Simultaneous estimation of precipitation and actual evapotranspiration by lysimeters - Comparison with tipping bucket and eddy covariance

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INTRODUCTION

The estimation of precipitation (P) and actual evapotranspiration (ETa) remains a challenge in regional scale hydrological modelling. This study compares precipitation and evapotranspiration estimates calculated with a set of six weighable lysimeters with nearby eddy covariance (EC) and tipping bucket precipitation measurements. This allows more insight into the performance and uncertainties of these methods. In addition, it allows a better interpretation of these data which are also used for model verification purposes.

STUDY SITE

The TERENO-site of Rollesbroich is located in the Eifel low mountain range. The catchment of the Ruhr river is a managed grassland with an extension of 31 ha and intensive high-resolution monitoring.

The mean air temperature for the site is 8°C and the average annual precipitation is ca. 1033 mm.

MATERIALS AND METHODS

- Investigation period: January - December 2012
- Datasets: EC-data (30 min.); Lysimeter (1 min.); Tipping bucket (30 min.);

Correction of energy balance deficit (Δ EB) EC data [1]

\[ΔEB = \frac{ETa - \Delta S}{L_E + \Delta L_E} \]

where:

- \(L_E\) net radiation (W m\(^{-2}\))
- \(\Delta L_E\) soil heat flux (W m\(^{-2}\))
- \(\Delta \) sensible heat flux (W m\(^{-2}\))
- \(\Delta T\) storage (canopy air space, biomass, soil) (W m\(^{-2}\))

Lysimeter Data Processing

1. Automated threshold filter for outliers
2. Smoothing of measured signal with AWAT filter
3. Estimation of hourly P and ETa with smoothed signal

Adaptive moving Window and Threshold (AWAT) filter routine [2]

- Calculates measures for signal strength and noise from moving polynomial
- Applies moving average with variable window width
- Applies variable threshold value

RESULTS

- For 2012 the lysimeter precipitation is 16.4 % larger than precipitation measured by tipping bucket: Absolute and relative precipitation differences are larger in winter than summer.
- The true precipitation lies most probably between the lysimeter value and the tipping bucket value, as in some cases the lysimeter is more reliable (dew, fog, snowfall), but for snow cover and snow drift the lysimeter provides erroneous values.

CONCLUSIONS

- ETa-EC (with EBD correction) and ETa-LYS data are in good agreement for the considered period (3.5% difference over the year). ETa differences are related to differences in grass length due to differing harvesting management.

The variations of the individual lysimeters devices compared to the lysimeter mean are small (P: 3%; ETa: 8%).

REFERENCES


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