Methane emissions from Western Siberian wetlands: sensitivity to climate change from multi-model estimations

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Scheme of methane emissions from wetlands which takes into account dependence of methane flux to climate state and was used in [1,2] is combined with the model of heat and moisture transport in soil [3]. Simulations with the combined model are performed for the region of Western Siberia (55-65°N, 65-85°E) for the 21st century forced by atmospheric parameters from the ensemble of climate models: CCCMA-CGCM3, INMCM3, ECHAM5/MPI-OM, NCAR-CCSM3 and IAPRAS CM.

On average, simulated methane emissions E_{CH4} for the chosen region increase from 9.1 $MtCH_4$/yr for the early 21st century to 21.3 $MtCH_4$/yr in its end (Fig.1). Different observational estimates of methane emissions from Western Siberia give wide range for total methane flux from 1 to 20 $MtCH_4$/yr [4]. According to estimates [4,5], E_{CH4} equals to 3.1 $MtCH_4$/yr and 1.7 $MtCH_4$/yr correspondingly. In the climate model of intermediate complexity developed at the A.M. Obukhov Institute of Atmospheric Physics RAS (IAPRAS CM), methane emissions for the analized region increase from 9.9 to 22 $MtCH_4$/yr during the 21st century [2]. Estimations of methane fluxes obtained for ensemble of models show notable scatter and the difference in E_{CH4} between the models may reach 15 $MtCH_4$/yr.

To access sensitivity of simulated methane emissions to input parameters of atmospheric forcing simulations are performed for 21st century when the value of one of parameters is kept corresponding to year 2001. When the air temperature is kept on the year 2001 level, simulated average E_{CH4} increases from 8.4 to 10.5 $MtCH_4$/yr during the 21st century (Fig.2). When other parameters are fixed corresponding to their values for year 2001, the simulations results are relatively close to base results depicted at Fig.1. Thus, the combined soil-methane emission model is most sensitive to the surface air temperature. Inter-model differences in E_{CH4} may be explained by the differences in surface air temperature for the analyzed region, which may be as high as 2-3°C.

This work was supported by the Russian Foundation for Basic Research, by the programs of the Russian Academy of Sciences, and by the Russian President scientific grant.

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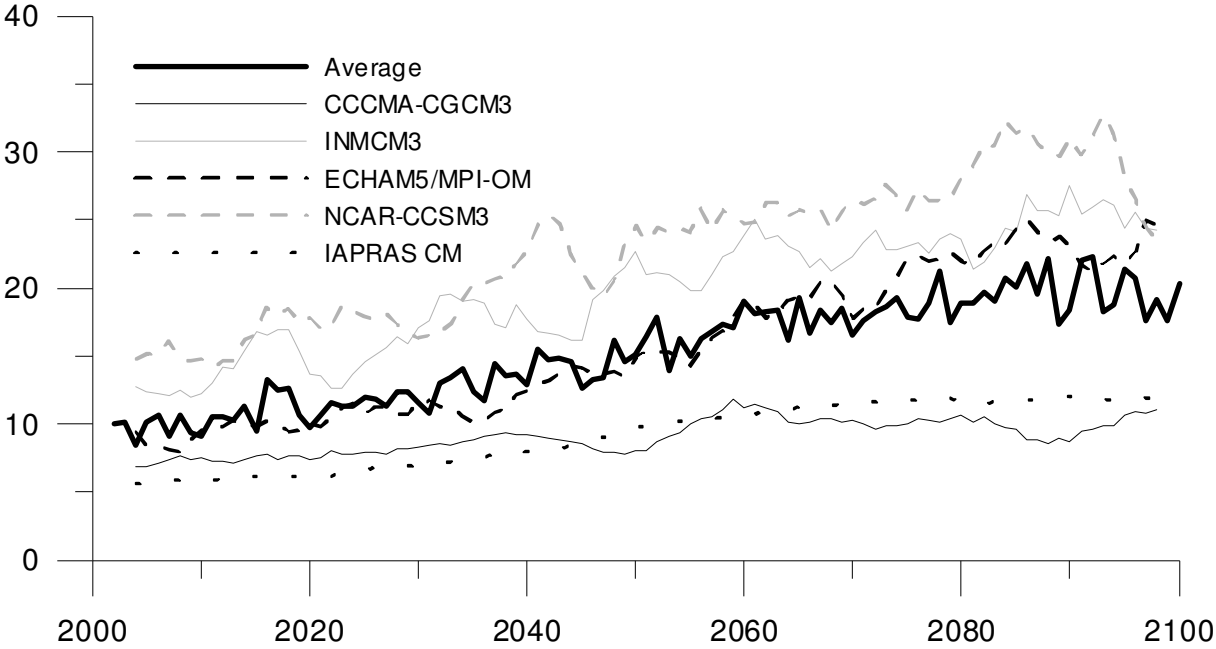

