B43H-0642

Disentangling Sources and Sinks of Carbonyl Sulfide in a Temperate Mountain Grassland

Wohlfahrt G., Gerdel K., Hammerle A., Kitz F., Laterza T., Spielmann F.

University of Innsbruck, Institute of Ecology, Austria | georg.wohlfahrt@uibk.ac.at

Carbonyl sulfide (COS), the most abundant sulfur-containing trace gas present in the troposphere, co-diffuses into plant leaves pretty much the same way as carbon dioxide (CO_2) does, but in contrast to CO_2, COS is not known to be emitted by plants. Thus uptake of COS by vegetation has the potential to be used as a tracer for canopy gross photosynthesis, which cannot be measured directly, however represents a key term in the global carbon cycle.

The use of COS as a tracer for canopy gross photosynthesis relies on the assumption that other sinks or sources of COS within an ecosystem are negligible, so that the COS exchange is through leaves only.

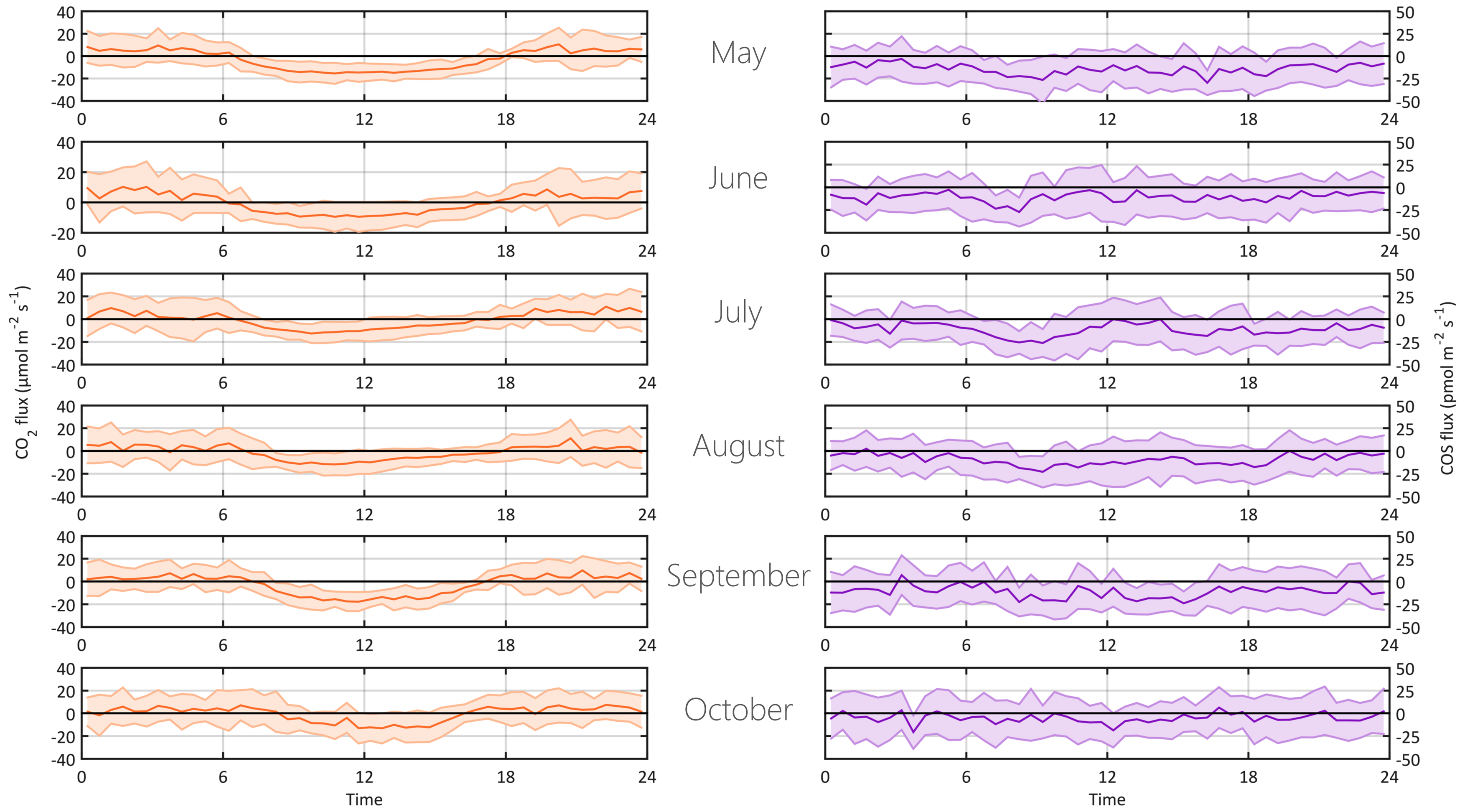
Here we ...

