

Hydrol. Earth Syst. Sci. Discuss., author comment AC2
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Reply on RC2

Matthias Sprenger et al.

Author comment on "Precipitation fate and transport in a Mediterranean catchment through models calibrated on plant and stream water isotope data" by Matthias Sprenger et al., Hydrol. Earth Syst. Sci. Discuss., <https://doi.org/10.5194/hess-2022-93-AC2>, 2022

Response: We thank Reviewer 2 for taking the time to critically evaluate our manuscript. We are glad to hear that Reviewer 2 believes that the topic is timely and fits the scope of HESS.

General comments:

In this study the authors use precipitation, stream water and xylem water stable isotope measurements to constrain a hydrologic transport model that is based on water ages. They find that the evapotranspiration is determined to be too young when only precipitation and stream water are used for calibration. When xylem water isotopes are added to the calibration, the water age of evapotranspiration is found to increase considerably.

The topic is timely and it fits the scope of the journal perfectly. Language, style and structure throughout the manuscript are quite good and easy to follow.

It is a bit unfortunate that the sampling of the xylem water only took place during a relatively short period of time (8 months) at the beginning of the measurement period compared to the sampling of precipitation and stream flow (4 years). This causes some uncertainty with regard to the water that was already in storage before the sampling and modeling began. Fortunately, the authors discuss the potential implications of the bi-weekly sampling interval and note that this could also lead to a seemingly damped signal in the ET and thus to an overestimation of ET water ages.

Despite some of these drawbacks, in my opinion, the novelty of the work merits publication.

Specific comments:

Page 1, line 25: '...or TO BE discharged...'

Response: Thanks, will be changed accordingly.

Page 1, line 28: 'additionally' instead of 'simultaneously'?

Response: We would prefer simulataneously, because the calibration is done

together for all parameters using both objective functions and not subsequent for some parameters using one or the other objective function.

Page 7, line 13: Delete 'a'.

Response: Thanks, will be changed accordingly.

Page 7, line 15: It would be nice to have a visual representation of how you convert xylem isotope ratios to ET isotope ratios. Just writing the equation in the text is not intuitive. Otherwise this important detail gets somewhat lost in the manuscript.

Response: The equation shown here is actually more complex as it needs to be, because d_{ET} is solely a mixture of the transpiration flux with the measured xylem isotopes and corrected for fractionation d_{source} and the evaporation flux (both from soils and canopy interception) with the assumed isotope ratio represented by the weighted average from the 30 days of rainfall prior to the xylem sampling. The revised equation is as follows and will be used in a revision:

$$d_{ET} = 0.77 ET * \delta_{source} + 0.23 ET * d_{30}.$$

We believe that thus, there is no need for a visualization

Page 9, line 9: See also Yang et al. (2018).

Response: We will add the reference.

Page 17, line 7: '...high frequency xylem sampling...'

Response: Thanks, will be changed accordingly.

Page 20, line 12: '...during THE largest rainfall-runoff events...'

Response: Thanks, will be changed accordingly.

Page 22, line 5-9: Could you please give some more details on what you mean when you state that the SAS approach does account for this heterogeneity – contrary to the traditional convolution transit time approaches?

Response: We will change this section as follows to clarify this matter:

"The SAS function approach seems to be a helpful tool to account for this heterogeneity in the catchment scale parameterization and its impact on water ages. Because convolution transit time approaches (see review by McGuire and McDonnell, 2006) cannot account for time-variable isotope tracer and water-age dynamics of the ET flux, such approaches – contrary to SAS function applications – are not able to reflect the impact of ET isotope tracer composition and water ages on discharge tracer and ages as shown above."

Figures:

Figure 1: '...meteoric station...?'

Response: Thanks, the caption will be changed to "meteorological station"

Figure 8: diamonds = triangles; points = circles.

Response: Thanks, will be changed accordingly.

Supplements

Supp. Fig. 1: You are referring to Figure 6 in the main manuscript, not to Figure 5, are you? Maybe you could add Figure 6 to this Figure too, so that the comparison is easier (the scales are quite different and it's hard to see that you want to show that one is way less variable than the other).

Response: Thanks, the reference to Fig. 5 is wrong and you are right, it's supposed to be Figure 6. We will change that accordingly. Thanks for the suggestion to improve the comparability. We will change the supplementary Figure to add the water age estimates of the multi-objective calibration approach (as shown in Figure 6 of the manuscript). Please see attached the proposed new figure for the supplementary material (The figure size was too large to include here and even when downsized it would not allow me to include it).

Literature

Yang, J., Heidbüchel, I., Musolff, A., Reinstorf, F., and Fleckenstein, J. H.: Exploring the dynamics of transit times and subsurface mixing in a small agricultural catchment, *Water Resour. Res.*, <https://doi.org/10.1002/2017WR021896>, 2018.

Please also note the supplement to this comment:

<https://hess.copernicus.org/preprints/hess-2022-93/hess-2022-93-AC2-supplement.pdf>