Geophysical Research Abstracts
Vol. 17, EGU2015-8735-1, 2015
EGU General Assembly 2015

Continuous atmospheric measurements of COS, CO_2, CO and H_2O at the Lutjewad tower in the Netherlands

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A critical step in carbon modelling studies is to resolve both Gross Primary Production (GPP) and Respiration (Re). Although several methods have been proposed to partition the Net Ecosystem Exchange (NEE) into GPP and Re, large uncertainties still exist in quantifying these fluxes. As a potential solution to this problem carbonyl sulfide (COS) was proposed as a tracer for photosynthetic CO_2 uptake as it is also taken up by plants, but not being released. Although atmospheric COS measurements have been made since a few decades, there has not been any atmospheric measurement station that performs continuous *in situ* measurements of COS on the long term. For this reason, the source and sink terms of COS are poorly known, which limits the ability of employing COS as a tracer for GPP. In July 2014 we set up a quantum cascade laser (QCL) spectrometer (Aerodyne Research Inc., MA, USA) for continuous and simultaneous measurements of COS, CO_2, CO and H_2O at the Lutjewad atmospheric monitoring station (60 m, 6°21'E, 53°24'N, 1 m a.s.l) in the Netherlands. The so called QCL mini monitor was initially configured to measure COS, CO_2 and H_2O. We extended the frequency range of the laser to include measurements of CO (2050.854 cm^{-1}). The short-term precision of the analyser is 2.5 ppt for COS, 0.03 ppm for CO_2 and 0.11 ppb for CO (1 Hz). Calibrations were necessary on time scales of an hour to correct for instrument response drift. Furthermore, we assessed the correction for water vapour interference applied by the instrument control software and present an alternative water vapour correction for CO_2. The accuracy of the instrument for measurements of CO_2 and CO is evaluated with a cavity ring-down spectrometer (Picarro Inc., CA, USA). Besides that, we tested the ability to do flask sample measurements with the QCL analyser for assessing the stability of the COS scale, and for controlling the quality of the COS measurements from our Lutjewad station. We will do tracer-tracer (COS, Radon, CO, and CO_2) correlation studies to estimate COS fluxes and to understand the sources and sinks of COS.