3.050 Long-term trend of tropospoheric N2O isotopocule ratios in the Northern Hemisphere .

Presenting Author:
Sakae Toyoda, Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, Yokohama, Japan, toyoda.s.aa@m.titech.ac.jp

Co-Authors:
Toshinobu Machida, National Institute of Environmental Studies
Yasunori Tohjima, National Institute of Environmental Studies
Motoki Sasakawa, National Institute of Environmental Studies
Shinji Morimoto, Center for Atmospheric and Oceanic Studies, Graduate School of Science, Tohoku University
Doug Worthy, Environment Canada
Kentaro Ishijima , Japan Agency for Marine-Earth Science and Technology
Naohiro Yoshida, Department of Chemical Science and Engineering, School of Materials and Chemical Technology, Tokyo Institute of Technology, Yokohama, Japan; Earth-Life Science Institute, Tokyo Institute of Technology

Abstract:

Nitrous oxide (N_2O) is one of the increasing greenhouse gases and is the most important stratospheric ozone-depleting gas emitted in the present century. Isotopocule ratios of N_2O, which include not only elemental $^{15}N/^{14}N$ and $^{18}O/^{16}O$ ratios but also site-specific $^{15}N/^{14}N$ ratio in asymmetric NNO molecule, are regarded as useful parameters to infer the origin and production–consumption mechanisms of N_2O, and to estimate its global budget. Previous studies on the firn air in polar ice sheet revealed the secular trend of isotopocule ratios, but there have been only a few reports on long-term monitoring of atmospheric N_2O isotopocule ratios in the Northern Hemisphere.
We present up to 19-year record of monthly or biweekly mixing ratio and isotopocule ratios of N_2O obtained at three sites in the Northern Hemisphere: Hateruma, a southwestern island of Japan (24°N, 124°E) (since 1999), Novosibirsk in the western Siberia, Russia (55°N, 83°E) (since 2005), and Churchill, northern Canada (59°N, 94°W) (since 2011). Results show that the bulk nitrogen isotope ratio ($d^{15}N^{bulk}$) are decreasing at the similar rate (about -0.04‰ yr^{-1}) as reported by firn-air analysis while the N_2O mixing ratio are increasing (about 0.8 ppbv yr^{-1}) at the three sites. This suggests isotopically light N_2O sources such as agriculture are still contributing to the increase in the atmospheric N_2O. Detailed analysis of the time series reveals that year-to-year variation of the mixing ratio and $d^{15}N^{bulk}$ has been enhanced since around 2010 at all the three sites, and that vertical gradient of the mixing ratio and $d^{15}N^{bulk}$ over Novosibirsk has been also variable recently. Cause of these findings will be discussed with respect to temporal change in N_2O flux and isotopic signature of surface sources and change in atmospheric circulation including troposphere-stratosphere exchange, with the aid of atmospheric model simulation.