability (-0.2 to -0.9 tC-CO_2 ha^{-1} yr^{-1}) at the Atlantic blanket peatland suggests that under climate change predictions, blanket peatlands are likely to become sources rather than remain as sinks for CO_2. The annual sink of CO_2 at the two grassland sites – Wexford and Cork - studied between 2002 and 2007 ranged between -1.3 to -5.8 tC-CO_2 ha^{-1} yr^{-1}. A significant property of Irish peatlands is vulnerable to loss of carbon to the atmosphere. To increase the CO_2 uptake and reduce the N_2O emissions from Irish grasslands, alternative grassland management practices to widespread nitrogen fertilisation and silage making should be examined.

Background

Agriculture in Ireland is estimated to be the largest contributor to GHG emissions at 26.1% of total (EPA, NIR 2008). There is a small negative trend in agricultural emissions since 1999, due to decreasing cattle and sheep populations (reducing CH_4 emissions) and decreasing fertiliser use (reducing N_2O emissions), (EPA NIR 2008 Report). In view of the significance of grasslands to Irish land cover, the economy, GHG emissions, and ongoing land use changes, the status of grasslands as a source or sink for GHG's needs to be quantified. O'Mara et al (2007) discussed the enteric emissions of methane from dairy and beef livestock. Grasslands remove CO_2 from the atmosphere via photosynthesis and emit CO_2 to the atmosphere via respiration.

When summed over the year, the net effect of photosynthesis and respiration may result in the grassland being either a source or sink for CO_2. Emissions of N_2O are a significant GHG (~298 times more potent than CO_2) and are released into the atmosphere from grasslands after the application of nitrogen in fertilisers, animal excreta and manures. It is generally thought that relatively intact peatlands in Ireland are sinks for carbon. Few field measurements of GHG's have been made in Irish peatlands and so their ecosystem status as a sink or source for carbon has not yet quantified. Because of their extent in Ireland, it is important to determine whether peatlands are a sink or source for GHG's.

Key Points

Irish Grasslands under current intensive management practices are a sink for CO_2 and a potential sink of carbon.

Peatlands are very susceptible to changing meteorology conditions, and may be a net source of carbon with only a modest change in climate. Precipitation and water table are critical issues.

The small annual sink of CO_2 and high interannual variability at the Atlantic blanket peatland suggests that under climate change predictions, blanket peatlands are likely to become sources rather than remain as sinks for CO_2. The huge store of carbon in Irish peatlands is in danger of being lost to the atmosphere. Table 1 summarises the findings of the annual CO_2 fluxes for three Irish sites.

To increase the CO_2 uptake and reduce the N_2O emissions from Irish grasslands, alternative grassland management practices to widespread nitrogen fertilisation and silage making should be examined, including: the reduction of N (in fertilisers and slurry); wider use of less intensive grassland management practices, such as REPS; wider use of clover grasses (as an N fixer); later first cut silage to extend the growing season length and enhance the CO_2 sink.

A multi-annual experiment including modelling on same soils should compare the CO_2 uptake (and the impact on N_2O emissions) between: grazed fields; silage fields (with different timing of the first cut); REPS fields; and clover grass fields. It is also recommended to continue the CELTICFLUX greenhouse gas experiments on grasslands on a range of soil types and management practices, and so capture the interannual variability of climate change with expected changes in greenhouse gas fluxes.

Concluding Remarks

Grasslands are a potential sink of carbon under current management practices.

Peatlands are very susceptible to changing meteorology conditions, and may be a net source of carbon with only a modest change in climate. Precipitation and water table are critical issues. This would be a national issue, as peatlands represent a very significant store of carbon in Ireland.

The findings regarding N_2O emissions from grasslands are of importance regarding determination of country specific emissions factors for the national inventory. However, more analysis is required.

Table 1. Measured CO_2 fluxes [tC ha^{-1} yr^{-1}] at the three sites in Southern Ireland

Site Name	Ecosystem	Period	CO_2 fluxes
Glencar, Co. Kerry	Blanket Peatland	2002 to 2007	-0.2 to -0.9
Dripsey, Co.Cork	Grassland	2002 to 2007	-2.1 to -3.9
Wexford	Grassland	2003 to 2005	-4.2 to -5.8
Wexford	Grassland + Kale	2006 to 2007	-1.3 to -2.2

For Further Information

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The full report CELTICFLUX: Measurement & Modelling of GHG Fluxes from Grasslands and a Peatland in Ireland by G. Kiely et al. is published by the Environmental Protection Agency and is available from (http://www.epa.ie/downloads/pubs/research/land/).