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ACE-FTS and HALOE observations of hydrogen fluoride (HF) and their comparison with SLIMCAT chemical transport model calculations

Jeremy Harrison (1,2), Martyn Chipperfield (3), Chris Boone (4), Peter Bernath (5), Lucien Froidevaux (6), John Anderson (7), and James Russell III (7)

(1) Department of Physics and Astronomy, University of Leicester, Leicester, United Kingdom, (2) National Centre for Earth Observation, University of Leicester, Leicester, United Kingdom, (3) School of Earth and Environment, University of Leeds, Leeds, United Kingdom, (4) Department of Chemistry, University of Waterloo, Waterloo, Canada, (5) Department of Chemistry and Biochemistry, Old Dominion University, Norfolk, Virginia, United States of America, (6) Jet Propulsion Laboratory, Pasadena, California, United States of America, (7) Department of Atmospheric and Planetary Sciences, Hampton University, Hampton, Virginia, United States of America

The majority of fluorine in the atmosphere has resulted from the anthropogenic emission of chlorofluorocarbons (CFCs), hydrochlorofluorocarbons (HCFCs), and hydrofluorocarbons (HFCs). Most tropospheric fluorine is present in its emitted 'organic' form due to the molecules having long lifetimes (up to a decade or longer). Thus they are able to reach the stratosphere where they are broken down, liberating fluorine. The principal degradation products are carbonyl fluoride (COF_2), carbonyl chloride fluoride (COClF), and hydrogen fluoride (HF); of these HF is the most abundant. In fact at the top of the stratosphere most of the fluorine is present as HF, which, due to its extreme stability, is an almost permanent reservoir of stratospheric fluorine. Since anthropogenic emissions of fluorine continue unabated, the amount of HF in the atmosphere continues to increase.

The use of satellite remote-sensing techniques allows the measurement of HF atmospheric abundances with impressive global coverage, and the investigation of HF trends, and seasonal and latitudinal variability. This work presents global distributions and trends of HF using data from two satellite limb instruments: the Atmospheric Chemistry Experiment Fourier transform spectrometer (ACE-FTS), onboard the SCISAT satellite, which has been recording atmospheric spectra since 2004, and the HALogen Occultation Experiment, onboard the Upper Atmosphere Research Satellite (UARS), which recorded atmospheric spectra between 1991 and 2005. These observations are compared with the output of SLIMCAT, a state-of-the-art three-dimensional chemical transport model (CTM). The model aids in the interpretation of the HF satellite observations, and the comparison provides a validation of emission inventories and the atmospheric degradation reaction schemes used in the model.