



EGUsphere, referee comment RC2
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Comment on egusphere-2022-45

Anonymous Referee #2

Referee comment on "Water Use Strategy of Riparian Conifers Varies with Tree Size and Depends on Coordination of Water Uptake Depth and Internal Tree Water Storage" by Kevin Li and James Knighton, EGU sphere,
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The work by Kevin Li and James Knighton describes an interesting investigation on tree water use across riparian trees of different diameters. The authors explored the relationship between patterns in tree water use, DBH and relative water content (RWC)

The investigation focused on eastern hemlock and the authors used xylem water and potential sources (i.e., soil water from different depths, groundwater, and stream) to understand patterns in tree water during the growing season. The authors sampled xylem water by coring trees and obtaining 7.5 cm cores. Those same samples were used to compute RWC from samples. Xylem isotopic data were compared against soil water distribution in dual-isotope space. Correlations between xylem water isotopic ratios and tree core RWC were computed. The authors also used multivariate models to understand the influence of DBH and elevation on xylem water isotope ratios. All xylem water isotope ratios were corrected based on RWC.

While I agree with the motivation of the work and the investigation is interesting, I see major issues with the methodology and conclusions drawn from the analysis. Additionally, some points need to be further clarified for a complete understanding of the work. Please see the main concerns below, followed by specific comments.

1) The hypothesis in the introduction (L107-109) does not reflect the study design or analysis.

2) The study compared xylem water isotopic composition from trees of different DBH to identify patterns in tree water sources. When using xylem water to identify sources, the use of sapwood is usually the sampled portion of the tree. The sapwood depth of trees usually varies with the diameter (i.e., the larger the DBH, the larger the sapwood depth) and this also applies to *Tsuga canadensis* (e.g., Daley et al., 2007). Thus, the sampling

depth (i.e., core length) should reflect the sapwood depth. However, here the authors collected a core of 7.5 cm for all trees (L 131) independent of the DBH. This results in trees of larger diameter having a sample that represents more sapwood, while trees of smaller diameter with a sample that is mostly composed of heartwood (e.g., Meinzer et al., (2013) *T. canadensis* of DBH ~ 35 cm, sapwood depth < 2 cm). Additionally, heartwood and sapwood have a distinct isotopic composition (Treydte et al., 2021). Thus, the comparison between sources across species of different diameters (a major point of this study) could be simply an artifact of the proportional sapwood sampled. Additionally, sapwood and heartwood have different RWC, which again, can affect another major conclusion of this study.

3) The authors correct xylem water based on RWC. There is a lack of evidence that supports this approach to this study/species or at least data that justifies it to be applied to all samples. Further evidence is necessary to justify this broadly applied correction to the data. The original work by Chen et al., (2020) observed a relationship between $\delta^2\text{H}$ (offset) and RWC. In this work, a clear relationship between xylem and RWC was not always evident, at least to the corrected presented xylem water. One would expect to see it consistently if the correction was necessary throughout the entire period. More information is necessary to evaluate this approach. See detailed comment below with additional concerns.

4) There are contradicting results within the study. For example, in the dual-isotope analysis, the authors showed that xylem water does not overlap with any source in certain months (e.g. March, August, September) and when it does overlap, the overlap is with shallow soil layers (<10 cm), and rarely few xylem samples overlap with deeper layers (e.g. July). Overall, there is no indication at all that the trees at the site use deep soil water. The following analysis using correlation and multivariate models suggests that trees of distinct diameters are using different sources (e.g., deeper layers), or that there is a dynamic water use at the site. The data in the study does not support it.

Specific comments:

The first paragraph of the introduction contains many different ideas (e.g. subsurface water partitioning, latent heat transfer, tree dispersal, foundational species, external stressors) and is not cohesive. Consider re-writing it.

The third and fourth paragraphs of the introduction could be summarized as this goes beyond the scope of this study and distracts the reader.

L34: High spatiotemporal sampling resolution

L49-52: This sentence is too long and hard to follow. It starts with subsurface water partitioning and ends with latent heat transfer. I would suggest breaking this down. How does root water uptake influence surface runoff?

L52: generating? Consider substituting by growing.

L64-66: This sentence is not very clear. Rephrase it.

L72: unclear what safe xylem water transport means in this context.

L76: what does "well adapted to trunk water loss" mean? Clarify and re-phrase.

L83-84: "the hydraulic relationships between rooting systems and stem water potential" this idea is not well illustrated in the text above with references. L87-89: Revise reference list. Not all the work here shows "biome-scale correlations between rooting depths, stomatal regulation of transpiration and climate".

L118-120: Why the loss of hemlock specifically would cause it? And not only any tree species? This is not clear within the text.

