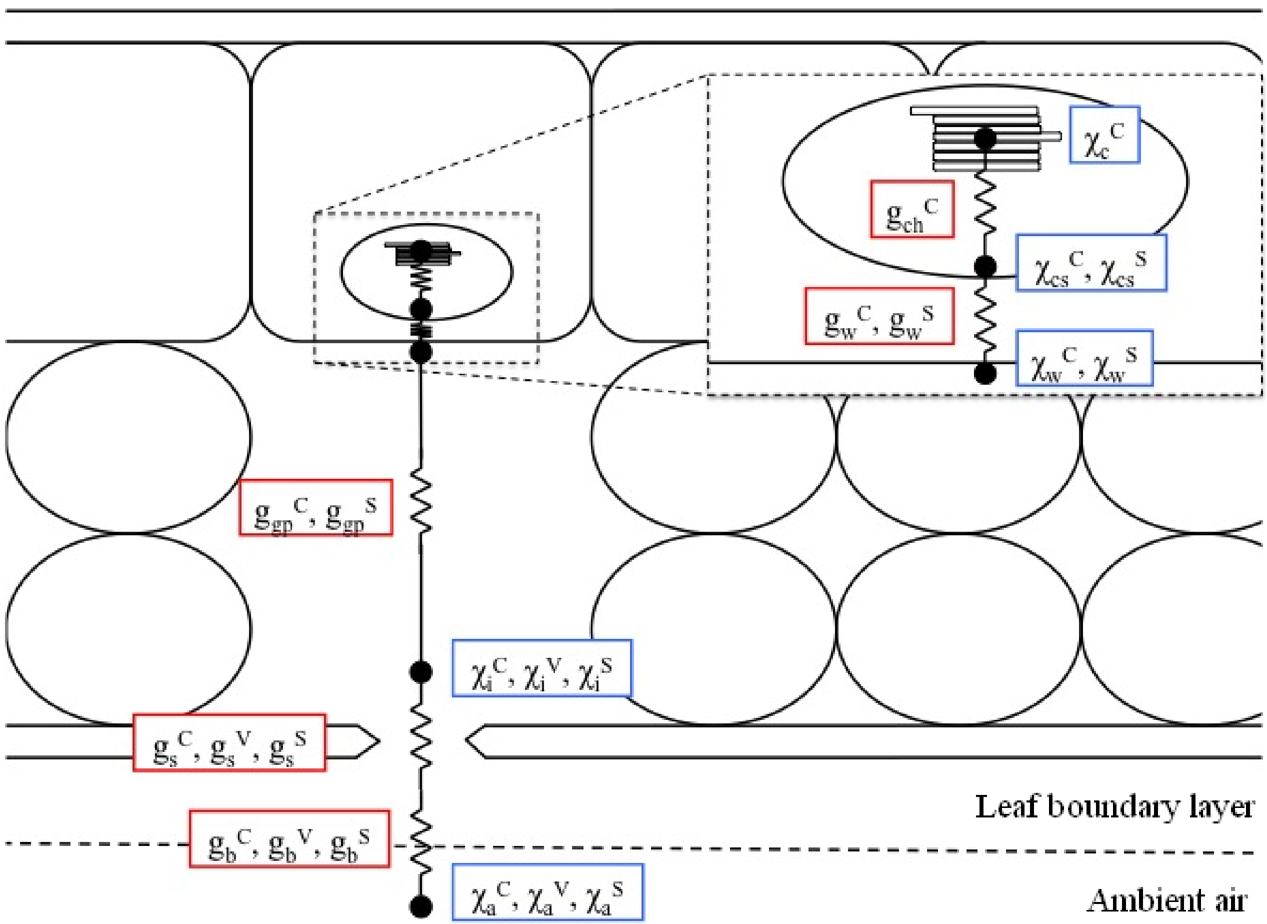
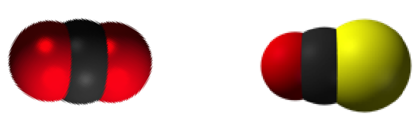
Sources and sinks of carbonyl sulfide in a mountain grassland and relationships to the carbon dioxide exchange

Felix M. Spielmann, Florian Kitz, Albin Hammerle, Katharina Gerdel, Georg Wohlfahrt

1. Introduction





Wohlfahrt et al. (2012)

1. Introduction



$$\lambda^{C} = \frac{F_{l}^{S}}{\chi_{a}^{S}} \Big/ \frac{F_{l}^{C}}{\chi_{a}^{C}}$$

Table 1. Normalized Leaf Relative Uptake Values Across the Campaign

Genus (Species)	Mean	Median	*n*	Hour of Day	Temperature (C)	Site
Malus sp.	2.1	2.1	2	12.2	37.9	GH
Fraxinus sp.	1.6	1.5	4	14.7	38.0	GH
Acer sp.	2.3	2.3	2	10.6	33.0	GH
Catalpa sp.	1.7	1.7	5	13.5	39.4	GH
Betula sp.	1.6	1.5	3	15.2	38.8	GH
Populus fremontii	**4.9**	4.9	3	15.8	40.9	GH
Ulmus sp.	1.9	1.8	3	11.2	34.3	GH
Gleditsia sp.	1.4	1.4	2	11.8	35.1	GH
Pinus ponderosa	1.3	1.4	3	12.7	NaN	GH
Quercus sp.	1.5	1.6	4	10.8	NaN	GH
Populus tremuloides	1.6	1.6	19	13.5	32.5	NWR
Pinus flexillis	1.5	1.4	15	12.1	29.9	NWR
All Samples[a]	**1.7**	**1.6**	65	-	-	-

[a]Daytime (9:00-17:00 local time) LRU (unitless) for all measured tree genera. Excluding *Populus fremontii*. Bold numbers denote the outlying value of *Populus fremontii* and the average (mean and median) LRU that emerges from all measurements.

