# Trace gas distribution and budget in the nocturnal boundary layer

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## MOTIVATION

- Different scales of biosphere-atmosphere exchange of GHG interrelate: local scale (ambient air concentrations), plot scale (emissions), valley scale (dynamics), Alpine foreland (convection)
- Emitted constituents accumulate in the nocturnal boundary layer (NBL)

## OBJECTIVES

- GHG concentrations near to surface (Fig. left outside)
- Role of atmospheric processes: vvertical profiles of meteorological parameters, concentrations (Figs. right, below)
- Quantification of local methane emissions (Figs. left inside)

Site flooded in the first half of June, then wet and drying fast in July.

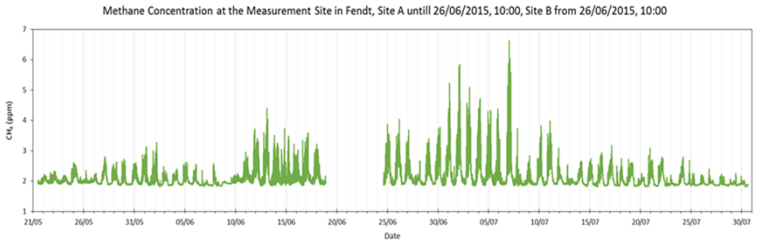
Measurement tunnel at the grassland.


Radio acoustic sounding system (Metek RASS).

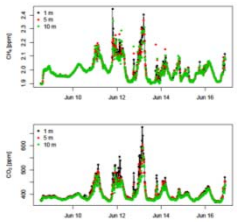
Ceilometer (Vaisala CL51).

## METHODS

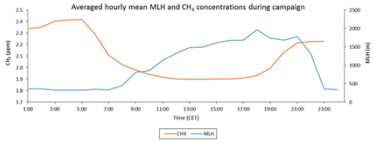
- Methane measurements: in situ with Los Gatos DLT-100, tubes: 0.3 m agl with 5 sampling heads
- Big chamber (tunnel) across the sampling heads, length 10 m, width 2.60 m, largest height 0.61 m, V = 8 $m^3$, A = 27 $m^2$, cover with plastic film, fixing at ground by granulate filled bags
- Measurement of soil moisture in situ
- GHG profiles by UAV (see poster Caroline Brosy) with tube and 10 m tower in situ (Picarro G2508)
- Mixing layer height MLH: ceilometer Vaisala CL51
- Temperature, wind, turbulence: Metek RASS



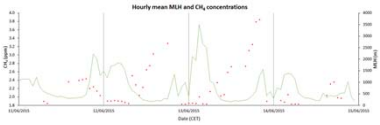

Sites A and B are located in a distance of about 50 m.



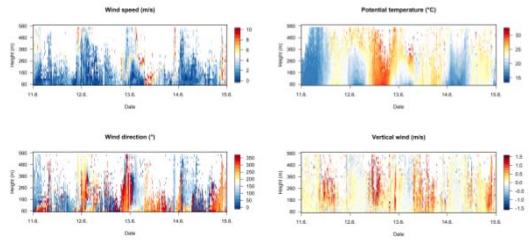
$CH_4$ and $CO_2$ concentrations in 1, 5, 10 m altitude from tower measurements 08–18/06.


Averaged temporal variation of hourly mean $CH_4$ concentrations and MLH.




Temporal variation of hourly mean $CH_4$ concentrations and MLH 11-14/06.




Wind speed (left above), potential temperature (right above), wind direction (left below) and vertical wind speed (right below) from RASS 11-14/06.

## RESULTS

**Methane concentrations** (Figs. above)

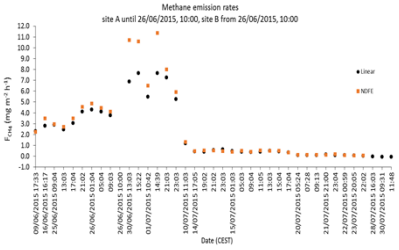
- Highest night level concentrations under wet and warm conditions
- Frequent double-peak structure during night-time
- Concentration decrease with altitude during early night – stable, not well-mixed NBL

**Influences of atmospheric processes** (Figs. left)

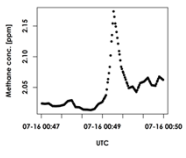
- Correlation coefficient of hourly mean methane concentrations with MLH: 0.56
- Concluded from RASS measurements:
  - First maximum: local stabilization of lower atmosphere
  - Second maximum: transport from the South

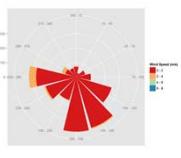
**Methane emissions** (Figs. right)

- Water saturated grassland patches: strong emission, emission decrease during drying of soil
- Dry grassland: up-take of methane
- Dairy farms located west and south/southeast of tower: can cause short-term concentration peaks




$CH_4$ emissions from grassland, measured by big chamber and determined by linear or NDFE model. Water saturated grassland until beginning of July. Up-take of $CH_4$ from 28 July on.



Example event of a $CH_4$ plume passing the measurement tower (left) and wind directions for plumes increasing the $CH_4$ concentration by more than 20 ppb during the whole campaign.

## OPEN QUESTIONS, CONCLUSIONS

- Long-term temporal variation of methane concentrations near to the surface
- Spatial distribution of methane concentrations in the lower atmosphere: copter / vehicle based measurements
- Detailed influence of farm emissions on methane concentrations near to surface at the measurement sites
- Spatial distribution of methane fluxes at grasslands, mainly near to the EC station
- Model evaluation at different scales using these filed observations

## REFERENCES

Wolf, B., Adler, B., Brosy, C., Brugger, P., Chwala, C., De Roo, F., Fersch, B., Garvelmann, J., Haas, E., Junkermann, W., Kosak, O., Ruehr, N., Schäfer, K., Philipp, A., Vogelmann, H., Zeeman, M., Arneth, A., Butterbach-Bahl, K., Dannenmann, M., Emeis, S., Kiese, R., Kunstmann, H., Mauder, M., Suppan, P., Sussmann, R., Schmid, H.P.: The ScaleX campaign: observations X-ing scales in the TERENO pre-alpine observatory. International Conference on Alpine Meteorology. ICAM, Innsbruck, Aug 31 - Sep 04, 2015; oral presentation.

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