

Dear Dr. Bonsoms and co-authors:

Thank you very much for the submission of the second revision of your manuscript. I appreciated you taking the time to address the reviewer's concern. While there are substantial improvements, there are still many inaccuracies and incomplete revisions that need to be fixed before your paper can be considered for publication.

Please read the following comments carefully and implement the required changes with attention to detail and diligently. It is important that your responses to the comments accurately represent what you have implemented in the manuscript.

Best wishes

Pascal Haegeli

NHESS Editor

Simon Fraser University, Burnaby BC, Canada

Dear Dr. Haegeli,

Thank you very much for your feedback and the time you dedicated to revising our manuscript. Please accept my apologies for any inaccuracies and omissions identified in the manuscript.

We agree with all the suggestions. Unfortunately, in our last review we did not interpret well the recommendation to maintain the same color scales between figures. I believe that implementing these changes has significantly improved the quality of the manuscript and visual interpretation of the figures.

After a thorough review of both the manuscript and supplementary materials, we are confident that we have carefully implemented all the corresponding changes. If you find any issues, please inform us, and I will promptly make the necessary corrections.

Please find a point-by-point response to your comments in the following lines.

1. Introduction of ROS topic

While you yielded to the reviewer's comment to tighten the introduction and rely more heavily on the IPCC report, you did not remove all the deleted references in the list of references at the end of the manuscript (e.g., Bartsch et al., 2010). This also applies to references that were deleted in other sections (e.g., deleted SAFRAN references). Please make sure that your list of references is completely up-to-date in your next submission.

Updated. We have reviewed and corrected the bibliography, implementing the required changes.

I think it would also be useful to explicitly point to readers to the relevant IPCC report and then clearly highlight additional relevant research that has been published since then or is particularly relevant for your research. Please update your introduction accordingly.

Done. We forward the readers to the IPCC chapter on mountain areas (Hock et al., 2019). We have modified the introduction to:

“...However, climate warming, is altering mountain snowfall patterns (Hock et al., 2019) by decreasing the snowfall fraction (Sf) (Lynn et al., 2020), leading in some cases to rain-on-snow (ROS) events in snow-covered areas, where they did not occur (often) before. The upward temperature trend in mountain regions (Pepin et al., 2022) are likely to change future ROS frequency in snow-dominated areas (López-Moreno et al., 2021) ...”

“ROS has relevant impacts on mountain ecosystem dynamics (Hock et al., 2019).”

2. Color scales and inconsistencies in figures

The use of colors in your figures is still challenging. While you changed most (not all!) of the inappropriately used divergent color scales for interval variables, the fact that you are using the same color scale to display different variables is very challenging since it forces readers to reorient themselves in every single figure. For example, you use the same PuBlu color scale to display increments in temperature (Fig. 4) and ROS days (Fig. 5). At the same time, you use three different color scales to display temperature increments: black to red (e.g., Fig. 2), white to red (e.g., Fig. 6), and white to green (e.g., Fig. 9). This is not reader friendly!

In the end you need distinct color scales for the following variables:

- Aspect: Figs. 1 and 8
- Elevation: Fig. 3
- Increments of temperature: Figs. 2, 3, 6, 9, S1, S2, S3, and S5
- ROS frequency: Fig. 5
- ROS rainfall amounts: Fig. 7
- ROS ablation: Fig. 10
- Changes in seasonal height of snow: Fig. S4
- Changes in snowfall fraction: Fig. S4

Please choose distinct and appropriate (i.e., not divergent) color scales for each of these variables and then apply them consistently throughout the manuscript. This will make the paper much more reader friendly.

Done, now we understand it... Unfortunately, we did not interpret it well in our last revision. Now we have adjusted the figures based on your feedback.

Please note that in this version of the manuscript, we transformed Figure 4 and 6 from monthly values to seasonal to enhance the visual interpretability of our results. However, the monthly ROS frequency and ROS rainfall amount are still included in the supplementary materials (Figures S4 and S5, respectively).

3. Other issues with figures

There are several additional issues with figures:

- It would be best if the elevation rows were organized in the same order (i.e., higher elevations higher up in the figure) in all figures in the entire manuscript. This order is currently used in some of the figures (e.g., Fig. 2), but it is the reverse in other figures (e.g., Fig. 5).

Done.

- The different heights of the elevation rows in Fig. 2 (and other figures with the same layout) are problematic. Note that the lowest row actually does not have a scale for HS and given that the scales are different in each row, it is not possible to actually know what the depicted values are. Please create these charts in a way where each row has the same height and scale.

