Analyses of trends, seasonal variations, and short-term variations of atmospheric N_2O concentrations observed at Hateruma Island and Cape Ochi-ishi

*Yasunori Tohjima[1], Keiichi Katsumata[1], Toshinobu Machida[1], Kentaro Ishijima[2]

1. National Institute for Environmental Studies, 2. Japan Agency for Marine-Earth Science and Technology

Nitrous oxide (N_2O) is one of the important anthropogenic greenhouse gas in the atmosphere, having a GWP 265 times that of CO_2 for a 100-year timescale. To enhance understanding of the global N_2O cycle, the National Institute of Environmental Studies (NIES) has been carrying out in-situ observations of the atmospheric N_2O at Hateruma Island (HAT; lat. 24.1˚N, long. 123.8˚E) since March 1996 and at Cape Ochi-ishi (COI; lat. 43.2˚N, long. 145.5˚E) since June 1999 by using gas chromatographic systems. In this study, the trends, the seasonal variations, and the synoptic-scale variations of the atmospheric N_2O observed at both sites are examined. The N_2O concentrations at both sites steadily increased at an almost same rate of about 0.8 ppb/yr. Although the interannual variations in the growth rates seem to be rather small, relatively large increasing rates larger than 1.1 ppb/yr were observed for HAT in 1999-2000 and for HAT and COI in 2014-2015. The average seasonal cycles show the maxima in April for both sites and the minima in July for HAT and in September for COI. The peak-to-peak amplitudes of the average seasonal cycles are about 0.5 ppb and 0.8 ppb for HAT and COI, respectively. It should be noted that the seasonal amplitude for HAT seems to increase temporally at a rate of 0.012±0.007 ppb/yr (p=0.1) although that for COI doesn’ t show a significant long-term change. In addition to the seasonal variations, synoptic scale variations are often observed especially at HAT during a period from November to March, when the polluted air masses are predominantly transported from the continental regions. The standard deviations of the detrended and deseasonalized time series of N_2O for the winter 5-month period for HAT show significant temporal increase. The EDGAR inventory estimation (v4.2, FT2012) shows that the anthropogenic N_2O emissions from China increase about 40% during 1996-2012. Therefore, the increasing trends in the amplitudes of the seasonal and short-term variations at HAT may reflect the anthropogenic emission increase in China.

Keywords: atmospheric N2O, greenhouse gas, seasonal variation, short-term variation

