HBLFA
Raumberg-Gumpenstein
Landwirtschaft

Eine Einrichtung des Bundesministeriums für
Landwirtschaft, Regionen und Tourismus

Comparison of lysimeter and scintillometer data with reference evapotranspiration

Lysimeter and soil water management: drought – irrigation – yield stability

19th Lysimeter conference,13.-14. April 2021, AREC Raumberg-Gumpenstein

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Evapotranspiration

Computational approaches

1. Direct approaches

A. Field Water Balance Approach

B. Soil Moisture Depletion Approach

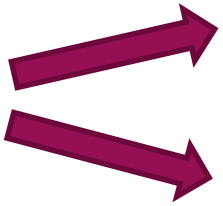
Lysimeter

2. Indirect approaches

A. Empirical/ Statistical Methods

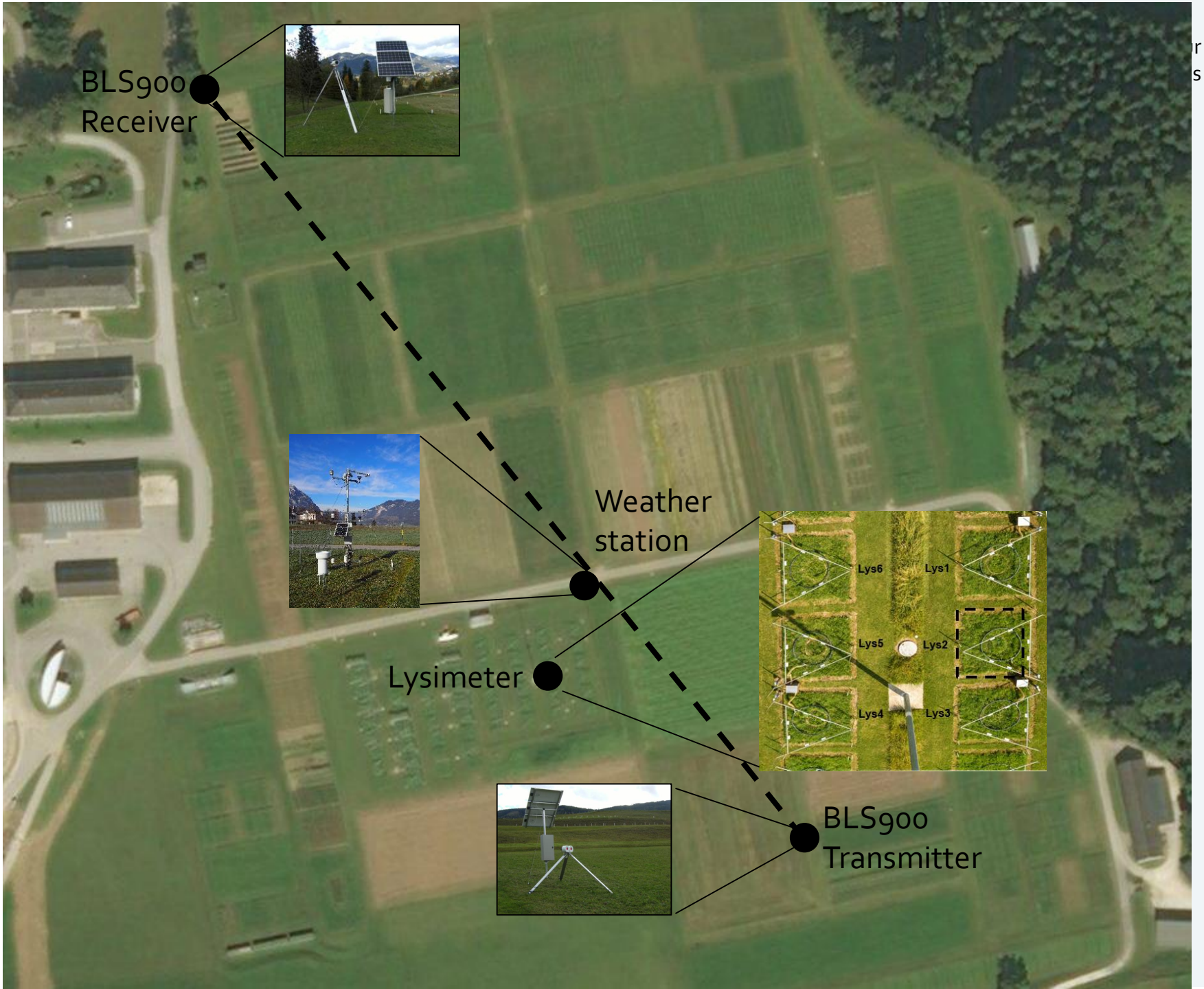
