Abiotic and Biogeochemical Signals in the Seasonal Cycles of Atmospheric Nitrous Oxide

C. Nevison

Institute of Arctic and Alpine Research, University of Colorado, Boulder, CO 80309; 303-494-6401, E-mail: nevison@colorado.edu

The seasonal cycle of atmospheric nitrous oxide (N_2O) is difficult to quantify due to the small signal to noise ratio and large interannual variability in the data. Differences among four monitoring networks (Advanced Global Atmospheric Gases Experiment (AGAGE), Commonweath Scientific & Industrial Research Organization, NOAA Carbon Cycle Greenhouse Gases, and Halocarbons & Other Atmospheric Trace Species (HATS) also influence the interpretation of the N_2O seasonal cycle. In the northern hemisphere, correlations between N_2O seasonal minimum anomalies and polar winter stratospheric temperature provide compelling evidence for a stratospheric influence, which may dominate the N_2O seasonal cycle at many stations. In the southern hemisphere, oceanic signals are comparable in magnitude to stratospheric signals. The oceanic signals include both thermal in/outgassing and ventilation components and are easier to distinguish in N_2O data than in other atmospheric species, e.g. CO_2 or O_2/N_2. As a result, N_2O seasonal cycles can provide insight into these important oceanic processes.

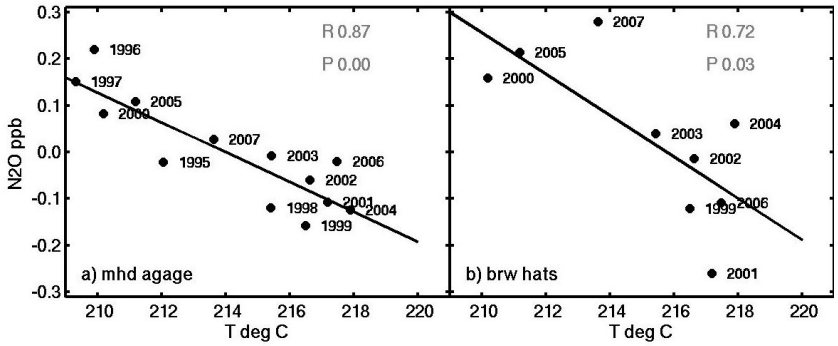

Figure 1. N_2O seasonal minimum anomaly plotted against mean January-March 100 hPa 60-90N lower stratospheric temperature: a) AGAGE data at Mace Head, Ireland, b) NOAA HATS data at Barrow, Alaska. Wintertime lower stratospheric temperature is a proxy for the strength of the seasonal descent of N_2O-depleted air from the middle and upper stratosphere, with greater descent occurring in warm years.

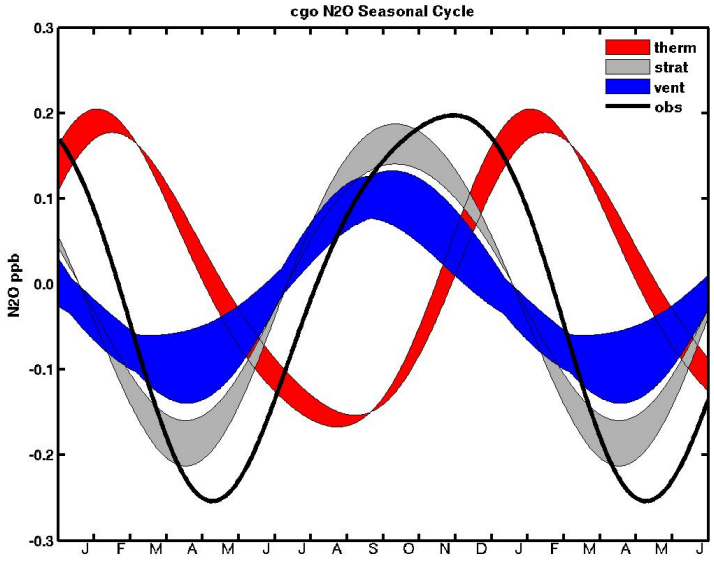

Figure 2. Partitioning of the observed mean N_2O seasonal cycle at Cape Grim, Tasmania into ventilation, thermal in/outgassing and stratospheric components, estimated based on AGAGE N_2O and CFC-12 data and National Centers for Environmental Prediction heatfluxes.