Assessing the viability of COS as a proxy for GPP in four major biomes across Europe

Kitz F. ¹⁾, Spielmann F.M. ¹⁾, Gomez-Brandon M. ²⁾, Hammerle A. ¹⁾, Insam H. ²⁾, Ibrom A. ³⁾, Kolle O.⁴⁾, Migliavacca M.⁴⁾, Moreno G.⁵⁾, Noe S.M.⁶⁾, Gerdel K.¹⁾, Wohlfahrt G.¹⁾

Introduction:

The measurement of carbonyl sulfide (COS), a trace gas with a mean concentration of about 500 pptv in the troposphere, is a promising new approach for partitioning the net ecosystem-scale CO_2 flux into photosynthesis and respiration. The utility of COS for flux partitioning on the ecosystem scale depends critically on the understanding of non-leaf sources and sinks of COS. Especially the role of soils, which have been shown to act both as sources and sinks for COS, needs to be clarified.

We combined

- **Eddy covariance** measurements of COS and CO₂ in 3 different ecosystems • with
- Soil chamber measurements (4 sites), to asses the contribution of the soil to the net ecosystem COS flux and



AUT

FSP

¹⁾ University of Innsbruck, Institute of Ecology, Austria | florian.kitz@student.uibk.ac.at

³⁾ Technical University of Denmark, Department of Environmental Engineering, Denmark

⁶) Estonian University of Life Sciences, Institute of Agricultural and Environmental Sciences,

²⁾ University of Innsbruck, Institute of Microbiology, Austria

⁵⁾ Universidad de Extremadura, Forest Research Group, Spain

⁴⁾ Max Planck Institute of Biogeochemistry, Germany

Estonia



• A lab experiment, to measure the COS flux of sieved soil samples always using a Quantum cascade laser absorption spectrometer (QCLAS) (Aerodyne-Research Inc., USA).



Study sites:

LL

Ś

Neustift (AUT): a temperate mountain grassland, in the Central Alps (47.11 N, 11.31 E) at an elevation of 990 m above sea level. Järvselja : a hemiboreal forest, in Estonia (58.27 N, 27.30 E) at an elevation of 36 m above sea level – soil measurements only Soroe (DEN): a deciduous broadleaf forest, in Denmark (55.48 N, 11.64 E) at an elevation of 40 m above sea level. Las Majadas del Tietar (ESP): a Mediterranean oak savannah, in Spain (39.94 N, -5.77 E) at an elevation of 260 m above sea level.



(I) Gross primary production (GPP) calculated for 3 different ecosystems using the traditional day- and nighttime approach (D and N respectively) using either air- or soiltemperature (Ta and Ts respectively) to derive the ecosystem respiration, and the COS method (COS).

COS ecosystem flux



Findings:

- On average, we observed COS uptake at ecosystem level at all sites during day and night.
- Using the suggested value of 1.68 to obtain the GPP using COS led to a higher GPP during high light conditions on 2 of the 3 sites (ESP & DEN) compared to the traditionally calculated GPP.
- The ratio between the uptake of COS to CO₂ increased during low light conditions due to the light-independent uptake of COS (data not shown).
- The relationship between COS flux and GPP might depend on a range • of environmental parameters, complicating its routine application.



higher radiation due to

the experimental setup -

COS fluxes compared to

showed much higher

the forest sites.

differently treated soil samples in COS fluxes *in situ.* the lab.



(VI) Summary of all COS fluxes $(means \pm sds)$ across all soil samples – 3 replicates per day) for differently treated sieved soil samples from Neustift (AUT).

Findings:

Neustift

In the field:

• Soil COS fluxes strongly influenced by radiation

Soroe

• Impact of soil water content negligible

Sites

Las Majadas del Tietar

• Soil fluxes aren't negligible and must be accounted for the calculation of the GPP.

In the lab:

Untreated soil samples were COS sinks, samples with added litter \bullet or glucose acted as sources.

Järvselja