

Author Response to Reviews of

CMIP6 climate model spread outweighs glacier model spread in 21st-century drought buffering projections

Ultee et al.
The Cryosphere

RC: Reviewer Comment, AR: Author Response, Manuscript text

1. Editor

RC: *Dear Lizz Ultee and co-authors,*

We have now received reports from our two reviewers who are satisfied with your revisions. Following both reviewers advise, I am happy, in principle, to accept your manuscript for publication in TC after considering the remaining comments from Reviewer 2, and my minor corrections listed hereunder.

Note that I will give the paper a final check before formal acceptance. Congratulations for an interesting study!

*Best wishes,
Brice Noël*

AR: *Thank you for your careful attention to our manuscript! Your work has improved ours. We appreciate it.*

1.1. Minor corrections

RC: *L44: Please verify that you actually mean “atmospheric moisture demand” instead of simply “atmospheric moisture”.*

AR: *Yes, we mean atmospheric moisture demand. Changing temperature could also affect atmospheric *moisture* through increased evaporation and other changes in the water cycle, but the relevant point for the drought metric is that the atmospheric demand for water from the surface is changing because of the dependence of saturation vapor pressure on temperature.*

RC: *L66: “...output (typically not finer than...)”*

AR: *Good wording, thanks. Changed as suggested.*

RC: *L67: By “non-trivial” do you mean “sufficient” or “non-negligible”? Please clarify.*

AR: *Changed to “non-negligible”.*

RC: *L69: Here you introduce the Ag and Abasin parameters for the first time without defining them. This is done in L132-133. Please, describe parameters Ag and Abasin here.*

AR: *Now introduced in the first line of the paragraph, L64. Good catch, thank you!*

Our analysis focuses on the world's 75 large river basins (basin area $A_{\text{basin}} \geq 3000 \text{ km}^2$) that have considerable glacier cover (glacier cover $A_g \geq 30 \text{ km}^2$), ...

RC: *L87: “Supplementary Table 2)” Please verify that Supplementary Figures and/or Tables are well referred to.*

AR: *Corrected to clarify that we are referring to “Supplementary Table S2 of Zekollari et al., 2025”, rather than to a supplement of the present manuscript.*

RC: *L101: “models are calibrated using the same observed ...”*

AR: *Corrected as suggested.*

RC: *L122: “month and the two previous ones, ...”*

AR: *Added “ones” as suggested*

RC: *L214: “has consistently a larger. . .”*

AR: *Changed from “is consistently larger amplitude” (which we agree is not good wording) to “has a consistently larger amplitude”. This sounds more natural to us.*

RC: *L261: “choosing 11 out of over 25 available. . .”*

AR: *Changed as suggested.*

RC: *L314: “(Section 2.3, above, ...”*

AR: *Changed as suggested.*

RC: *L340: “increases or remains steady through. . .”*

AR: *Changed as suggested.*

RC: *L356-363: Please move the Author contributions, Competing Interests and Acknowledgements before the Appendix section.*

AR: *Moved as requested. The previous format seemed to be the default in the Copernicus LaTeX template...strange!*

RC: *Eq1 and L132: Here “A” is used instead of “Abasin” from L69. I understand they represent the same quantity. Please consistently use “Abasin” across the text and equations.*

AR: *Fixed, thank you.*

RC: *Figure 1 caption: “each $\geq 3000 \text{ km}^2$... with glacier cover $\geq 30 \text{ km}^2$...”*

AR: *Changed as suggested.*

2. Reviewer 1

RC: *Thanks for addressing all my comments. I only have a few minor points remaining before publication:*

1. *In Table B1 (“Forcing for historical period simulation”), my understanding is that W5E5/ERA5 is used for the historical period, while historical GCM runs are only used to bias correct future simulations. Please double-check.*

AR: *It’s vice versa – PyGEM and OGGM use ERA5 or W5E5 to bias correct the GCMs, but both models are using (bias-corrected) GCM forcing in the historical period 2000-2014, while GloGEM is directly using ERA5 forcing for that period. This is apparent in the runoff time series, shown for example in the attached Figure R.1. GloGEM runoff series (green) have no inter-GCM spread until 2015, because they are using a single ERA5 forcing until that time. Most easily visible in the Serrano basin (rightmost column).*

