Understanding COS fluxes in a boreal forest: towards COS-based GPP estimates.

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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, which makes COS a potentially powerful tracer for GPP. While vegetative uptake is the largest sink of COS, the environmental drivers are poorly understood, and soil fluxes represent an important but relatively unconstrained component. Therefore, the realization of the COS tracer method requires proper characterization of both soil and ecosystem fluxes. A campaign to provide better constrained soil and ecosystem COS flux data for boreal forests takes place in the summer of 2015 at the SMEAR II site at Hyytiälä, Finland. Eddy covariance flux measurements are made above the forest canopy on an Aerodyne continuous-wave quantum cascade laser (QCL) system that is capable of measuring COS, CO_2, CO and H_2O. Soil COS fluxes are obtained using modified LI-COR LI-8100 chambers together with high accuracy concentration measurements from another Aerodyne QCL instrument. The same instrument alternately measures concentrations in and above the canopy on a cycle through 4 heights, which will be used to calculate ecosystem fluxes using the Radon-tracer method, providing ecosystem fluxes under low-turbulent conditions. Concentrations, and soil- and ecosystem flux measurements will be linked to measurements of e.g. stomatal conductance, soil temperature and humidity, and O_3 concentrations. This dataset will be used to provide better understanding of ecosystem COS fluxes and its relation with soil fluxes, and to develop COS-based GPP estimates for the forest, as well as testing and parameterization of a newly developed soil COS flux model.