

Recent stagnation of CH₄ emission growth from East Asia based on the analysis of synoptic variations of atmospheric CH₄ and CO₂ observed at Hateruma Island

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Atmospheric mixing ratios of greenhouse gases including CO₂ and CH₄ have been monitored at Hateruma Island, Japan (HAT; lat. 24.1°N, long. 123.8°E) for more than 20 years by the National Institute of Environmental Studies (NIES). The observed CO₂ and CH₄ show secular increasing trends and seasonal variations, typical of a regional background sites, and consist of synoptic variations (Δ CO₂ and Δ CH₄) with duration ranging from several hours to several days. These synoptic variations contain signals arising from the regional emissions from the continental East Asia, especially China, and were observed more often during late fall to early spring because of the suppression of the continental emissions signal during the East Asian monsoon in summer. Since the observed Δ CO₂ and Δ CH₄ in wintertime generally showed fairly good correlations, the variation ratio (Δ CH₄/ Δ CO₂ ratio) can be used to constrain the regional emission ratio. In previous study (Tohjima et al., 2014), based on the fact that the fossil fuel CO₂ emissions were relatively well determined, we obtained the increasing rate of the CH₄ emission from China (about 1 Tg-CH₄ yr⁻²) in 2000s from the comparison of the Δ CH₄/ Δ CO₂ ratios between the observation and simulation. In this study, we revisited the temporal change in Δ CH₄/ Δ CO₂ ratio at HAT and investigate the recent change in the CH₄ emissions from China. The observed Δ CH₄/ Δ CO₂ ratio showed decrease for the entire period (1997-2019) from about 13 ppb/ppm to 8 ppb/ppm while its decreasing rate showed a gradual slowdown and appeared to reach bottom after 2010. Such change in the decreasing rate is mostly attributed to the slowdown of the increase in the fossil fuel CO₂ emissions from China. We calculated Δ CO₂ and Δ CH₄ by using a Lagrangian Particle Dispersion Model (LPDM) and several CH₄ and CO₂ flux maps based on bottom-up and top-down approaches. Then we scaled the CH₄ emissions from China so as to match the calculated Δ CH₄/ Δ CO₂ ratio with the observation. The results suggested that the linear increasing trend of the CH₄ emissions from China for 2010s is significantly reduced in comparison with that for the 2000s.

Keywords: atmospheric CH₄, atmospheric CO₂, synoptic variation