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Updating hydrogen fluoride (HF) FTIR time series above Jungfraujoch: comparison of two retrieval algorithms and impact of line shape models

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Fluorine enters the stratosphere mainly in the form of chlorofluorocarbons (CFCs; principally CFC-11 and CFC-12) and tetrafluoromethane (CF_4), which have been widely emitted at ground level by human activities over the past few decades. In the lower stratosphere, the photolysis of the long-lived CFC-11 (CCl_3F) and CFC-12 (CCl_2F_2), whose emissions from the ground have been progressively phased out by the Montreal Protocol and its successive Amendments and Adjustments, leads to the formation of the two reservoirs: COClF and COF_2. Subsequent photolysis of these two compounds then liberates F atoms, which could quickly react with CH_4, H_2O or H_2 to form the extreme stable hydrogen fluoride (HF) gas. The formation of HF by these reactions is significant, as they make HF the largest fluorine reservoir in the middle and upper stratosphere. Despite the fact that fluorine does not directly participate in ozone depletion, measurements of the concentration of individual F-containing species at different altitude of the atmosphere are important as they reflect the amounts of anthropogenic gases – which also often bear ozone-threatening Cl atoms - transported into the middle atmosphere as well as their decomposition.

Since the first detection of hydrogen fluoride in the Earth's atmosphere by Zander (1975), several studies dealing with HF total column amounts derived from ground-based Fourier transform infrared (FTIR) observations at several latitudes in both hemispheres have been published. In addition, these last years have seen the emergence of more sophisticated retrieval algorithms (e.g. SFIT-2, PROFFIT) allowing to inverse total or partial columns as well as vertical distribution of the target gas from ground-based FTIR spectra.

In this contribution, we propose to compare HF total columns derived from FTIR high-resolution ground-based observations performed at the Jungfraujoch (46.5°N, 8.0°E, 3580 m asl) by using two different retrieval codes: SFIT-2 v.3.91 and PROFFIT v.9.5. The impact of spectroscopic parameters (Voigt line shape model versus Galatry model line shape) on HF retrievals is also analyzed.

References:
Zander, R.: Présence de HF dans la stratosphère supérieure, C.R. Acad. Sci. Paris. Série B., 281, 213-214, 1975.