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Trend and lifetime of sulfur hexafluoride at mid-latitudes deduced from ACE-FTS occultation measurements

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Sulfur hexafluoride (SF_6) is one of the strongest greenhouse gases on a per molecule basis, with a global warming potential of 22800 (100-yr horizon). This is an extremely stable gas in the atmosphere, which results in a very long lifetime, with large uncertainties. The value adopted by IPCC is 3200 years, but some studies suggest shorter lifetimes, as low as 800 years. Surface concentrations are now about 7 ppt, with reported trends indicating a steady and strong increase of 0.3 ppt/yr. Most emissions are of anthropogenic origin, related to its use as an insulator in high-voltage electrical installations. Secondary contributions result from magnesium and aluminum production as well as from the manufacturing of semiconductors (see e.g. Levin et al., 2010; Rigby et al., 2010 and references therein).

In this contribution, we use occultation measurements performed by the ACE-FTS (Atmospheric Chemistry Experiment Fourier Transform Spectrometer) instrument, launched in August 2003 onboard the Canadian SCISAT satellite (Bernath et al., 2005). ACE-FTS is still in operation to date, with no significant degradation in its performance. This spectrometer achieves a spectral resolution of 0.02 cm^{-1} in the broad 750-4400 cm^{-1} range which covers the unresolved ν_3 band Q branch of SF_6 centered at 947.9 cm^{-1}. Signal-to-noise ratios of 200-300 are typically obtained in the spectral region of interest.

Version 3 retrievals performed by University of Waterloo give volume mixing ratio profiles of SF_6 in the 11-32 km altitude range. We consider all available sunrise and sunset occultation measurements obtained at mid-latitudes in both hemispheres to derive the trend of SF_6 in the lower stratosphere, from late February 2004 onwards. Consistency between both hemispheres will be investigated. In addition, concurrent N_2O measurements are used to evaluate the atmospheric lifetime of SF_6, following a method used previously for other long-lived gases (e.g. Zander et al, 1996).

Comparisons with trends derived from in situ surface measurements or from ground-based remote-sensing observations (e.g. at the Jungfraujoch station, 46.5ºN) are also included.

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