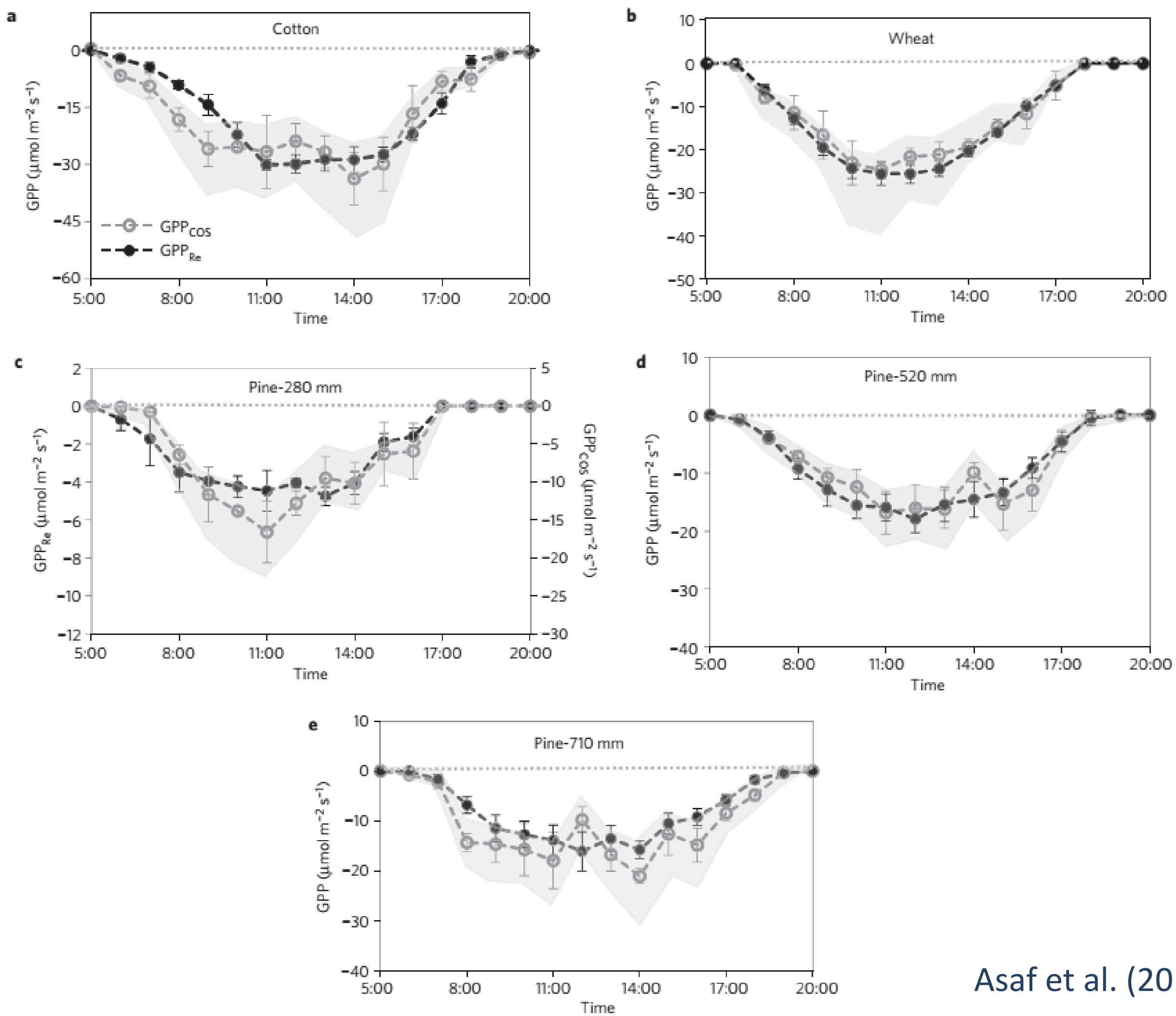
Berkelhammer et al. (2014)

1. Introduction

GPP_{Reco}

vs.

GPP_{COS}



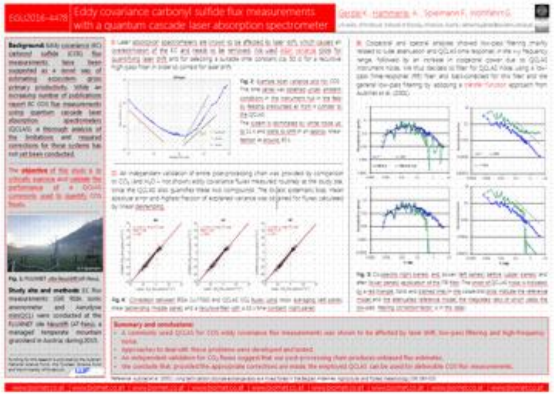
Asaf et al. (2013)

2. Methods

Hall X2
Board number X2.305

Site: Managed temperate grassland (3-4 cuts/year)

