Author's response on "Modelling the artificial forest (*Robinia pseudoacacia* L.) root-soil water interactions in the Loess Plateau, China" by Li et al.

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

We are thankful 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.

1. Abstract:
a) The argument that incorporating dynamic soil depth is necessary for reproducing the drying soil process is an important point. It needs more explanation with concise results in the abstract.
b) The important role of dynamic root depth information of the drying soil layer is not *adequately* explained.
We refined the abstract according to your comments, please see lines 19-32.

2. Introduction: again, why root dynamics is important for the understanding of drying soil layer? It is not clear in the introduction part. It seems the two aspects are parallelly discussed and their connection is not clearly expressed.
We recomposed the introduction section following your comments, please see lines 88-100.

3. The lower boundary condition for 1D Richards' equation is field capacity. Any supporting evidence for such a configuration?
Field investigation indicates that the soil water content is relatively stable around the field capacity at depth of 20-100 m in Yangling, Loess Plateau (Qiao et al., 2018). We added this reference to the main text. Please see lines 308-310.
References:
Qiao, J., Y. Zhu, X. Jia, L. Huang, and M. Shao.: Factors that influence the vertical distribution of soil water content in the Critical Zone on the Loess Plateau, China, Vadose Zone J, 17, 170196, 10.2136/vzj2017.11.0196, 2018.

4. What's the reason that the static method cannot capture the soil water variation? Previous modeling work without root dynamics does not do such a bad job as shown in Figure 6. This needs more explanations.
Thanks for your comment. We made some modifications in Figure 6 in the revised version.

We updated the parameters of the SS (static root distribution and static rooting depth) method by the observed root distribution (Fig.A1) and updated Figure 6 in the main text. Along the soil profile, The SS method used less soil water from the deep layer of 100-400 cm than the SD and DD methods (Fig.A2, also **Fig.S3** in **Supplementary File**). The SS method reproduced the changing patterns of soil water over time, although the results of it shows much more deviation to the observations than the SD and DD methods (Figure 6 in the main text).

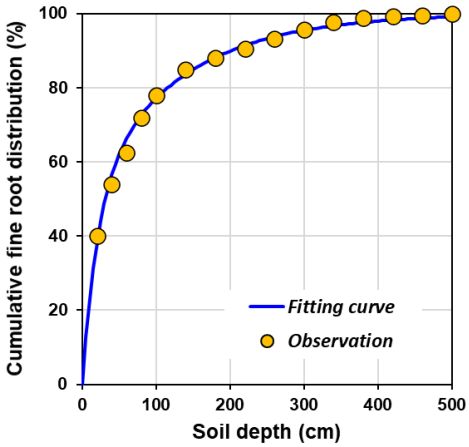

Fig. A1 The fitted root density distribution over soil profile for the SS method

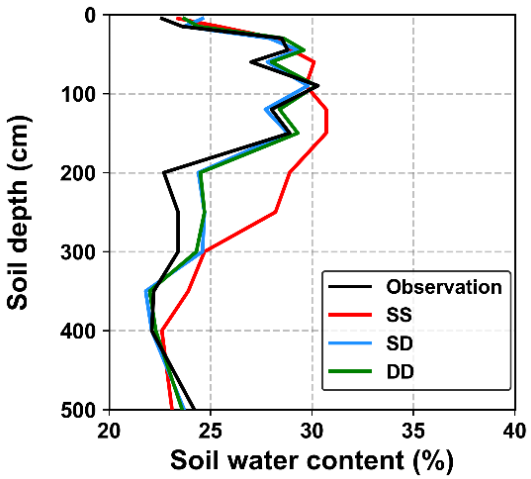

Figure A2: The simulated and observed average soil water content over the soil profile

The SS method is widely used in different ecological or hydrological models. In the Loess Plateau, these models have been used to simulate soil water variations in field crops, shrubs, and forests (Table A1). Short-term model calibration and validation, ranging from months to five years, has usually shown acceptable performance, while long-term evaluation has rarely been undertaken. When used to address the long-term issue in this study, comparisons between the static and dynamic rooting depth approaches indicated that the former did not reproduce the occurrence and evolution of the drying soil layers due to its pre-set rooting depth (Figure 12 in the main text). We revised the discussion section, please see lines 513-524.

Table A1 root models used in some publications the in the Loess Plateau

Literature	Hydrological or ecological Models	Vegetation types	Root distribution	Rooting depth (cm)	Simulation period
Zhang et al. (2015)	Modified Biome-BGC with 1D Darcy's equation	Forest	Exponential distribution	100	Calibration and validation: 2003-2006 Simulation: 1944–2007
Tian et al. (2016)	WAVES	Forest	Exponential distribution	100	Calibration and validation: June 2011 to September 2011 Simulation: 1980–2010
Li et al. (2019)	Hydrus-1D	Apple	Observed distribution obtained from local sampling	620	Calibration and validation: 2011-2013 Simulation: 1960-2013
Bai et al. (2020)	Hydrus-1D	Crop, grass and shrub	Linear distribution or observed distribution collected from literature	400	Calibration and validation: 2004-2016 Simulation: 1970-2060

Reference

Zhang, Y., Huang, M., & Lian, J. (2015). Spatial distributions of optimal plant coverage for the dominant tree and shrub species along a precipitation gradient on the central Loess Plateau. Agricultural and Forest Meteorology, 206, 69–84. https://doi.org/10.1016/j.agrformet.2015.03.001

Tian, F., Feng, X., Zhang, L., Fu, B., Wang, S., Lv, Y., & Wang, P. (2016). Effects of revegetation on soil moisture under different precipitation gradients in the Loess Plateau, China. Hydrology Research, 48(5), 1378–1390. https://doi.org/10.2166/nh.2016.022

Li, B., Wang, Y., Hill, R. L., & Li, Z. (2019). Effects of apple orchards converted from farmlands on soil water balance in the deep loess deposits based on HYDRUS-1D model. Agriculture, Ecosystems & Environment, 285, 106645. https://doi.org/10.1016/j.agee.2019.106645

Bai, X., Jia, X., Jia, Y., Shao, M., & Hu, W. (2020). Modeling long-term soil water dynamics in response to land-use change in a semi-arid area. Journal of Hydrology, 585, 124824. https://doi.org/10.1016/j.jhydrol.2020.124824

5. Please double-check Figure 7 (the title is wrong?).
Thanks, we made the correction of the caption of Fig 7 in the revised version.

6. It is hard to tell the difference between SD and DD simulations compared to observation.
Yes, the differences between these two approaches are not remarkable over the ~4 years of evaluation period. However, significant difference appears when they are used to address the long-term issues, e.g., 50 years in this study. The main reason for that is the SD method presets a maximum rooting depth, e.g., 5 m in this study. However, the DD method let the rooting depth develops to use soil water available in deeper soil layer.