Author responses to J. Ignacio López-Moreno, reviewer 1 comments on:

"Technical note: Literature based approach to estimate future snow"

by Richter et al. in *Hydrology and Earth System Sciences* (*HESS*)

We thank J. Ignacio López-Moreno for the time to assess our work and for the valuable feedback and suggestions. We respond to each point of the reviews below. The reviewer comments are highlighted in blue while our responses and comments are kept in black.

I enjoyed reading this note and believe it addresses, in a very smart way, an important issue in comparing previous snow projections: the use of different time horizons, models, emission scenarios, etc. Most of the implications of the assumptions and simplifications are well discussed. The manuscript is well written, and I did not identify any methodological flaws. Therefore, I recommend its publication.

Below, I provide a few minor suggestions and some ideas from my related research, which the authors may consider using to further strengthen the discussion:

-I wonder about the impact of the methodology used in previous studies to perturb observed series with climate projections (e.g., the Delta method on seasonal or monthly bases, quantile perturbation, or directly using simulated climate to drive snow models). Different methods may influence the asymmetry in the start and end of the snow season or other metrics that relate snow changes solely to temperature.

That's an interesting question, and we agree that the method used may have an impact on some snow metrics. However, we were unable to identify any clear influence of this aspect on the corresponding results. Probably, other differences between the studies and their uncertainties as well as the low number of studies prevented a clear conclusion in this regard.

- It is somewhat surprising to me that the changes in the start and end of the snow season appear symmetric. Is the projected temperature increase generally similar for winter and spring? Even if it is, I would expect some patterns related to elevation—for instance, an earlier snowmelt may eliminate periods of very high solar radiation, whereas a later snow onset may have less significant implications for incoming solar radiation and melt dynamics. This is particularly true at higher elevations but not at lower ones.

Unfortunately, we are not sure if we understand your question correctly since the projected snow depth changes for the start and end of the season are clearly asymmetric as shown in Fig. 2 (upper graph) and Figure 4. The reduction curve in Figure 2 (lower graph) is indeed symmetric but only around the value b. We didn't observe any consistent trend in their shape across the different studies. We will clarify this more explicitly in the revised manuscript in section 2.2 (lines 67-70).

-One of the strengths of this methodology is its ability to translate different scenarios into temperature changes. This can make it easier to communicate results for policy decisions, as many greenhouse gas emission targets are linked to temperature thresholds (e.g., 1.5 °C). This aspect could be highlighted more explicitly in the discussion, as it helps make the results more accessible to non-scientific audiences.

Thanks for this input on the additional strengths of our manuscript, we will add this extra benefit of our translation to temperature scenarios in the discussion.

- Related to the previous point, in recent years I have preferred, instead of simulating future snow conditions for different climate models and emission scenarios, to perform sensitivity analyses (e.g., adding 1–2 °C, or ±5–10 % changes in precipitation; see DOI: 10.1088/1748-9326/abb55f). Then, the changes in T and P can be framed with climate projections for specific regions. While this approach requires simplifying assumptions about the system, I find it makes the results much easier to compare. It may be interesting to contrast your approach with this type of sensitivity analysis.

Interesting point. We will add a few sentences in discussion to demonstrate the differences of the two approaches.

- Perhaps Figure 2 could more clearly illustrate how changes in “b” and “c” are derived.

To illustrate changes in “b” and “c” more clearly, we will add the following information in the legend: Future relative snow depth is computed by dividing the future snow depth by reference snow depth. Furthermore, we will add a line in peak snow depth to highlight Delta b and similar for Delta c. We will change Figure 2 accordingly and adapt the corresponding text.

Hoping my comments will result useful,

Best,

J. Ignacio López-Moreno