Measuring and modelling the effect of fine-scale heterogeneity on whole-peatland hydrological behaviour

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Background

Peatlands may be regarded as prototypical ecohydrological systems (*Baird et al.,* 2008; *Kettridge et al.*, 2008), and it has been suggested that small-scale (1-10 m) processes may affect whole-peatland ecohydrological functioning (*Belyea and Baird, 2006*). This project seeks to understand, through both field and modelling work, how process linkages across scales affect whole-peatland hydrological behaviour.

Many peatlands show strong patterning of microhabitats, which may be defined as pools, hollows, lawns, and hummocks (Figure 1). Different microhabitats have characteristic water-table regimes and characteristic plant communities. The hydrological processes in the different microhabitats both affect and are affected by the larger-scale hydrological functioning of the whole peatland, and it is the nature of this two-way linkage that we wish to understand. It has been suggested that the different microhabitats lay down peat with strongly differing hydraulic conductivities (permeabilities). It is known that many soils and aquifers display extreme heterogeneity in their hydraulic properties and peatlands seem to be no exception (*Baird et al.*, 2008). However, it is also known that the patterning of peatland microhabitats arises from complex endogenic processes; in other words, pattern in peatlands is an *emergent* (cf. *Peterson*, 2002) property of the system and is not imposed (generally) by, for example, outside structural controls such as variations in the topography of the mineral soil underlying the peat.

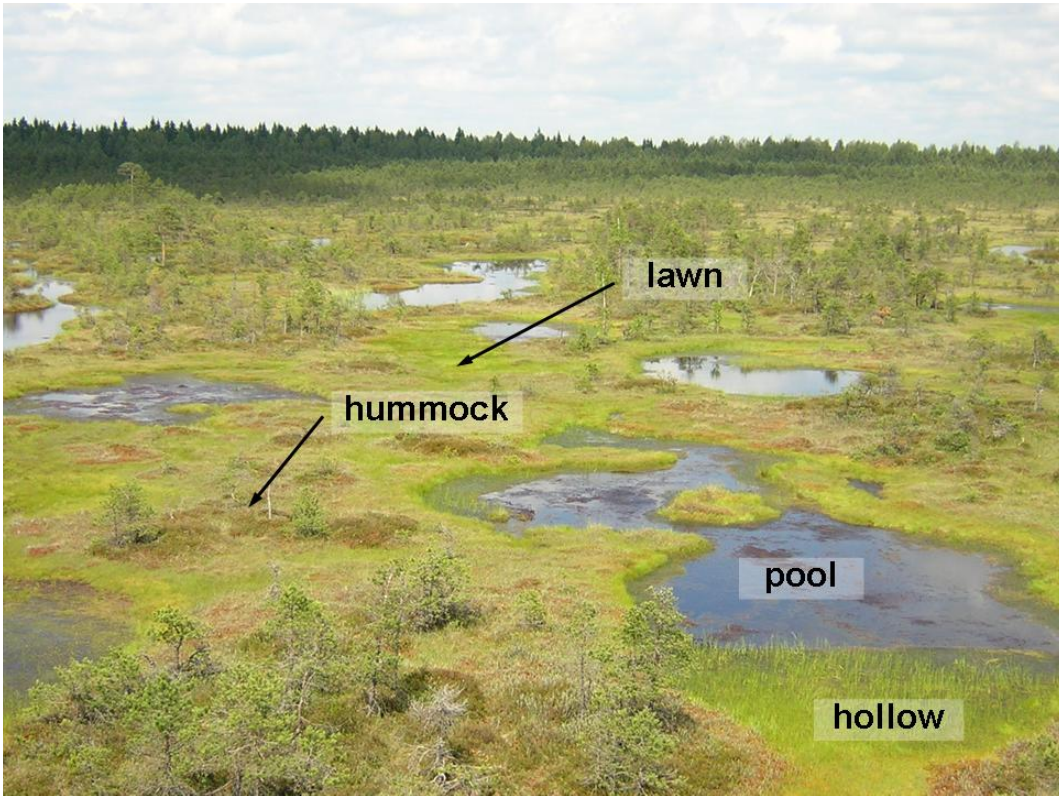

Figure 1. Peatland landscape in Estonia showing patterning of microhabitats (photo: Nick Kettridge).

The project

The project has two parts which will overlap to some extent. In the first part, the candidate will conduct field work at one or more peatlands (probably in Estonia) to establish how much hydraulic conductivity and other peat properties vary between different microhabitats. They will also map microhabitat patterns using a low-altitude aerial digital camera (suspended from a kite or large helium balloon – cf. *Aber et al.* [2002]). The information from the field campaign will be used to parameterise a model of bog hydrology. The model that will be used – **DigiBog** – conceptualises a peatland as consisting of square-sectioned columns of peat, which individually, or in small groups, represent fundamental units such as hummocks and hollows. The properties of the peat in each column can vary with depth; in essence each column is conceptualised as consisting of layers of peat (of any set thickness), with hydraulic conductivity and drainable porosity allowed to vary between layers. In the model, water may be added to a peatland via precipitation and lost to the atmosphere via evaporation and transpiration. Water may also be lost via subsurface seepage which is simulated explicitly. The model will be set up to represent different types of microhabitat patterning found on peatlands, and numerical experiments will be performed to establish how these different patterns influence whole-peatland hydrological behaviour.

Project partners and training

It is anticipated that the successful candidate will liaise with partner modelling groups at McMaster University in Canada. Training will be given in Fortran 95 and the use of high-end computers. The candidate will also visit peatland research sites (probably in Estonia) to measure variation in hydraulic conductivity in the peat under different microhabitats and to map microhabitat pattern. Training will be given in all of the field techniques and in field risk and hazard assessment.

References

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