- Eddy covariance →

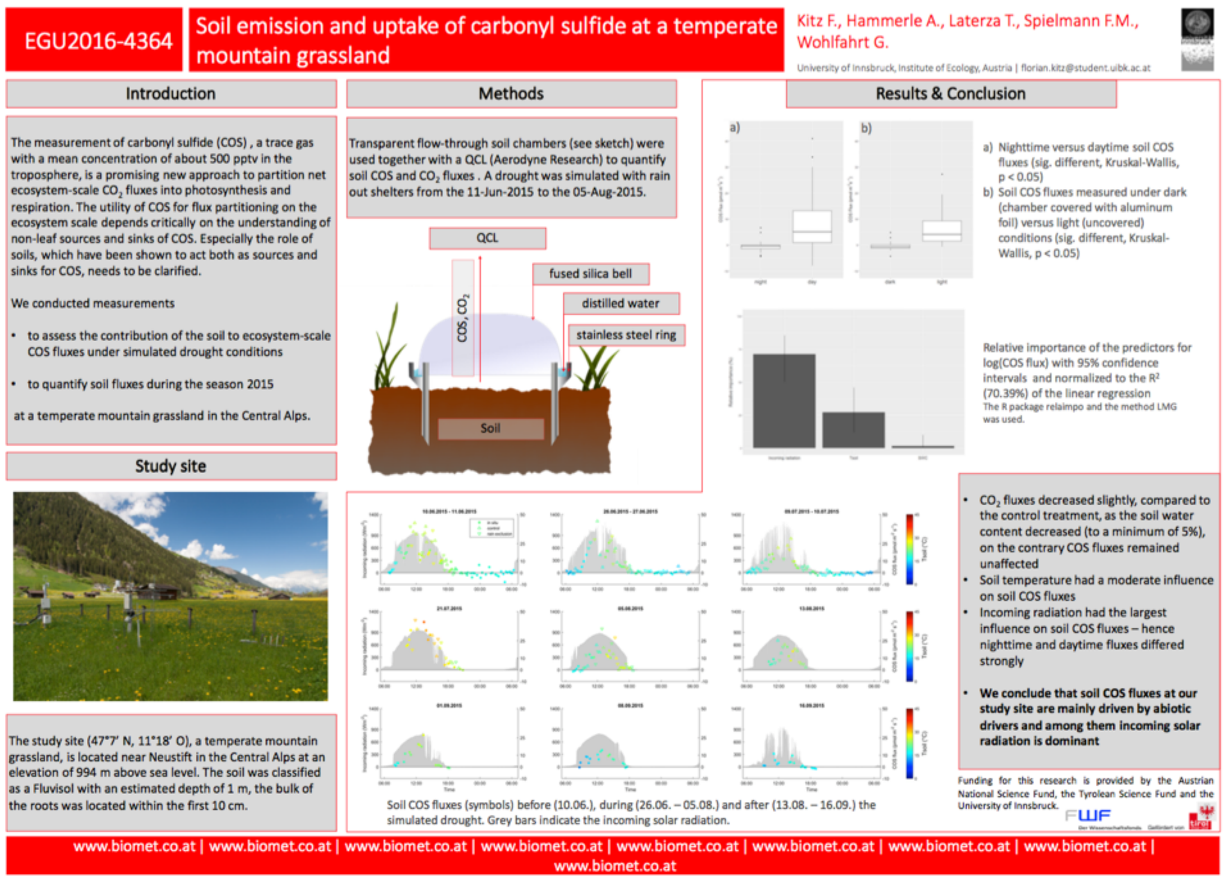


- QCL-Laser (Aerodyne Research)
- R3-Sonic(Gill Instruments)

2. Methods

Soil chamber

Poster N.48



EGU2016-4364

Soil emission and uptake of carbonyl sulfide at a temperate mountain grassland

Kitz F., Hammerle A., Laterza T., Spielmann F.M., Wohlfahrt G.

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

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

at a temperate mountain grassland in the Central Alps.

Study site

The study site (47°7' N, 11°18' O), a temperate mountain grassland, is located near Neustift in the Central Alps at an elevation of 994 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.

Methods

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.

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

Results & Conclusion

a) Nighttime versus daytime soil COS fluxes (sig. different, Kruskal-Wallis, $p < 0.05$)

b) Soil COS fluxes measured under dark (chamber covered with aluminum foil) versus light (uncovered) conditions (sig. different, Kruskal-Wallis, $p < 0.05$)

Relative importance of the predictors for log(COS flux) with 95% confidence intervals and normalized to the R^2 (70.39%) of the linear regression. The R package relaimpo and the method LMG was used.

- CO_2 fluxes decreased slightly, 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
- **We conclude that soil COS fluxes at our study site are mainly driven by abiotic drivers and among them incoming solar radiation is dominant**

