

Interactive comment on “Tracing ecosystem water fluxes using hydrogen and oxygen stable isotopes: challenges and opportunities from an interdisciplinary perspective” by D. Penna et al.

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Response to Reviewer #2

“Tracing terrestrial ecosystem water fluxes using hydrogen and oxygen stable isotopes: challenges and opportunities from an interdisciplinary perspective”, by D. Penna et al.

We thank dr. Steve Good for the very useful comments he gave on our manuscript that have helped us to improve the paper. The reviewer’s comments are reproduced in their entirety and the authors’ responses are given directly afterward.

[Comment 1] The submitted paper is a review of recent studies in the use of stable

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isotopes to understand water cycling within ecosystems. The paper draws together multiple up-to date papers that, when taken together, present a somewhat concerning view of the field as it currently stands. This I feel is much needed within the community, and publication of an even-handed review of these issues is well suited to Biogeosciences. A few clarifications would be helpful before publication. Wording: Given the above, it is critically important that the authors of this paper are very careful with their citations and the language used to discuss the conclusions of others. For example, on P5L10, the authors claim that in Brooks 2010, the sampled xylem water doesn’t match the signature of potential source waters. I think this is a misinterpretation of the Brooks 2010 conclusions, which as stated in the abstract of that paper were that: “initial rainfall events after rainless summers is locked into small pores with low matric potential until transpiration empties these pores during following dry summers.” So, Brooks 2010 et. al. do hypothesize that the xylem water does match the signature of a potential source, just not that of the well-integrated stream water. I do not take issue with your conclusion that the wrong pools are often sampled, just how this section (and others) is written could be improved for clarity and consistency.

[Response] We thank the reviewer for noticing this inappropriate interpretation of the findings by Brooks et al (2010). We will modify the sentence accordingly.

[Comment 2] Another example is P5L24, where the authors state that soil water isotope ratios vary with water potential (citing Brantly 2017), then introduce the study of McCutcheon (2017) as a singular example that didn’t find this to be true. Given that you have two competing recent phenomenological studies, some readers are likely to decide that this issue is decidedly unknown at this movement. However, reading through the paper as is currently worded, other readers could interpret that Penna and co-authors are definitively claiming that tight or loosely bound waters always have differing isotope ratios (though only one citation for this is given). Again, the wording needs to be clarified and more citations added.

[Response] We will clarify the sentence reporting the correct citations and presenting

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this concept more clearly.

[Comment 3] Figures: A bit more work on your figure 2 would be helpful. I found the first two panels very difficult to interpret. I think a lot more thought needs to go into this figure and its description. For instance, your caption discusses multiple measurements made to characterize a heterogeneous domain. However, panel A doesn't depict multiple samples, but only the variation within a sample as it's volume or duration increases. In panel B you show what looks like a gaussian distribution, but I fail to see how this represents the presence of both micro-scale and macro-scale heterogeneities. I find panel C the most informative here, but it also seems highly speculative and difficult to compare. Since you've got no x-axis, the location of the mean is meaningless, and all you're really plotting is differences in standard deviations, so why not have similar set of axis as figure 1, but with variation itself? Also, what justification do you have for any of these standard deviations. This figure seems highly speculative and is only referenced in an off hand manner (P10L14).

[Response] This figure will be removed from the revised manuscript. As reported in the response to comment 33 by Reviewer 1, the inclusion of this figure in the manuscript stemmed from debates engaged in the discussion groups at the workshop. Introducing this figure aimed at providing a concept of a representative sampling size or scale over which to bulk a sample. It did not focus on averaging multiple samples but on achieving a bulk sample of a typical size that could reflect – upon multiple samplings – the variability (distribution of mean and standard variation) that is representative for the sample type (soil water, plant water etc). Ultimately, these considerations would result into the recommendation of typical sample sizes and frequencies. However, we share the perplexities of all three reviewers on the usefulness of this figure, and we agree with them that the figure is vague and may be confusing. In addition, it is not strictly related to the text and the main focus of this commentary. Therefore, we will remove this figure from the revised version of the manuscript, as well as mention to it in the text.

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[Comment 4] Finally, is figure 1 adapted from Bowen & Good 2015, it seems quite similar.

[Response] We apologize for this. The figure is an original work but based on Blöschl and Sivapalan (1995), and Bowen and Good (2015). We will specify this in the revised version.

Blöschl, G. and Sivapalan, M., Scale issues in hydrological modelling: a review, *Hydrological Process*, 9(3-4), 251-290, doi: 10.1002/hyp.3360090305, 1995.

Bowen, G. and Good S.P., Incorporating water isoscapes in hydrological and water resource investigations, *WIREs Water* 2015, 2:107–119. doi: 10.1002/wat2.1069

[Comment 5] Spatial Patterns: On P7L7 the authors claim that less attention has been paid to spatial processes, which is decidedly not the case. Gabe Bowen has spent many years pursuing this topic in particular, published many papers, and even publish a book (*Isoscapes*) and recent review paper (Bowen and Good 2015). While much work has been focused on precipitation and surface water isotope ratios, many studies have extended this concept to plant and animal tissues.

[Response] We are aware of the relevant work by Gabriel Bowen on isoscapes and spatial patterns of isotopic composition in hydrological systems. Here, we are mainly referring to the small spatial scales, especially for soil water and groundwater isotopic composition, while isoscapes are more traditionally applied at larger scales. However, the topic is appropriate and we will re-arrange the sentence and include the concept of isoscapes.

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