L120-122: Be more specific. This is a quite generic sentence in a paragraph that describes the species.

L128-129: Where the climate data was obtained from? What is the period in consideration?

L131: What kind of increment borer? What is the diameter?

L131: Why did the authors use a 7.5 cm depth? The sapwood depth of *T. canadensis* in the literature for trees with a similar diameter to the ones in the study is smaller than the sampled depth in this study for water extraction. It is likely that the authors also collected heartwood water, which is shown to have different isotopic composition than sapwood (Treydte et al., 2021). What is the implication of this approach in the results of this study?

L131: How were the cores stored in the field?

L131: How many trees per DBH class? Why did the authors later define 31 cm as the threshold between larger and smaller trees?

L135: What the dry root mass per unit mass of soil can provide? A more standard practice in the literature is to report dry root mass per soil volume (root density).

L140: Why the soil sampling depth was limited to the first 50 cm?

L139: missing delta

L155: What kind of CVE system was used? Provide reference.

L159: Plant water extracted via CVE is known to contain other co-extracted organic compounds (e.g., Millar et al., 2018) and result in spectral contamination in laser spectrometry which requires identification and correction (e.g., Martín-Gómez et al., 2015). How did the authors deal with spectral contamination or identified it?

L161-162: How did the authors define when correction was necessary using RWC? Or was it applied to all samples? Was there a relationship observed within the collected samples that justified this correction (e.g. Chen et al., 2020)? Additionally, how much water was obtained per extracted core/sample? How did the authors differentiate spectral contamination from VWC correction?

L161-162: Since this is an area of large uncertainty in the field, especially because the mechanisms that drive observed fractionation are unclear and still in debate, caution is necessary. Therefore, additional information is required when describing the method and underlying assumptions. More importantly, how did this correction affect the results? The authors use RWC to correct the samples and use the same data (RWC) to analyze patterns in tree water use. Later in the results, the relationship between xylem $\delta^2\text{H}$ and core RWC is not always present. How does it affect the interpretations? This point should be further explained in the methodology and later included in the discussion of the uncertainty of this analysis.

L165: When/how did the authors measure the fresh weight of the core? Describe this step in more detail as this plays an important role in this study.

167: Which software/ programs were used to conduct the analysis?

L178: How was the end of the season and growing season defined?

L179: Why was two-sample Kolmogorov Smirnov test applied? An additional sentence would be helpful to the reader.

L185: How deep is the rooting zone? How was it defined? This information is not previously described in the manuscript. Previously, the authors presented a methodology

to define root mass per soil mass (up to 100 cm soil depth) but method/results from root zone depth were not presented.

L190: The text refers to soil water content in relation to elevation. This information is not presented in figure 2, referenced in the text. It would be helpful to show the temporal variation in SWC across the topographic locations.

L201-203: It would be interesting to show xylem water isotopic composition in dual-isotope space regarding the DBH since this is a key investigated aspect in this study.

L211: The word stored here does not make sense. Not because it is erroneous, but because previously it was defined as xylem water to define transpiration sources, and at this point of the results is referred to as "stored". It would be useful to the reader that the authors establish their assumptions earlier in the paper (e.g., xylem water is a representation of bulk water, stored water and transpiration source, or something in this vein).

L218-220: But in May and June, all of the hemlocks seem to be using shallow soil water (top 10 cm) (Figure 3). How is this possible? The two analyses do not seem to be supportive of one another. How is xylem water correction using RWC affecting this result itself?

L228: In March there was no overlap between xylem and available water sources (L204-205). How does the author see this follow-up analysis in March being valid?

L235: Or simply, a change in the ability of the model to explain xylem water? Perhaps other parameters would be more relevant throughout the growing season.

L245-246: By sampling 7.5 cm core from trees of different diameters (<31 and >31 cm in DBH) the authors likely sampled a different mix of sapwood vs heartwood between larger and smaller trees. It is very likely that the 7.5 cm core covered a larger portion of sapwood in relation to heartwood in larger trees (>31 cm), but a larger portion of heartwood in trees of smaller diameter (<31 cm). Heartwood water is shown to contribute to transpiration during periods of water stress, but it is less likely to contribute to transpiration in periods where soil water content meets transpiration demands.

Additionally, heartwood water content is more stable over time. Thus, It is likely that the observed more considerable temporal variability in RWC in xylem water of larger trees is more representative of sapwood water content. In contrast, smaller trees would be seen as more stable in this study because of the more significant portion of heartwood in the sample.

L256-257: This wasn't earlier hypothesized in the paper. This adds to an earlier comment on the need for clear hypotheses in the introduction.

L272-273: How would the authors explain these results? What would be this strategy? Is there any evidence in the literature that supports higher stomata control in hemlocks?

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