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Impact of lower stratospheric dynamical variability on total inorganic fluorine derived from ground-based FTIR, satellite and model data

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Long-lived tracer concentrations in the lower stratosphere are affected by short time scale circulation variability as highlighted by recent papers (e.g., Mahieu et al., 2014). Many tracers, such as hydrogen chloride (HCl) or hydrogen fluoride (HF) have now been successfully used to investigate or identify this variability (e.g., Harrison et al., 2016).

In this work, the main reservoirs of inorganic fluorine [i.e. HF, carbonyl fluoride (COF2) and carbonyl chloride fluoride (COClF)] and their sum (total inorganic fluorine, Fy) are used to investigate the lower stratospheric circulation changes. We use Fourier Transform InfraRed (FTIR) ground-based observations conducted in the framework of the NDACC network (http://www.ndacc.org) to derive column abundances of HF and COF2, thus providing a good proxy for Fy. To support this research, we also include satellite observations from HALOE (HF available) and ACE-FTS (HF, COF2 and COClF available).

Moreover, we use the Chemical-Transport Model (CTM) BASCOE (Belgian Assimilation System for Chemical ObsErvations; Chabrillat et al., 2018) to evaluate the representation of the investigated circulation changes in state-of-the-art meteorological reanalyses. We also evaluate if WACCM4 (Whole Atmosphere Community Climate Model version 4) is able to reproduce these changes through a free dynamics and free chemistry run. Finally, SLIMCAT CTM (Chipperfield et al., 2015) simulations are included to provide information on the partitioning between the main Fy reservoirs.

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