Geophysical Research Abstracts
Vol. 21, EGU2019-17204, 2019
EGU General Assembly 2019

Instrument development for better observation of anthropogenic emissions of COS in the Netherlands

Steven van Heuven (1), Linda Kooijmans (2), Andrea Scifo (1), Bert Scheeren (1), Maarten Krol (2), and Huilin Chen (1)

(1) Centre for Isotope Research, Energy and Sustainability Research Institute, University of Groningen, Groningen, The Netherlands (s.m.a.c.van.heuven@rug.nl), (2) Meteorology and Air Quality Group, Wageningen University, Wageningen, The Netherlands

Carbonyl sulfide (OCS or, here, COS) is a trace constituent of atmospheric air. COS is a precursor in stratospheric sulfate aerosol formation and a tropospheric tracer for biospheric processes (e.g., an indicator of photosynthesis). Our knowledge of the COS sources and sinks does currently not close the COS budget, as there are more known sinks than sources. An enhanced capability to make measurements of COS mole fractions in the troposphere and stratosphere will help to better understand the COS sources and sinks. However, the acquisition of accurate measurements of COS from discrete samples is challenging, due mainly to its sub-ppb concentration range.

We've developed a field-deployable COS sample analysis system based on a newly acquired quantum cascade laser spectrometer (QCLS; Aerodyne Research Inc., MA, USA), which allows precise, concurrent measurements of COS, CO_2, CO, CH4, N2O and H_2O on small samples. This instrument employs a small-volume multi-pass cell ($\sim$150 ml), yielding fast instrument response at acceptable precision. A newly developed frontend to the QCLS allows switching between 5 pressurized gases (cylinders), 5 samples at (sub-) ambient pressure (flasks, bags, sampling lines). Switching is of arbitrary order and timing, and is performed without pressure differences between consecutive samples. This newly developed instrument brings advancements in the ability to measure small-volume air samples. The system additionally allows for analysis of air samples collected by AirCore for profile measurements in the near future.

We report COS sources and sinks observed from atmospheric observations at the Lutjewad tower in the Netherlands. Enhancements of COS mole fractions on the order of 100 ppt to 1000 ppt were observed at three occasions, which were most likely caused by ploughing of nearby agricultural fields. In one occasion, the coincidence of the enhancement of COS with that of SF6 suggests an anthropogenic source, but the exact origin could not be determined. To study the regional anthropogenic COS emissions, a field campaign with a mobile van was carried out in the province of Groningen in September 2018. A number of discrete flask air samples were collected downwind of potential sources, among which are a peat fire and an agricultural bio-digestion facility.