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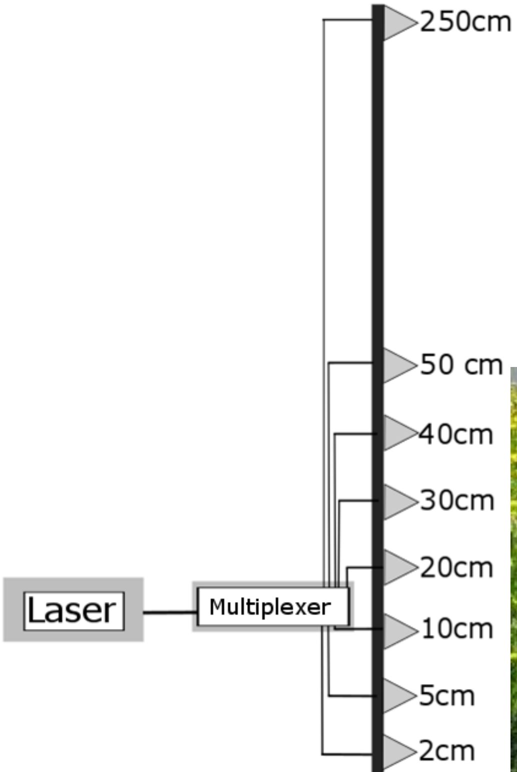
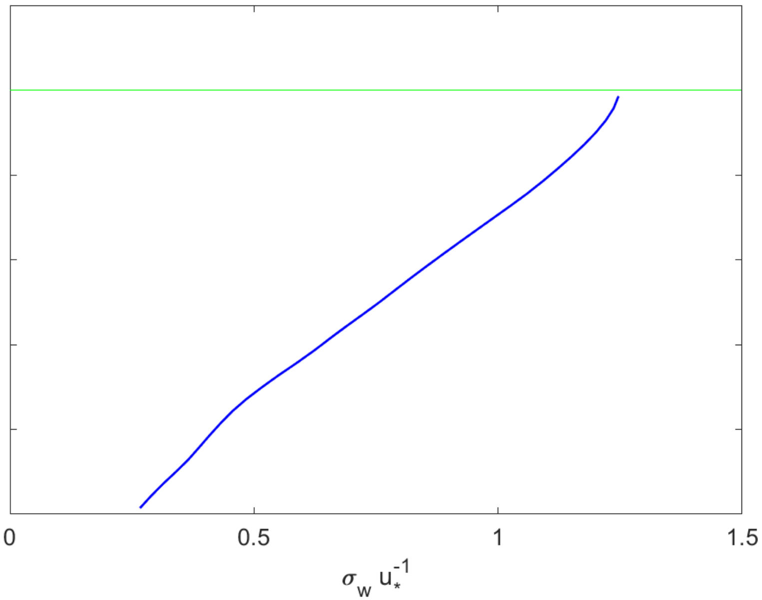
2. Methods

