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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Root growth, water uptake, and sap flow of winter wheat in response to different soil water availability" *by* Gaochao Cai et al.

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In this manuscript, the authors compare and assess the ability of two models of soil moisture dynamics to represent root-water uptake for a detailed field experiment with two different soils and three different watering schemes. The paper is well-written and detailed. I have only minor suggestions that I offer in the spirit of improving clarity and message.

1. Intent In the opening sentence of the abstract, the authors state "How much an where water is taken up by roots from the soil profile are important questions that need to be answered to close the soil water balance equation and to describe water

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fluxes in the soil-plant-atmosphere continuum." While I do not wish to quibble with the importance of these questions, I would offer that a detailed description of from where in the root zone water is removed is not necessarily needed to close the soil-water balance and describe water fluxes. Indeed, there are simple models of the root-zone, some without vertical resolution, that "adequately" represent overall water uptake and the soil-water balance with varying degress of precision.

Reply: the first sentence of the abstract was changed accordingly (line1 to line 2) on Page 1.

That said, I agree that there is a need or opportunity for more detailed models that can represent spatial variations in water uptake – both for description (i.e., uncovering and representing the processes at work within the vadose zone) and for prediction. I suggest that the authors offer a stronger articulation of intent for their work – is it that they care most about overall water balance, and these two models offer the appropriate degree of flexibility and/or complexity? Or, is it that they care most about the vertical variations in water uptake? (i.e., is it figures 5 and 6 or figures 8 and 9 that are most important)? Why these two models versus others that could be employed? This is not a major point, but I think the results will be more impactful if the authors can make clearer how the results are extensible to other situations and when such details are warranted (and when not). Why these models and what are the modeling goals?

Reply: we changed the sentences in the last but second paragraph of the introduction part on Page 3 to explain why we used these models (line24 to line 27). Actually we mentioned the advantages of using the Feddes-Jarvis model and used the second and third paragraphs on Page 2 to explain why we used the C model. Given the data that we have, we put the focus on the total uptake. We did not focus on uptake depths since that would require the use of isotope tracer data or measuring sap flow in the roots.

I finished the paper impressed with the work and conscientious detail that had gone into the field and modeling experiments, but also without a clear sense of how I would

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incorporate these results and conclusions into future work – a clearer statement to that effect would help.

Reply: thanks for the suggestion! We added some sentences in the second and fourth paragraphs of the conclusions part on Page 14 (line 24 to line 28) and Page 15 (line 5 to line 8) to state the suggestions in future work (the fourth paragraph stated as well) based on what we obtained in this study.

2. Big-picture site context The field experiment that is being described and modeled in this work is quite detailed. I sometimes found myself losing the forest for the trees. I recommend embellishing section 2.1 to provide the big-picture context for the reader.

First, I recommend providing insight to the climate/aridity. Perhaps simply stating the overall ratio of precipitation to reference evapotranspiration for the duration of the study. Obviously, the treatments modulate the available water, but providing a starting point for the aridity (and whether the climate is fundamentally arid or humid) would help.

Reply: it was added accordingly at the end of the last paragraph of section 2.1 on Page 4 (line 23 to line 26).

Additionally, differences between the two soils are many and nuanced. At the same time, offering a statement in section 2.1 regarding the plant-available water content (i.e., the difference in water content at field capacity [however defined] and at the wilting point) for both soils would help the reader understand some of the fundamental differences. Are they similar? Very different? What about hydraulic conductivity? What, from the authors' perspective are the 1 or 2 key differences between the two soils, as they relate to the objectives of the study?

Reply: thanks for the suggestions! The information of plant-available water content was added in the first paragraph of section 2.1 on Page 4 (line 4 to line 7).

3. Figure 8 Figure 8 is quite helpful. However, it is a bit misleading/confusing. I recommend the following: - label the sub-figures with the dates themselves rather than

the less clear terms such as “whole period” and “overlapping period.” This will also help the reader understand the differences in potential ET, since the stony soil data start much earlier, when LAI is low. - add a bar for the sapflux estimates of water uptake to provide additional context, especially since some of the low values for the stony soil seem to be partly due to error (see figure 9) - finally, while it may begin to get a bit crowded, I also recommend including a bar for precipitation/irrigation. Such a bar would really help contextualize the similarity or differences among the actual and potential transpiration.

Reply: thanks for your suggestions! - The dates were added in Figure 9 (new order). - We do not to include sap flow in this figure for two reasons: first, we did not focus on the difference in absolute total values between simulated RWU and measured sap flow; second, the sap flow was mentioned later and the measurement period of sap flow was different from the overlapped period of the estimated RWU between the two soils. - The precipitation and irrigation bars were added in Figure 9 (new order).

4. Figure 9 Why is it that the silty soil plots have just two lines (sap flux and Couvreur model)?

Reply: there are four lines in Fig. 10a and 10b (new order). No reduction of water uptake was simulated in the silty soil so that the values of Tact simulated by the FJ and C model were equal to Tpot. The lines overlapped. A sentence was added in the caption of Fig. 10 to clarify this issue.

5. Figure 10 I understand how taking the ratio of transpiration eliminates variations in potential ET – makes sense. Using these ratios, however, also masks the absolute error in the estimates of ET from the stony soils (see Figure 9). That’s fine, but it should be more appropriately acknowledged. For example, on line 34 of page 11, the authors articulate that the FJ model underestimates sap flux. However, the same is true of the C model, and this statement seems to be stretching the superiority of the C model over the FJ model. (The second statement about better representing the variability between

soils seems to be the primary difference.)

Reply: this is correct. In order to avoid confusion, we skipped the sentence in line 33 on Page 12. The absolute difference between the sap flow measurements and the simulated root water uptake is discussed with figures 10 and 11 and we did not have to pick up that discussion again here.

Also, I do not see any red x's in Figure 10a (for FJ model in silty soil).

Reply: the same answer to question 4. The red x's and red circles overlapped since no water stress was simulated in the silty soil.

Please also note the supplement to this comment:
https://www.hydrol-earth-syst-sci-discuss.net/hess-2017-711/hess-2017-711-AC1-supplement.pdf

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