(I) use concurrent COS and CO_2 ecosystem-scale eddy covariance and

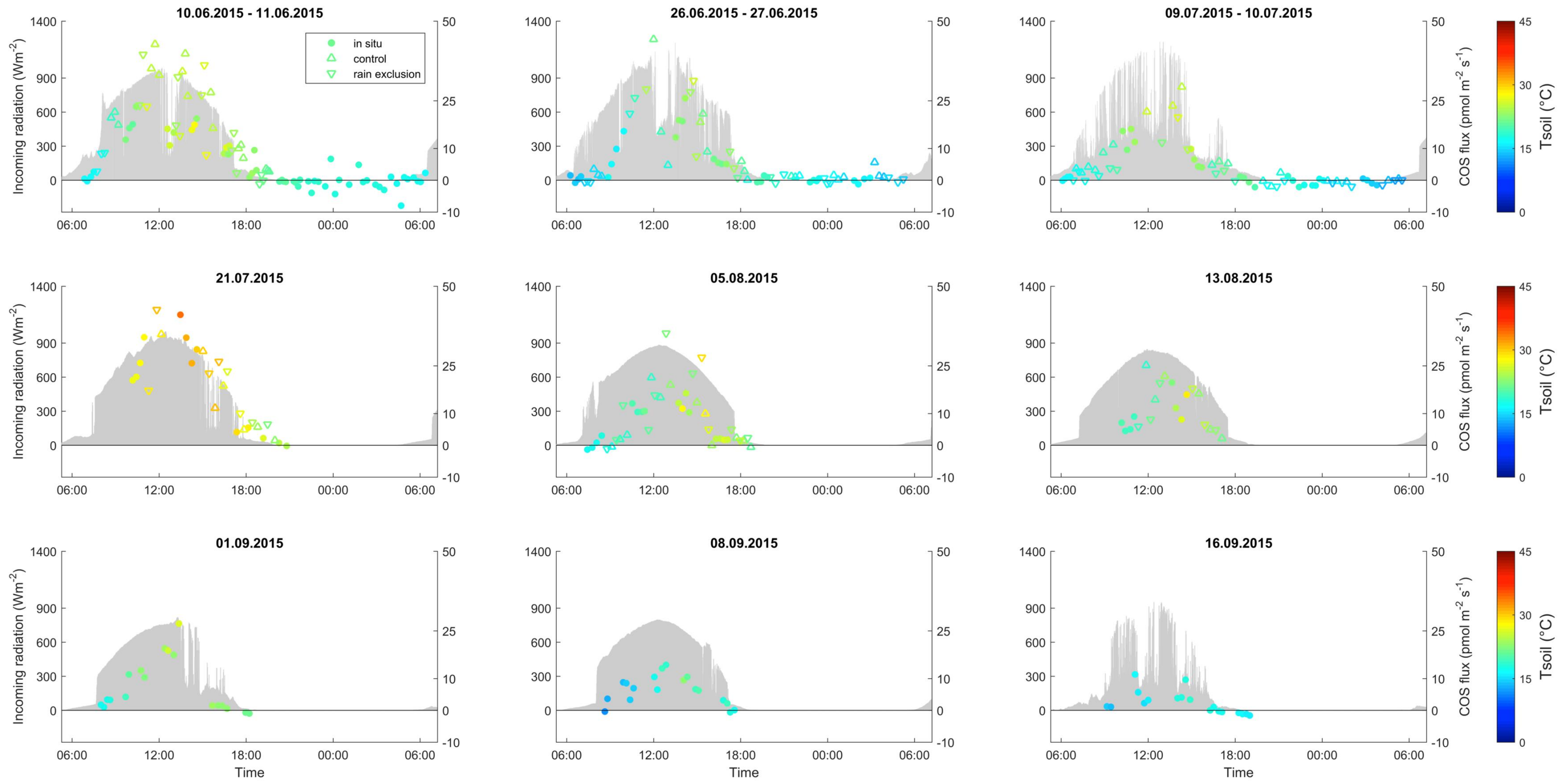
(II and III) soil chamber flux measurements together with

(IV) within and above-canopy concentration profiles and an inverse Lagrangian analysis to