Gradient concentration analysis



Canopy structure

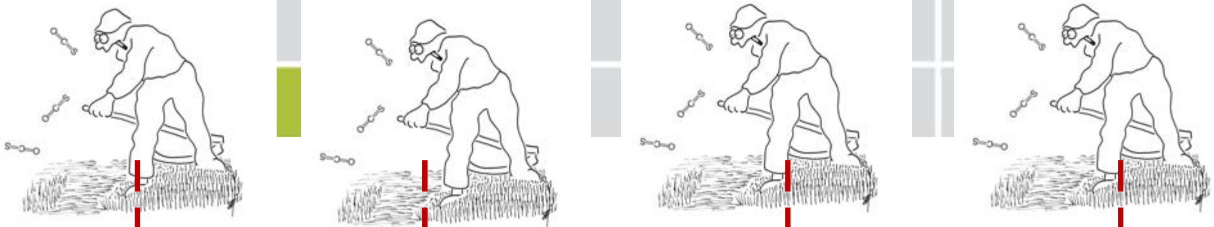
SD Vertical wind velocity

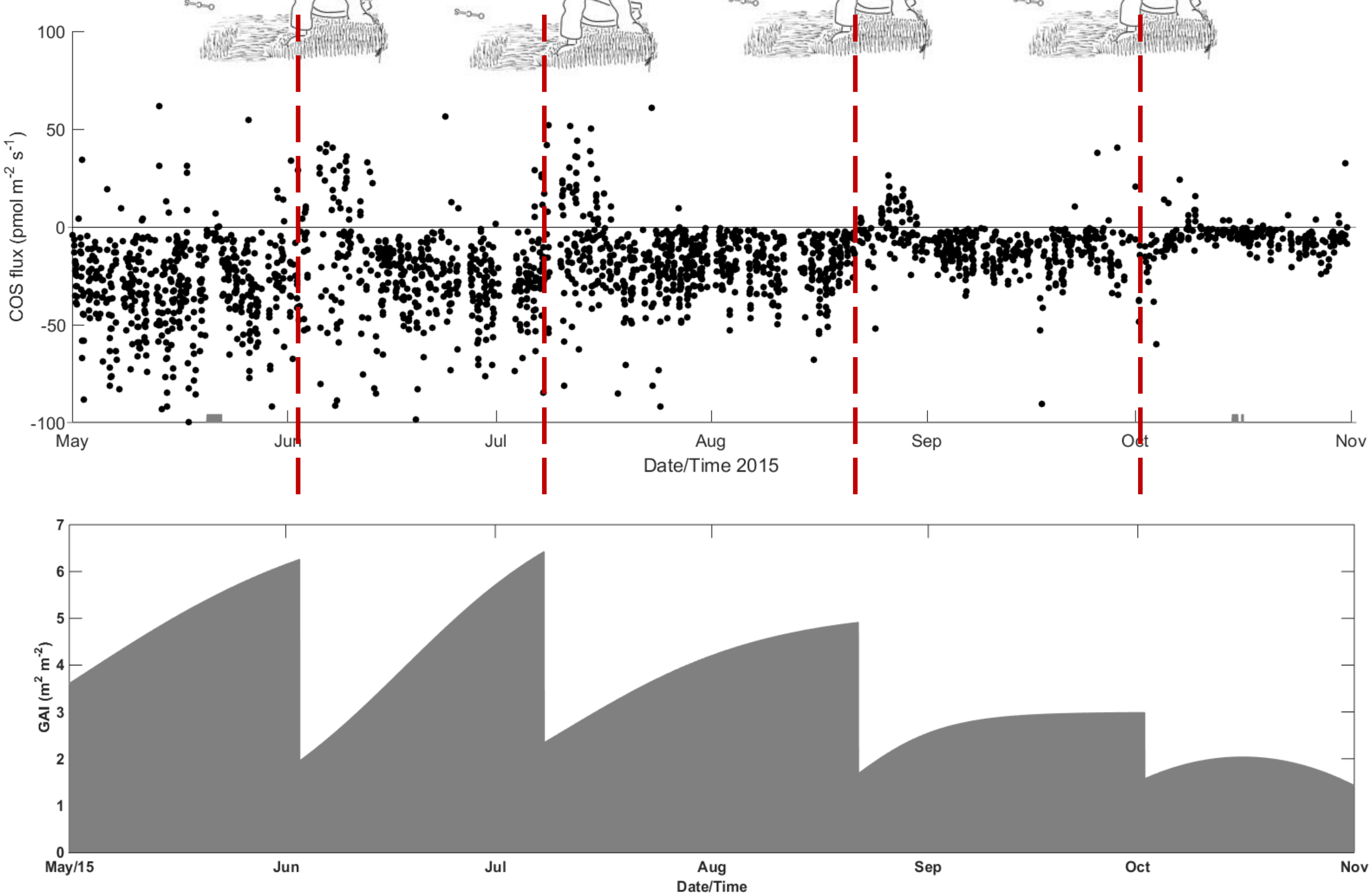


University of Innsbruck

Institute of Ecology

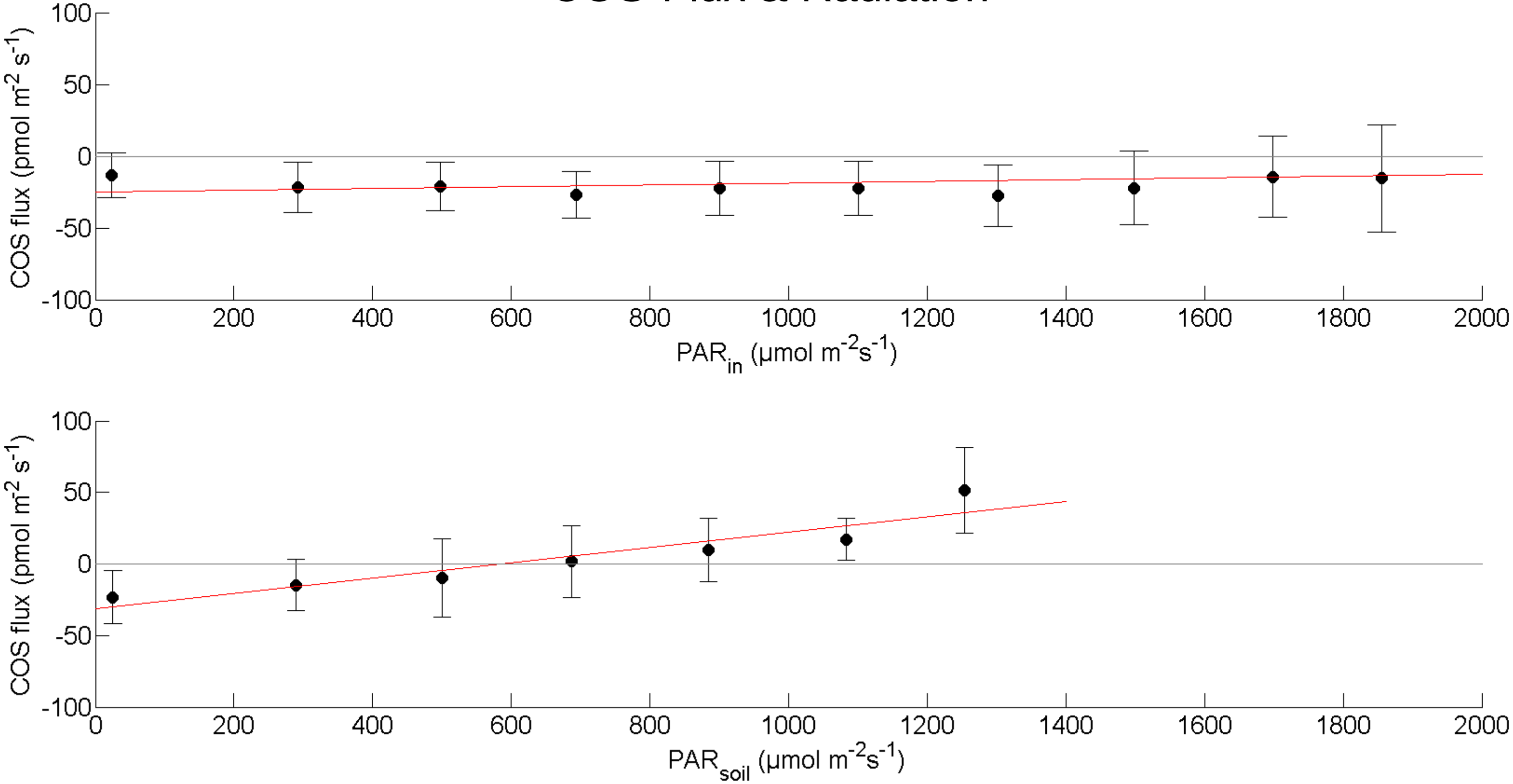
3. Results



