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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Disentangling temporal and population variability in plant root water uptake from stable isotopic analysis: a labeling study" *by* Valentin Couvreur et al.

Anonymous Referee #1

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Couvreur and colleagues present an interesting isotopic labelling experiment and innovative simulations of the processes in the soil-roots interactions. Their study is addressing current research gaps and will thus be of interest to the readership of HESS. The manuscript is well prepared and the figures are mostly informative. I provide two general recommendations and several minor technical comments below. I recommend publication after addressing these comments.
General aspects:
The "rollercoaster hypothesis" and the "swarm pattern hypothesis" both focus on the variation of δ^{18}O in tiller across plants and/or over time, respectively. However, the studied system is likely to be more complex due to heterogeneity of the water

flow/capillary rise. Do you see a chance to improve the modelling results when moving from a uniform flow/capillary rise to some kind of dual-permeabilty approach accounting for potential subsurface isotopic heterogeneity?
I was missing a discussion of the uncertainties regarding for example soil moisture estimates and the impact of such uncertainties for the interpretation regarding potential processes (i.e., hydraulic lift).
I further think that the implications of their interesting findings (i.e., no match between the ensemble of various simulations and the observations; Fig. 5) for both field studies labelled or with natural isotope compositions and the modelling of the soil-root interactions could be made clearer. This way, the manuscript might have a higher impact and could provide recommendations to overcome limitations in observation techniques and modelling approaches.
I appreciate that the authors will upload the data of the study. Are they further intending to make the model code available?
Technical comments:
L 77: monotonic gradient? Consider sinusoidal variability across the depth, which would cause issues of identifiability
L 80: Not only GW, also due to increasing dispersion with depth – even if the GW table is several meters deep
L 100: This paragraph is kept quite general after a very informative introduction. I suggest to be more specific and especially pose hypothesis or specific research questions.
L 117: Since you provide the variable and unit for soil moisture, you probably should also add that to matric potential.
L 140: replace "isotopic" with "δ^{18}O"

L 140: How was the sampling done? Soil corer? How much soil was sampled?

L 149: provide info about temperature, applied vacuum and time of extraction
158: Not sure what "(95 m root (g root)$^{-}-1$)." Means
Figure 1: The circles connecting the bottom of the profile of Figure 1a and the histogram of 1c are more confusing than helping. I suggest to get rid of them. The same would apply for the arrow connecting to 1b.
L 172: All variables should be explained here. For example L_{pr} is explained in L 216
L 181: The variable "n" should be briefly explained as one of the MVG parameters. Also, consider adding n and Sej to the list of variables.
L 209: Please define conditions for exudation. I believe it is for S_j<0, but not sure.
L 239: I do not see how the soil moisture varied notably at 1.3 m depth. What do you mean here? How comes that you refer to 12:00 and 20:00 on DaS 167, while that is not shown in Figure 2a?
L 243: Again, you refer to a time (7:30), which is not shown in the Figure and you should refer to it as soil$_{labelled}$" and not "soil" to be consistent with Figure 2.
L 244: "lead us to assume" or "leads to the assumption"
L 262: It is unclear which of the correlations are describe a significant relationship. I suggest to only draw the regression lines for significant relationships in Figure 4.
L 281: replace "et" with "and"
L 298: Unclear what is meant with "over all dataset". I believe you mean the 60 different root system classes. Please be more specific.
L 315: It seems to me that in-situ measurements would overcome these limitations. One could sample in parallel several plants and thus, observe the temporal dynamics at individual plant level.
L 319: What is the expected accuracy of your volumetric soil moisture measurements. Given that you derived this from gravimetric water content and a bulk density, which was assumed to be constant in the repacked soil. However, relatively small differences in bulk density of just a few g cm^{-3} will affect the estimates of the volumetric water content. It would be good to account for such uncertainties in this discussion.
L 325: What do you mean with "significantly higher"? Did you apply a statistical test? I

believe that you mean that the difference is higher than the measurement uncertainty.
Figure 6b: The title says "standard error", but the caption says "standard deviation". Which one is it? Please correct.
L 360: the upper half of the soil profile
L 367: "water addition is localized and not broadcasted in the soil" is unclear. What do you mean with "broadcasted"?
L 370: "simple"? In addition to the usual struggle of assessing meaningful MVG parameters to describe the soil water transport, also like for example L_{pr} and K_{axial} are needed, which are not easily derived, but its estimation adds to the uncertainty of the uptake depths.

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