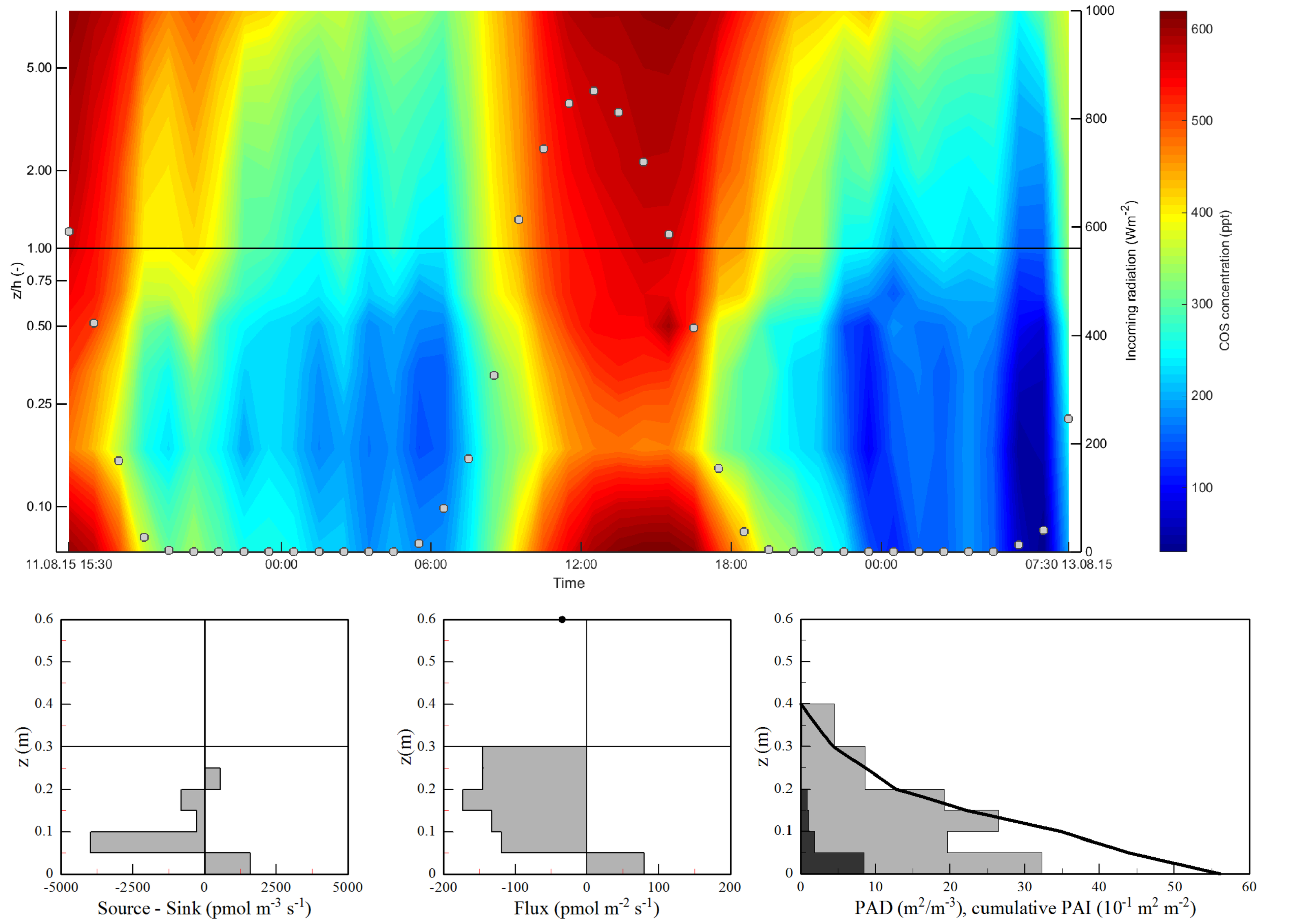
disentangle sinks and sources of COS in a temperate mountain grassland.



