Quarter Century of NOAA Airborne Observations of Halocarbons and Other Atmospheric Trace Species

J.W. Elkins[1], J.D. Nance[2], F.L. Moore[2], E.J. Hintsa[2], G.S. Dutton[2], B.D. Hall[1], D.F. Hurst[2], S.A. Montzka[1], B.R. Miller[2], C. Siso[2] and E.L. Atlas[3]

[1]NOAA Earth System Research Laboratory, 325 Broadway, Boulder, CO 80305; 303-497-6224, E-mail: james.w.elkins@noaa.gov
[2]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, CO 80309
[3]University of Miami, Rosenstiel School of Marine and Atmospheric Sciences, Miami, FL 33173

The scientific motivation for measuring vertical profiles of ozone-depleting and greenhouse gases is that many of these gases are transported into the upper atmosphere and destroyed. Changes in transport caused by climate change could affect the magnitude of their sinks, and thereby their atmospheric lifetimes. Our first airborne Gas Chromatograph (GC) was a modified commercial, one channel Shimadzu gas chromatograph. Our first airborne measurements were of chlorofluorocarbon-12 (CFC) aboard the NOAA King Air Aircraft over eastern Colorado on 6 December 1988 from ground level to 5.5 km (500 hPa). Since then, custom, multi-channel airborne gas GCs followed for high altitude aircraft, balloons, and unmanned aircraft systems. With collaboration from the Global Monitoring Division's Carbon Cycle Greenhouse Group to altitudes of 32 km (10 hPa), we added measurements from programmable flask packages for a low altitude aircraft and a pole-to-pole greenhouse gas survey of the troposphere since the mid-2000s. We have created a dataset of all of these measurements for use in modeling transport, distributions, and trends of these important trace atmospheric gases. Besides quantifying the vertical distribution and trends of these gases, these data have been used to define the atmospheric result of the Montreal Protocol (see figure), atmospheric lifetimes, the leaky tropical pipe model, vertical descent in the polar regions, atmospheric transport, mixing times and fractions between regions of the atmosphere, and trends in atmospheric age of the air mass.

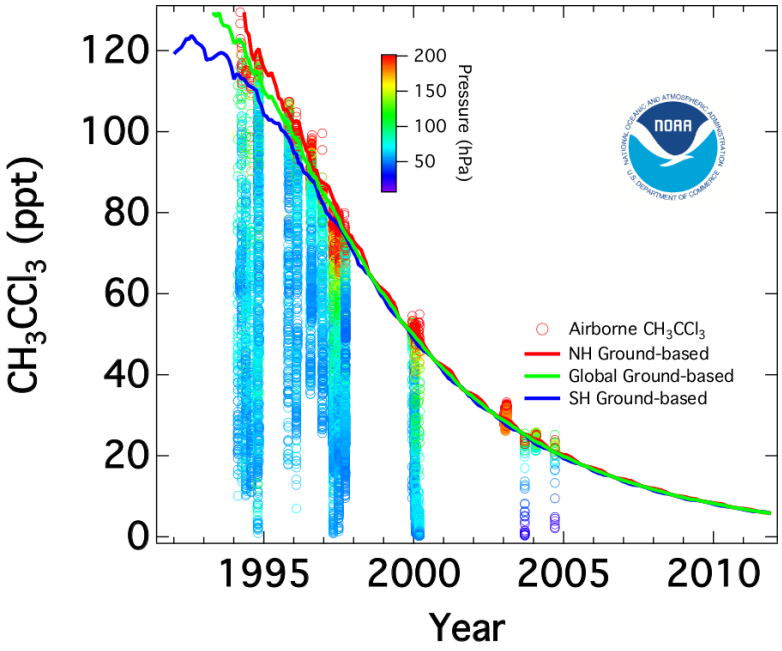

Figure 1. Methyl Chloroform decline over time at all altitudes as a result of the Montreal Protocol.