Comment on hess-2020-674

Anonymous Referee #1

Referee comment on "Ecohydrological travel times derived from in situ stable water isotope measurements in trees during a semi-controlled pot experiment" by David Mennekes et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2020-674-RC1, 2021

General comments

Mennekes et al. present an experimental study in which they apply in-situ water isotopic monitoring techniques to estimate water travel times through the soil-plant-atmosphere continuum in three species with contrasting wood anatomy. They compare water travel times derived from in-situ isotopic monitoring with those obtained with sap flow measurements. At the same time, they also compare the isotopic results from the in-situ monitoring system with those of more traditional (destructive) approaches. The in-situ monitoring of isotopic composition appeared to estimate travel times consistently as travel times were very similar as those estimated with sap flow sensors. On the other hand, the isotopic composition as measured with the three different techniques was highly divergent.

This manuscript presents an experiment of high technical quality and that makes use of the most advanced methodologies to address scientific questions from a new perspective. Their results have thus the potential to advance our knowledge in ecohydrological travel times and provide new elements for the continuous development of in-situ isotopic monitoring techniques. The study falls well within the scope of HESS and has the novelty standards required for the journal. Despite this scientific high quality (both methodological and conceptual), I feel that the manuscript is not currently written in a way that it can take advantage of its strengths to make it the excellent contribution it could be. I recommend a thorough revision of some sections of the text but in my opinion, it is mainly the discussion that needs to be substantially improved. The experiment and all methodologies applied are well described and allow their replication. Please find below more specific comments.

1) In the Introduction, you present a rather broad context of the field, i.e. research on plant water relations using the isotopic composition of water. However, some of the open questions in this field are not actually addressed by your experiment. For instance, you mention the two water worlds hypothesis but do not provide any related new data. Also, you talk about improving plant water uptake models but never discuss the implications of your results on that. On top of that, I believe that your data allow you to make some inferences about potential isotopic effects during and after root water uptake (L41) but I did not find such discussion later in the text. Therefore, I would focus the Introduction on

these questions in which your findings can matter most.

2) The Results subsection beginning at L340 should be synthesized and perhaps reformulated. In its current form, there is too much detail in the description of the results. This complicates the identification of the most relevant results and so, it is difficult to get the big picture. I understand that because you only have three trees, most of the results must be descriptive, and quantitative comparisons are limited. But for instance, figure 6 is very comprehensive but does not allow to identify the more general differences between and within methods, species and campaigns. A possibility would be to reframe the results along these three axes (species, method and time) while highlighting their interaction. I do not know if this is possible, other alternatives might be better.

3) The Discussion (and Conclusions) is the section of the manuscript that in my opinion, requires more work. First of all, it is unnecessarily long (7 pages). These are my humble suggestions to improve it (but see further comments in the "Specific comments"):

- Avoid repeating the aims/goals of the study. This information should be in the Introduction.
- Start the Discussion with an opening paragraph in which in a couple of sentences, you report the two or three most relevant results of the study but without going into much detail. Importantly, compare these main results with the most relevant literature. Currently this would be in the paragraph starting at L400, but I am not sure that you are putting everything relevant there. Obviously, my proposal for this first paragraph is questionable. In any case, I find it useful for the readers to make it easy to find the most relevant results and conclusions in the beginning of the Discussion.
- Try to avoid as much as possible the repetition of the results (L475-484 but check the rest).
- Do not report others' results if they are not clearly linked to yours (Millar et al. 2018).
- Structure the paragraphs (not only the subsections) with clear and identifiable concepts, do not leave isolated two-line sentences.
- The Conclusions are well-written but somewhat repetitious with the rest of the Discussion. I would use this briefer conceptual scheme for the rest of the Discussion, while embedding the relevant literature. In any case, I think that the Discussion should be shortened, retaining only the most relevant points to discuss.

Specific comments

Abstract (L9): Perhaps I miss a sentence on the main goal of the experiment.