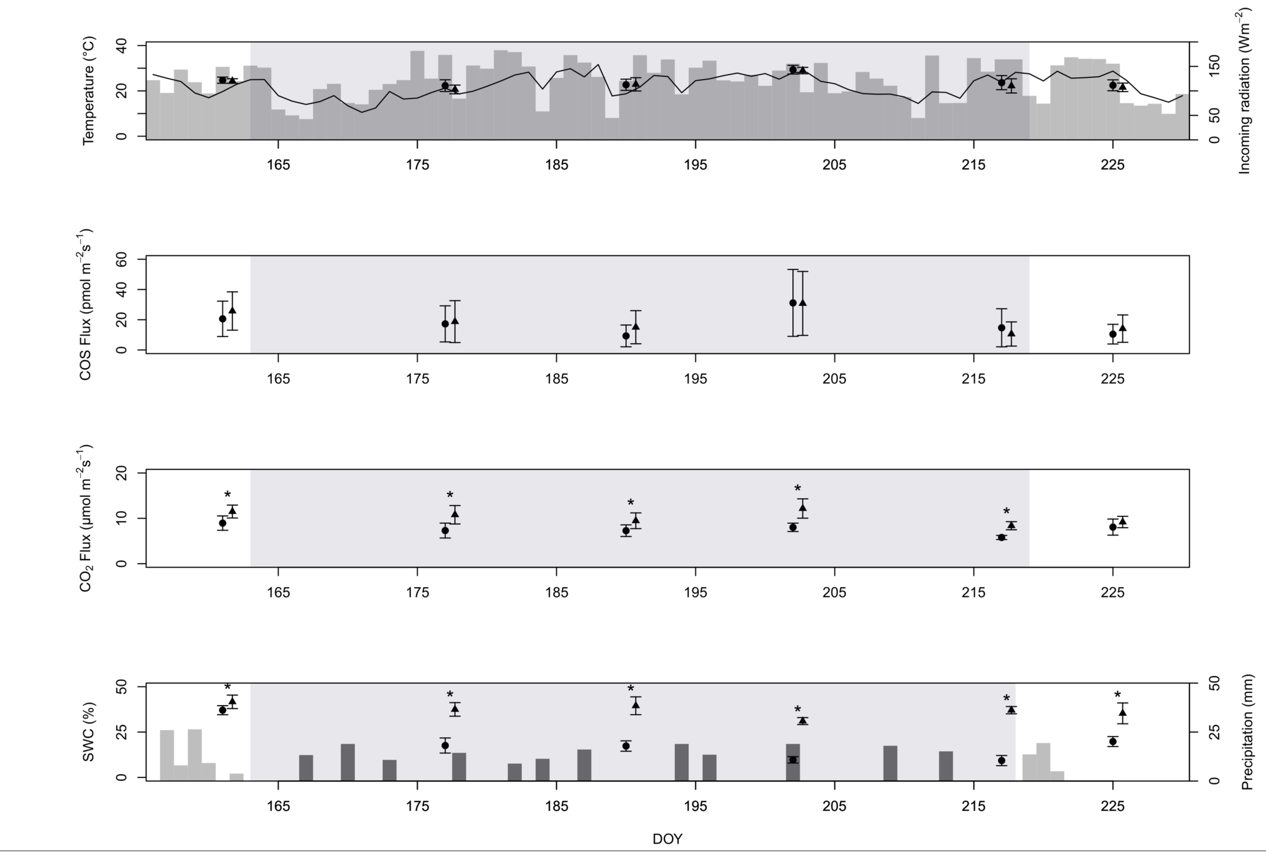
(I) Monthly bin-averaged diurnal courses of the net ecosystem exchange of CO_2 and COS during May-October 2015.



(II) Soil COS exchange based on episodic measurements with UV-transparent chambers.



(IV) Time course of vertical COS concentration profiles, inferred source/sink distribution and cumulative flux and plant area density distribution.



(III) Effects of simulated drought (● – treatment, ▲– control; shifted for visualization) on soil COS and CO_2 exchange (means 10-17 CET) based on measurements with UV-transparent chambers (* ... $p < 0.05$).

Preliminary results for the vegetation period 2015 suggest: (I) a modest correlation between ecosystem-scale COS and CO_2 fluxes, with uptake dominating the COS exchange most of the time; COS fluxes are however characterized by large run-to-run variability and post-processing and QA/QC routines require further work; (II and III) measurements with UV-transparent chambers suggest soil COS emissions to scale with incident radiation resulting in close to zero fluxes during darkness, with a secondary influence of temperature; contrary to expectations, soil moisture did not affect the soil COS exchange even under a strong simulated drought; we conclude that soil COS exchange appears dominated by abiotic light/temperature-driven production; (IV) COS within-canopy profiles and inverse Lagrangian analysis locates the major sink for COS in the middle canopy where the leaf area density is high, but light availability still acceptable; COS concentrations typically increase towards the soil surface during daytime suggesting a source in this part of the canopy, which is consistent with soil chamber measurements.

Taken together our results suggest that using COS as a tracer for canopy gross photosynthesis may be less straight forward than previously thought and that further work is required to better understand the ecosystem-scale COS exchange and its drivers.

FWF Der Wissenschaftsfonds.

Funding for this research is provided by the Austrian National Science Fund, the Tyrolean Science Fund and the University of Innsbruck.