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Sulfur and carbon isotope measurements of carbonyl sulfide (COS) from small air samples using GC-IRMS

Sophie Baartman¹, Maarten Krol^{1,2}, Thomas Röckmann¹, Maria Elena Popa¹, Linda Kooijmans², Steven Driever³, Maarten Wassenaar⁴, Leon Mossink³, and Steven van Heuven⁵

¹Utrecht University, Institute for Marine and Atmospheric research Utrecht, Physics, Netherlands (s.l.baartman@uu.nl)

²Meteorology and Air Quality, Wageningen University & Research Center, Wageningen, Netherlands

³Centre for Crop Systems Analysis, Wageningen University, Wageningen, Netherlands

⁴Horticulture & Product Physiology, Wageningen University, Wageningen, Netherlands

⁵Centre for Isotope Research, Energy and Sustainability Research Institute Groningen, University of Groningen, Groningen, Netherlands,

Carbonyl sulfide (COS) is the most abundant sulfur-containing trace gas in the atmosphere, with an average mixing ratio of 500 parts per trillion (ppt). It has a relatively long lifetime of about 2 years, which permits it to travel into the stratosphere. There, it likely plays an important role in the formation of stratospheric sulfur aerosols (SSA), which have a cooling effect on the Earth's climate. Furthermore, during photosynthetic uptake by plants, COS follows essentially the same pathway as CO₂, and therefore COS could be used to estimate gross primary production (GPP). Unfortunately, significant uncertainties still exist in the sources, sinks and global cycling of COS, which need to be overcome. Isotopic measurements of COS could be a promising tool for constraining the COS budget, as well as for investigating its role in the formation of stratospheric sulfur aerosols.

Within the framework of the COS-OCS project, we developed a measurement system at Utrecht University using GC-IRMS that can measure $\delta^{33}\text{S}$ and $\delta^{34}\text{S}$ from S⁺ fragment ions of COS from small air samples of 2 to 5 L. This system was recently expanded to also measure $\delta^{13}\text{C}$ from the CO⁺ fragment ions of COS, which has never been measured before. We will present the preliminary results from a plant chamber experiment conducted at Wageningen University, in which one of the goals was to quantify the COS uptake and isotopic fractionation factors of different C3 and C4 plants.