A modeling study of effective radiative forcing and climate response due to increased methane concentration

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An atmospheric general circulation model BCC_AGCM2.0 and observation data from ARIS were used to calculate the effective radiative forcing (ERF) due to increased methane concentration since pre-industrial times and its impacts on climate. The ERF of methane from 1750 to 2011 was 0.46 W m^{-2} by taking it as a well-mixed greenhouse gas, and the inhomogeneity of methane increased its ERF by about 0.02 W m^{-2}. The change of methane concentration since pre-industrial led to an increase of 0.31 ˚C in global mean surface air temperature and 0.02 mm d^{-1} in global mean precipitation. The warming was prominent over the middle and high latitudes of the Northern Hemisphere (with a maximum increase exceeding 1.4 ˚C). The precipitation notably increased (maximum increase of 1.8 mm d^{-1}) over the ocean between 10˚N and 20˚N and significantly decreased (maximum decrease >−0.6 mm d^{-1}) between 10˚S and 10˚N. These changes caused a northward movement of precipitation cell in the Intertropical Convergence Zone (ITCZ). Cloud cover significantly increased (by approximately 4%) in the high latitudes in both hemispheres, and sharply decreased (by approximately 3%) in tropical areas.

Keywords: Methane, Effective radiative forcing, Climate change

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