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Methane emissions from Arctic are increasing

Greenhouse gases have been considered as the primary reason of climate change. In these greenhouse gases, methane (CH_4) is the second most important greenhouse gas contributing to global warming following carbon dioxide (CO_2), and its effect is about 26 times stronger than CO_2. Recently, scientists

The Arctic tundra has been considered as one of the most sensitive areas to global climate change. One impact of global warming is that permafrost thawing could result in more waterlogged and anaerobic conditions, and consequently an increasing release of methane (CH_4) to the atmosphere. These potential CH_4 emissions can further amplify global warming. Therefore, it is important to assess the quantity of CH_4 emissions from Arctic tundra wetlands and their sensitivity to climate change. Process-based CH_4 modelling is commonly used to estimate CH_4 emissions using single-source fractional wetland maps; however, it is not clear how the difference among multisource of fractional wetland maps affects CH_4 estimations. In this study LPJ-GUESS WHyMe was applied to simulate CH_4 emissions of Arctic tundra between 1961 and 2009 by using multisource fractional wetland maps, and their quantitative and qualitative differences in estimating CH_4 emissions from these fractional wetland maps was compared. Parameter sensitivity tests and a parameter optimization for the model were performed before the model was applied to Arctic tundra. The CH_4/CO_2 production ratio under anaerobic conditions (CH_4/CO_2) and fraction of available oxygen used for methane oxidation (f_{oxid}) were identified as the most important model parameters in estimating total CH_4 fluxes of Arctic tundra in the period 1961-2009. The regional simulation using multisource fractional wetland maps showed that the uncertainties of CH_4 emissions in Arctic tundra caused by fractional wetland maps were larger than that due to parameter uncertainty. However, the temporal variability of CH_4 emissions in Arctic tundra is not significantly different when using different fractional wetland maps. For different transport pathways of CH_4 emissions, diffusion was determined as the dominant pathway for methane transport from wetland to the atmosphere in Arctic tundra. CH_4 fluxes in Arctic tundra are more sensitive to soil temperature at 25 cm if the water table position is above the soil surface.

Keywords: Physical Geography and Ecosystem analysis, LPJ-GUESS, Biogeochemical modelling, Methane emissions, Arctic tundra, Fractional wetland maps, Sensitivity test, Parameter optimization

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