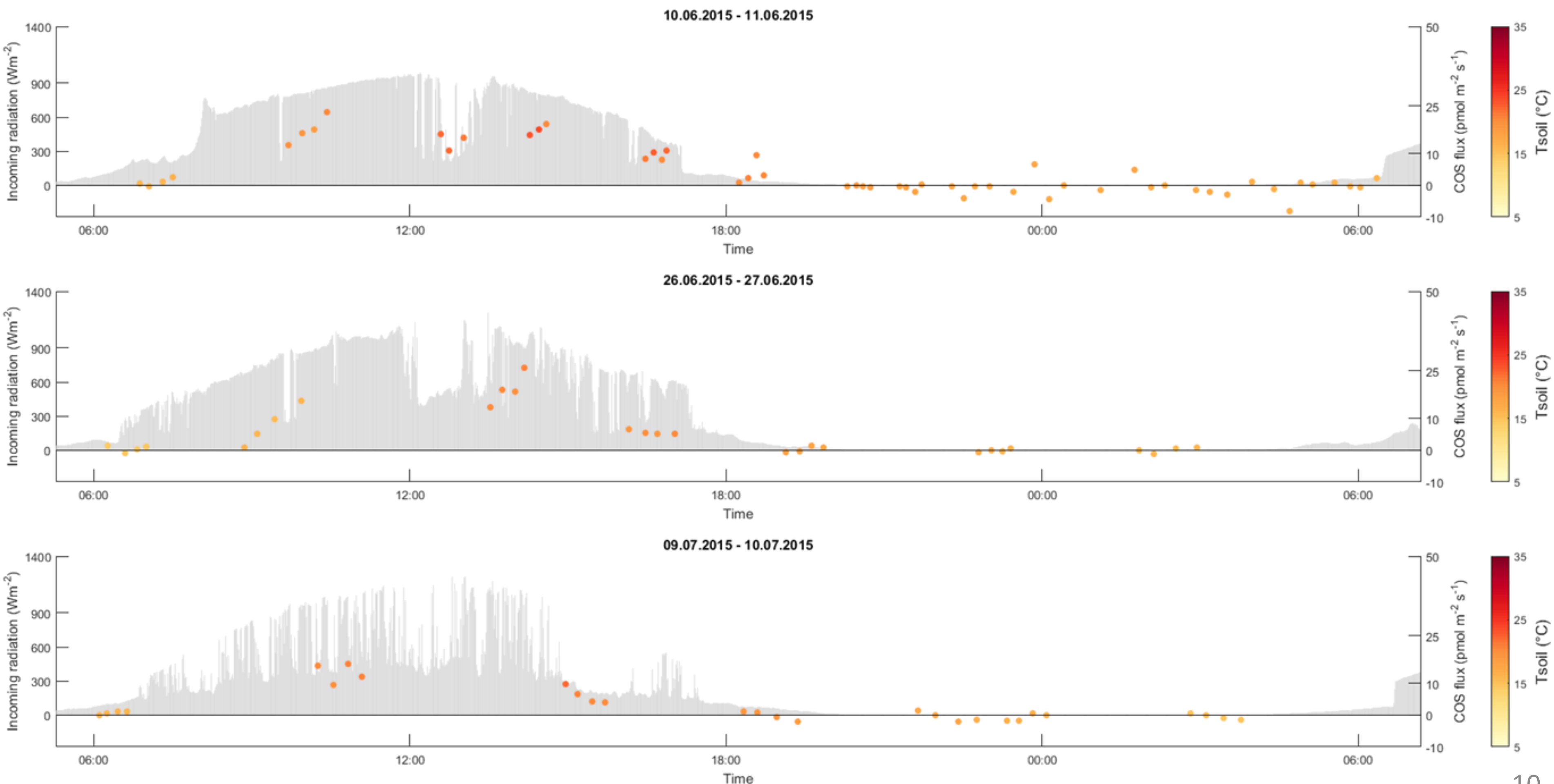


3. Results

COS-Flux & Radiation

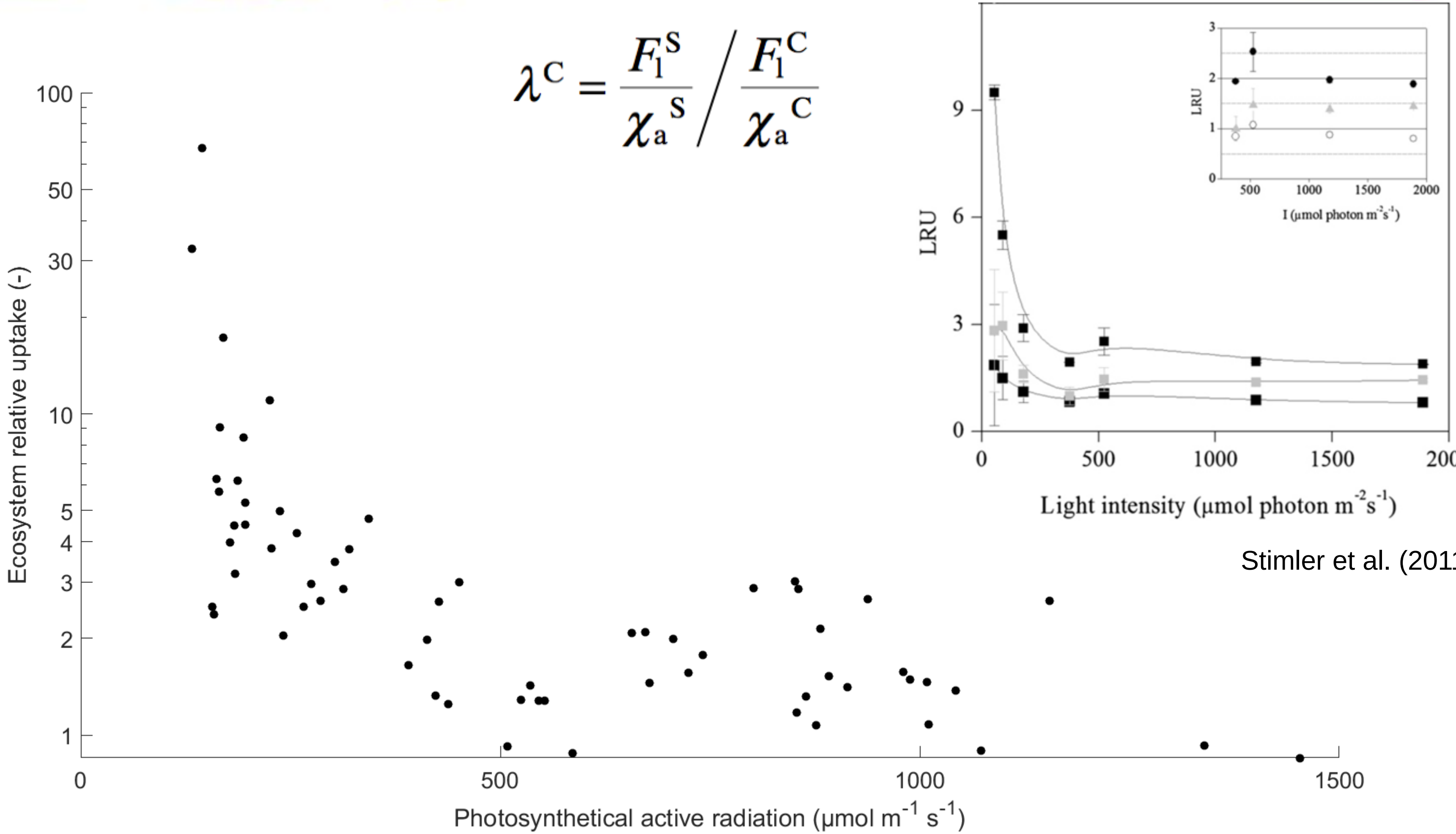


3. Results


10.06.2015 - 11.06.2015
26.06.2015 - 27.06.2015
09.07.2015 - 10.07.2015
Incoming radiation (Wm-2)
1400
900
600
300
0
COS flux (pmol m-2 s-1)
