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ACE-FTS measurements of HCFC-22

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In the 1980s scientists discovered an annual springtime minimum in stratospheric ozone over the Antarctic. It was determined that the decline in ozone concentration was primarily caused by catalytic reactions of ozone and chlorine. The emissions of anthropogenic chlorofluorocarbons (CFCs) were determined to be major sources of the chlorine. The Montreal Protocol on Substances that Deplete the Ozone Layer (with its subsequent amendments) restricts the emissions of ozone depleting substances. To fulfill the need for safe, stable replacements of CFCs, hydrochlorofluorocarbons (HCFCs) and hydrofluorocarbons (HFCs) were developed. The use of HCFC-22 as a replacement has led to an increase in its atmospheric abundance. This is of concern due to its ozone depletion potential and its global warming potential.

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 altitude distribution from the ACE-FTS profiles provides information that is complementary to the ground-based measurements that have been used to monitor these species.

The global distribution of HCFC-22 has been computed from measurements by ACE-FTS. Both seasonal variations and an inter-hemispheric difference are observed. Additionally, a rapid increase in the global concentration of HCFC-22 has been observed since the start of the ACE mission in 2004. Comparisons to ground-based and air-borne measurements show good agreement with the ACE-FTS measurements. The global distributions of HCFC-22 have also been compared to a chemistry and transport model (CTM), the Global Modelling Initiative Combined Stratospheric-Tropospheric Model. There are distinct differences between the model results and ACE-FTS measurements. The causes and consequences of these differences will be discussed.