

## ***Interactive comment on “Seasonal origins of soil water used by trees” by Scott T. Allen et al.***

### **Anonymous Referee #1**

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This manuscript describes a seasonal index developed using stable water isotope data from precipitation to characterize the seasonal water source origin (i.e., winter or summer) of soil water or tree xylem water. The data represent almost 200 forest sites in Switzerland, which is an impressive sample of systems. Using the seasonal origin index, the authors describe that winter precipitation was the predominant water source that was stored in soil water or that trees were using during the mid-summer. This manuscript contributes to the ongoing discussion in the ecohydrological community about how plants extract water from the soil storage and the so called ecohydrologic separation between plant water and water that contributes to streamflow or groundwater recharge. In my opinion, this is an important paper and will generate discussion. The manuscript is very well written and the analysis is pretty thorough. I also appreciate the detailed information that is provided by the supplemental information. I would recommend publication of this work. I have a few comments, mostly editorial, that I

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hope will help improve the manuscript.

One minor issue is that the authors consider that suction lysimeters sample mobile water. In a relative sense compared to other sampling methods this is largely true. However, mobility is a continuum and it might be better to relax that dichotomy. For one, the suction that is used is rather high compared to other studies that are attempting to sample “mobile” water (e.g., -10 to -30kPa, especially considering that many use the somewhat arbitrary definition of field capacity as  $\sim$ -30 kPa). Also, it should be noted that even though the suction was applied for a month or so, most of the water was likely sampled within the first day or so and that the longer suction is maintained, the more the sample water represents the applied tension (i.e., finer pore space; see Severson & Grigal, Everett & McMillion, and Weihermuller et al. for example).

The analysis with rooting distribution is interesting and it was certainly an achievement to collect observations from so many sites. The method, however, is likely biased by coarse roots and may not reflect the finer roots that participate in water uptake. Some discussion of this is encouraged. It also wasn't clear what depths were involved in the root survey, i.e., only that it was by horizon. I understand that horizon depths vary by site, but please provide more information, for example, were O horizons surveyed? In general, there are more fine roots and root distribution is highest in the upper 10 cm of soil, which would typically include the O horizon.

Line comments:

P2, Line 6, comma after thus

P2, Line 14: after water ages, perhaps cite a study where storage selection functions are used to describe how ET is selected from storage and hence represents water of varying age. The Sprenger et al. citation in the sentence above is close by there might be something else that work better (e.g., Botter et al. 2011 show this idea conceptually with eqn. 6, but maybe there is a field study showing something similar). Also, it's not just fast/slow pathways, but as is discussed later, it is dependent upon rooting

distribution.

P2, Line 23: more mobile relative to what?

P3, Line 8: In addition to texture, some additional characteristics related to soil (e.g., all same soil order or type?) and parent material would be helpful.

P4, Line 10: Please give range of depths here.

P6, Line 22: Perhaps note parenthetically that Pearson is only in the supplemental information.

P7: Line 9: Could snow canopy interception make the difference here?

P7, Lines 21-22: Surprising that most roots are not nearer the surface. Jackson et al. suggest that the top 10 cm contain about 25% of the roots. Could this be the bias of survey more coarse roots than fine?

P7, Line 33: There are about 8-9 places in the manuscript where using the possessive seems awkward and the sentence could be recast. Please consider reducing the use of the possessive.

P8, Line 4: There are other soil properties that could be quite relevant, e.g., structure.

P8, Line: Be specific and refer to suction cup lysimeters and perhaps give a few sampling methods that do in fact sample water that is less mobile.

P8, Line 24-25: Could this be related to litter interception since spruce litter is quite different than the broad-leaved species? Also, here and the next sentence are two more examples where the sentences could be slightly recast to remove the use of a possessive.

References:

Botter, G., Bertuzzo, E., & Rinaldo, A. (2011). Catchment residence and travel time distributions: The master equation. *Geophysical Research Letters*, 38(11).

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Everett, L. G., & McMillion, L. G. (1985). Operational ranges for suction lysimeters. *Groundwater Monitoring & Remediation*, 5(3), 51-60.

Jackson, R.B., J. Canadell, J.R. Ehleringer, H.A. Mooney, O.E. Sala, and E.D. Schulze. 1996. A global analysis of root distributions for terrestrial biomes. *Oecologia* 108:389–411.

Severson, R. C., & Grigal, D. F. (1976). Soil solution concentrations: effect of extraction time using porous ceramic cups under constant tension. *JAWRA Journal of the American Water Resources Association*, 12(6), 1161-1170.

Weihermüller, L., Kasteel, R., Vanderborght, J., Pütz, T., & Vereecken, H. (2005). Soil water extraction with a suction cup. *Vadose Zone Journal*, 4(4), 899-907.

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