Interactive comment on “Modelling the artificial forest (*Robinia pseudoacacia* L.) root-soil water interactions in the Loess Plateau, China” by Li et al.

Anonymous Reviewer #2

*Reviewer’s comments are typed in **black** color, whereas the responses are typed in **blue** color.*

General comments:

Based on the in situ observations, the manuscript proposes a root growth model that simulates both the dynamic rooting depth and fine root distribution. Subsequently, the model was used to simulate the forest-soil water relationships, including soil water availability and the temporal–spatial dynamics distribution of the dynamic rooting depth and fine root distribution in the Loess Plateau (LP) of China. Further, a long-term simulation was performed to address the drying soil layers issues in the region. The results show that incorporating the dynamic rooting depth into the currently available root growth models is necessary for accurately reproducing the drying soil processes. The manuscript is well-written and innovative. The proposed provides a much needed and powerful tool to address the drying soil layer issue than in situ sampling techniques. The findings on the thickness of the drying soil layer and the difficulties in recovery offer insight and strong implications for forest–water management in this region. The manuscript is of interest to the readers of the journal as well the wider ecohydrology community. I only have the following minor suggestions for the authors to consider:
Thanks for the valuable comments and suggestions. We revised the manuscripts following the comments and suggestions. The point-to-point explanation to the revisions are as follows.

Specific comments:

Yes, it is true how the black locust roots and soil water interact has not been addressed in previous modelling studies in the Loess Plateau of China, a brief and precise of similar findings/studies for other tree species in other regions/countries would help readers understand the current research gap and strengthen the innovative nature of the manuscript.
The suggestion is crucially important.
We accessed the latest publication that is published on Biogeosciences on 12 July 2021,

which is closely related to our work.

Sakschewski et al. (2021) reviewed the root growth approaches in the current Earth System Models and concluded that “none of those studies have acknowledged resource investment, timing and physical constraints of tree rooting depth within a competitive environment”. To deal with this issue, they proposed a variable rooting depth approach for the LPJ model. Their results indicate that “variable tree rooting strategies are key for modelling the distribution, productivity and evapotranspiration of tropical evergreen forests”. In this work, the maximum rooting depth is related to the tree height by a logistic growth function (Sakschewski et al., A5) and the vertical distribution of the fine roots follows a shape function (Sakschewski et al., A2).

In our work, root growth and soil water are coupled. Growth of the coarse and fine roots is determined by an optimization function that takes account of the ratio of water uptake and the biomass allocation between the coarse and fine roots.

The variable root approach by Sakschewshi et al. (2021) deals with the trade-off of biomass allocation between the above- and below-ground parts. Our work of dealing the similar issues is still on-going. It is hoped that better understandings of vegetation – water interactions in the semi-humid and semi-arid Loess Plateau can be achieved soon.

We incorporated the latest information into the revised manuscript.

References:

Sakschewski, B., von Bloh, W., Drüke, M., Sörensson, A. A., Ruscica, R., Langerwisch, F., Billing, M., Bereswill, S., Hirota, M., Oliveira, R. S., Heinke, J., & Thonicke, K. (2021). Variable tree rooting strategies are key for modelling the distribution, productivity and evapotranspiration of tropical evergreen forests. Biogeosciences, 18(13), 4091–4116. https://doi.org/10.5194/bg-18-4091-2021

P7 Eq. 6 defines the relationship between the coarse and fine roots. An addition of the definition of coarse and fine roots in the introduction would also clarify the potential confusion about the distinction of the two.

The definition of coarse (>2 mm diameter) and fine roots (<2 mm in diameter) in the classic approach is used in this study, and we will try to clarify this in introduction part of the revised version.

References:

Smithwick, E. A. H., Lucash, M. S., McCormack, M. L., & Sivandran, G. (2014). Improving the representation of roots in terrestrial models. Ecological Modelling, 291, 193–204. https://doi.org/10.1016/j.ecolmodel.2014.07.023

Jackson, R. B., Mooney, H. A., & Schulze, E.-D. (1997). A global budget for fine root biomass, surface area, and nutrient contents. Proceedings of the National Academy of Sciences, 94(14), 7362–7366. https://doi.org/10.1073/pnas.94.14.7362

P3, Line 79, “potentially beneficial…” should be “potentially benefit..”

We made the correction in the revised version.