Reactive nitrogen in the global upper troposphere from NASA DC8 and MOZAIC aircraft campaigns

Nana Wei1, Eloise A. Marais2, Paul O. Wennberg3, Hannah M. Allen4, John D. Crounse3, Donald R. Blake5, Andy J. Neuman6, Greg L. Huey7, Patrick R. Veres6, Chelsea R. Thompson6, Ilann Bourgeois8, Jeff Peisch6, and Bastien Sauvage8

1University of Leicester, Department of Physics and Astronomy, United Kingdom of Great Britain – England, Scotland, Wales (nw177@leicester.ac.uk)
2University College London, Department of Geography, United Kingdom of Great Britain – England, Scotland, Wales (e.marais@ucl.ac.uk)
3Division of Geological and Planetary Sciences, California Institute of Technology, Pasadena, California 91125, USA
4Division of Chemistry and Chemical Engineering, California Institute of Technology, Pasadena, CA, USA
5Department of Chemistry, 572 Rowland Hall, University of California, Irvine, Irvine, California 92697-2025, USA
6NOAA Chemical Science Laboratory, Boulder, CO, USA
7School of Earth and Atmospheric Sciences, Georgia Institute of Technology, Atlanta, Georgia, USA
8Laboratoire d’aérologie (LA), CNRS UMR-5560 et Observatoire Midi-Pyrénées, Université de Toulouse, France

Reactive nitrogen in the upper troposphere (~8-12 km) impacts global climate, air quality and the oxidizing capacity of the whole troposphere. Here we use aircraft observations from instruments onboard the NASA DC8 aircraft for campaigns from 1997 (SONEX) to the recent ATom campaign (2016-2018) and the MOZAIC commercial aircraft campaign (2003-2005) to address uncertainties in the dynamics of reactive nitrogen (NOy = NOx + NOy reservoir compounds) in the global upper troposphere (UT). Our initial analysis of the DC8 aircraft observations is consistent with previous work in that PAN is the dominant NOy component (average: 43%; range: 40-60%), followed by NOx (on average, 21%), with smaller contributions (on average, 3.5-12.5%) from pernitric acid (HNO3), organonitrate (RONO2) and nitric acid (HNO3). We go on to compare multiyear mean NOy from MOZAIC to the combination of all NASA DC8 campaigns to determine whether we can build a near-global climatology of NOy and its components to compare to GEOS-Chem to assess our understanding of these very important atmospheric components.