6.004 Wintertime Reactive Nitrogen Chemistry During the 2015 WINTER Aircraft Campaign.

Early Career Scientist

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Abstract:

Tropospheric ozone (O_3) is a potent greenhouse gas that degrades regional air quality. Anthropogenic NO_x emissions and chemistry are an important regional O_3 source during midlatitude summer, but may destroy O_3 during winter. The large majority of previous field studies have focused on understanding reactive NO_x-O_3 relationships under summertime conditions. However, there remain outstanding scientific questions regarding the influence of NO_x on wintertime O_3, in part because of the relevant atmospheric chemistry that occurs largely at night, including N_2O_5 multiphase processes. The winter tropospheric O_3 budget depends critically on N_2O_5 production and the efficiency of its subsequent reaction on aerosols to nitric acid (HNO_3) or nitryl chloride ($ClNO_2$). These processes are highly uncertain due in part to the limited database for wintertime atmospheric chemical measurements.

The Wintertime Investigation of Transport, Emissions, and Reactivity (WINTER) campaign conducted 13 research flights over the eastern US in February and March 2015. A wide variety of environments were sampled during day and overnight flights over continental and marine environments. Reactive nitrogen measurements were collected with a cavity ring down spectrometer, while HNO_3 and $ClNO_2$ were measured with chemical ionization mass spectrometry. Initial analysis of these data has shown that wintertime N_2O_5 mechanisms and reactive nitrogen partitioning are highly variable. Presented here is further analysis aimed at quantifying the observed N_2O_5 aerosol reactive uptake coefficient as a function of different ambient conditions observed during WINTER (e.g. temperature, relative humidity, gas vs. particle phase nitrate and chloride). In addition, a chemical box model is used to assess the chemical and/or environmental factors that influence reactive nitrogen partitioning.