B. Micrometeorological methods

C. Remote Sensing Methods

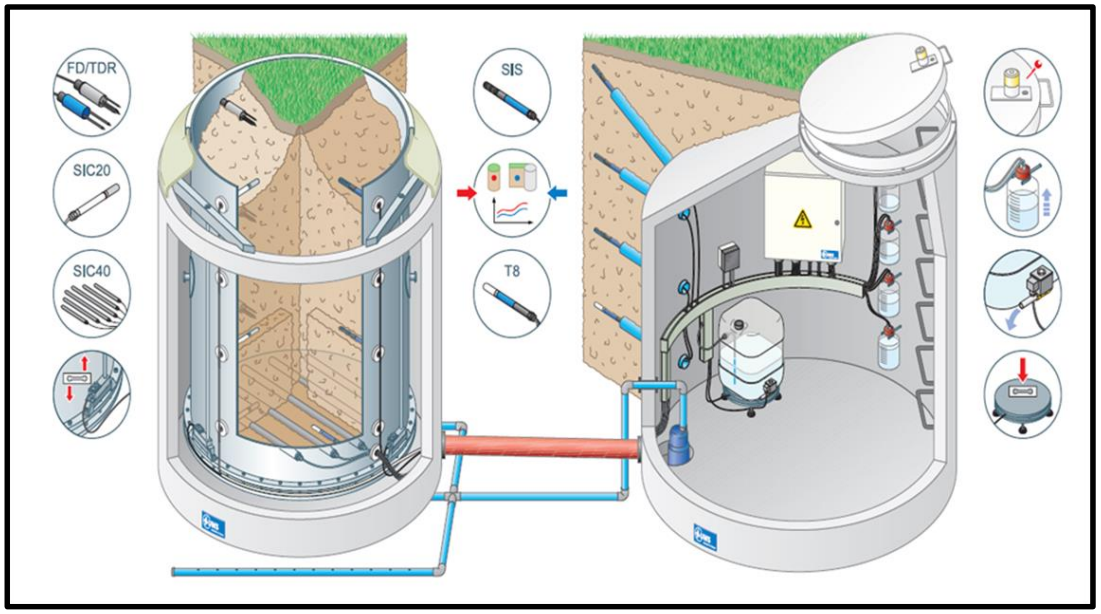


Scintillometer – energy balance

Penman-Monteith equation – ET_o, ET_c


BLS900
Receiver
Weather
station
Lysimeter
BLS900
Transmitter
Lys6
Lys1
Lys5
Lys2
Lys4
Lys3

Lysimeter



→ Seepage water weight via a 50 liter tank
→ Temporal resolution 1 min
→ Precision 100 g

Scintillometer

Scintec BLS900 Large Aperture Scintillometer

Receiver

Transmitter

$$LE = R_n - H - G$$

LE is the latent heat flux

R_n is the net radiation,

H is the sensible heat flux

G is the soil heatflux

$$ET = LE/\lambda$$

λ is the latent heat of vaporization

Penman-Monteith equation

Crop evapotranspiration (ET_c):

