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Interaction between climate change and natural methane fluxes taking into account the wetland area dynamics

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Methane is a greenhouse gas with one of the most significant radiative forcing on the Earth's climate system. The natural emission of methane is estimated at 35-50% of the total, the main natural source is wetlands. It is not only the largest source of methane, but also the most volatile on an inter-annual scale. There are concerns that methane emissions from wet ecosystems can grow significantly with climate warming and the inclusion of feedbacks between the climate and the methane cycle. A number of numerical experiments both in a non-interactive and interactive mode were carried out using the model of methane emission from wet ecosystems proposed in A.M. Obukhov Institute of Atmospheric Physics RAS (IAP RAS). The main drawback of the model, pointed out by the reviewers, was the use of a time-constant wetland mask reflecting only the current situation. It resulted in the low sensitivity of modeled methane emissions to changes in precipitation, so most of the experiments were limited to the 20-21st centuries. This study is aimed at improving the model of methane emissions from wet ecosystems, developed at the IAP RAS, which will allow to make more detailed assessments under climate changes and the corresponding transformation of the natural environment. A model of thermal and hydrophysical processes in the soil was supplemented with a scheme for calculating the area of wetlands within the model cell based on TOPMODEL approach. A number of numerical experiments was conducted using atmospheric data from CMIP5 global climate models for the 21st century with anthropogenic and natural forcing on the system in accordance with the RCP (Representative Concentration Pathways) scenarios. Global and regional interannual and seasonal changes in wetland area, methane emissions from wetlands and their uncertainties are estimated. This study is supported by Russian Science Foundation (17-77-10152).