Insights from combining *in situ* and laboratory measurements of carbonyl sulfide fluxes from a temperate mountain grassland soil

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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 to partition net ecosystem-scale CO_2 fluxes 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 conducted measurements

- to assess the contribution of the soil to ecosystem-scale COS fluxes under simulated drought conditions
- to quantify soil fluxes during the season 2015
- to asses the contribution of the soil, under different treatments, to the COS flux – in the laboratory

Study site

A temperate mountain grassland (47°7’ N, 11°18’ E), located near Neustift in the Central Alps at an elevation of 990 m above sea level. The soil was classified as a Fluvisol with an estimated depth of 1 m, the bulk of the roots was located within the first 10 cm.

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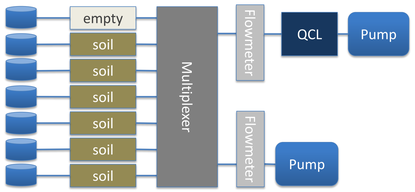
FWF Der Wissenschaftsfonds. Gefördert von tirol Unser Land

Methods

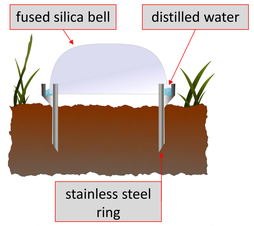
In the field:
Transparent flow-through soil chambers (see sketch) were used together with a QCL (Aerodyne Research) to quantify soil COS and CO_2 fluxes . A drought was simulated with rain out shelters from the 11-Jun-2015 to the 05-Aug-2015.

In the lab:
Transparent glass tubes (see sketch) were used together with a QCL (Aerodyne Research) to quantify soil COS and CO_2 fluxes. The following treatments were applied to sieved soil samples from Neustift:

1. Untreated soil (in 2 glass tubes)
2. Soil with 6- ethoxy-2-benzothiazole-2-sulfonamide
3. Soil with litter (from Neustift)
4. Soil with glucose
5. Gamma irradiated soil

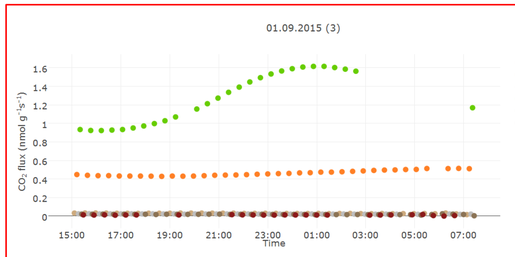


Experimental setup to measure differently treated soil samples.

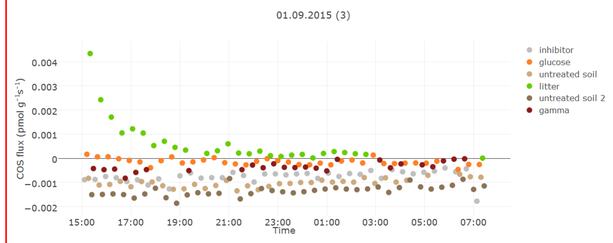


Soil chamber to measure soil COS fluxes *in situ.*

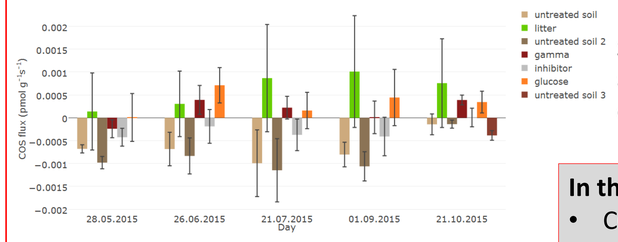
Preliminary results



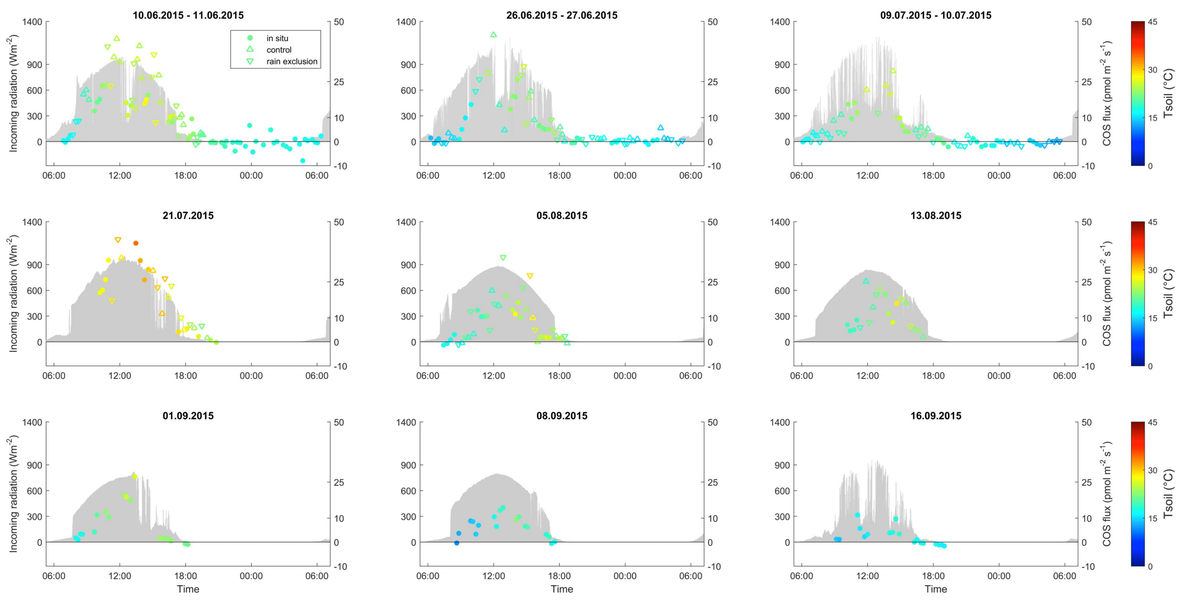
CO_2 fluxes from the different treatments; As expected the litter and the glucose treatment stimulate microbiological activity and led to an increase in respiration.



COS fluxes from the different treatments; COS emission from the litter treatment started high and descreased fast over the course of the measurement. This pattern can be seen on all days (not shown). Untreated soil samples exhibited COS uptake, which decreased, when the CA inhibitor was added or the samples were sterilized.



Summary of all COS fluxes (means ± sds across all soil samples – 3 replicates per day).



Soil COS fluxes (symbols) before (10.06.), during (26.06. – 05.08.) and after (13.08. – 16.09.) a simulated drought. Grey bars indicate the incoming solar radiation.

In the field:

- CO_2 fluxes decreased, compared to the control treatment, as the soil water content decreased (to a minimum of 5%), on the contrary COS fluxes remained unaffected
- Soil temperature had a moderate influence on soil COS fluxes
- Incoming radiation had the largest influence on soil COS fluxes – hence nighttime and daytime fluxes differed strongly

In the lab:

- Untreated soil samples were COS sinks, samples with added litter or glucose acted as sources.
- Both the CA inhibitor and sterilization lowered the uptake of COS in the samples.

Conclusion:
Soil COS exchange at this site reflects a complex interplay between microbial uptake and abiotic release.