

Measurements of the Ozone-Depleting Chemicals Regulated by the Montreal Protocol

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All nations that have signed the Montreal Protocol and its subsequent amendments have agreed to limits on production of the primary ozone depleting substances (ODS) including chlorofluorocarbons (CFCs), halons, and selected chlorinated solvents (CH_3CCl_3 and CCl_4). Developed countries ceased production (except for sale to developing countries including Russia, China, India, etc., and minor critical uses) of the halons by 1994 and the CFCs and chlorinated solvents in 1996. Developing countries have until 2010 to end production of all ODS except for CH_3CCl_3 , for which the deadline is 2015. Total equivalent chlorine ($\text{Cl} + 45 * \text{Br}$) peaked in the troposphere sometime between mid-1992 and mid-1994 based on observations from the CMDL network. Results from CMDL airborne observations indicate that this peak of equivalent chlorine propagated into the lower stratosphere in about 1999. While tropospheric equivalent chlorine is decreasing at a constant rate of about 0.7% per year and appears to be on track with the Montreal Protocol, atmospheric levels of CFC-12 and all of the major halons are still increasing (figure). This talk will examine differences between observed mixing ratios and those predicted using industrial emissions and a two-box model of the atmosphere. For example, halon observations appear to be about 50% higher than predicted from reported emissions. Recent tower observations of the CFCs at Harvard Forest indicate that CFC-12 emissions from large metropolitan areas like the Washington-New York corridor are most likely still occurring from the reservoirs (or banks) of stored refrigerants. Large emissions of CFC-12 and the halons are occurring from continued production in developing countries, chemical banks in developed countries, or both. Multiple, continuous trace-gas observations from inside developing countries, similar to those from towers, are urgently required.

