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Interactive comment on "Seasonal partitioning of precipitation between streamflow and evapotranspiration, inferred from end-member splitting analysis" *by* James W. Kirchner and Scott T. Allen

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We thank Dr. Kuppel for his thoughtful review of our manuscript. Below we respond (in bold type) to Dr. Kuppel's specific comments (in normal type).

L298-299: The link with tree rings records is not obvious, maybe add a few words?

We will clarify this. The point here is that tree-ring isotope values are often assumed to reflect the isotopic composition of either growing-season precipitation or annual average precipitation, but the seasonal sources of xylem water (and

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Discussion paper

thus of tree-ring isotopes) may vary with climate and subsurface moisture storage characteristics. Thus, being able to infer the isotopic composition of the transpiration flux would provide an additional constraint for calibrating tree-ring isotopes.

L378: Please provides a reference for the SWE estimates

Will do (it's Campbell et al., 2010, cited earlier in the paper).

L456: It can actually be a combination of both

Correct. When we used "or", we meant it in the mathematical sense (which includes "or both"), but we can be more explicit about this.

L541-554: The added values of the young water fraction comparison is not obvious to me. As the authors write right after, precise mathematical comparison is not possible, given the numerous unknown overlaps between season length and the reference 2-3 months. As a result, I find it hard to see the consistency of the 0.45?0.09 young water fraction with a 55?19% of intra-season contribution over a 4-month season AND a 62?9% of intra-season contribution over a 8-month season... Consider removing this analysis, or restrain it to the shortest seasons. Note that such limitation is much less significant for the new water fraction (as interestingly used in the next section), given the much shorter time step involved (as compared to seasons' lengths).

The point here is that we have two different lines of analysis that both show significant (40-55 percent) fractions of streamflow originate as precipitation within the previous 2-4 months, and that, unsurprisingly, this fraction becomes bigger as one considers longer and longer intervals of time. (One could view this as an approximation of the cumulative transit time distribution, for example). The point is that it did not have to turn out this way. If one or the other method was sufficiently ill-conceived, one could have gotten results that made no sense together. And considered together, all of these lines of evidence point toward

significant inter-seasonal carryover of water in catchment storage (as we say in the last paragraph of Section 2.7). We can add a couple of sentences of further explanation here.

L570-575: Considering giving more details about alpha and epsilon_j in Eq. (38), so that readers can get the "main" picture without necessarily reading Kirchner (2019).

Alpha is the intercept and epsilon_j is the error term in this linear regression equation. We thought that most readers would understand these terms since Eq. (38) has already been identified as a linear regression, but we can certainly define them here too.

L607-609: I am not sure to understand how one can link "10% of growing season streamflow is less than 2 weeks old" to "half of growing season streamflow comes from P in that same 4-month season".

One way is by considering the counterfactual case: what if our results showed that, say, 80% of growing-season streamflow was less than two weeks old (from ensemble hydrograph separation) and that half of growing-season streamflow came from precipitation in the same 4-month season? Then clearly something would be wrong with one or both methods, since the amount of water that is less than four months old must exceed the amount of water that is less than two weeks old (since all of the latter is also part of the former). Instead, our results show that during the growing season the biweekly new water fraction (7.8-13.4 percent, within one standard error) is small enough to be broadly consistent with the end-member mixing estimate that roughly half (36-74 percent, within one standard error) of growing-season streamflow originates from growing-season precipitation. We will slightly expand on our discussion of these points in the text.

Technical comments

Eqs. 26, 27, 28, 29: I think there is a typo in the second member with eta instead of delta eta

Yikes! You are right. Such are the perils of copy-paste errors during late-night equation editing. Thanks for catching those. We'll fix them (and check all the equations once again).

L411: To help the reader, consider starting this sentence with "Regarding summer precipitation, the monthly end-member [....]"

Instead, we will just include the corresponding expressions for both summer and winter precipitation end-members.

L411: typo: "streamflow" instead of "rainy-season precipitation"

This typo isn't on L411, but instead on L433. We'll fix it.

L596: "We" instead of "I" ?

Dr. Ala-aho caught this one too. We'll fix it.

Fig12 This figure has a lot of different color/line type codes, making it complex to read. Consider adding (colored) mention of f or eta directly on the graphs

We understand that this figure is complex and takes some effort to decode. We tried to simplify it in several different ways, and they only made things worse. We can of course color-code the f and ? symbols on the y-axes. However, it isn't possible to annotate each curve on each diagram; we've tried, and there just isn't space. The interpretation would be simpler if we made each panel into a separate figure, or panel (a) into one figure and (b) and (c) into a second figure. But we think that this sensitivity analysis isn't important enough to justify two or three figures.