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Modeling methane emissions from boreal peatlands

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Natural wetlands are a significant source of methane (CH4): they have been estimated to account for about 30% of total global CH4 emissions. At the moment, the emission estimates are highly uncertain. These natural emissions respond to climatic variability, so it is necessary to understand their dynamics, in order to be able to predict how they affect the greenhouse-gas balance in the future.

We have developed a model of CH4 production and transport in boreal peatlands. The aim is to make it a part of JSBACH, the land component of the Earth System Model of MPI Hamburg. The soil carbon model of JSBACH simulates peatland carbon processes like peat accumulation and decomposition and our CH4 module simulates production of CH4 as a proportion of the anaerobic peat decomposition, transport of CH4 and oxygen between the soil and the atmosphere, and oxidation of CH4 by methanotrophic microbes. The model has the three main pathways for transport: diffusion in aerenchymatous plants and in peat pores (water and air filled) and CH4 ebullition. The oxidation of CH4 depends on the oxygen concentrations in the peat. The model is largely based on existing models of CH4 production and transport but it includes some modifications that we will present here. We also will present the results of the first validations against observational data. The datasets are from two Finnish peatland sites, Siikaneva (southern) and Lompolojänkkä (northern Finland). Measurements of eddy covariance CH4 and CO_2 fluxes and meteorological variables, as well as diverse ecological studies have been carried out on both sites over several years.