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Modelling alternative states of an ombrotrophic bog with experimentally deposed nitrogen

Yuanqiao Wu, Philipp Keller, and Christian Blodau
Hydrology Group, Institute of Landscape Ecology, University of Münster, Germany

Nitrogen (N) pollution of peatlands alters their vegetation composition and carbon (C) sequestration. We applied a coupled carbon and nitrogen wetland model (PEATBOG) to analyse alternative steady states of an ombrotrophic bog exposed to experimentally deposited N at 1.6, 3.2 and 6.4 $\mathrm{gN\,m^{-2}\,yr^{-1}}$. The study predicted discontinuous responses of the peatland ecosystem to differing N deposition and a lack of recovery after 15 years of fertilization with 6.4 $\mathrm{gN\,m^{-2}\,yr^{-1}}$, which indicated a regime shift of the modelled ecosystem. In combination drought, as concurrent disturbance, reduced the resilience of the system and contributed to the regime shift. Internal feedbacks may interact with the direct feedback of the external disturbances from nitrogen and climatic drivers and alter the responses of the ecosystem. The result suggested that the state of a peatland exposed to N deposition may be highly uncertain due to a dominant feedback loop that emerged from all disturbances. The finding highlighted the need for systematically quantifying the relative importance of multiple disturbances to predict the potential shift of a peatland ecosystem to alternative states as response to N deposition in a changing environment.