Continued increase in CH_4 emissions from China estimated from atmospheric CH_4 observation at Hateruma Island

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There are growing concerns about acceleration of global warming caused by the increase of atmospheric methane (CH_4) because it is the second most important anthropogenic greenhouse gas in the atmosphere. Nevertheless, global CH_4 cycles including the geographical flux distributions and their temporal variations remain poorly understood to explain the recent atmospheric increasing trend and to predict the future atmospheric levels. To deepen our understanding of the global CH_4 cycle, the National Institute of Environmental Studies (NIES) has been carrying out in-situ observations of atmospheric CH_4 at Hateruma Island (HAT; lat. 24.1˚N, long. 123.8˚E) since 1996 by using gas chromatographic system. In this study, we present 20-year record (1996-2017) of CH_4 at HAT and examine the temporal change in the synoptic-scale variability. The CH_4 concentrations at HAT showed elevated peaks with amplitudes of more than several tens ppb when the air masses were transported from the continental regions. The frequency of such CH_4 elevation events increase during a winter 5-month period (Nov.-Mar.) because of the East Asian monsoon. Model simulations based on a Lagrangian Particle Dispersion Model (LPDM) revealed that the most of the elevated CH_4 during the winter 5-month are mainly attributed to emissions from China. The simulated CH_4 increments (ΔCH_{4sim}) based on the LPDM and fixed climatological monthly flux maps generally well explain the observed CH_4 increment (ΔCH_{4obs}), which is obtained by subtracting the estimated baseline from the observation. The regression slopes between the observed and simulated CH_4 increments ($\Delta CH_{4obs}/\Delta CH_{4sim}$) for the winter 5-month periods show steady increase after the middle of 2000s. These results suggest that the CH_4 emissions from China during the winter 5-month period, probably abiogenic CH_4 emissions, steadily increased after the middle of 2000s.

Keywords: atmospheric CH4, greenhouse gas, LPDM

