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Abrupt changes in climate and methane emissions in northern peatlands

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Temperature and precipitation show large and abrupt variations in the past as recorded in climate archives. In addition, these records demonstrate that the concentrations of atmospheric methane, which is the third most important anthropogenic greenhouse gas, follows closely temperature on glacial/interglacial time scales as well as rapid climate changes in the northern hemisphere. Examples of abrupt changes are the Dansgaard-Oeschger events in the glacial period or the 8.2-kyr-event in the Holocene.

Northern hemispheric peatlands and permafrost soils are associated with large carbon stocks that serve as substrate for methane production undergoing large changes during Dansgaard-Oeschger events. For the understanding of the covariance of atmospheric methane and climate it is thus crucial to investigate climate-carbon feedbacks of the northern hemispheric peatlands.

For this purpose we use LPJ-WHyMe, a dynamic global vegetation model, which combines process-based, large-scale representations of terrestrial vegetation dynamics and land-atmosphere carbon and water exchanges in a modular framework. It includes permafrost dynamics, peatland hydrology, peatland vegetation and the involved processes for methane production, transport and oxidation. It is therefore suited to simulate the response of peatland methane production to climate changes. LPJ-WHyMe is forced with temperature and precipitation changes from two freshwater experiments with the NCAR-model.

Results from LPJ-WHyMe for methane emissions from northern peatlands and its sensitivity on fast temperature and precipitation changes will be discussed in the context of paleoclimatic records.