Response to Reviewer 3 Comments

I have carefully read the comments from other reviewers as well as the authors' responses and the updated version of the manuscript. The manuscript has largely improved and is nearly ready for publication. I only have a few minor suggestions for further enhancement:

Lines 35-40: As noted in my first-round review, the authors have listed several ecological projects. It would be beneficial for the readers to see the advantages of these projects highlighted in existing studies. This part should be further enhanced.

Liu, Y., Ge, J., Guo, W., Cao, Y., Chen, C., Luo, X., Yang, L. and Wang, S., 2023. Revisiting biophysical impacts of greening on precipitation over the Loess Plateau of China using WRF with water vapor tracers. Geophysical Research Letters, 50(8), p.e2023GL102809.

Response: Thank you for your suggestion. We have included the advantages of ecological projects as follows:

L37-40: These ecological engineering program programs have been beneficial for water conservation (Liu et al., 2023), mitigating climate warming (Yu et al., 2020), increasing terrestrial carbon sequestration (Shi and Han, 2014), reducing water erosion risk (Wang et al., 2021), and alleviating dust storm (Tan and Li, 2015).

References

Wang, H., Zhao, W., Li, C., and Pereira, P.: Vegetation greening partly offsets the water erosion risk in China from 1999 to 2018, Geoderma, 401, 115319, doi:10.1016/j.geoderma.2021.115319, 2021.

Liu, Y., Ge, J., Guo, W., Cao, Y., Chen, C., Luo, X., Yang, L., and Wang, S.: Revisiting biophysical impacts of greening on precipitation over the Loess Plateau of China using WRF with water vapor tracers, Geophys. Res. Lett., 50(8), e2023GL102809, doi:10.1029/2023GL102809, 2023.

Yu, L., Liu, Y., Liu, T., and Yan, F.: Impact of recent vegetation greening on temperature and precipitation over China, Agr. Forest. Meteorol., 295, 108197, doi:10.1016/j.agrformet.2020.108197, 2020.

Tan, M., and Li, X.: Does the Green Great Wall effectively decrease dust storm intensity in China? A study based on NOAA NDVI and weather station data, Land Use Policy, 43, 42-47, doi:10.1016/j.landusepol.2014.10.017, 2015.

Shi, S., and Han, P.: Estimating the soil carbon sequestration potential of China's Grain for Green Project, Global. Biogeochem. Cy., 28(11), 1279-1294, doi:10.1002/2014GB004924, 2014.

Lines 55-60: I concur with reviewers 1 and 2 that a discussion on the temperature impacts for here is desired.

Response: In the revised manuscript, the temperature impacts are discussed, as follows:

L402-411: Afforestation can provide temperature benefits (e.g., cooling the land surface) according to previous studies (Peng et al., 2014; Yu et al., 2020; Breil et al., 2024). However, the biophysical response of afforestation on temperature varies spatially. At a global scale, it is common sense that afforestation causes the warming effect in high-latitude regions due to the albedo-dominant radiation effect, while the cooling effect in low-latitude regions due to the evapotranspiration-dominant non-radiation effect (Bonan, 2008; Arora and Montenegro, 2011). Thus, afforestation-induced regional temperature changes depend on the net effects. Afforestation also can cause daytime cooling but nighttime warming (Yuan et al., 2022), and increase the surface temperature in winter, but decrease in other seasons (Ma et al., 2017). Differential responses in season and daily lead to more larger uncertainties in the net effects induced by afforestation. Therefore, a more realistic afforestation scenario is necessary to quantify the effects of afforestation on temperature under future climate change background and develop climate change mitigation policies.

References

Peng, S., Piao, S., Zeng, Z., Ciais, P., Zhou, L., Li, L. Z. X., Myneni, R. B., Yin, Y., and Zeng, H.: Afforestation in China cools local land surface temperature, P. Natl. Acad. Sci. USA, 111, 2915–2919, doi:10.1073/pnas.1315126111, 2014.

Yu, L., Liu, Y., Liu, T., and Yan, F.: Impact of recent vegetation greening on temperature and precipitation over China, Agr. Forest. Meteorol., 295, 108197, doi:10.1016/j.agrformet.2020.108197, 2020.

Arora, V. K., and Montenegro, A.: Small temperature benefits provided by realistic afforestation efforts, Nat. Geosci., 4(8), 514-518, doi:10.1038/ngeo1182, 2011.

Ma, W., Jia, G., and Zhang, A.: Multiple satellite-based analysis reveals complex climate effects of temperate forests and related energy budget, J. Geophys. Res.-Atmos., 122(7), 3806-3820, doi:10.1002/2016JD026278, 2017.

Yuan, G., Tang, W., Zuo, T., Li, E., Zhang, L., and Liu, Y.: Impacts of afforestation on land surface temperature in different regions of China, Agr. Forest. Meteorol., 318, 108901, doi:10.1016/j.agrformet.2022.108901, 2022.

Bonan, G. B.: Forests and climate change: forcings, feedbacks, and the climate benefits of forests, Science, 320(5882), 1444–480 1449, doi:10.1126/science.1155121, 2008.

Breil, M., Schneider, V. K. M., and Pinto, J. G.: The effect of forest cover changes on the regional climate conditions in Europe during the period 1986–2015, Biogeosciences, 21, 811–824, doi:10.5194/bg-21-811-2024, 2024.

The analysis in this paper is based on the SSP 245 scenario, which the authors claim to be the most reliable. I have reservations about this assertion and believe that SSP 370 might be a more appropriate choice, considering its widespread use in large ensemble simulations such as LENS2. While the authors have provided some info on this topic, a more thorough discussion of the scenario impacts on the results and conclusions of this manuscript is necessary.

Liu, W., Wang, G., Yu, M., Chen, H., Jiang, Y., Yang, M. and Shi, Y., 2020. Projecting the future vegetation–climate system over East Asia and its RCP-dependence. Climate Dynamics, 55, pp.2725-2742.

Response: We have included the discussions as follows:

L429-434: For instance, the high emission scenario could lead to higher temperature and stronger precipitation in China relative to middle emission (Yang et al., 2021). The obvious differences are found in the northern China. It implies that there are greater opportunities for afforestation in semi-arid areas. Thus, the suitability of future forest lands depends on emission scenarios (Liu et al., 2020; Elsen et al., 2022). Exploring the impacts of different SSPs on the distribution of potential afforestation regions would be an intriguing avenue for future research.

References

Liu, W., Wang, G., Yu, M., Chen, H., Jiang, Y., Yang, M., and Shi, Y.: Projecting the future vegetation–climate system over East Asia and its RCP-dependence, Clim. Dyn, 55, 2725-2742, doi:10.1007/s00382-020-05411-2, 2020.

Yang, X., Zhou, B., Xu, Y., and Han, Z.: CMIP6 evaluation and projection of temperature and precipitation over China, Adv. Atmos. Sci., 38, 817–830, doi:10.1007/s00376-021-0351-4, 2021.

Elsen, P. R., Saxon, E. C., Simmons, B. A., Ward, M., Williams, B. A., Grantham, H. S., Kark, S., Levin, N., Perez-Hammerle, K. V., Reside, A. E., and Watson, J. E. M.: Accelerated shifts in terrestrial life zones under rapid climate change, Global. Change. Biol., 918–935, https://doi.org/10.1111/gcb.15962, 2022.

I strongly recommend making all data openly accessible online to facilitate further research within the scientific community.

Response: The future potential afforestation distribution data is available at https://zenodo.org/records/10900150.