Author responses to reviewer 2 comments on:

“Technical note: Literature based approach to estimate future snow”

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

We thank the reviewer 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.

This technical report takes an interesting approach, harmonising multiple manuscript sources under a common framework and synthesising their findings into a unified indicator using various future projection results. It is a technical method of consolidating various types of data into a single metric and yields compelling results. In my opinion, the manuscript is ready for publication as a technical report.

While reviewing this manuscript, I came across several points that I found unclear. I have commented on these below.

minor comments

Lines 45–60, Section 2.1.2 and Figure 1: Please clarify the roles of what is represented as NDJFMA – xxx (e.g., DJF) and NDJFMA-decrease. My understanding is that equation (1) refers to NDJFMA-decrease, while Figure 1 shows NDJFMA – xxx. The decreases such as –25% mentioned in lines 58–60 presumably correspond to NDJFMA-decrease. It seems to me that NDJFMA – xxx and NDJFMA-decrease are conceptually different (the former being adjustments due to different averaging periods, and the latter being the actual future decrease ratio). However, in the current explanation, they appear to be mixed together. Could you please make their distinction more explicit?

We agree that this part may be misleading. We will clarify that literature values did not use a unique period to report seasonal decreases and depending on the period of interest those variable may vary significantly, making an intercomparison hard. We therefore synthesized these values to the NDJFMA-decrease and tried to highlight that a decrease in yearly snow depths is larger than decreases in winter snow depths. We will rewrite this paragraph accordingly and show a specific example using the decreases in Figure 2.

Lines 58–60: To which values do the reported decreases of 25% and 20% refer? They do not appear to be within the range shown in Figure 1. Could you please clarify what these percentages are based on?

We agree that this illustrative example is misleading as those values are not shown in Figure 1. We will change this example to a concrete example, using the decreases in Figure 2 and compute decreases for the different periods. We will additionally highlight those data points in Figure 1 for better understanding.

Lines 84–85: Could you include an illustration of Δb and Δc in Figure 2? It would help readers better understand the concept.

To illustrate Δb and Δc more clearly, we will add a line in peak snow depth to highlight Δb and similarly for Δc. Additionally, we will add the following information in the legend for clarification: Future relative snow depth is computed by dividing the future snow depth by reference snow depth. We will change Figure 2 and the corresponding text accordingly.

Lines 141–143: I understand that, due to global warming, the snowmelt season begins earlier, as does the peak in snow depth. One point I found questionable is that the dependence of Δb on elevation appears stronger than its dependence on temperature change compared to parameters such as a or Δc. The weak temperature dependence may be due to discontinuous changes; for example, when two peaks exist and the position of the dominant peak

shifts. However, the fact that Δb shows stronger elevation dependence than dependence on temperature change raises the question of whether this behaviour is a general characteristic or a result specific to the dataset used. If the latter, the explanatory power of the Δb equation would be reduced. It is important to clarify this point.

That is an interesting remark and we were also investigating this shift in more detail. We think it's important to keep in mind that with increasing elevation, the snow depth peaks later in the season as the accumulation period is longer. We further want to remind that we didn't use a specific dataset but in total 5 independent studies (see Table 1a in the appendix) for deriving this variable. That said, we argue that this variable Δb is important to preserve the local climatology rather than providing explanatory power related to temperature change. Technically, this simply means that the peak of the reduction curve is positioned relative to the peak in snow depth rather than fixing the curve to a specific date in the season. We will clarify the role of Δb in the manuscript.