

Effects of Energy in our Environment

Case study: Peatlands and Wind Farm Microclimates

Introduction

In the UK, there are **3300** operational wind turbines and **2600** approved or under construction. **50%** of new onshore wind farms will be built on **peatlands** in Scotland.

Peatlands contain $\frac{1}{4}$ of the world's **soil carbon** and fluxes of carbon in these ecosystems are affected by **climate**. Wind turbines could affect **ground-level climate** by modifying wind speed, turbulence, air temperature and humidity^{1,2}.

Wind farm-induced microclimates and their effects on **carbon cycling** in the host environment have not been measured at the **field scale** until now.



Research



Black Law Wind Farm, Scotland

The University of Glasgow, working with the Centre for Ecology & Hydrology and National Centre of Atmospheric Science, have monitored **climatic conditions** and **carbon cycling** across peatland at **Black Law Wind Farm** in Scotland.

1. Climate effects on bare peat greenhouse gas (GHG) fluxes

Air temperature ($\uparrow 2-4$ °C) and water table levels ($\downarrow 10-20$ cm) were controlled in the laboratory. Fluxes of carbon dioxide and methane from peat cores were measured for one year.

Findings suggest that GHG fluxes from peat e.g. without vegetation due to wind farm construction or natural erosion, are sensitive to small changes in climate.



Greenhouse gas sampling in the lab



Bare peat at Black Law Wind Farm

2. Peatland carbon cycling at a Scottish wind farm

Peatland properties (physical, chemical and biological), carbon dioxide and methane fluxes, dissolved organic carbon concentrations and litter mass losses were measured across Black Law Wind Farm for one year.

Findings show that this wind farm peatland is functioning like other UK peatland sites, even those that are undisturbed or have had far less disturbance³.



Greenhouse gas sampling in the field

3. Ground-level climate change at a wind farm

Climate data was collected during the summer of 2012, during operational and idle periods at Black Law Wind Farm.

Findings provide the first field evidence that operational wind turbines can affect ground-level climate⁴.

Effects of operational wind turbines were:

- Increased air temperature and absolute humidity at night
- Decreased air temperature during the day
- Greater variability in absolute humidity and the temperature of the soil, surface and air during the diurnal cycle



Installing temperature and humidity sensors

Summary

Given the importance of climate as a driver of carbon cycling in peatlands, the findings of this study demonstrate the potential for the biogeochemical functioning of the host peatland ecosystem to be affected by wind farm operation and associated changes in ground-level climate. However, wind farm microclimate effects are likely to be no greater in magnitude than those anticipated as a result of climate change.

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1. Zhou *et al.* (2012), Impacts of wind farms in land surface temperature, Nature Climate Change

2. Baidya Roy and Traiteur (2010), Impacts of wind farms on surface air temperatures, PNAS

3. Armstrong *et al.* (Submitted), Multiple interactive controls on northern peatland CO₂ and CH₄ fluxes and pore water DOC concentrations, Ecosystems

4. Armstrong *et al.* (Submitted), Wind farms change the ground-level climate, Environmental Science & Technology