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Cold humid Islands: peatlands as tools for cooling the climate

1. Background

Different environments will partition the solar energy that falls upon them in different ways. Comparing a dry and wet environment, the dry environment would partition incoming energy in favour of sensible heat relative to the wet environment where the presence of more water means that incoming energy is more likely to be partitioned in favour of latent heat, i.e. more of the energy can be used for evaporating water. This relative behaviour between dry and wet environments means that the drier environment would produce more warmer air and thus increase air temperature above them whereas for the wetter environment more energy is dissipated as latent heat and so gives rise to relatively cold humid air. ***These effects of land use on changing energy balance means that we could have a way of manipulating landscapes to mitigate climate change impacts.***

Worrall et al. (2019) showed that peatland restoration (revegetation and raising water tables) led to a 1.7 ^{o}C decrease in air temperature. Subsequently, Worrall et al. (2020) has suggested that the dominant effect on air temperature was not changes in available water but changes in surface roughness due to vegetation changes. ***Therefore, to understand how a landscape impacts air temperature we need to understand how energy partitions across different landscapes.***

2. Methods

The project will utilise a transect across Thorne Moors in Yorkshire (Figure 1). The Thorne Moors is England's largest lowland peat bog (21 km^2) and sits surrounded by arable land creating a sharp contrast in land use at the regional scale. The Thorne Moors peat soils were extracted for horticultural use until 2004 which left behind bare, dry soils, but after 2004 Natural England started restoration and raised the water tables and revegetated bare soil surfaces. The project will use:

1) Field measurement – the project will measure the three important factors that connect land use and air temperature, these are: the albedo; the Bowen ratio; and the surface roughness. The Dept of Earth Sciences has the means of using all 3 of these factors with both fixed and portable towers as well as albedo measurement. The measurements will be made in contrasting locations across the Thorne Moors landscape in an established statistical design.

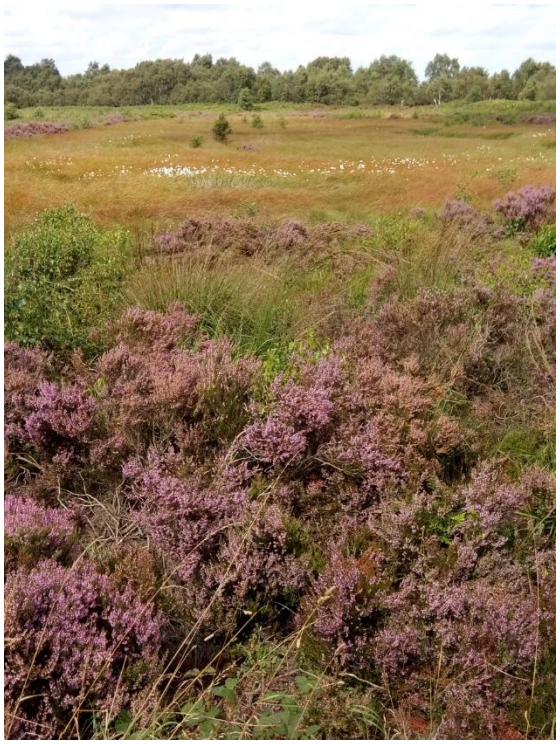

Figure 1: Restored peatland at the Thorne study site.

3) Remote sensing – we have been successfully using MODIS data to explore the impact of land use change on air temperature and now we can expand the study to consider all UK peatlands.

3. Scientific benefits

The project has a number of important benefits. If we can show that areas can act to cool a landscape then we have a new and novel means of increasing resilience to climate change. Peatlands have often been thought of as acting as a sink of greenhouse gases and so to act as a means of mitigating climate change, but now we could show that peatlands act to directly cool a landscape. The approach also provides a means

of testing how effecting peatland restoration and function is at landscape scales.

4. Training

The project will provide the necessary training in all three areas of research and so the project brings together three types of research – field measurements, laboratory experiments and statistical analysis. The project has secured access to Thorne Moors as a site of lowland peatland that extends to over 10s km^2 and surrounded by arable land. Meteorological stations are in place and other field equipment available.

5. Further information

Worrall, F., et al. (2019). The Impact of Peatland Restoration on Local Climate: Restoration of a Cool Humid Island. *Journal of Geophysical Research - Biogeosciences 124, 6, 1696-1713*.

Worrall, F., et al. (2020). Are peatlands cool humid islands in a landscape? *Hydrological Processes* DOI: 10.1002/hyp.13921

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