3.022 Rapid increase in N2O emissions from continental East Asia estimated from the atmospheric observation at Hateruma Island.

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Abstract:

The National Institute for Environmental Studies (NIES) has been carrying out in-situ observations of the atmospheric greenhouse gases at Hateruma Island (HAT; lat. 24.1°N, long. 123.8°E) located off the coast of continental East Asia. Here, we present two-decadal (1996-2017) time series of the atmospheric nitrous oxide (N_2O) at HAT. The observed time series of N_2O mixing ratio show not only a steady increase and a seasonal cycle but also short-term enhancements with synoptic time scales especially during winter, when the air mases are often transported from the continental region due to the East Asian monsoon. We analyze the short-term variations to infer the temporal change in the N_2O emissions from East Asia, especially China. After removing the baseline of the N_2O mixing ratios, we compute the standard deviations of ΔN_2O^{obs} (observation – base line) for the winter 5-month periods (Nov.-Mar.) during 1997-2016. The standard deviations gradually increase at an accelerating rate and are doubled in the two-decadal period. We simulate the short-term variations (ΔN_2O^{sim}) by using a Lagrangian Particle Dispersion Model (LPDM) and N_2O emission maps based on the EDGAR inventory. Since the LPDM simulation generally well explain the observed short-term variations, we compute the regression slopes ($\Delta N_2O^{obs}/\Delta N_2O^{sim}$) of the correlation plots between ΔN_2O^{obs} and ΔN_2O^{sim} for the winter 5-month periods. The regression slopes more than doubled during the two-decadal period when the N_2O emission map for a fixed year was repeatedly used for the entire period of the simulation. In addition, even when the N_2O emissions from China increase by about 40% during 1996-2012 according to the EDGAR v4.2 FT2012 estimation, the regression slopes still increase by about 30% during 1996-2012. These results suggest that the anthropogenic N_2O emissions from China increase more rapidly than the EDGAR estimation.