ACE-FTS measurements of anthropogenic ozone depleting substances

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The depletion of stratospheric ozone is primarily caused by catalytic reactions of ozone and atomic chlorine. Stratospheric photodissociation of chlorofluorocarbons (CFCs) is the major source of this chlorine. To fulfill the need for safe, stable replacements of CFCs, hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs), have been developed. Monitoring the changing global distribution of CFCs in addition to their replacement species is critical to understanding the recovery of the ozone layer in a changing climate. Launched in August 2003, the Atmospheric Chemistry Experiment (ACE) is a mission on-board the Canadian satellite SCISAT. The primary instrument on SCISAT is a high-resolution infrared Fourier Transform Spectrometer (ACE-FTS). With its wide spectral range, the ACE-FTS is capable of measuring an extensive range of gases including key CFC and HCFC species.

The global distributions of CFC-11, CFC-12, and HCFC-22 have been computed from measurements by ACE-FTS. In particular, the use of HCFC-22 as a replacement for CFC-11 and CFC-12 has led to an observable increase in its atmospheric abundance. The rapid increase in the concentration of HCFC-22 over the course of the ACE mission is of concern due to both its ozone depletion potential and its global warming potential. Although more predominant in the distribution of HCFC-22 concentrations, seasonal and inter-hemispheric variations are observed for all species studied here. Comparisons to ground-based and air-borne measurements show good agreement with the ACE-FTS measurements. Comparison of results from transport models driven by assimilated winds with global trace gas datasets can provide insight on the representation of transport in such models. Fields from the Global Modelling Initiative (GMI) Combined Stratospheric-Tropospheric Model (driven by winds from the MERRA reanalysis) show reasonably good agreement with the observed distribution of CFCs. However, the HCFC-22 surface boundary conditions used in the GMI simulation have a slower than observed growth and lack an interhemispheric gradient as observed for 2004-2010. This impacts model gradients in the UT/LS.