

Review to Long-term firn and mass balance modelling for Abramov glacier, Pamir Alay

Summary:

The authors apply an energy and mass balance model for firn and ice to a glacier in High-Mountain Asia (HMA) using the almost 50-year record of meteorological weather station data (AWS) together with down-scaled reanalysis data from ERA5. There is no significant trend in the annual mass balance found, though differences in space and time exist.

There is a significant improvement of the manuscript compared to the initial submission. The current manuscript is easier to follow and much more streamlined, some unnecessary figures have been moved to the supplement. Clear answers and adjustments have been made and the restructuring was to the benefit of the overall quality of the work. However, there are still some more minor changes to make which fall in line with the previous comments.

General remarks:

Ask yourself again what does the figure show and why do you show it. Does it show relevant info or just proves that the model works (its not a model development paper)? For example, Figure 11 shows subsurface temperatures being too high in the model for June 2018. The plot is shown, the results about it are briefly mentioned, but there is not really a discussion linked to it. Why is there disagreement or not between model and observations. One could speculate about the effect of fresh snow fall albedo increase in the model, you mention that during observations it fresh snow often melts early, etc. I am wondering if during 4.2 the discussion, fig. 11 could be linked more to the discussion or else why is it shown for this particular time period (2018) or at all.

All correlation/regression plots show regressions of data points with larger modeled than measured SMBs (away from the line of equality) (Fig 6,14, S4). This is seams to be a systematic effect from the modeling. Could you comment on this, and mention and discuss it in uncertainty/discussion. Why is this observed? It is only briefly mentioned that the model does underestimate ablation as well as accumulation, but does it, or only extreme values?

There are still some vague statements for quantities: “a certain threshold” etc. Try to avoid those and provide numbers.

Specific comments:

Figure 5a: The colors are updated now from gray shading, which makes it easier to see, but from my understanding of how the plot is composed it still plots the later years on top of the earlier so if the maximum glacier extent was observed at a later time scale one cannot see the extent of earlier times? So the problem remains, could transparency solve this?

Line numbering refers to the markup version:

Line 26: Should it be singular? climates-> climate?

line 285 : “Liquid water is instantly distributed along the depth axis following a normal distribution until a maximum depth z_{lim} unless it reaches an impermeable ice layer before.” how big is z_{lim} roughly?

Line 334 value → valueS

Line 335ff: I am still wondering when you distribute precipitation over the entire day equally but the cloud cover not what effect this has. At least for days with precipitation shouldn't the cloud-cover be correlated with the precipitation. You reason for your choice of cloud cover distribution due to convection effects (“During the melt season, convection is a main driver of cloudiness and cloud formation mainly takes place along the mountain ridges (Suslov and Krenke, 1980).”). On non synoptic scale precipitation events, are you not expecting more in the second half of the day too? Would this play a role? As your albedo due to earlier precipitation on the day may be too high? Or are convective solid precipitation events (snowfall) rare? Your comment specifically also mentions the melt season, is this applied for the entire year – I assume yes, but its not 100% clear out of the manuscript.

Line 393 which monthly precipitation threshold value, provide a number

Line 480: It is not entirely clear what a stronger RMSE is, i.e. stronger wrong word, higher? But what is higher? What is the reference? Higher than bias? Higher than RMSE for winter/summer balance?

501 “, and mass loss through runoff “ . I would add an “and “

504 Change "other results" to “other (output) variables”

505: The sentence does not make sense, though I get what you mean: ... is analysed on a grid/mask corresponding ... for decade-wise updated glacier extents. Until the end of the hydrological year 1978, the entire model output is analysed corresponding to the glacier area of 1975.

531-535 There are multiple formatting issues with the parenthesis (and which units do the values provided here have? kg/m^2 (mm w.e.)

621: One of the parenthesis is too much or there is one too little

707: “EBFM reproduces the observations satisfactorily, as shown by the the comparison of modelled and measured surface mass balances (Fig. 6) and especially the comparison of subsurface properties (Figs. 10, 11). How does 4b fall in line with that, with annual biases around of up to 0.7m w.e.?”

Figure 4b: Caption: I am not sure what is meant with bias of surface accumulation and surface ablation. Are those the values of measured accumulation and ablation over the entire glacier over the entire year or for ablation area? i.e. what is exactly compared here? You do not have a continuous height record at your measurement stations I guess?

Regarding the Supplement:

Supplement: Are the figures S2, S3 necessary? Can you really see something there? Does it make more sense or is it available as downloadable data?

S 14. Does it make sense to mention in the caption again what composes the alternative forcing? For better understanding