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Evaluation of modelled methane emissions over northern peatland sites

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Methane (CH4) is a powerful greenhouse gas, with approximately 34 times the global warming potential of carbon dioxide (CO_2) over a century time horizon (IPCC, 2013). The strong sensitivity of methane emissions to environmental factors has led to concerns about potential positive feedbacks to climate change. Evaluation of the ability of the process-based land surface models of earth system models (ESMs) in simulating CH4 emission over peatland is needed for more precise future predictions. In this study, two peatland sites of poor and rich soil nutrient conditions, in southern and northern Finland respectively, are adopted. The measured CH4 fluxes at the two sites are used to evaluate the CH4 emissions simulated by the land surface model (JULES) of the UK Earth System model and by the Helsinki peatland methane emission model (HIMMELI), which is developed at Finnish Meteorological Institute and Helsinki University. In JULES, CH4 flux is simply related to soil temperature, wetland fraction and effective substrate availability. However, HIMMELI has detailed descriptions of microbial and transport processes for simulating CH4 flux. The seasonal dynamics of CH4 fluxes at the two sites are relatively well captured by both models, but model biases exist. Simulated CH4 flux is sensitive to water table depth (WTD) at both models. However, the simulated WTD is limited to be below ground in JULES. It is also important to have the annual cycle of LAI correct when coupling JULES with HIMMELI.