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Modelling blanket peatland hydrology and Holocene peatland development in north-eastern Scotland.

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To study long-term peatland dynamics, several peatland models have been constructed in recent decades. Most modelling efforts have focussed on peat bogs, but for other peatland types, such as blanket peatlands, modelling studies are limited. Although blanket peatland is a rare ecosystem type on a global scale, 87 percent of the peat cover in the UK is of this type. Hillslope hydrology is fundamental to blanket peatland development and an improved representation and understanding of the relationships between climate, hydrology and peat growth is crucial to better understand the effects of environmental change on peatland evolution and the carbon balance.
Here, a new spatially explicit process-based peat growth model is presented for blanket peatlands, which couples a detailed 2.5D-hillslope hydrology model with a peat accumulation and decomposition module. The resultant model allows to study the hillslope hydrology and blanket peatland development along topographically complex hillslopes over a Holocene timescale. Calibration and validation of the model parameters is based on a dataset of more than 250 peat thickness measurements along several hillslope transects and eight radiocarbon dated peat samples in the headwaters of the river Dee (Cairngorms National Park, north-eastern Scotland).
The model results show that the topography-driven hillslope hydrology has a strong influence on the resultant peat development along the hillslope, stressing the need for spatial models in studying blanket peatlands. Model simulations for the studied area result in peat growth initiation dates situated mostly in the period 9000 – 7000 a BP, which corresponds largely to basal calibrated radiocarbon dates for peat deposits in central and north-eastern Scotland. The simulated blanket peat growth initiation occurs before the mid-Holocene forest cover decline. These results indicate that, for the studied area, the blanket peatland development is largely driven by the early-Holocene increases in temperature and precipitation, rather than by an alteration of the hillslope hydrology due to a declining forest cover. The model allows to study the sensitivity of blanket peatlands to changes in environmental factors such as land cover, temperature and precipitation, providing a new tool to study the response of blanket peatlands to the future environmental changes under different climate change scenarios.