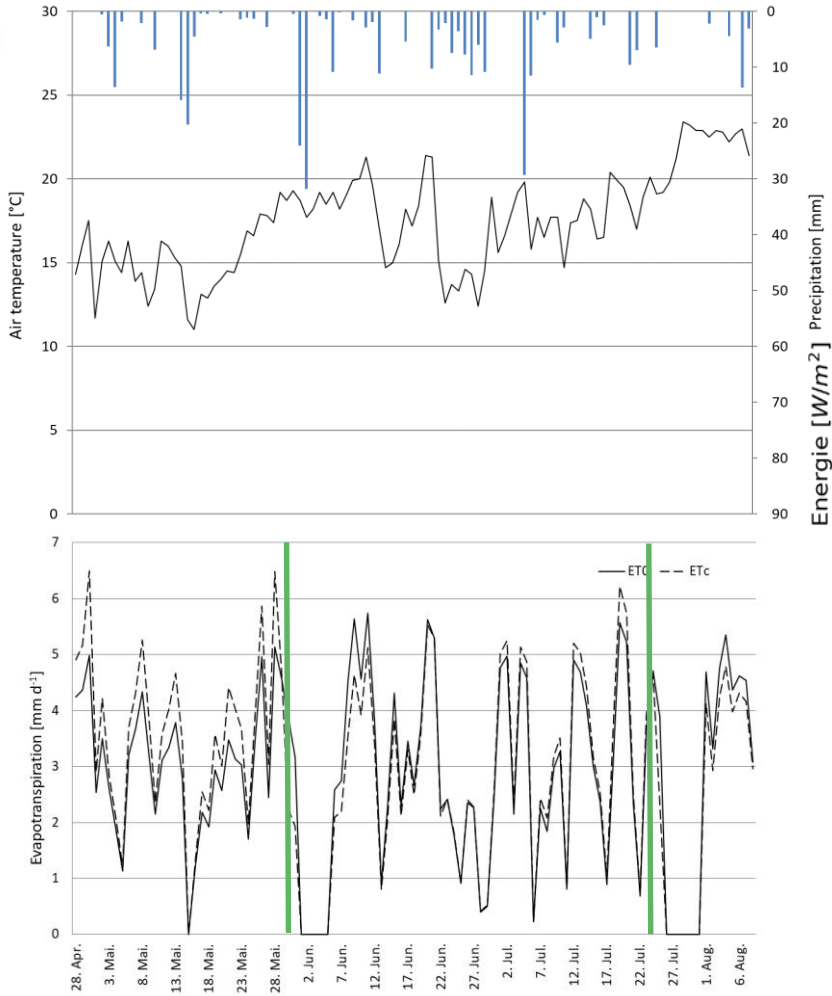
$$ET_c = \frac{\Delta(R_n - G) + \rho_a c_p (e_s - e_a)/r_a}{\lambda\left[\Delta + \gamma(1 + \frac{r_s}{r_a})\right]} \quad (1)$$

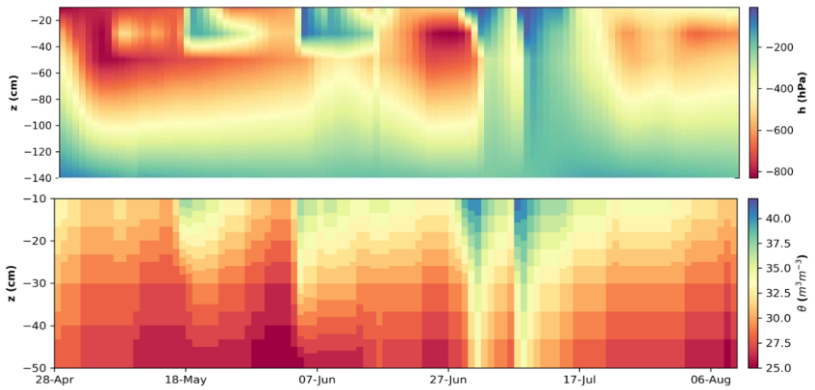
where ET, R_n and G are in MJm^{-2} d^{-1}; Δ is the slope of the saturation vapor pressure temperature relationship (kPa°C^{-1}); ρ_a is the air density (kg m^{-3}), c_p is the specific heat of air (MJkg^{-1}°C^{-1}); γ is psychrometric constant (kPa°C^{-1}); r_a and r_s are the aerodynamic and surface resistances (ms^{-1})

Reference evapotranspiration (ET_o):

