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The evolution of the inorganic fluorine budget since the mid-1980s based on FTIR measurements at northern mid-latitudes

Pierre Duchatelet (1), Wuhu Feng (2), Martyn Chipperfield (2), Roland Ruhnke (3), Peter Bernath (4), Chris Boone (5), Kaley Walker (5,6), Philippe Demoulin (1), and Emmanuel Mahieu (1)

(1) University of Liège, Institute of Astrophysics and Geophysics, Liège, Belgium (p.duchatelet@ulg.ac.be), (2) Institute for Climate and Atmospheric Science, School of Earth and Environment, University of Leeds, Leeds, UK, (3) Institute for Meteorology and Climate Research, Karlsruhe Institute of Technology, Karlsruhe, Germany, (4) Department of Chemistry, University of York, Heslington, UK, (5) Department of Chemistry, University of Waterloo, Waterloo, Canada, (6) Department of Physics, University of Toronto, Toronto, Canada

Fluorine enters the stratosphere principally in the form of CFCs (chlorofluorocarbons, mainly CFC-12 and CFC-11), HCFCs (hydrochlorofluorocarbons, mainly HCFC-22) and HFCs (hydrofluorocarbons, mainly HFC-134a) which have been (or are still) widely emitted at ground level by human activities. In the lower stratosphere, the photolysis of these halogenated source gases leads to the formation of the two fluorine reservoirs COClF and COF_2. The subsequent photolysis of these two compounds frees F atoms, which principally react with CH_4 and H_2O to form the extremely stable HF gas, by far the dominant fluorine reservoir in the middle and upper stratosphere.

Despite the fact that fluorine does not significantly contribute in stratospheric ozone depletion, measurements of the concentrations of individual F-containing species in different altitude ranges of the atmosphere are important as they reflect the amounts of anthropogenic gases transported into the middle atmosphere as well as their decomposition. Such measurements also provide insight into the partitioning between major fluorine source gases (which are potent greenhouse gases) and reservoirs and allows a global inventory of organic (CF_y), inorganic (F_y) and total (F_{TOT}) fluorine burdens to be monitored as a function of time. Indeed, regular updates of such inventories are important as the partitioning between F-containing gases in the stratosphere is continually evolving as emissions of anthropogenic gases from the surface change, principally as a consequence of the progressive ban on the production of CFCs and HCFCs adopted by the Montreal Protocol and its subsequent Amendments and Adjustments.

To complement recent studies regarding fluorine species (Duchatelet et al., 2009, 2010, 2011; Mahieu et al., 2011), this communication presents the time series of the inorganic fluorine budget F_y over the last twenty-five years, based on HF and COF_2 total column amounts derived from high resolution Fourier transform infrared (FTIR) solar spectra recorded at Jungfraujoch (46.5°N, 8.0°E, 3580m asl). A trend analysis of our HF, COF_2 and F_y time series is performed and discussed in the context of past and current emissions of halogenated source gases. Comparisons with model and space data are also included.

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