50
25
10
0
-10
Tsoil (°C)
35
25
15
5
06:00
12:00
18:00
00:00
06:00
Time

3. Results

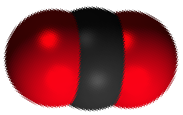
$$\lambda^{C} = \frac{F_1^{S}}{\chi_a^{S}} \bigg/ \frac{F_1^{C}}{\chi_a^{C}}$$

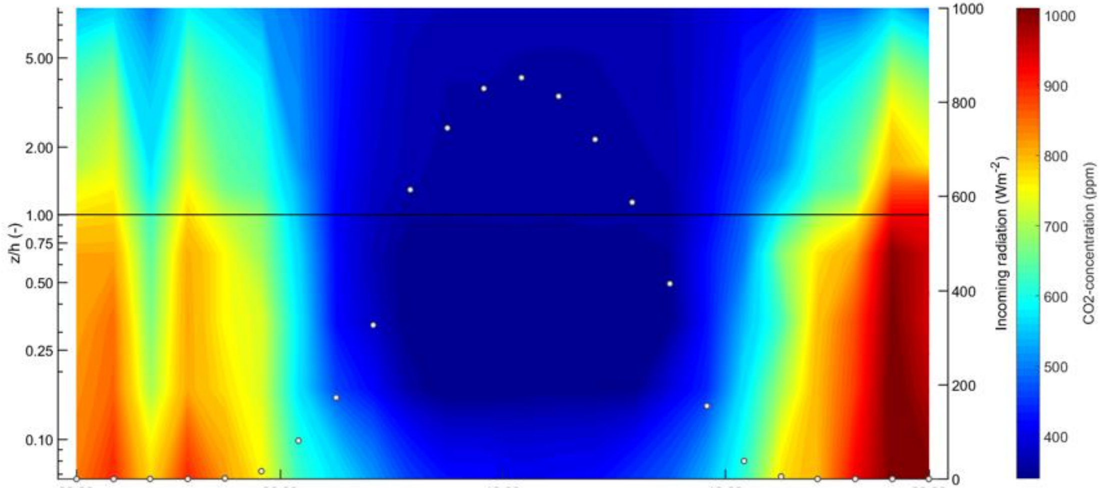


Stimler et al. (2011)

