Seasonality of short-term variations in atmospheric CH_4 observed at Hateruma and relationship with the reginal emissions from East Asia

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National Institute of Environmental Studies (NIES), Japan, has been carrying out in-situ observation of atmospheric CH_4 at Hateruma Island (HAT; lat. 24.1˚N, long. 123.8˚E) since 1996 by using a gas chromatographic system. Since HAT is in the marginal region of the East Asia, air masses from the continental region would cause elevated concentrations of a variety of species including CH_4. Such events were often observed especially during late autumn to early spring due to the Asian monsoon. In the previous studies, we revealed a secular increase in the short-term variations of CH_4 and its relationship with the emission increase from the continental China. Here, we examined the seasonality of the short-term variations of CH_4 in 1996 to 2017. First, we computed the increment of the hourly CH_4 (ΔCH_4) over the baseline, which was the smoothed averages of CH_4 below the 20 percentile in a 101-hour moving time-window. Then the standard deviation of ΔCH_4 for each month of each year was computed. The average monthly standard deviations of ΔCH_4 show rather stable values in winter (November-February, 18~20 ppb), peaks in May (28 ppb) and September (26 ppb), and a dip in July (11 ppb). We simulated ΔCH_4 by a Lagrangian particle dispersion model (LPDM) using the monthly CH_4 emission maps of Patra et al. (2009) and EDGAR v4.3.2, respectively. Although the monthly variability of the simulated ΔCH_4 based on the Patra et al. (2009) emission maps well reconstructed the observed pattern of the monthly standard deviations, that based on the EDGAR v4.3.2 emission maps showed a maximum in March, which was not consistent with the observed pattern. The simulated maximum variability in March is related to the emission peak in March of the EDGAR v4.3.2 inventory, which is attributed to the maximum emissions from agricultural and livestock sectors. The lack of the spring peak in the observation suggests that the anthropogenic CH_4 emission in March of EDGAR v4.3.2 may be overestimated.

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