Changes in wetland methane emissions in the IAP RAS global model under RCP anthropogenic scenarios.

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The global climate model of Institute of Atmospheric Physics of the Russian Academy of Sciences (IAP RAS CM) is extended by module of heat and moisture transport in soil [1]. Module of methane emission from wetlands [2] was improved and now takes into account carbon content in soil. The set of numerical experiments with IAP RAS CM is performed with the anthropogenic scenarios RCP for the 18th-21st centuries taking into account response of methane emissions from wetlands and the effects of chemical processes in the atmosphere to changing climate. In experiment E1 the characteristic time of methane decomposition in the atmosphere was constant. In experiments E2 and E3 it was given by temperature dependence according to the Arrhenius law and van 't Hoff equation respectively.

The IAP RAS CM generally reproduces characteristics of methane cycle in pre-industrial and modern period. Methane emission from wetlands to the atmosphere for the modern period equals to 150-160 $MtCH_4$/yr (which is consistent with observational estimates of 145±30 $MtCH_4$/yr [3]) and increasing by the end of 21st century to 170-230 $MtCH_4$/yr depending on imposed anthropogenic scenario.

Under the aggressive RCP 8.5 anthropogenic scenario concentration of methane reaches in E1 experiment 3900 ppb in the end of the 21st century (Fig. 1a). Under more moderate anthropogenic scenarios RCP 4.5 and 6.0, it reaches 1850-1980 ppb in the second half of the 21st century and decreases afterwards. Under RCP 2.6 scenario, maximum concentration of methane in the atmosphere (1730 ppb) is reached in the second decade of the 21st century. Acceleration of methane oxidation in the atmosphere due to global warming (experiments E2 and E3) reduces the growth of methane concentration by 5-40%. Related changes in the surface air temperature are rather small (less than 0.1 K globally or 4% of warming by the end of 21st century).

Although the growth of the total methane emissions amounts 10-25% it varies greatly depending on the region. Estimated growth is highest in the wetlands of Western Siberia. Simulated modern emissions for this region equal 0.5 $MtCH_4$/yr which is lesser than observational estimates of 1.5-7 $MtCH_4$/yr [4]. But the growth of emissions in 21st century amounts up to 700% depending on imposed anthropogenic scenario (Fig. 1b). This may be due not only to increasing temperature (which grows faster in high latitudes) but with increasing duration of the period of methanogenic bacteria activity in the soil.

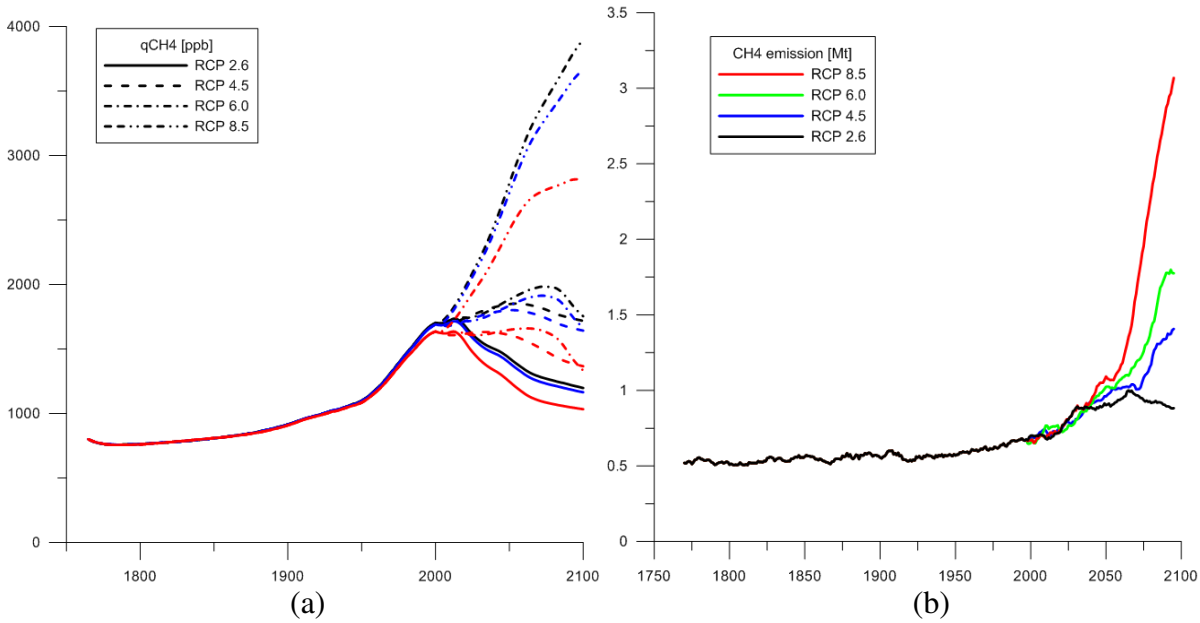

Fig. 1 Simulated concentrations of methane in atmosphere for E1 (black), E2 (blue), and E3 (red) experiments (**a**) and simulated methane emissions from Western Siberia for E1 experiment (**b**).

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