Quantification of NO_y and CO Emissions from Washington, D.C.-Baltimore during the WINTER Campaign

O.E. Salmon[1], P.B. Shepson[2], X. Ren[3,4], R.R. Dickerson[3], B.H. Stirm[5], S.S. Brown[6], D.L. Fibiger[7,6] and E. McDuffie[7,6]

[1]Purdue University, Department of Chemistry, West Lafayette, IN 47907; 920-366-5276, E-mail: osalmon@purdue.edu
[2]Purdue University, Department of Earth, Atmospheric, and Planetary Sciences, West Lafayette, IN 47907
[3]University of Maryland, Department of Oceanic and Atmospheric Science, College Park, MD 20742
[4]NOAA Air Resources Laboratory (ARL), Silver Spring, MD 20910
[5]Purdue University, Department of Aviation Technology, West Lafayette, IN 47907
[6]NOAA Earth System Research Laboratory, Chemical Sciences Division (CSD), Boulder, CO 80305
[7]Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, CO 80309

Regulations to limit surface-level ozone have successfully targeted emissions of carbon monoxide (CO) and nitrogen oxides (NO_x = NO + NO_2) from combustion sources. Bottom-up inventories are updated periodically to reflect reductions in emissions. However, because emissions of CO and NO_x are highly dependent on equipment age, type, and operating conditions, inventories must be sophisticated to accurately estimate emissions. Similarly, estimating top-down NO_x emissions can be complicated as NO_x readily partitions to other reactive nitrogen species (NO_y; total reactive nitrogen). The Wintertime INvestigation of Transport, Emissions, and Reactivity (WINTER) campaign, conducted in the northeastern U.S. in 2015, investigated NO_y chemistry and transport unique to the cold season.

Airborne mass balance flights conducted around Washington, D.C.-Baltimore allow for the determination of the urban area's NO_y and CO emission rates by calculating the product of the perpendicular wind speed and the downwind enhancement in NO_y and CO, respectively. Here we compare our top-down NO_y and CO emission rate estimates to inventory estimates. Preliminary analyses suggest agreement between top-down and bottom-up NO_y emissions estimates, while our CO emissions estimates are a factor of ~3 lower than inventory estimates. It is possible our preliminary results indicate improvements to the National Emissions Inventory are required to better estimate CO emissions, at least in some regions of the U.S.

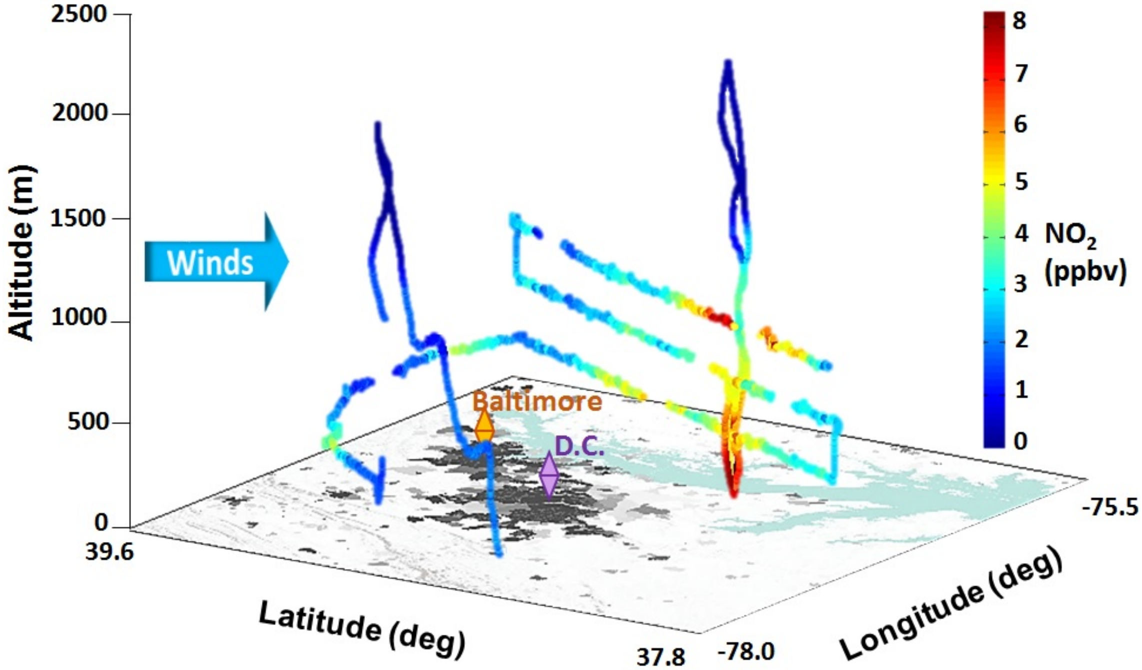

Figure 1. A mass balance flight path on February 27, 2015 around the Washington, D.C.-Baltimore area.