Response to Anonymous Referee #2

We thank Referee #2 for these helpful comments (listed below in standard font). Our responses and planned changes to the manuscript are listed below in **bold font**.

Anonymous Referee #2

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The manuscript "Seasonal origins of soil water used by trees“ by Allen et al. presents a study from Switzerland showing that in summer beech and oak trees preferably used soil water that was recharged by winter precipitation in contrast to spruce trees that used soil water with more contributions from summer precipitation. The topic is highly relevant because it gives details about the importance of winter and summer precipitation for the growth of three tree species. The manuscript is very well written and most of the conclusions are supported by the data. Below are given some comments relevant for the interpretation of the soil water data and for the conclusions on water uptake by the trees.

Abstract, page 1, line 27/28: there are very good concepts of how water flows through soils, and this statement is not a consequence of the findings of this manuscript because soil water fluxes were not investigated. Therefore, I suggest deleting this statement

The presence of different seasons' precipitation in soils and tree water uptake directly reflect timescales of transport, mixing, and storage in soils. Specifically, the last three paragraphs of Section 3 show how our isotope measurements can be used to draw inferences about soil water fluxes. In any case, the statement in question was simplified and now reads "These results challenge common assumptions concerning how water flows through soils and is accessed by trees."

Introduction, page 2, line 20: the general literature introduction is rather short. There are studies from humid regions, and I suggest already mentioning some and their findings in the introduction and not only in the discussion (e.g. Brinkmann et al (cited in the study) or Dubbert et al., accepted (doi: 10.1111/nph.15670).

There are hundreds of studies that discuss water uptake, and the ones we have selected are not arbitrary. Here we are interested in temporal (rather than spatial) separation among water sources to plants, for which the relevant literature is indeed small. We have now mentioned Brinkmann et al. in the second paragraph of the introduction. We have also added a citation of Dubbert et al., although we point out that this paper only became available online two months after our paper was submitted, and four days before the review was posted.

Page 4, lines 6-15: The applied tension of 60-70 kPa results in sampling water from a large range of different pores. This includes both water from larger and smaller pores, and thus more and less mobile water. In some of the very sandy soils, this could even be the entire pore water pool (depending on the water retention function of these soils). Therefore, it is rather speculative which pore regions the sampled water is representative for. This should be considered in the entire interpretation of the data.

We have certainly considered that there are uncertainties concerning what water is extracted from soils. Note that we do not refer to soil water, but instead “lysimeter soil water” (although we remind the reviewer that trees are also samplers of soil water). We also remind the reviewer that with few exceptions, we use these lysimeter water values as ancillary data to bolster the arguments made using the xylem water samples. In our experience, hydrologists have widely diverging opinions on what information is conveyed by suction lysimeter samples; for example, the comments by Reviewer 1 and Reviewer 2 contrast on this point. We believe our assumptions to be very conservative, compared to those by others, and we recognize that some researchers

may differ in opinion. Nonetheless, we have expanded discussion of lysimeters in the methods section to comment on this debate and clarify our assumptions.

Although the *tension* applied by a lysimeter will be felt in pores of all sizes, but how efficiently those pores are *sampled* will depend on their conductivity and connectivity. Large pores conduct water much more readily (Hagen–Poiseuille equation), and we do not agree that it is speculative to assume that the smallest pore spaces will generally contribute less to the lysimeter water. We now refer to the "the more mobile fraction" accessed by lysimeters, because it is by definition true (i.e., the water that moved to the lysimeter is certainly more mobile what was left behind and not sampled). We agree that there are no absolute pore size thresholds, which we now state. These concepts have been discussed elsewhere (now cited in the paper), and they are not the focus of this study. Regardless, none of our conclusions depend on subtle interpretations of suction lysimeter data.

Page 8, lines 3-5: to be more precise, I would add "for humid regions" here.

The statements in question concern our specific sites in Switzerland, so adding "for humid regions" would imply a global extrapolation that we do not make here. No changes are made.

Page 8, line 18: there are no supporting data that water from finer pores had lower isotopic ratios compared to the pore water extracted with the lysimeters.

We don't understand the comment. There is no statement about lysimeter data or pore sizes on line 18.

Page 8, line 19: see previous comment on soil water sampling

We don't understand the comment. Line 19 does not concern soil water sampling.

Page 9, line 1: I agree that these trees may be less vulnerable to summer precipitation deficits; however, only when considering short-term effects, as outlined in the next lines.

We agree (which is why the next lines are written the way that they are). No changes are made.

Page 9, lines 30-32: already mentioned at the beginning of this paragraph (lines 22-28) and thus redundant

In the online pdf, 30-32 and 22-28 are different paragraphs, so we do not understand the specific comment.

Page 10, line 6: considering general low flow velocities in soils, I don't think that it is very surprising to find winter precipitation in these soils

The point is not that the soils contain some winter precipitation, but that tree uptake is often *dominated* by winter precipitation. We have shown using simple mass balance models that translatory flow assumptions are inconsistent with the persistence of winter precipitation in the rooting zones of these soils. No changes are made.

Page 10, line 11-19: 1) what is the average measured water content in these soils, in summer and in winter? The assumption of a field capacity of 0.35 for silty soils could be okay but is too larger for sandy soils. 2) the 77 days only refers to the time when all water (summer precipitation) is taken up by the roots. The total soil water balance (including up-/downward fluxes below the root zone) need to be considered for an estimation of mean transit times. 3) mean water contents are higher in winter/spring compared to summer strongly influencing the transit time of water. The back-of-the envelope calculation needs further support by measured data and calculation of water fluxes and could be part of a more thorough, next investigation. From the presented data a more detailed interpretation

of soil water fluxes is not possible and cannot be generalized over all investigated sites considering the wide range of investigated soils (see variation of soil texture).

We intentionally call this a back-of-the-envelope calculation. It is not a fully elaborated simulation model and is not intended as such. The model that the reviewer is suggesting would require even more assumptions (e.g., regarding how spatially representative soil moisture measurements are, how well texture defines the storage capacity, and so on). While such a model could be useful, it would still be uncertain, and its assumptions would be much less transparent. Thus, we believe that this back-of-the-envelope thought experiment is appropriate in the context of our work. We believe that the calculation is discussed with appropriate qualifiers, but we will now more clearly state those considerations in the revised version.

Page 11, line 12: see earlier comment on soil water sampling

See response to general comment above.