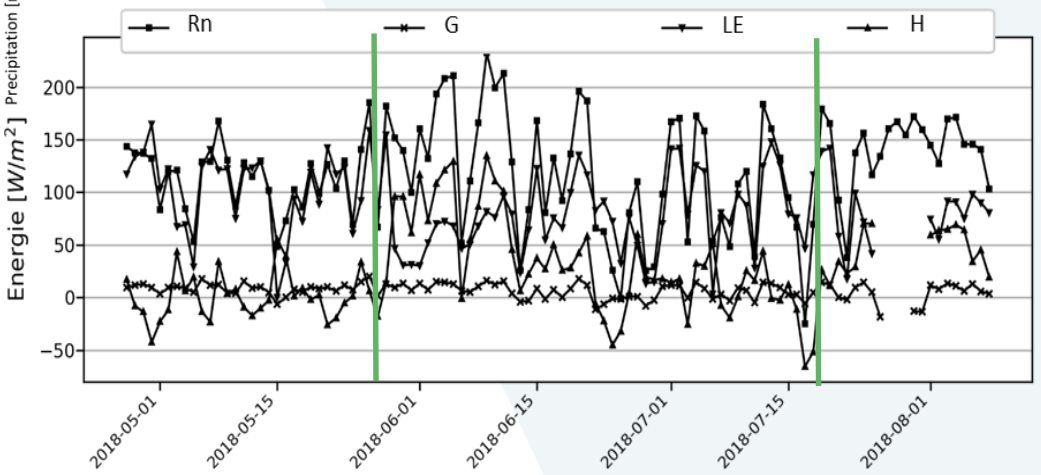
$$ET_0 = \frac{0.408\Delta(R_n - G) + \gamma \frac{37}{T + 273} u_2 (e_s - e_a)}{\Delta + \gamma(1 + 0.34u_2)} \quad (2)$$

ET_o is derived from equation 2, assuming a grass height of 12 cm, LAI of hcrop * 24 and rs of 70 (sm-1):



