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Uncertainties in modelling CH_4 emissions from northern wetlands in glacial climates: effect of hydrological model and CH_4 model structure

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Abstract. Methane (CH_4) fluxes from northern wetlands may have influenced atmospheric CH_4 concentrations at climate warming phases during the last 800 000 years and during the present global warming. Including these CH_4 fluxes in earth system models is essential to understand feedbacks between climate and atmospheric composition.

Attempts to model CH_4 fluxes from wetlands have previously been undertaken using various approaches. Here, we test a process-based wetland CH_4 flux model (PEATLAND-VU) which includes details of soil-atmosphere CH_4 transport. The model has been used to simulate CH_4 emissions from continental Europe in previous glacial climates and the current climate.

This paper presents results regarding the sensitivity of modeling glacial terrestrial CH_4 fluxes to (a) basic tuning parameters of the model, (b) different approaches in modeling of the water table, and (c) model structure. In order to test the model structure, PEATLAND-VU was compared to a simpler modeling approach based on wetland primary production estimated from a vegetation model (BIOME 3.5). The tuning parameters are the CH_4 production rate from labile organic carbon and its temperature sensitivity.

The modelled fluxes prove comparatively insensitive to hydrology representation, while sensitive to microbial parameters and model structure. Glacial climate emissions are also highly sensitive to assumptions about the extent of ice cover and exposed seafloor. Wetland expansion over low relief exposed seafloor areas have compensated for a decrease of wetland area due to continental ice cover.

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