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Recent trends of inorganic chlorine and halogenated source gases above the Jungfraujoch and Kitt Peak stations derived from high-resolution FTIR solar observations

Emmanuel Mahieu (1), Curtis P. Rinsland (2), Tom Gardiner (3), Rodolphe Zander (1), Philippe Demoulin (1), Martyn P. Chipperfield (4), Roland Ruhnke (5), Linda S. Chiou (6), Martine De Mazière (7), and the GIRPAS Team

(1) University of Liège, Institute of Astrophysics and Geophysics, LIEGE, Belgium (emmanuel.mahieu@ulg.ac.be), (2) NASA-Langley Research Center, Hampton, VA, USA, (3) National Physics Laboratory, Teddington, UK, (4) School of Earth and Environment, University of Leeds, Leeds, UK, (5) Karlsruhe Institute of Technology (KIT), IMK-ASF, Karlsruhe, Germany, (6) Science Systems and Applications inc., Latham, MD, USA, (7) Belgian Institute for Space Aeronomy, Brussels, Belgium

The longest series of Fourier Transform Infrared (FTIR) high spectral resolution solar absorption observations are available from the Jungfraujoch and Kitt Peak stations, located at 46.5ºN and 30.9ºN, respectively. State-of-the-art interferometers are operated at these sites within the framework of the Network for the Detection of Atmospheric Composition Change (NDACC, visit http://www.ndacc.org). These instruments allow to record spectra on a regular basis, under clear-sky conditions, using a suite of optical filters which altogether cover the 2 to 16 micron spectral range.

Numerous absorption features characterized in the HITRAN compilations (e.g. Rothman et al., 2008) are encompassed in this mid-infrared region. Their analyses with either the SFIT-1 or SFIT-2 algorithm allow retrieving total columns of the target gases. Moreover, information on their distribution with altitude can generally be derived when using SFIT-2 which implements the Optimal Estimation Method of Rodgers (1990). Among the two dozen gases of atmospheric interest accessible to the ground-based FTIR technique, we have selected here a suite of long-lived halogenated species: HCl, $ClONO_2$, CCl_2F_2, CCl_3F, $CHClF_2$, CCl_4 and SF_6.

Time series available from the two sites will be presented, compared and critically discussed. In particular, changes in the abundances of theses gases since the peak in inorganic chlorine (Cl_y, which occurred in 1996-1997) and their intra-annual variability will be characterized with a statistical tool using bootstrap resampling (Gardiner et al., 2008). Trends and their associated uncertainties will be reported and put into perspective with the phase-out regulations of the production of ozone depleting substances adopted and implemented by the Montreal Protocol, its Amendments and Adjustments.

For instance, the trends affecting the reservoir species HCl, $ClONO_2$, and their summation which is a good proxy of the total inorganic chlorine, have been calculated using all available daily mean measurements from January 1996 onwards. The following values were obtained for Jungfraujoch, when using 1996 as the reference year: -0.90±0.10%/yr for HCl, -0.92±0.26 %/yr for $ClONO_2$, and -0.96±0.14 %/yr for Cl_y; in all cases, the uncertainties define the 95% confidence interval around the trend values. For Kitt Peak (covering 1977-2009 but with far fewer measurements than from Jungfraujoch), the corresponding trends are: -0.55±0.34 %/yr for HCl, -1.27±0.84 %/yr for $ClONO_2$ and -0.61±0.51 %/yr for Cl_y, they are statistically consistent with the Jungfraujoch rates of decrease.

Further trend data will be presented at the EGU General Assembly while supplementary information on Jungfraujoch results will be available from communications at the same meeting by Duchatelet et al. (2010), Lejeune et al (2010) and Rinsland et al (2010). Comparisons with model data are also foreseen.

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