Figure 1: Average simulated methane emissions and 5-year running average emissions for each model.

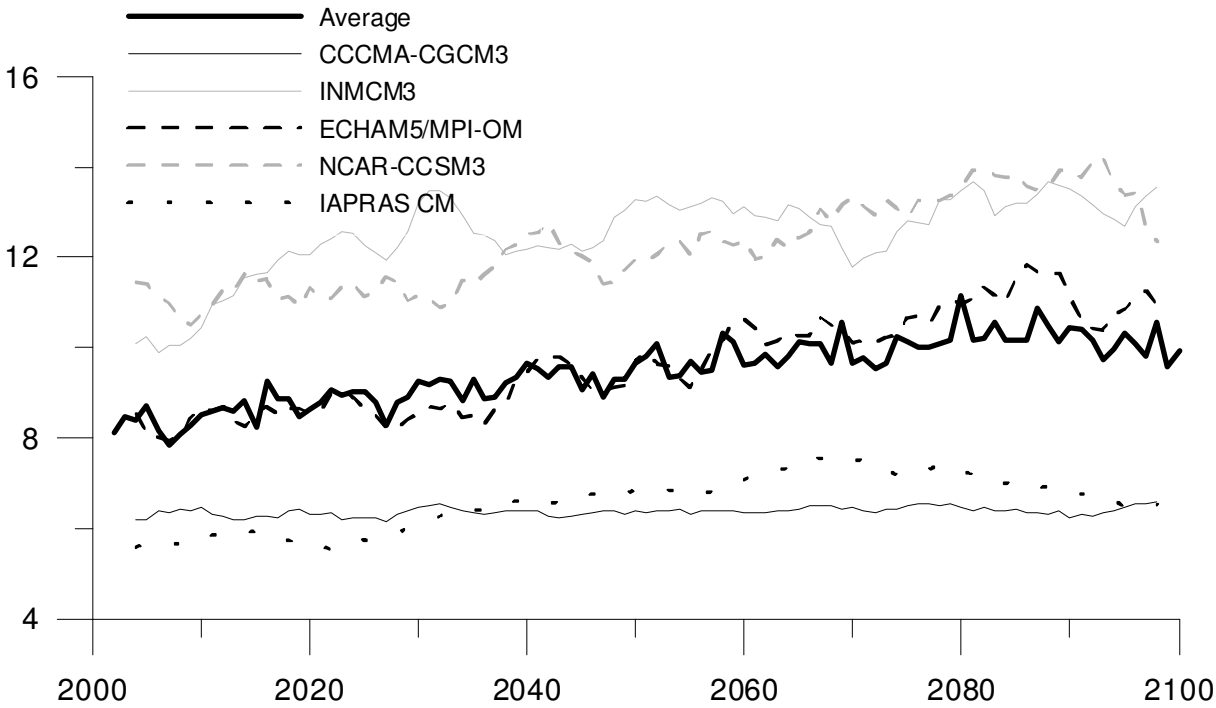

Figure 2: Average simulated methane emissions and 5-year running average emissions for each model when temperature remains on the 2001-year value.