Comment on hess-2022-183
Anonymous Referee #1

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The authors present a study on the current and forecast snow conditions and their hydrological impacts in the Upper Salween River. They include two forecast scenarios that represent a range in possible changes to snowpack using a cryosphere-hydrological model.

General Comments:

The current study is well thought out, while being presented and organized in a clear manner. The results are important for the scientific community and beyond (water managers and water users within the basin), and this study could play a role in initially quantifying the types of changes that may occur in the future within the context of a warming climate. I would recommend the manuscript be published, after some minor concerns are addressed. The paper suffers from a lack of validation datasets at the relevant spatial and temporal scales. This is often the case with remote, data sparse, mountainous environments that are the subject of long-term snow research questions. The authors seem to creatively address those problems, but need to make some of the limitations of the validation datasets more clear. I will divide my comments into two categories: minor concerns and minor suggestions.

Minor Concerns:
- Line 148: This is the first time the SSP scenarios are mentioned. They are never defined and this is problematic for the study since it relies heavily on two of the SSP scenarios. Please briefly define the scenarios that are being used in this study and be clear about the differences between SSP126 and SSP585. This is important for readers that may be unfamiliar with these scenarios.

- Line 205: A limitation of this study is the model output resolution of 5km. In complex, mountainous terrain with high relief, a 5km grid cell introduces a huge amount of uncertainty and potential for inaccuracy, both for snow process modeling and for satellite snow remote sensing datasets. Can the authors address this scale issue in the discussion and add some references to important snow scaling literature related to complex mountain environments? What do the authors think would change in the results if they could model at a significantly higher resolution?

- Line 218-219: What type of evaluation did the authors conduct for the historical time period? How was the evaluation assessed and what metrics were used? They do not mention their methods in this paragraph (or anywhere in the publication?) and how they came to the conclusion that ERA5 was the best.

- Line 235: The delta method is mentioned here (and later in the publication) but never described. Please briefly describe this method for readers who are unfamiliar.

- Line 303: I've never seen a remotely sensed satellite temperature dataset used for validation in a snow modeling study. This does not mean using this dataset is invalid and please correct me if I'm wrong (and add some publication citations for clarity). The need for this validation dataset is likely due to the lack of other spatially extensive snowpack observational datasets, however it still seems a bit odd to me. I'm left wondering how this validation method/dataset performs at elevations in the Upper Salween River watershed where temperatures are most likely to influence snow processes? Also, how does this validation method/dataset perform during the months of the year that snowpack is accumulating and melting, rather than just looking over the entire 18-year time period?

Minor Suggestions:

- The title is awkward and a little unclear. I would suggest something more along the lines of "Hydrological changes to runoff in the Upper Salween River from forecast changes to snowpack under climate warming scenarios". This is just a suggestion.

- Line 19: The authors chose to abbreviate Upper Salween to US but this may be confusing for readers based in the United States, which is also often abbreviated to US. Consider USR for Upper Salween River using instead of US?

- Line 22: I would encourage the authors not to assume that everyone reading the abstract knows what these abbreviations (SSP126 and SSP585) mean without context or the full spelling.

- Line 51: I'm unsure what 'all walks of life' means in this context.

- Line 84: The sentence beginning on this line is long and complex, consider splitting apart for clarity.

- Line 99-100: Consider 'study area' instead of 'research object.'

- Line 101: This is vague, I am not sure what the authors mean by 'complex underlying surface.' Same with line 105 'underlying surface.'

- Line 144: Use 'observational' instead of 'observation'

- Line 322: Are there any stats that can quantify the 'very close' and 'slightly overestimated' claims here, thus bolstering your argument?

- Line 365, Figure 6: Using the off-white color to represent no snow and the blue color to represent snow is not easy to interpret here. Anytime white is used in a snow study it is
often interpreted as the presence of snow.

- Line 415, Figure 8: These figures are excellent and easy to interpret. However, the SSP585 line becomes difficult to see during the long-term portion of the figure in both (a) and (b). Consider changing the color of the trend line to clarify.
- Line 436, Figure 9: Again, excellent and intuitive figure. The only thing that needs clarification is the dashed vertical lines, I'm not sure what they represent.
- Line 474, Figure 10: In figure 10 (c) and (d) does the solid line represent snowfall? If so, that is not clear from the legend.
- Line 479: I am not sure what is meant by 'fluctuation range of the data'.
- Line 497: I think FSAC should be FSCA here.
- Line 500: I think 'ere' needs to be deleted.
- Line 605 (Fig14) and line 626 (Fig15): These figures are very informative while also being a little complicated to understand. My suggestion is to: 1) remove the seasonal average percentage stats from the figures and put them in a table and 2) separate out the third column as a separate figure that is reported alongside the new table. Then, the authors could group the SSP126 runoff figs and the SSP585 runoff figs into the same figure. In other words, Fig14 column 1 & 2 would be beside Fig 15 column 1 & 2 in a new Figure14. Likewise, Figure14 column 3 would be beside Figure15 column 3 in a new Figure 15. I think this would help simplify the experience for the readers.
- Lines 628 through 675: These paragraphs could be condensed for clarity and ease for the readers.
- Line 746: I am unsure what 'a lot' means in this context, consider quantifying it or maybe remove?
- Line 766: I am confused by the term 'at the edge' here, please clarify.
- Line 839: I am unsure of what is meant by 'massive continued snow melting' here.
- Line 857: I am unsure of what is meant by 'result in a weak balance' here.