Geophysical Research Abstracts
Vol. 18, EGU2016-13203, 2016
EGU General Assembly 2016

Stomata-controlled nighttime COS fluxes in a boreal forest: implications for the use of COS as a GPP tracer

Linda M.J. Kooijmans (1), Kadmiel Maseyk (2), Ulli Seibt (3), Timo Vesala (4), Ivan Mammarella (4), Ian T. Baker (5), Alessandro Franchin (4), Pasi Kolari (4), Wu Sun (3), Helmi Keskinen (4,6), Janne Levula (4,6), Huilin Chen (1,7)

(1) Centre for Isotope Research, University of Groningen, Groningen, The Netherlands, (2) Department of Environment, Earth and Ecosystems, The Open University, Milton Keynes, United Kingdom, (3) Department of Atmospheric and Oceanic Sciences, University of California, Los Angeles, California, USA, (4) Department of Physics, University of Helsinki, Helsinki, Finland, (5) Department of Atmospheric Science, Colorado State University, Fort Collins, Colorado, USA, (6) SMEAR II, Hyytiälä Forestry Field Station, University of Helsinki, Korkeakoski, Finland, (7) Cooperative Institute for Research in Environmental Sciences, University of Colorado, Boulder, Colorado, USA

Carbonyl Sulfide (COS) is a promising new tracer that can be used to partition the Net Ecosystem Exchange into gross primary production (GPP) and respiration. COS and CO_2 vegetation fluxes are closely related as these gases share the same diffusion pathway into stomata. This close coupling is the fundamental principle for the use of COS as tracer for GPP. Nonetheless, in contrast to CO_2 , the uptake of COS by vegetation is not light-dependent, and therefore the vegetative uptake of COS can continue during the night as long as stomata are open. Nighttime stomatal conductance is observed in a variety of studies, and also nighttime depletion of COS concentrations is reported several times but it is not confirmed with field measurements that the depletion of COS in the night is indeed driven by stomatal opening. In the summer of 2015 a campaign took place at the SMEAR II site in Hyytiälä, Finland to provide better constrained COS flux data for boreal forests using a combination of COS measurements, i.e. atmospheric profile concentrations up to 125 m, eddy-covariance fluxes and soil chamber fluxes, and collocated measurements of stomatal conductance and ^{222}Radon. A high correlation between concentrations of ^{222}Radon and COS implies that the radon-tracer method is a valuable tool to derive nighttime ecosystem COS fluxes. We find that soils contribute to 17% of the total ecosystem COS flux during nighttime in the peak growing season. Nighttime ecosystem COS fluxes show a correlation with stomatal conductance (R^2 = 0.3), indicating that nighttime COS fluxes are primarily driven by vegetation. The COS vegetation fluxes will be compared with calculated fluxes from the Simple Biosphere model. Furthermore, the nighttime vegetative COS uptake covers a substantial fraction (25%) of the daily maximum COS uptake by vegetation. Accurate quantification of nighttime COS uptake is required to be able to use COS as a useful tracer for GPP.