Geophysical Research Abstracts
Vol. 19, EGU2017-13286, 2017
EGU General Assembly 2017

COS as a proxy for photosynthesis: foliage and soil contributions to ecosystem COS flux

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Traditionally the photosynthetic sink of CO_2 (described by gross primary production, GPP) is defined from ecosystem scale measurements of CO_2 flux taking into account respiration defined from the nighttime CO_2 flux data. The problem with this method is the accurate determination of ecosystem respiration, since the respiratory processes can vary remarkably between daytime and nighttime. Carbonyl sulfide (COS) has been suggested to be a useful proxy for GPP since plants take up COS in a similar way as CO_2 via their stomata. In contrast to CO_2, there is no back-flux (respiration) of COS by plants and GPP can be calculated directly from COS flux measurements. However, leaf relative uptake (LRU) ratio, that is used when converting COS flux into GPP with a linear relation, has been treated as a constant and needs to be better determined for more accurate GPP estimates.

This presentation shows the preliminary results of a measurement campaign organized in Hyytiälä Scots pine (*Pinus sylvestris*) stand in southern Finland during the growing season 2016. COS fluxes from the soil were measured with soil chambers over different vegetations. Pine and aspen branches were measured with branch chambers and ecosystem scale exchange was monitored via eddy covariance measurements.

Preliminary results show night-time ecosystem uptake of COS (negative flux) that is about 15% of the daily uptake. Soil chambers show constantly negative COS fluxes, although there is no uptake of CO_2 and the soil flux is about 25% of the total ecosystem flux. Pine and aspen branches seem to be sinks of COS throughout the day indicating open stomata during night-time. These findings suggest that negative ecosystem COS flux can be explained by soil and vegetation uptake during night-time.

From branch chamber measurements we were able to calculate the leaf relative uptake (LRU) separately for aspen and pine. We find that LRU has an exponential correlation with photosynthetic active radiation (PAR) when PAR<500μmol $m^{-2}s^{-1}$. On the other hand, when PAR>500μmol $m^{-2}s^{-1}$, the LRU seems to be constant and for aspen LRU=1.7 and for pine LRU=1.4. We find that the light dependency of LRU needs to be taken into account when calculating GPP from COS measurements for better photosynthesis estimates.