

Dear Reviewer,

we are very thankful for the generally positive judgement of our manuscript and for the specific comments, which help us to strengthen the paper.

Please find below all replies to the comments as inserted blue text.

Kind regards,

Andre Peters, Thomas Nehls and Gerd Wessolek

This paper aims at improving the automatic processing of time series from high resolution-lysimeters, allowing one to better estimate the evapotranspiration and rainfall effects. In a scientific context evolving towards data-mining processes, such an investigation is very useful and deserves publication as a technical note in HESS, when the following comments are taken into account.

Detailed comments:

1. P2 L20-23: need not to be discussed in this paper, but suggestion for future work: have you looked at routines used to process GNSS (GPS, GLONASS) time series, where identifying steps is challenging as well?

No but we are thankful for that hint and will come back to it if we further improve the filter routine. However, we want to emphasize here that this contribution is not meant to help identifying the steps but to avoid them when interpreting the data.

2. P2 L25: "if the signal strength is high" ..."noise is high": could you quantify?

This is no easily done in the text. The signals can be extremely high if strong precipitation like a rain storm event takes place (several mm in a few minutes; Fig. 1 in the original paper of Peters et al., 2014; heavy precipitation event). Noise made up to almost 2 mm fluctuations without a significant signal (see strong wind event in the same Fig.). Yet, under other climatic conditions both can be even higher. As this part of the introduction is meant to be very general, we would like to prefer not discussing this issue in depth here.

3. P3 L4: the flux is zero: but what happens if the distance between anchors is reduced?

The flux (first derivative of cumulative flux with respect to time) is zero between two anchor points by definition in the case of the step scheme, irrespectively of the distance between anchor points or the magnitude of delta (see Fig. 2 for instance). Steps mean that the calculated flux is either zero or, at the step, very high. We think that this is clear from the text and the figures in both the manuscript and the original paper (Peters et al., 2014).

4. P5 l14: what is a “very high value”?

We set it arbitrarily to 9999, which means that no rain correction is made since no step is higher than 9999 delta. This is now added by modifying the sentence to “In order to test the importance of the rain correction, we additionally applied the linear and spline interpolation schemes without rain correction setting a to the very high value of 9999 (linear*, spline*). This guaranteed that the criterion $\Delta M > a\delta$ is never met.”

5. P5 L18: “with no fluxes”: I suppose that ET plays a major role in July. So I don’t understand “no flux”.

Before the rain event started, ET became less as shown in Fig. 6. However, ET was not zero, thus we will change the sentence to “... with low flux...”. We thank the reviewer for this hint.

6. P5 L24: which filter? As described in 2.3? Elaborate.

Yes, this part is derived for the general filtering scheme with using first the MA and then the threshold filtering with interpolation. In order to make it clearer we introduced “...(as described above)...”

7. P6 L20: “problematic”: I do not understand your point. As even at night a small slope (probably significant, this may be tested) appears, this implies steps. So, what’s the problem? The fact that an apparently smooth decrease in fluxes appear as an abrupt change when looking at steps? Why is it quantified as “high changes”?

This is the central point of the manuscript: Each step for ET calculation is somehow problematic since ET does not occur in steps but rather continuously. Since the magnitude of the step is at least δ_{\min} this is especially problematic for low “real” ET fluxes since then a continuously small ET within several hours is lumped into one single step as shown in Fig. 2. This is now written clearer by modifying the sentence to: “Moreover, this interpolation scheme leads to single, very high changes at the steps and no fluxes during the other time periods, which is especially problematic at low evapotranspiration rates, e.g. at night (see step in upper subplot in Fig. 2, right) or in winter (Fig. 2, left), where the continuously low ET fluxes of several hours are lumped into one single step.”

Incidentally, why do the raw data on Fig 2 (left) appear as sawtooth, i.e. as small groups, of increasing slopes (and to a lesser extent, in an opposite way on fig 2 right, upper panel), while on Figure 6 the raw data are rather grouped by constant levels? Elaborate.

We thank the reviewer for this question, which needs to be answered in the manuscript. The sawtooth shape is caused by the measurement system consisting of two scales with different resolution. We add a small paragraph at the end of section 2.2:

“Note that the “sawtooth” shape of the first subplot is caused by the two scales with different resolution. If outflow at the lower boundary occurs, each 5 g outflow is recorded in the data leading to an apparent increase of cumulative outflow. If approximately 100 g flew out, the lysimeter scale records an apparent decrease of cumulative outflow of 100 g. This is repeated and sometimes superimposed by a real signal like ET or P.”

Minor details, typos

8. P2 L32: derivative of the cumulative...

Has been changed

9. P2 L32-33: the syntax of this sentence ("ET....interval") looks strange.

We do not understand. To our knowledge the sentence is correct and can be understood. Thus, we would like to keep it as it is except the minor modification given in point 8.

Elaborate. What is "certain"?

This is explained in the two sentences following this sentence. However, we substituted "certain" by "application specific"

10.p 3 L29: "in the time between": prefer: ""between 2 and 8 April, no data..."

Thanks, has been changed

11. P6 L14: "At the two days": prefer: "On February 16 and 17, ..."

Thanks, has been changed

12. P6 L15: "only approximately": prefer: "the ET rate is estimated at the XX level" (and if you can provide an error bar, just add it).

No, ET is not estimated but can be approximately derived from visual inspection of Fig. 2 if we subtract the cumulative fluxes between two night times. Error bars cannot be given since only two days are given in each subplot. We just omitted the word "only" to make the sentence clearer.

13. P6 L23: "are only minimal": what do you mean? "the difference is negligible"?

Yes, has been changed

14. P8 L18: "in the same magnitude": I suppose: "is similar of larger..."

Has been changed

15. P12: mai → May

Thank you very much, has been changed