Reply to Reviewer 2

Introduction:

The manuscript presents an innovative analysis on how large-scale tree cover changes might influence the impacts of climate change on future water availability, focusing on both global and specific basin scales. The interdisciplinary approach, combining Budyko models, CMIP6 climate projections, tree cover datasets, and moisture tracking, offers valuable insights into a highly complex issue. Despite acknowledging the inherent uncertainties and methodological limitations, the paper contributes significantly to the ongoing discourse on climate change mitigation strategies and ecosystem restoration. The clarity in presenting the complex methodologies and the transparent discussion of limitations is notable. In addition to the first referee's comments, to strengthen the paper further, detailed below are minor issues requiring attention.

We thank reviewer 2 for their positive feedback on the paper and constructive comments to improve the paper. We reply in detail to the comments below. The reviewer comments are made blue, and our reply is in black.

Method:

-The paper uses a set of assumptions in its modeling approach, especially in applying the Budyko framework and the UTrack dataset for future climate scenarios. A more detailed justification of these assumptions and their validity in the context of climate change, and how they influence the results would strengthen the paper's scientific rigor. For instance, the sensitivity of Budyko model to vegetation type and coverage. Alternatively, you could mention how these assumptions might impact the findings in light of previous research in the discussion section.

Our application of the UTrack dataset under different climate- and land cover scenarios has some limitations, which are discussed in the methodology (line 180) and Section 4.2 (line 397). We believe that all important assumptions and uncertainties of the use of UTrack in our context are discussed in these sections. We will strengthen the discussion section by citing the recent study of Staal et al. (2024) on the effects of future climate change on moisture recycling.

In Section 4.1 (line 386) we discuss the uncertainties of the Budyko models in relation to climate change and vegetation type. In the last sentence, we briefly mention the sensitivity of the Budyko parameters to e.g., species type. We will extend this section and more quantitatively discuss the water use by broadleaf forest compared to coniferous forests, and plantations versus natural forests (e.g. Bosch and Hewlett 2006; Ding et al., 2022; Komatsu et al., 2007).

Uncertainties:

- The spatial resolution of the datasets used, including CMIP6 projections, tree cover, and moisture recycling data, may influence the study's conclusions, especially when scaling down to specific basins. The impact of using a uniform spatial resolution across diverse ecological and climatic zones could introduce inaccuracies in regions with high spatial variability in climate and land cover, which is worthy of mentioning.

We thank the reviewer for raising this point and agree that this should be emphasized within the paper, we propose the following sentence which will be included in the

discussion section: “The coarse spatial resolution applied within this study may introduce inaccuracies for regions with diverse land cover and climate conditions over a relatively small area. Therefore, the variability of water fluxes with land and climate characteristics may not be fully captured in our results.”

- The study seems to treat tree cover changes as static between the two periods compared. However, tree cover dynamics, including growth rates, succession stages, and potential dieback could significantly affect water cycling processes. it is worth mentioning these temporal dynamics might influence the study's outcomes.

It is indeed currently not clearly specified in the paper that the tree cover datasets are assumed to include only mature trees. We will insert the following clarification in line 136: “We assume that the tree cover datasets for both the present and the future time period consist of mature trees.”

Our analysis does indeed assume a static tree cover, and we fully agree with the reviewer that tree cover dynamics also impact water fluxes. We propose to add this simplification to the text at line 383, as indicated in orange.

“Additionally, the potential tree cover map describes the tree cover that could be established given certain climate conditions. We assume a static tree cover, and do not consider temporal variability in water fluxes that result from for example forest disturbance and forest succession stages (Goeking and Tarboton, 2020; Teuling and Hoek van Dijke, 2020). Furthermore, the three decades are not sufficient to reach the level of tree cover that we assume here, especially in areas that currently do not contain trees.”

Textual corrections:

Line 55: The phrase "allows to study" could be grammatically improved to "allows us to study." Improved

Line 290: "93mmyr−1" should include a space for clarity, "93 mm yr−1." Corrected

References

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