**Hydrology and
Earth System
Sciences**

Open Access

Discussions

**Interactive
Comment**

# *Interactive comment on* "Separating precipitation and evapotranspiration from noise – a new filter routine for high resolution lysimeter data" *by* A. Peters et al.

**J. Fank (Referee)**

johann.fank@joanneum.at

Received and published: 1 January 2014

## General comments

Weighing lysimeters yield the most precise and realistic measures for P and ET. A precise knowledge of the water fluxes between the soil-plant system and the atmosphere is of great importance for understanding and modeling water, solute and energy transfer in the soil-plant-atmosphere system. In the last decades resolution and precision of the weighing systems have been substantially improved, so that modern lysimeters, resting on weighing cells can reach resolutions of up to 0.01 mm. As the resolution of

the weighing systems increased, small mechanical disturbances (e.g. caused by wind) became visible in the data as noise. Therefore, precision and accuracy of the lysimeter measurements do not only depend on the precision of the weighing device but also on external conditions, which cannot be controlled or turned off. In the evaluation process of lysimeter mass data every increase in system weight (lysimeter mass + cumulative seepage mass) might be interpreted as P, whereas every decrease in system weight is interpreted as ET. To apply this concept correctly, the noise has to be separated from signals using a filtering routine. The paper introduces a new filter routine, which is appropriate for any event, including events with low disturbances as well as strong wind and heavy precipitation in small time intervals. The novel approach is based on (i) an adaptive window width which depends on the signal strength and on (ii) an adaptive threshold value which depends on noise severity. The filter is compared to other routines using real lysimeter data, which comprise all above mentioned events. The manuscript represents a substantial contribution to scientific progress – specifically in the evaluation of precision lysimeter data. The concept of coupling a smoothing routine with the application of a certain threshold value separating significant from insignificant weight changes is realized using time variable window widths for averaging and threshold values. The window width depends on signal strength and the threshold value on the amplitude of the data noise. The scientific approach and the applied mathematical methods are valid. The results are discussed in an appropriate and balanced way based on references and on a well-defined data set. The scientific results and conclusions are presented in a clear, concise, and well-structured way. The number of figures and tables is on the necessary level in supporting the reader to get the scientific idea presented in the paper. The use of English language is fluent and precise.

Specific comments

The AWAT – Adaptive Window and Adaptive Threshold – filter presented in the paper works properly on the Marienfelde lysimeter data set presented. Because the setting of the filter parameters influences the result of P and ET separation the parameter def-

inition seems to be a key element in the application of the method. To test the new filter with other data sets and with artificial data to prove its general applicability is a definite requirement for further research. The authors submitted the software "AWAT" with the parameterization file and the data file used in the paper. A deeper insight on the data set and a comparison with a manual evaluation of P and ET showed the efficiency of the used method. In a second step I tested the software with a data set from the "Wagna" lysimeter in Austria with a high resolution of the scale ($\sim$ 0,015 mm) and very low noise due to low wind velocities. The AWAT – method worked very well for the whole year 2010 - for periods with low changes in the upper boundary fluxes as visible for November 3rd, 2010 (Fig. 1) and in a sequence of rainfall and evaporation periods as visible for April 21st, 2010 (Fig. 2). The filter parameters were set to delta min = 0,02 mm and w max = 41 min, respectively. For the other parameters the values of the original software were used. Mainly the setting of the parameter delta min = 0,02 mm was the result of a trial and error process in comparing the estimated results with externally measured P (using a tipping bucket and a precipitation balance), the parameter value influenced the estimated results on precipitation and evapotranspiration in a significant way. The variation of the parameter w max had only low influence on the absolute values of estimated precipitation and evaporation for the period from January 1st, 2010 to May 2nd, 2010 (Fig. 3) although a nearly linear reduction of precipitation and evapotranspiration with increasing values for the parameter w max is visible. The parameter definition seems to be a key element in using the proposed filter. Actually it needs a lot of specific knowledge for application. Further research will have to focus (i) on automatisms to reduce possible errors in setting the parameters for the AWAT filter, (ii) on external and internal influences on the parameters of the AWAT filter, and (iii) on the comparison of estimated P and ET using precision lysimeters and the AWAT filter with measured P and ET using different and independent methods.

Technical corrections

In Fig. 9 in the graph and in the figure caption "evaporation" should be replaced by

"evapotranspiration" or "ET"

In Fig. 10 in the graph and in the figure caption "evaporation" should be replaced by "evapotranspiration". If "ET" will be used, "precipitation" should be replaced by "P" in both cases.

