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Stratospheric observations of carbonyl sulfide using AirCore and LISA

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Carbonyl sulfide (COS) is a long-lived sulfur compound present in the atmosphere with an average mole fraction of around 450-500 ppt, and is considered as a potential tracer to partition gross primary production (GPP) and net ecosystem exchange (NEE) in plants' photosynthesis, possibly by satellite observations. However, its sources and sinks are not fully understood, and remote sensing observations of COS still require validation and need to be linked with a reference measurement scale, e.g., NOAA's. In this work, we present vertical profiles of COS mole fractions obtained in Trainou, France (47°58' N, 2°06' E) in June 2019, in Kiruna, Sweden (67°53' N, 21°04' E) in August 2021, and in Sodankylä, Finland (67°22'N, 26°37'E) in August 2023 using AirCore samplers and two versions of the lightweight stratospheric air (LISA) sampler. Additionally, simultaneous measurements of CO_2, CO, CH_4 and N_2O have been made. Measurement methods (i.e., LISA vs AirCore) will be compared. Moreover, the retrieved COS profiles will be compared with COS FTIR remote sensing observations and COS simulations from the TM5-4DVAR modeling system, to get a better understanding of the behavior of these species in the stratosphere, i.e., the sources and the sinks of COS, as well as vertical structures due to atmospheric transport. Furthermore, these stratospheric observations could be used to estimate the stratospheric lifetime of COS. These findings will improve our understanding of the budget and the variabilities of COS in the stratosphere, and advance the use of remote sensing observations of COS from satellite and ground-based spectrometers to study the global cycle of COS.