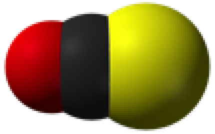
3. Results

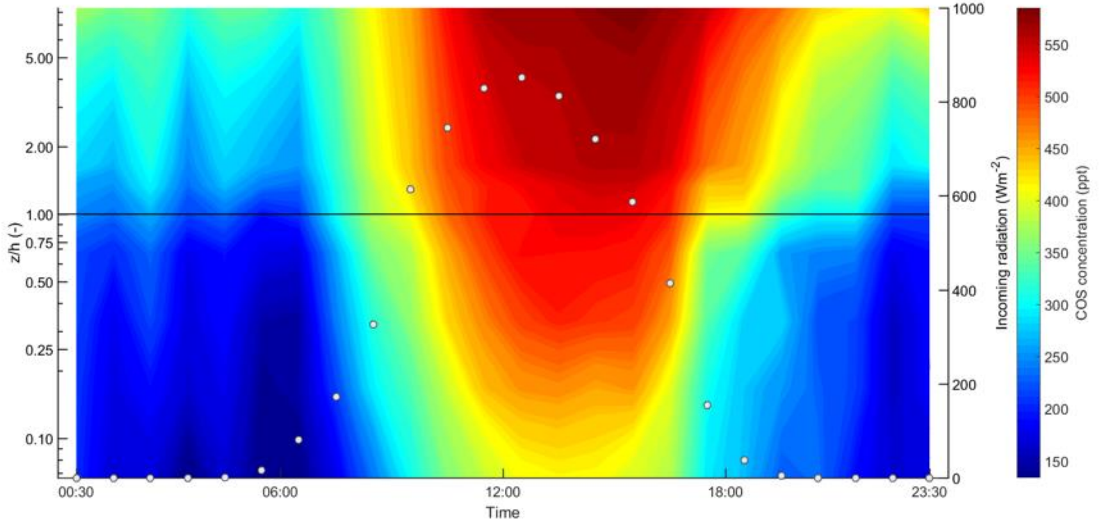
CO_2





COS

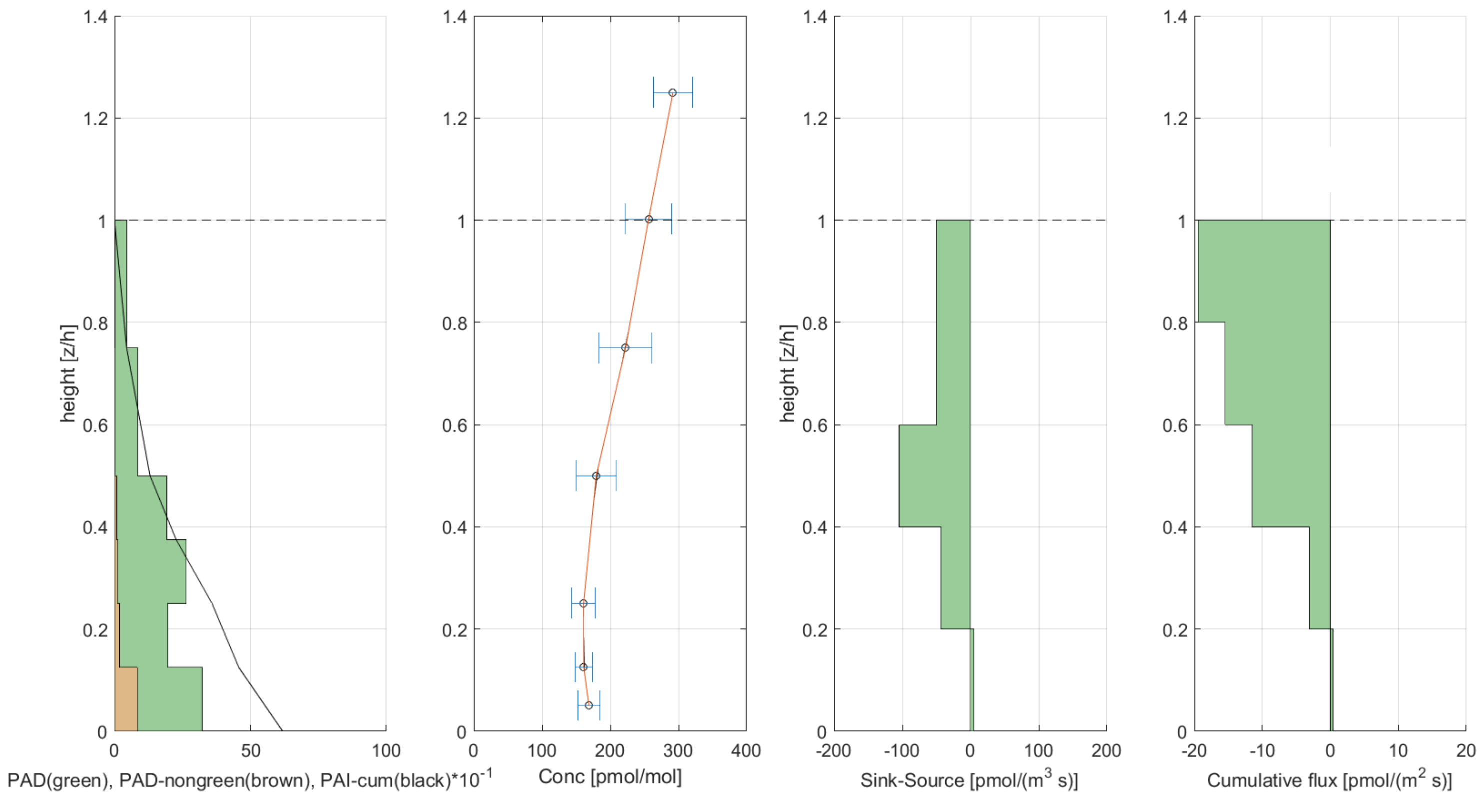




3. Results

Inverse lagrangian analysis

12.08.2015 22:00-23:00



4. Conclusions

- **>90% uptake (also during night)**
- **Magnitude decreases during the season**
- **Emission after management events**
- **Radiation-driven soil COS emissions**

- **Outlook:**
  - Inverse Lagrangian Analysis
  - Influencing factors

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Felix M. Spielmann

Institute of Ecology
University of Innsbruck

Felix.spielmann@student.uibk.ac.at

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