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A new approach to simulate peat accumulation, degradation and stability in a global land surface scheme

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Representing peatlands in global Earth System Models (ESMs) is a major challenge, but a crucial one since peatlands represent a significant component of the global carbon cycle.

Here we present the first ESM implementation of peat accumulation and degradation that integrates both organic and mineral soils in a single formulation, implemented in JULES - the land-surface component of the UK Earth System Model (UKESM). In this scheme, the soil column is able to expand with the addition of new organic material and to subside as this material decomposes, with variable organic layer thickness, which means that peat can appear and disappear within the landscape without a need for a prescribed peatland fraction.

Thermal and hydraulic characteristics of the soil are dynamically updated depending on the organic matter content and its level of decomposition, using relationships derived from observations. This scheme captures important feedbacks within the soil, such as the way that peatlands - once formed - can be self-sustaining even under conditions where they would not form today. It also captures the loss of carbon and soil structure when peatlands are drained. We demonstrate this behaviour in the model.

This provides a new approach for improving the simulation of organic and peatland soils, and associated carbon-cycle feedbacks in ESMs.

The key remaining challenges for simulating global peatlands are to realistically distribute water around the landscape, in order to represent topographically-controlled peatlands, and to develop appropriate peatland vegetation types.