Role of advection for the ecosystem-atmosphere carbon dioxide exchange of alpine grasslands

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Background

Estimates of net ecosystem CO_2 exchange (NEE) have been attracting a lot of attention because of the important role of CO_2 in global climate change. The contribution of advection to CO_2 flux measurements is often ignored in the estimation of NEE, even though some studies reported that more realistic estimates of night-time and daily total NEE could be gathered if horizontal and vertical advection was accounted for.

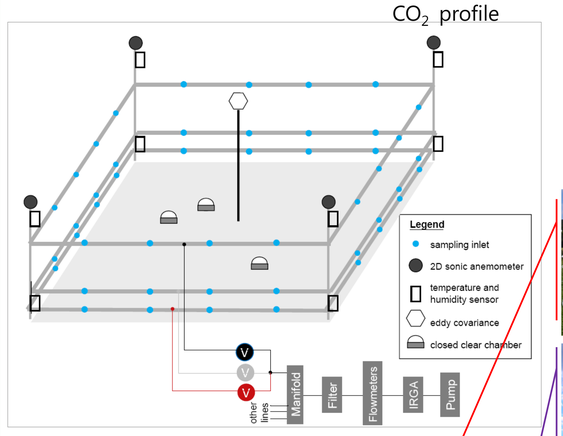
Objectives

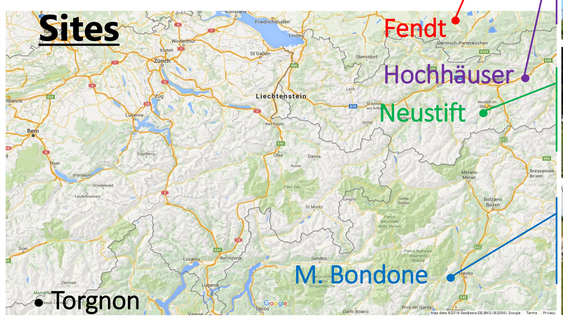
- To quantify the contribution of advection to NEE at grasslands.
- To study the advection flux terms in differently complex terrain types in the Alps.

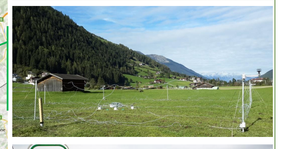
Methods

$$\overline{F_c} \approx \bar{F}_{c,s} + \bar{F}_{c,h} + \bar{F}_{c,v} + \bar{F}_{c,t}$$

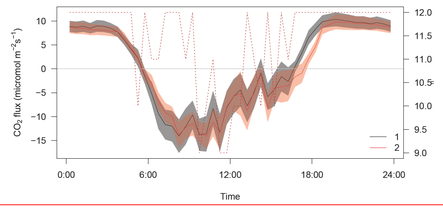
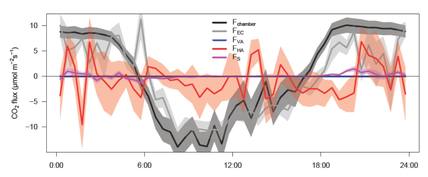
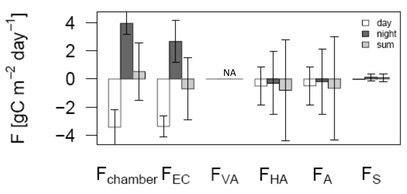
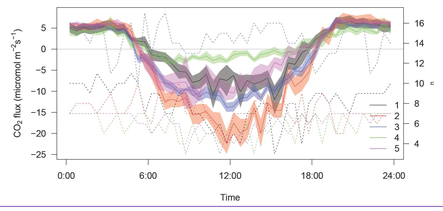
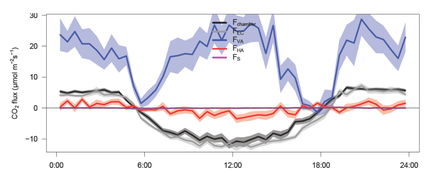
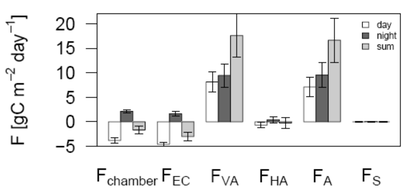
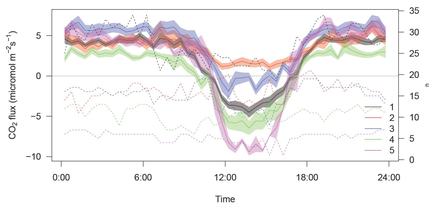
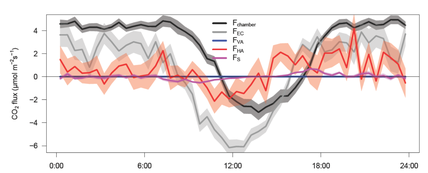
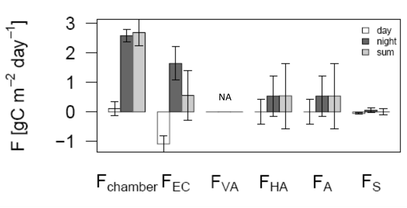
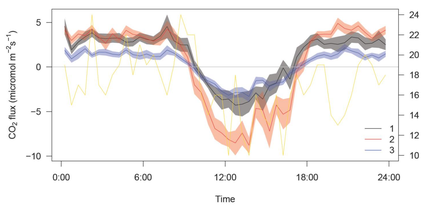
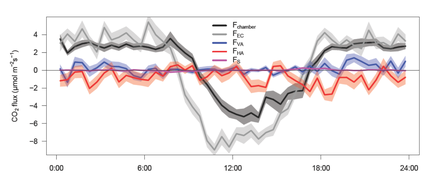
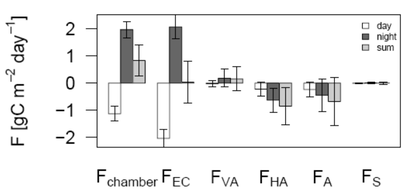
- $\bar{F}_{c,s}$: Chamber measurement
- $\bar{F}_{c,h}$: CO_2 profile, Horizontal wind
- $\bar{F}_{c,v}$: CO_2 profile, Vertical wind
- $\bar{F}_{c,t}$: Eddy covariance







Results

Site	Info	Chamber fluxes	Diurnal flux components	Average flux components
Fendt	595 m asl. Shallow valley July 2016			
Hochhäuser	1010 m asl. Steep slope May 2016			
Neustift	970 m asl. Deep valley Oct. 2016			
M. Bondone	1550 m asl. Undulating terrain Oct. 2015			

Conclusions

- Both the horizontal and vertical advection contributed more significantly to the CO_2 flux at night time than at daytime at most sites.
- At the flatter sites, horizontal advection played a more important role than the vertical advection, and vice versa at the steep site.
- The above-canopy advection contributed more to the CO_2 flux than within-canopy advection due to short canopy heights.
- Large variability of NEE measured by the three chambers indicates the challenge of comparing chamber and micrometeorological fluxes resulting from the heterogeneity of the grassland surface.

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