

The energy and entropy budgets of UK peatlands – are some peatlands near equilibrium?

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The energy budget of an ecosystem must obey the 2nd law of thermodynamics even if it is an open system. Several studies have sought to use a consideration of entropy budgets to understand ecosystem energy budgets and more specifically evapotranspiration. It has been assumed that ecosystems are far-from-equilibrium systems and as such would always seek to maximise their entropy production. Although the approach has been used to consider the behaviour of environments there are no studies that have tested the approach or its implications: maximum entropy production (MEP) is a prediction of the far-from-equilibrium assumption that could be tested. The simplest way for an ecosystem to maximise entropy production is to maximise water loss through evapotranspiration. To test whether a system is acting to maximise entropy production this study chose to consider how the energy budget of a peatland system responded to changes in incoming energy, specifically how a change in net radiation was transferred to changes in latent heat flux - an ecosystem maximising its entropy production would transfer the majority of change in net radiation to change in latent heat flux.

This study considered nine sites across the UK where an energy budget had been measured. All sites were on peat but included: upland and lowland sites; sites under intensive and extensive agriculture; and sites with differing nutrient status. The changes in the energy fluxes were assessed on a daily time step and the comparison made between the change in net radiation and the change in latent flux. Statistically significant positive linear relationships were found for all sites; however, the average proportion of a change in net radiation that was transferred to change in latent heat flux varied from 24 to 57%, i.e. for some sites the majority of change in input was transferred to latent heat while at another site, the majority was transferred to sensible heat flux. The most intact site (Moor House, North Pennines) was the site where the least entropy was produced in response to a change in net radiation which could be an indicator that this peatland is near-to-equilibrium rather than the assumed far-from-equilibrium.