Done. We have modified Figure 2.

- Please have consistent font sizes in your figures. Compare, for example, Fig. 4 and Fig. 6 where the column headers have different font sizes.

Done.

- Elevation is presented in both columns (e.g., Fig. 4) and rows (e.g., Fig. 2). I think it would be best if there was more consistency in the axis of your figures. Hence, please create all figures in a way where elevation is presented in rows like in Figure 2. This means flipping the axis of Figs. 4 and 6. Please make sure to update the captions accordingly.

We have adjusted the axis orientation, presenting elevation in rows for Figures 4 and 6. Additionally, we have updated the captions accordingly.

- Fig. S4: You are still using divergent color scales for interval variables. As highlighted previously, this is not meaningful!

We have removed this figure as the information is already presented in Figures 2 and 3.

4. Language

There are considerable challenges with the English in this manuscript (some but not all noted below). Please ensure you have the manuscript proofread by the native English speaker ahead of resubmission to ensure the writing is free of grammatical errors.

The English has been carefully reviewed and all authors have thoroughly read and approved the manuscript. We utilized DeepL to correct grammar in certain sentences of the manuscript. We included a disclaimer:

“Disclaimer: We utilized DeepL (<https://www.deepl.com>) to correct grammar in certain sentences of the manuscript.”

However, if you still think it is necessary, we are open to engaging a professional English editor for further refinement.

5. Minor comments

- L126: The sentence about the FSM2 might read better as follows: “The full details of the FSM2 configuration used in the present study are shown in Table S1.”
Done.

- L141: Should be “first” (no firstly) or “originally”.

Done.

- L149: It should be “... in steps of ...”. Please adjust throughout the entire manuscript. When you refer to temperature increments, it should be “in steps of 1°C” and not “in steps of +1°C”.

Done.

- L202: Typo in sensitivity still exists.

Corrected.

- L209: Reword to “As shown in Figures S1 to S3, the role of” This makes it more obvious to the reader why these figures are referenced.

Corrected to “As shown in Figures 2, S1, S2 and S3, precipitation variability plays a moderate to low role in seasonal HS evolution”

- L227 and others: The caption of Fig. 2 in the manuscript was not changed as described in your responses to the reviewer comments. I find the caption in the responses better since it is more detailed: “... and different increments of temperature (colors) grouped by precipitation change and elevation (boxes).” Please properly implement the changes that you describe, and make sure the captions for the same type of figure are consistent throughout the manuscript.

Corrected to: “**Figure 2.** Seasonal (a) height of snow (HS) and (b) snowfall fraction (Sf) anomalies with respect to the historical climate period (1980 – 2019). Data are shown by different increments of temperature (colors) grouped by precipitation changes and elevations (boxes) ”

- L251: Reword the sentence that it does not start with a number as that is considered poor writing style. For example, you could write “At an elevation of 1500 m, the annual ROS frequency is ...”.

There are several other instances of this issue in your manuscript. Please change throughout.

Done.

Changed to: “The annual ROS frequency at 1500 m elevation for the historical climate period...”

- L331: This sentence is still unclear because small changes in frequency are detected despite/in addition/and (?) small increases in the amount of ROS rainfall. Also the opener “On the contrary” does not seem to make sense in this context as this sentence is not actually contrasting the previous sentence. Please rewrite to make the information more accessible to the reader.

Changed to: “... For most sectors and elevations, the ROS frequency and ROS rainfall amount typically increase during winter and early spring (Figure 8). The most important increases in ROS frequency and ROS rainfall amount are simulated at 2400 m. Conversely, smaller changes in ROS frequency are observed at elevations of 1500 m and 1800 m, particularly with large increments in temperature, despite an expected increase in ROS rainfall amount (< 10 mm/day). Similarly, during summer, ROS frequency generally decrease across all elevations due to severe warming and snow cover depletion...”

- L400: “In contrast to” would be better than the term contradiction.

Done.

- L420: “Thicker snowpack” would be better than “larger snowpack”.

Corrected.

- L428: Since the entire paper is about ROS, it is not needed in this heading.

Corrected.

- L435: While these sentences with brackets seem efficient, they are REALLY hard to read. Please reword and properly describe the information in full sentences. There are other instances of this in the manuscript.

Corrected.

- L580: Should be “at 2400 m”.

Corrected.