## Carbonyl sulfide and sun-induced fluorescence as joint constraints on terrestrial carbon cycling in a temperate alpine grassland ecosystem

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## Introduction

Quantitative understanding and monitoring of gross primary productivity (GPP) and its response to environmental variables is critical for understanding the feedbacks of ecosystems to the changing climate and projecting the future climate state.

Due to limitations of the eddy covariance (EC) method related to the restricted spatial coverage obtained with the method, as well as drawbacks of the so-called CO, flux partitioning approaches, adding scale-appropriate extra-information on canopy physiological status and flux partitioning is crucial for constraining GPP, also beyond the ecosystem scale.

Here, we present the preliminary outcome of the H2020-MSCA-IF COSIF project aiming at investigating the potential of two novel GPP traces, i.e. carbonyl sulfide (COS) and sun-induced fluorescence (SIF) for inferring GPP.

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(SIF\_O2A; mW m<sup>-2</sup> sr<sup>-1</sup> nm<sup>-1</sup>). SIF and NDVI data were collected between 8 am and 18 pm CET and averaged over 30 min periods to match GPP observations. PANEL B: Seasonal pattern of fraction of absorbed photosynthetically active radiation (FAPAR; -). FAPAR data were collected between 11 am and 13 pm CET at 1 min intervals and averaged over 30 min periods. Gray vertical bar indicates grassland cut event. Different colours highlight periods before and after the grassland cut.







## **Preliminary results**

highlight periods before and after the grassland cut. Points represent half-hourly data collected between 8 am and 18 pm CET. PANEL E: Relationship between SIF and GPP during sunny (red) and cloudy periods (black) in the period before the grassland cut. Points represent hourly means between 8 am and 18 pm CET. Cloudy conditions were defined as those when the diffusion index (DI), which is the ratio of the diffuse to total incident PAR, exceeded 0.7. Sunny conditions were defined as those, when DI<0.4.







# before the cut 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 DOY fraction before the cut 0.0 0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 DOY fraction

## EDDY COVARIANCE (QCL)



Mean diel variation of net CO<sub>2</sub> and COS ecosystem fluxes before and after the grassland cut event. Positive fluxes indicate net emission, while negative fluxes indicate net uptake. Shaded areas represent ± one standard deviation of the mean.



## SUMMARY

COS flux followed diurnal and seasonal changes in net CO2 uptake and GPP SIF and NDVI both followed seasonal changes in GPP, however NDVI saturated at low values of fAPAR, while SIF continued to scale with seasonal and day-to-day changes in GPP SIF-GPP relationship altered after harvest of grassland. Possible reasons: stress symptom, differences escape factor, fluorescence IN differences species composition and physiology? SIF-GPP relationship was dependent on light conditions and can be improved when considering data collected under cloudy and sunny conditions on a separate basis Next steps: use data to calibrate SCOPE model and use model as a tool to investigate underlying structural and functional processes; compare against active fluorescence measurements

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