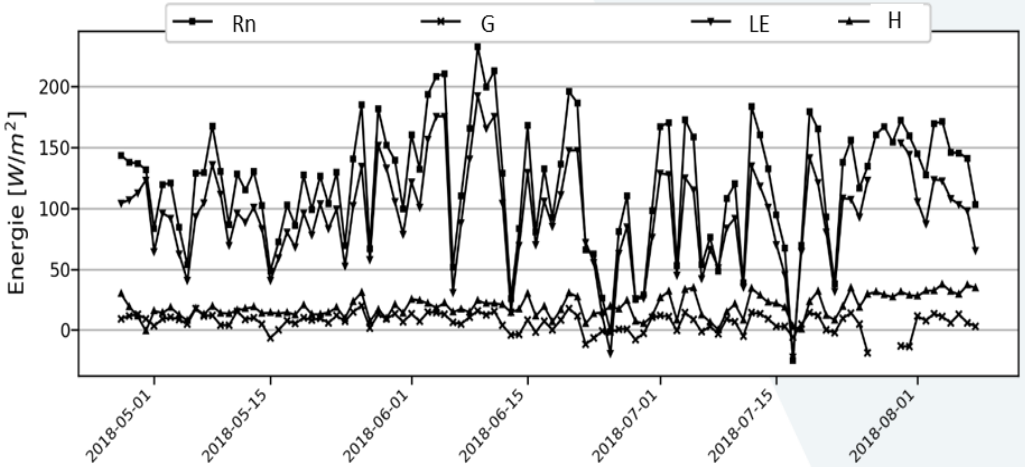


Lysimeter



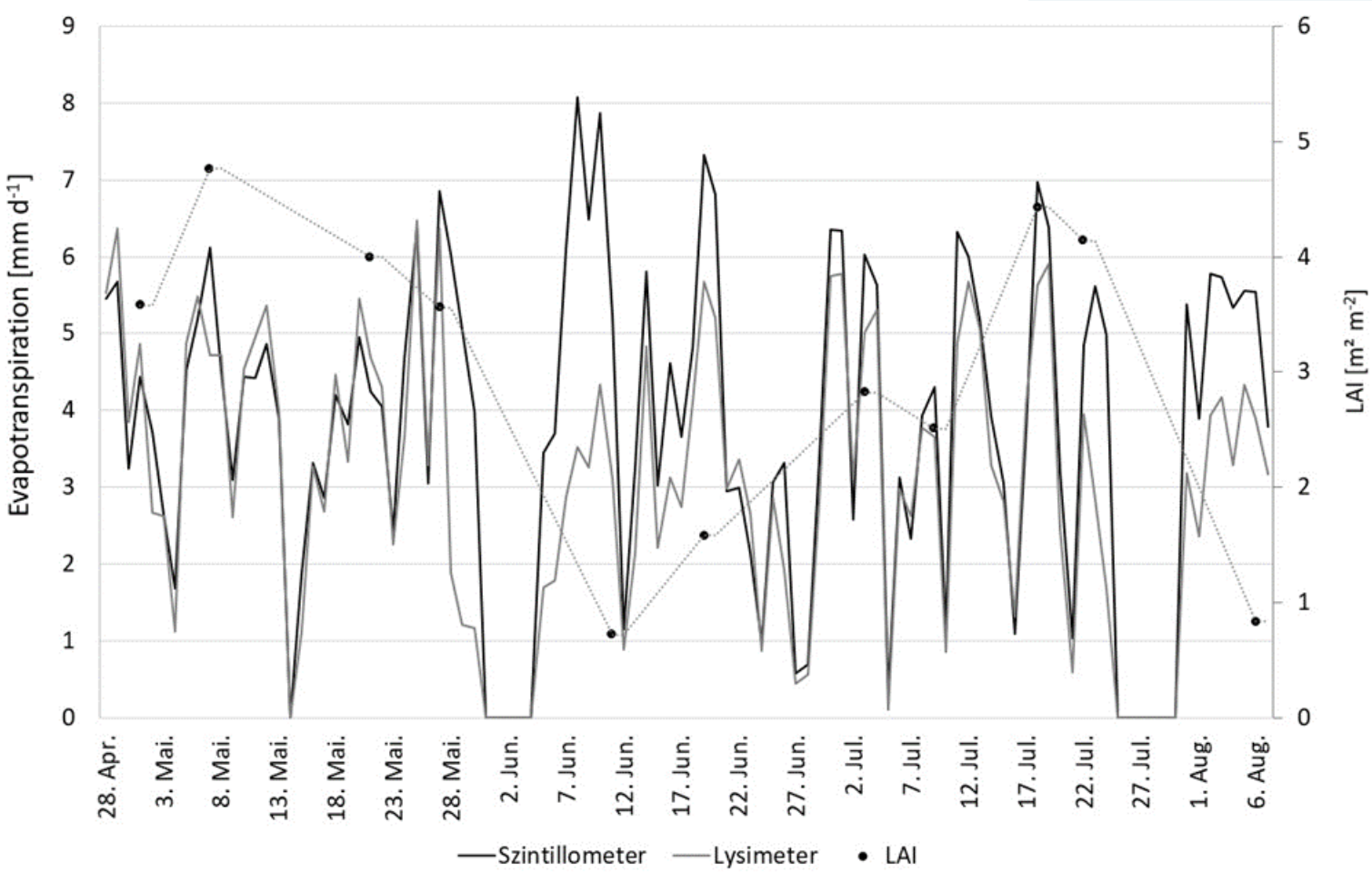
Rn net radiation; G soil heat flux; LE latent heat flux, ; H sensible heat flux

