

Interactive comment on “Validation of modeled snow properties in Afghanistan, Pakistan, and Tajikistan” by Edward H. Bair et al.

Anonymous Referee #2

Received and published: 31 August 2019

The authors present a study using three different models computing SWE for the Hindukush-Pamir region, as well as snow stratigraphy for selected locations and are able to compare point scale simulations to large scale datasets. The topic is of great importance (as they point out, the region has seen very little attention in the direction of snow even though it is understood to be a major driver of streamflow and important to understand droughts/floods in both Pakistan and Afghanistan) and generally very little field data is available or accessible. The main advancement of the study is the availability of a large number of snow depth measurements from the region.

I find the study (a) in general of great value for the community and The Cryosphere in its proposed scope, (b) covering an area that desperately needs more data analysis and (c) generally clearly written and of solid scientific quality. However I would like to see

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my major concerns I detail below addressed before I find it acceptable for publication.

Major concern:

I appreciate that getting field data as shown here is very hard to collect and once stored by on site staff, often difficult to impossible to obtain. That the authors managed to do so is impressive and I know the general hesitation of local institutions to provide any such sets. However I fear that this does not absolve authors of scientific studies to (a) ascertain the data quality and (b) if not provide then visualize the data to the reader. The authors themselves are cautious with the data quality (L216: 'appeared to be most reliable ...'). This warrants an assessment of the quality, how that is assessed, what the 'good' data looks like (incl uncertainty) and eventually how this data quality affects model outcomes in ParBal/SNOWPACK. AKAH has excellent staff and can be considered among the most reliable institutes in this area, but many of the stations shown (like the one in the Little Wakhan or north of Ishkashem on the Afghan side) are in areas hardly accessible at all and I wonder how this data was recorded at daily intervals and quality checked internally. I have checked the earlier paper and the report on the avalanche program and equally fail to find details there.

I also find it problematic to sell the story as a 'validation of models with measurements', as the snow depth measurements are used as an input for one model (ParBal, equally dependent on other remote sensing data but which I think is being understood as the 'validation data' here) that is then compared to another (SNOWPACK/ALPINE3D). This makes it difficult to appreciate where the advancement via the new dataset is and whether the point measurements are not lost in the general uncertainty of the satellite data. Additionally I find uncertainties of models inadequately addressed. The stratigraphy is shown as a single mean figure for all stations, with no further consideration of the spatial variability or at least a mention of it and I wonder whether the one line as an aggregate over all station locations does provide a trustworthy result. As a result the Conclusion becomes very brief and somehow lacking the essential take home message for further studies.

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And while I appreciate that a number of models were utilized, I think a clearer Figure 2 plus a longer Conclusion on the usefulness of all datasets/models would be prudent.

Minor comments:

Figure 1: Here and in the text (L86) you write ‘stations flow into the Indus/Amu Darya’. I get the meaning but I doubt that is technically a sound expression. ‘Catchments including stations in xxx drain into the xxx ...’

L93: ‘questionable’ – although I agree on the assessment, I think you need to explain your criticism rather than just throwing a lead without an argument if you want to mention this here

L103: replace ‘x’ with ‘times’ or reword

L110: I don’t understand how limited climate data would explain why the remotely sensed data from Smith&Bookhagen2018 are too low.

L243: ‘hr’ to ‘hour’

L269: the ‘Nuristan avalanche’ is not a commonly known event. You place a citation later in the text, consider placing that here instead with the description of the impact

Figure 2: I find the salad of arrows unnecessarily confusing – a number of them could be straight but have corners for no reason making it very hard to decide which path to follow to really get the main aim Figure 7: Remove ‘The white letters are ... codes’. Just the acronyms plus actual names are fine.

Figure 7: The video supplementary material is valuable, however I would also expect a discussion of the consistency/variability between the models in space, i.e. have a corresponding map that shows the average over the complete period or the total number of days the models actually simulate any SWE.

Figure 9/10: It is explained in the text but I believe the Figure still needs a y-label

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