RC: **2.** *The Discussion could benefit from 2–3 subheadings to better guide the reader, for example focusing on (i) robustness across glacier models, (ii) the dominance and under-sampling of climate model uncertainty, and (iii) implications and limitations for downstream hydrological applications.*

AR: *Great suggestion, thank you. Added subsection headers very similar to the suggested.*

RC: **3.** *There seems to be a formatting issue in Appendix D, where the break between the Appendix D figures and the Acknowledgements is incorrect.*

AR: *Corrected.*

4. *Both “glacial drought buffering” and “glacier drought buffering” are used; consider standardizing the terminology. The same with “Late century” and “end of century”.*

AR: *Good catch. Changed to use “glacial drought buffering” and “Late century” throughout. The only exception is a reference to previous work finding that glacial drought buffering continues through the end of the 21st century; that work analysed changes in 2070-2100, which is 10 years longer than our Late century period (2080-2100), so we kept the original wording to avoid conflating them.*

3. Reviewer 2

Reviewer 2 advised the manuscript be accepted as is. No further corrections are noted.

References

- [1] Wimberly, F., Ultee, L., Schuster, L., Huss, M., Rounce, D. R., Maussion, F., Coats, S., Mackay, J., and Holmgren, E.: Inter-model differences in 21st century glacier runoff for the world's major river basins, *The Cryosphere*, 19, 1491–1511, doi:10.5194/tc-19-1491-2025, 2025.

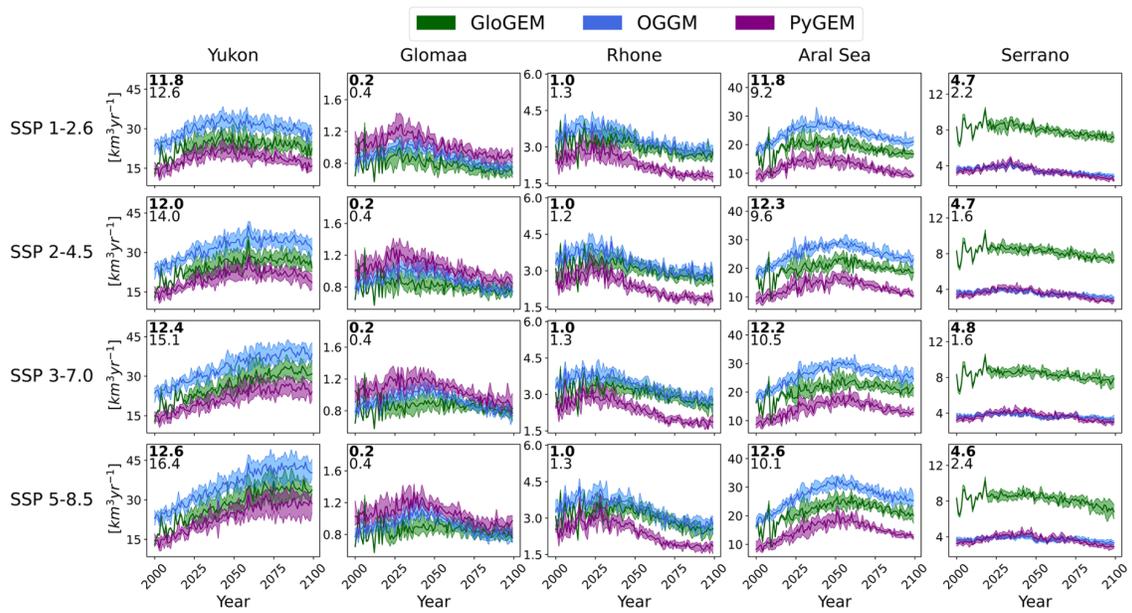


Figure R.1: Runoff time series from the three glacier models, illustrating the effect of different historical forcing choices. Reproduced from Figure 2 in Wimberly et al. (2025).