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Sensitivity analysis of a wetland methane emission process model based on temperate and arctic wetland sites.

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Plot-scale soil carbon transfer models usually incorporate a large number of parameters. A quantitative analysis of the sensitivity of these parameters is necessary to improve model structure, reduce parameter requirements, and to test the feasibility of model upscaling.

We performed a sensitivity analysis of a widely used methane emission model (Walter-Heimann model, as incorporated in the PEATLAND-VU model). The methods used are the Hornberger-Spear-Young and GLUE methods, which both have been extensively applied to hydrological runoff models. Different objective functions for model performance evaluation have been tested. A particularly useful objective function is a variant of the Nash-Sutcliffe efficiency, which compares the performance of the model with a simple linear regression model.

The model has been tested on two wetland sites in the Netherlands and an arctic permafrost wetland site in northeastern Siberia, from which several years of methane flux data are available. The performance of the model relative to a regression model varies per site, and is strongly dependent on the spatial homogeneity of the data set against which the model is tested. In some cases, the process model does not perform better than the regression model, in other cases, it performs significantly better. In particular the high temporal variation of the measured fluxes causes deviations between data and model, both for the process model and the regression.

The results also indicate that the most sensitive parameters are vegetation parameters governing methane transport by plants. Some of these parameters are notoriously difficult to measure and generally have to be obtained from model calibration.