

## 4.157 A model study of atmospheric OCS; current understanding and geoengineering implications.

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Abstract:

Carbonyl sulfide (OCS) is the most stable and therefore abundant reduced sulfur compound in the atmosphere. OCS stratospheric oxidation is the main sink source and the source of a sulfate aerosol layer between 17 and 30 km. This stratospheric sulfur aerosol (SSA) also known as the Junge layer affects the planet's Albedo and catalysis the hydrolysis of  $\text{N}_2\text{O}_5$ , promoting mid-latitude ozone depletion. While volcanic eruptions are an important source of stratospheric sulfate, they are sporadic and the source of sulfur in volcanically quiescent times has been a matter of debate. Application of sulfur stable isotopes has provided evidence for OCS as the main source of the SSA. Ice core studies show that of pre-industrial tropospheric levels of OCS were 372 ppt while current levels are 500 ppt. In this study, we created a new 1-D photochemical model that includes stable isotopes as an additional tool for model calibration and consider the historical variation of anthropogenic emissions of OCS and its tropospheric precursor  $\text{CS}_2$ <sup>[1]</sup>. In order to calculate the OCS atmospheric vertical profile, the model that takes into account chemistry, transport, deposition, stable isotopes and high-resolution absorption spectrum. This last feature is important since the main isotopic imprint of the stratospheric oxidation pathway is produced by photo-dissociation. The application of stable isotopes not only confirm as OCS as the main source of SSA during volcanic quiescent times but also confirms the isotopic mixing ratio of tropospheric OCS measured by Hattori et al (2015)<sup>[2]</sup>. Our findings show that about 33% of today's SSA is anthropogenic. Furthermore, the anthropogenic contribution to SSA means that an estimate of  $-0.16 \text{ Wm}^2$  of radiative forcing should be accounted in pre-industrial pollution free models.

[1] Aydin, M., et al., (2016), J. Geophys. Res-Atmos., 121(4), 1943-1954

[3] Hattori, S., et al., (2015), Anal. Chem., 87(1), 477-484.