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 #1

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

General comments:

This article develops a root growth model which adjusts root distribution and rooting depth in the root water uptake model based on the cost-benefit theory, and the model verified by observational data is used to simulate the root depth and distribution from 1971 to 2020 to analyze and study the drying soil layers (DSLs), but this article is not thorough enough in some respects. It is of great practical significance for artificial afforestation to analyze the changes of the root system over water-scarce areas such as the Loess Plateau, and the regional analysis chart formed in the article has certain significance for various arid and semi-arid areas to carry out the regional ecological restoration.

As one of the important issues that this research focuses on, although DSLs have been extensively reported in artificial forest land, the issue should be introduced with a certain background in the introduction part.

Thanks. We will expand the introduction to the drying soil layer in the revised manuscript. See more details in the response of Line 503-513.

Specific comments:

Line 46: "complicated morphological distribution" should be "a complicated morphological distribution".

We will make the correction in the revised version.

Line 331: "imply" should be "implies".

We will make the correction in the revised version.

Line 352 and 353: "a NSE" should be "an NSE".

We will make the correction in the revised version.

Line 361: “non-availability” should be “the non-availability”.
We will make the correction in the revised version.

Line 462: “the dynamic approach resulted in root uptake of 24 mm” should be “the dynamic approach resulted in a root uptake of 24 mm”.
We will make the correction in the revised version.

Line 500-502: “Comparisons between the static and dynamic rooting depth approaches also determined that the former was incapable of reproducing the occurrence and evolution of the drying soil layers that have been widely reported in this region (Fig 12).” How this conclusion was obtained needs a more detailed and in-depth explanation.
Your suggestion is appreciated. The observations indicate that the occurrence, the upper and lower boundary, the soil water status within the drying soil layer change with time. The static rooting depth approach pre-sets a fixed root depth over the simulation period, which does not capture the hydraulic traits of roots that may develop to use water from the wetter zone beneath the pre-set root depth. We will add the explanation in the revised manuscript.

Line 509-511: “Exploration of water from wetter but deeper soil is also an adaption strategy when it is more profitable, usually with more cost when coarse root growth requires additional biomass investment.” please provide evidence or reference for how this conclusion was obtained.
Appreciated. These understandings come truly from literature. We will cite some of these studies in the revised version, e.g., Pierret et al. (2016) and Germon et al. (2020).
References:
Pierret, A., Maeght, J.-L., Clément, C., Montoroi, J.-P., Hartmann, C., and Gonkhamdee, S.: Understanding deep roots and their functions in ecosystems: an advocacy for more unconventional research, Ann. Bot., 118(4), 621-635, doi:10.1093/aob/mcw130, 2016.
Germon, A., Laclau, J.P., Robin, A. and Jourdan, C.: Tamm Review: Deep fine roots in forest ecosystems: Why dig deeper? Forest Ecol. Manag., 466, 118135, doi:10.1016/j.foreco.2020.118135, 2020.

Line 503-513: “Notably, the development of the drying soil layers is predominantly due to water utilisation by the deep fine roots, which accounts for approximately only 5% of the total profile uptake (Fig. 11). Although minor compared with the total, it caused a 505 sustained negative soil water balance in the deep soil due to difficulties in receiving recharge, as described in the results section. The continuous development of the lower boundary of the drying soil layer implies that its recovery is critically difficult. This is because of the large thickness and vast storage capacity of loess soil (Huang and Shao,

2019). Plants tend to develop more fine roots in the topsoil and use more soil water due to lower costs but higher benefits, that is, a more profitable adaptation strategy when experiencing water stress. Exploration of water from wetter but deeper soil is also an adaption strategy when it is more profitable, usually with more cost when coarse root growth requires additional biomass investment. This explains why the top 2.0 soil was the most active zone of water uptake in this study. Depletion of topsoil always vacates the storage for infiltration, making it difficult for the rainfall to replenish the deeper dried soil layer or groundwater (Turkeltaub et al., 2018)." Pleas e supplement the significance of this research from a practical perspective in combination with the actual vegetation restoration situation on the Loess Plateau.

We appreciate this suggestion very much. As a matter of fact, Huang and Shao (2019) reviewed the studies on soil water in the Loess Plateau of northwest China. In this paper, the research progresses in the drying soil layer of the artificial forestation and their practical significance have been discussed in depth. In our manuscript, we focus on discussing mechanisms of the occurrence and evolution of the drying soil layer on basis of the mathematical simulation. In the revised version, we will try to enhance the discussion about the practical significance of this study by referring to the earlier review work by Huang and Shao (2019).

References:

Huang, L., & Shao, M. (2019). Advances and perspectives on soil water research in China's Loess Plateau. Earth-Science Reviews, 199, 102962. https://doi.org/10.1016/j.earscirev.2019.102962.

Figure 8: Since the circles on Figures 8b and 8c represent observation values, please explain what their different colors mean in the caption.

Appreciated. The explanations of the different colors will be added in the caption of Figure 8.

Figure 10b: The DD symbol has a black edge but the SD symbol does not. Please unify the style.

Appreciated. The plotting style of Figure 10b will be unified.