Scintillometer

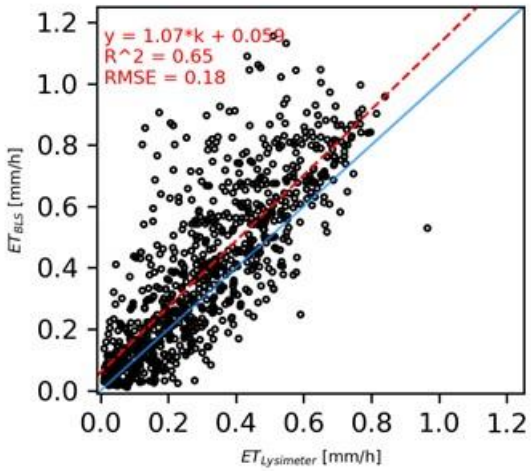


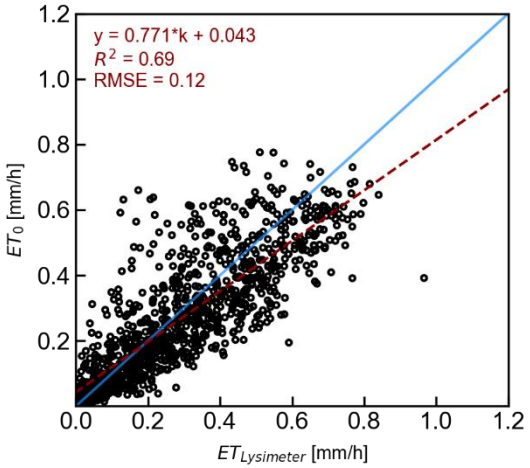
Rn net radiation; G soil heat flux; LE latent heat flux, ; H sensible heat flux

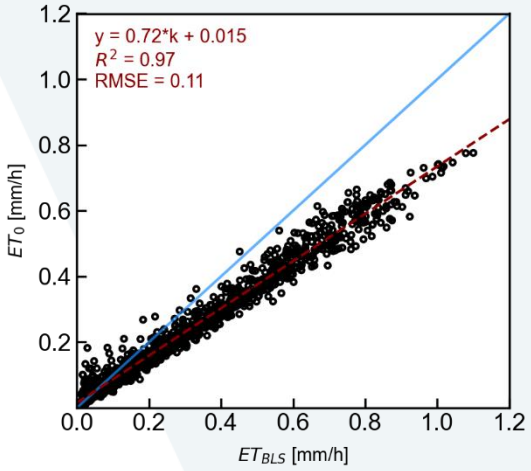
Results and Discussion

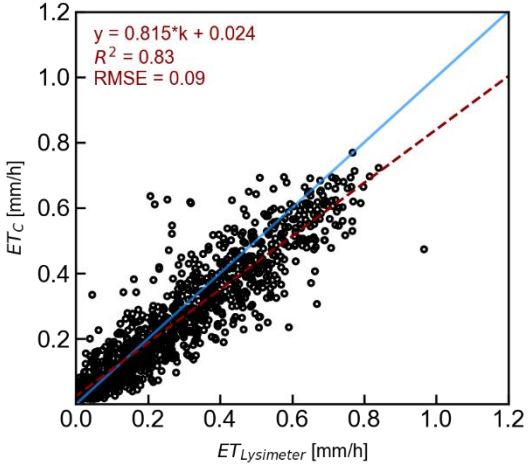


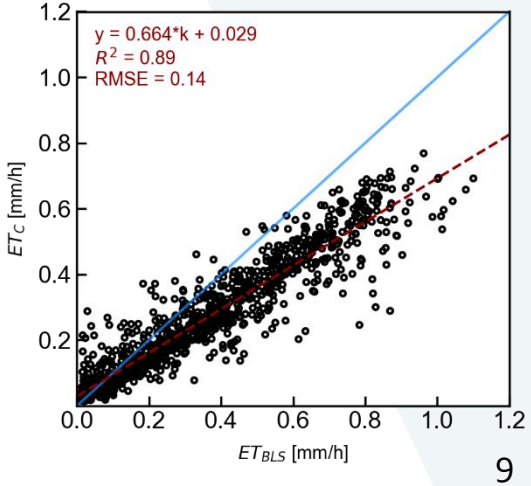
Results and Discussion











Conclusions and outlook

- Data from a lysimeter and a scintillometer were compared with data from two reference evapotranspiration methods (ET_c, ET_0)
- In the period April-August 2018, ET_c showed the best fit with the lysimeter ET (r^2=0.83), whereas ET_0 correlated best with the scintillometer ET (r^2=0.97)
- These relationships can be attributed to the different consideration of the LAI and the growth height in the two different methods
- As a possible consequence, the ET_0 method could be used to estimate ET for heterogeneous grassland stands and ET_c for homogeneous ones

→ further datasets must be analysed to be able to consolidate this conclusion

Thank you for your attention!

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