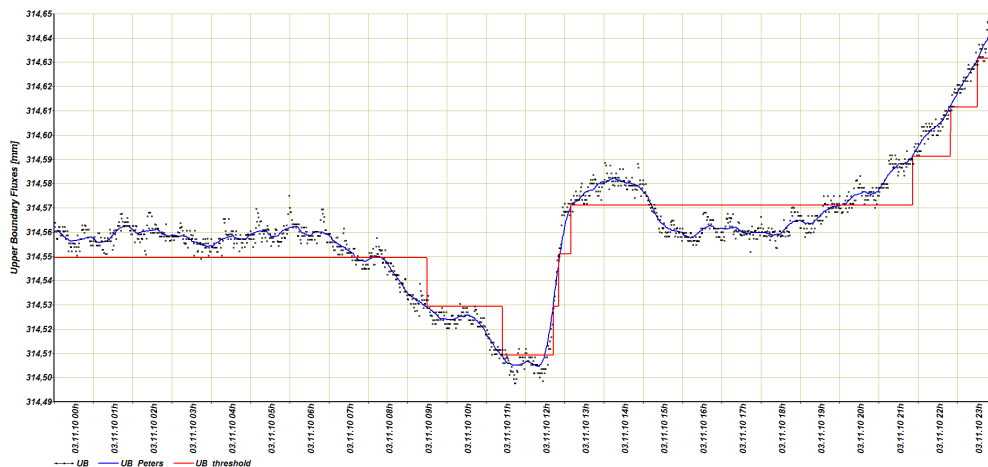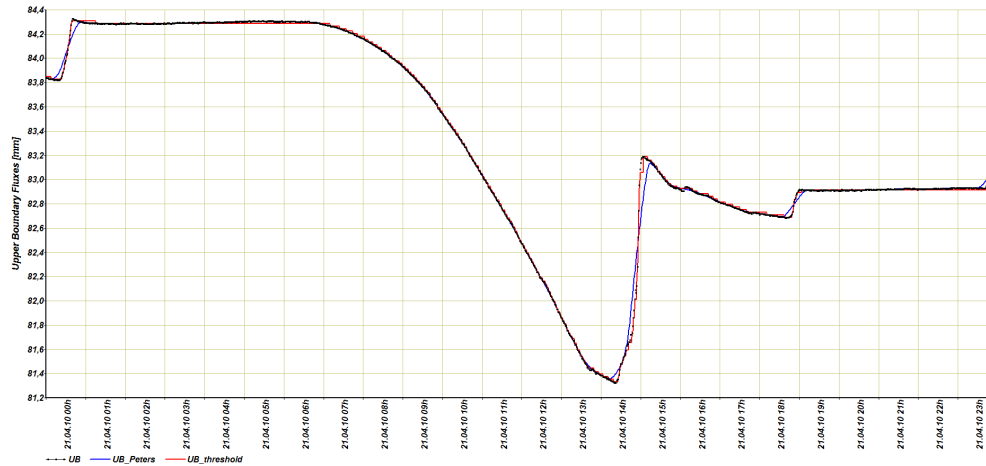Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 14645, 2013.

Fig. 1: Raw data (UB), smoothed data (UB_Peters) and smoothed and threshold data (UB_threshold) using the AWAT - filter for cumulative upper boundary flux of the"Wagna" lysimeter for November 3$^{rd}$, 2010.

**Fig. 1.** Raw data (UB), smoothed data (UB_Peters) and smoothed and threshold data (UB_threshold) using the AWAT - filter for cumulative upper boundary flux of the"Wagna" lysimeter for November 3rd, 201

Fig. 2: Raw data (UB), smoothed data (UB_Peters) and smoothed and threshold data (UB_threshold) using the AWAT - filter for cumulative upper boundary flux of the"Wagna" lysimeter for April 21$^{st}$, 2010.

**Fig. 2.** Raw data (UB), smoothed data (UB_Peters) and smoothed and threshold data (UB_threshold) using the AWAT - filter for cumulative upper boundary flux of the"Wagna" lysimeter for April 21st, 2010.
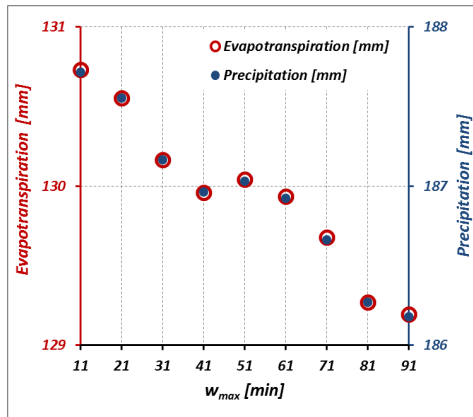
Fig. 3: Estimated sum of evapotranspiration and precipitation for the time from January 1st, 2010 to May 2nd, 2010 with varied filter parameter $w_{max}$.

**Fig. 3.** Estimated sum of evapotranspiration and precipitation for the time from January 1st, 2010 to May 2nd, 2010 with varied filter parameter w max.