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Resilience in heterogeneous landscapes: The effect of topography on resilience of carbon uptake in northern peatlands

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Northern peatlands contain and store enormous amounts of carbon, and therefore represent an important component of the carbon cycle of the earth. In these wetland ecosystems, the quality of the soil added to the soil surface is determined by the type of peat-forming plants, and affects the carbon accumulated in the peat soil later formed and overall ecosystem functioning.
Peatland vegetation is frequently organized in alternating dry hummocks with wet hollows. Such patterned vegetation is associated with different soil carbon accumulation rates, and may develop due to various self-regulating processes originating from ecohydrological feedbacks. Simulation models have shown that vegetation patterning may promote the resilience of peatlands to environmental change (climate, land use), hence maintaining their function as carbon sink.
Critically, the results of these model studies rely on the fundamental assumption that environmental conditions are spatially homogeneous. Yet, in real landscape settings, catchment topography has a major impact on water flow and nutrient availability, and is expected to alter vegetation patterning. However, whether, where and how topography affects vegetation patterning in peatlands and associated resilience of ecosystem service provision remains unknown.

By combining field observations, remote sensing, and dynamic simulation models (used both as ‘sandbox’ and ‘resilience calculator’ for given geomorphological settings), we determine how landscape topography affects ecohydrological processes, vegetation patterning, and associated resilience to environmental change in northern peatlands.