L21 Notable differences in the sampled water pools, is this related to the consistency of the measurements? Is it based on the differences of the average isotopic composition obtained by each method?

L30-32 I am not sure of the meaning of this sentence, please split it in two or rephrase it. Also, the last part after "by different tree species" is not well-connected with the rest.

L32-34 I suggest to reshuffle this sentence the other way around. For example, "The ecohydrological processes related to water uptake and usage at the tree- or plant-level are not yet fully understood".

L35 Not clear what do you mean by "patterns" here. I guess that you meant "the depth of plant water uptake and its spatiotemporal patterns". I would end the sentence here and start a new one: "The isotopic composition of water allows to link plant water to its

putative…".

L37 Unfortunately, each water pool has not always its own unique isotopic composition.

L40-41 I agree that it used to be widely accepted that root water uptake does not entail isotopic fractionation, and that there are some exceptions. But in many cases unknown fractionation processes occur before, during or after water uptake. Many recent papers reported that. Nowadays, I would not say that the absence of isotopic effects is widely accepted, but the opposite.

L42 Some of those cited studies are not so recent (e.g. Wigmosta et al. 1994).

L42-48 The message of this paragraph is rather vague.

L49 "Isotopic information" is not a precise term. I would say "isotopic composition".

L50 Why consecutive? Usually, each water sample is analysed just once.

L52 What is the particular effect of organic contamination here? Did you mean the interference of organic compounds in laser-based isotopic analysis?

L56 It is not controversial? What do you mean?

L66-68 Please rephrase these sentences.

L93-94 "Water" travel times.

L27-128 Perhaps watering several times would have been more effective in removing the antecedent water in the soil. I don't see the problem as long as you know the isotopic composition of irrigation water.

L130 I don't understand what do you mean by "split the total amount".

L212 It could be easier to provide extraction temperatures and times for soil and plant water samples here (without having to search for another paper).

L280 Why do you think this is due to sensor failure? Is this sap flow velocity not consistent with the literature?

Results: synthesise, simplify

Figure 3: It would be helpful to somehow indicate the signal of each labelling (as done for the precipitation and the irrigation).

L341-244 It is not clear if the differences you mention are between xylem water of the same species, or within an individual xylem water and its corresponding soil water.

L378 "For instance" instead of furthermore?. Also, "soil xylem", what is this?

L374-385 This paragraph is difficult to read. Also, the L386-388 short paragraph summarises the result but the main idea that I got is that there are "partial" differences between methods.

L388-392 Good!

L396 I would say "for deriving ecohydrological…".

L403 soil depths, in plural?

L408 Could you define more precisely what you mean by "path diffusion"?

L416 Martín-Goméz et al (2016) discussed Branch evaporative enrichment. These others you mention might be perhaps Barbeta et al. 2020?

L450 "European beech". In fact, better if you give the scientific names and optionally, the English common name which might not be known by everyone.

L457 *Quercus suber* is a Mediterranean species, and it probably has denser wood than *Alnus incana*. Also, the lumen area per trunk section might be also smaller, which implies a smaller hydraulic conductance. I think that this could explain the different travel times.

L478 Which previous findings?

L480-484 Please synthesise the explanation in a manner than it is not required to jump from figure to figure to follow the argument.

L486 This sentence should not be a single paragraph.

L502-506 You should go straight to the point and avoid repeating your results.

L509 "less for d2H". Please be more precise here.

L511 Is this result statistically significant?

L531-543 I think that the details of the results of a previous study over more than ten lines should not be provided in the discussion. In my opinion, you should stick to discussing your results, in the light of the previous literature, true, but the link between Millar et al. (2018) and your study is not even clearly done.

L549-550 I suggest that this sentence should be joined to another paragraph.

L551-568 So, what we can conclude from these results?

L536-656 This sentence arises from the results of your study? I do not find the evidence supporting that DVE is more reliable than CVE.

L568 This is a good point of the study, but I believe that it does not belong to the Discussion but instead, to Material and Methods or the Introduction.