Wintertime Airborne Measurements of Greenhouse Gases and Criteria Pollutants in Washington D.C.

O. Salmon[1], P.B. Shepson[1,2], R.M.G. II[3], B.H. Stirm[3], X. Ren[4,5], R.R. Dickerson[4], J.D. Fuentes[6] and J.B. Leen[7]

[1]Purdue University, Department of Chemistry, West Lafayette, IN 47907; 765-496-2404, E-mail: osalmon@purdue.edu
[2]Purdue University, Department of Earth, Atmospheric, and Planetary Sciences, West Lafayette, IN 47907
[3]Purdue University, Department of Aviation Technology, West Lafayette, IN 47907
[4]University of Maryland, Department of Oceanic and Atmospheric Science, Maryland 20742
[5]NOAA, Air Resources Laboratory, Silver Spring, MD 20910
[6]The Pennsylvania State University, Department of Meteorology, University Park, PA 16802
[7]Los Gatos Research, Inc., Mountain View, CA 94041, U.S.

Colder temperatures and fewer daylight hours in winter provide a unique environment for anthropogenic pollutants to accumulate and react. Lower boundary layer heights and generally poorer turbulent mixing combined with increased home heating, and high traffic in urban areas lead to greater ambient concentrations of some combustion fuels and their products, such as, methane (CH_4), carbon dioxide (CO_2), carbon monoxide (CO), and water vapor (H_2O). Additionally, nitrogen oxides (NO_x = NO + NO_2), found in emissions from combustion sources, behave differently as compared to warmer, sunnier seasons, e.g. relatively larger concentrations of dinitrogen pentoxide (N_2O_5). They experience longer photochemical lifetimes, and can take part in a number of reactions that can alter the oxidizing capacity of the atmosphere or result in unique aerosol chemistry. A collaborative study dubbed Wintertime INvestigation of Transport, Emissions, and Reactivity (WINTER) was conducted in the Northeastern United States during the winter of 2015 to better understand the seasonal trends in anthropogenic emissions and the activity of these reactive pollutants.

Measurements were conducted from three airborne platforms, the NCAR C-130, Purdue University's ALAR aircraft, and the University of Maryland's Twin Cessna. Intercomparison flights were flown between the three aircraft at different stages of the field campaign. Purdue's ALAR was instrumented to measure greenhouse gases: CO_2, CH_4, and H_2O and criteria pollutants: ozone (O_3), NO_2, and particulate matter (PM), as well as turbulence. ALAR flew a total of 8 mass balance flights during the study, two of which were coordinated with the University of Maryland's aircraft. An example flight path from Purdue's February 27th mass balance flight is pictured in Fig. 1. Mass balance flights were designed to quantify emissions from the Baltimore-Washington D.C. area by sampling upwind and downwind of the urban centers, and conducting vertical profiles to characterize the boundary layer. In this presentation we will discuss preliminary results of Purdue's WINTER experiments.

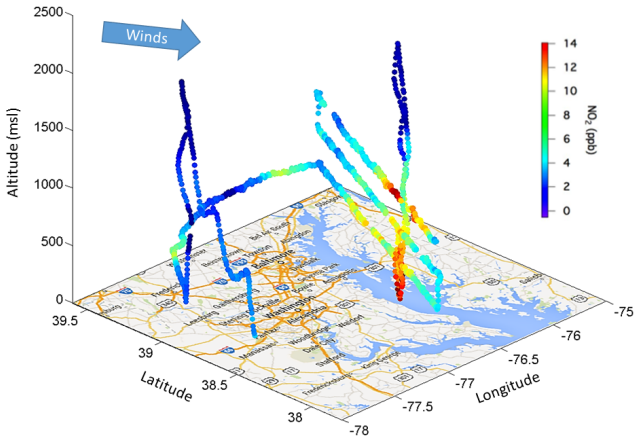

Figure 1. Feb. 27th flight colored by NO_2.