Emissions of Ozone-Depleting Substances in the Trans-Siberian Railway Corridor During Summer 2001

D.F. Hurst[1,2], P.A. Romashkin[1,2], J.W. Elkins[2], E.A. Oberlander[3], N.F. Elansky[4], I.B. Belikov[4], I.G. Granberg[4], G.S. Golitsyn[4], C.A.M. Brenninkmeijer[3], and P.J. Crutzen[3]

[1]Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder 80309; 303-497-7003, Fax: 303-497-6290; E-mail: Dale.Hurst@noaa.gov
[2]NOAA, Climate Monitoring and Diagnostics Laboratory, Boulder, CO 80305
[3]Max Planck Institute for Chemistry, Mainz, Germany D-55020
[4]Institute for Atmospheric Physics, Moscow, Russia 109017

The atmospheric loading of ozone-depleting halogens is currently diminishing because of severe reductions in the global production and emissions of ozone-depleting substances (ODSs) during the 1990s. Most of these reductions occurred prior to 1996, the Montreal Protocol requisite deadline for ending chlorofluorocarbon (CFC) production in developed countries. Despite these reductions, considerable emissions of many ODSs continue today and will likely persist for several decades in transitional nations, and in developing countries (Article 5) where production is allowed until 2010-2015. Estimates of the magnitudes of these current and impending emissions are central to projections of the recovery of the stratospheric ozone layer during this century.

The Russian Federation, a non-Article 5 country and producer of approximately 10% of the world's CFCs and halons during 1989-1995, continued to manufacture these chemicals until the end of 2000 with allowances from the Protocol as a transitional nation. Russian ODS emission estimates for years prior to 1986 are based on pure conjecture because manufacturing companies never disclosed production figures. Since 1986, Russia has reported ozone-depletion potential (ODP)-weighted, aggregated production figures in accordance with the Protocol, but these are not audited for accuracy and require speculative apportionment into production estimates for individual compounds. Consequently, the production-based estimates of more recent Russian ODS emissions carry large uncertainties.

During summer 2001, we made thousands of measurements of six different ODSs along 17,000 km of the Russian trans-Siberian railway with the intention of estimating the magnitudes of ODS emissions in the rail corridor. This work was part of the seventh Trans-Siberian Observations Into the Chemistry of the Atmosphere (TROICA-7) expedition, a collaboration between Russian, German, and American scientists. Our measurements reveal strong emissions of CFC-12 (CCl_2F_2), weaker but globally significant emissions of halon-1211 ($CBrClF_2$) and CFC-113 (CCl_2FCClF_2), and globally negligible emissions of CFC-11 (CCl_3F), carbon tetrachloride (CCl_4), and methyl chloroform (CH_3CCl_3) (e.g., Figure 1). The impacts of these measurement-based emission estimates on present-day discrepancies between the measured atmospheric burdens and estimated global emissions of certain ODSs are discussed.

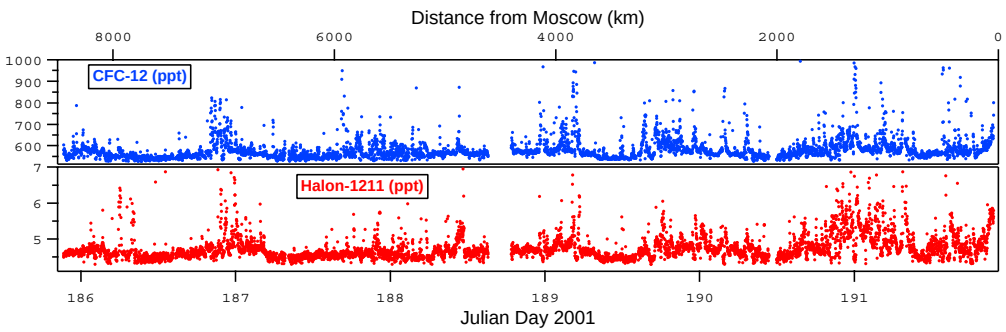

Figure 1. Atmospheric mixing ratios of CFC-12 and halon-1211 along the Russian trans-Siberian railway during the westbound transect of TROICA-7.