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Modelling regional to global CH_4 emissions of boreal and arctic wetlands

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Methane (CH_4) emission from arctic and subarctic wetlands constitutes a potentially positive feedback to global climate warming. Many process-based models have been developed, but high uncertainties remain in estimating the amount of CH_4 released from wetlands at the global scale. This study tries to improve estimates of CH_4 emissions by up-scaling a wetland CH_4 emission model, PEATLAND-VU, to the global scale with a spatial resolution of 0.5° for the period 2001–2006. This up-scaling was based on the global circum-arctic distribution of wetlands with hydrological conditions being specified by a global hydrological model, PCR-GLOBWB. In addition to the daily hydrological output from PCR-GLOBWB, comprising water table depths and snow thickness, the parametrisation included air temperature as obtained from the ECMWF Operational Archive. To establish the uncertainty in the representations of the circum-arctic distribution of wetlands on the CH_4 emission, several existing products were used to aggregate the emissions. Using the description of potential peatlands from the FAO Digital Soil Map of the World and the representation of floodplains by PCR-GLOBWB, the average flux over the period 2001–2006 was estimated to be 78 Tg yr^{-1}. In comparison, the six-year average CH_4 fluxes were 38, 89, 146, and 157 Tg yr^{-1} for different estimates of wetland extends based on studies by Matthews and Fung, Prigent et al., Lehner and Döll and Kaplan, respectively. This study shows the feasibility to estimate interannual variations in CH_4 emissions by coupling hydrological and CH_4 emission process models. It highlights the importance of an adequate understanding of hydrology in quantifying the total emissions from northern hemispheric wetlands and shows how knowledge of the sub-grid variability in wetland extent helps to prescribe relevant hydrological conditions to the emission model as well as to identify the uncertainty associated with existing wetland distributions.

Reference

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