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Hydrology and Earth System Sciences Discussions

Interactive comment on "Simulation of high mountainous discharge: how much information do we need?" *by* B. Schaefli and M. Huss

Anonymous Referee #3

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General Comments

This manuscript presents an innovative approach of multi-criteria-based model structure improvement and model calibration for glacier fed high-mountain runoff simulation. I agree with previous referees that the main contribution, is 'how to use' the two criteria to obtain a model that performs correctly in the presented case, where accumulation and melt can compensate and thus easily produce ambiguous results. But that the contribution to 'how much information is needed' is not as systematically followed as the title may suggest and hence there are no strong conclusions on the 'how much'. The manuscript is well worth publishing after A) clarifying and sharpening the focus in this respect (and consequently the conclusions) B) improving the structure and pre-

sentation of the Methods section, which I found a bit confusing and C) addressing a number of smaller specific comments listed below.

Specific comments

Introduction

1) The introduction would benefit from a clearer problem/research gap statement as well as short reviews of a) the combined use of point observations and integrated continuous data and b) the elimination of compensating sources and sinks in models through successive structural improvements in general. Some of the introductory material under 3.1 could be moved to the introduction.

2) This would then also allow to lead to clearer specific objectives for this paper, which are lacking in the introduction of the present manuscript.

Case Study

3) I agree with referee 2 that a map would be useful. It could also indicate the elevation bands used (as no other information on e.g. area and elevation range of these is given).

4) Section 2.1 last paragraph, section 2.2 last sentence and entire section 2.3.: if I understand correctly these modeled mass balance data were only used for the final comparison with the results obtained here (Fig.6). They should be presented together in one section (validation data?) and the part of 2.3. could possibly be shortened. Their use must be introduced more clearly. Fig. 6 cannot be introduced here if it is to remain Fig.6.

5) The model/optimization descriptions in Sections 2.2 and 2.4 are not specific to the 'case study' (heading). They should be part of Section 3 '. . .and Model'.

Merging Data and Model

6) The heading alone may suggest to a browsing reader something like a climate reanalysis or a mass balance reconstruction from a combined model and observation

database. Perhaps consider 'Modeling approach' or simply 'Methods'. 'Merging' appears in one of the subheadings anyway and needn't be duplicated.

7) 3.1. I suggest to integrate the lead paragraph and some general aspects of MOO and sequential merging into the Introduction and here introduce it directly followed by the context of this particular study.

Results

8) Methods and Results section need to be separated more clearly. 4.1 are only methods and should be presented there.

9) p.8679 line 18: I suppose the authors mean 'fudge factor'. The entire term should be quoted and the paragraph fits better into the discussion section.

10) p.8680 line 11 I cannot see that ' there is still too much discharge in spring. . ..'. Check statement to reflect what one 'sees' in the figure and choose a figure that shows what you claim.

11) 4.3 Again, the lead paragraph to me belongs into the methods section.

12) 4.6 contains quite a lot of 'discussion' which makes it difficult for the reader to distinguish and remember the actual results. I suggest to consider leaving comparison with the literature to the discussion section.

13) p. 8683 last sentence. The authors claim that water retention in firn is the most plausible explanation for the spring peak that wasn't observed. Without displaying temperature or discharge components it's difficult to judge, but I would expect any first discharge peak in the river in spring to be attributable to snowmelt from the lower elevation areas (the ablation area where there is no firn) and particularly from the unglacierized part of the catchment. Was there any data to constrain snow accumulation of the unglacierized part (ca. 50% of the basin area according to the numbers in section 2 and hence substantial)? The reason could also be an overestimation of snow or the not-accounted-for influence of aspect and slope at this time of the year. Melt rates but

also water retention and refreeze in the remaining snow cover likely play a greater role than that in firn. The ablation area where there is firn is probably rather small and quite high up. If I count days correctly (please use date on axis) this over estimated 'spring event' was as early as March or beginning of April in 1977 and a systematic miss of the first spring melt seems not to be the case in subsequent years (Fig.6c). Could it also have to do with consequences from the extreme dry year 1976 (refill of depleted storage in talus, moraines, englacial drainage, pro-glacial lake, etc. after the dry year 1976)?

14) I found section 5.3.2 a bit redundant and too general. What do the authors mean by 'assimilated' in the last sentence?

Figures

15) Figures need to be reorganized. Use multi-panel figures only where direct comparison is facilitated (either for graphs with same axes (=one axis for all) or for same type of information displayed (= one legend for all)). Otherwise they confuse more than facilitate information.

16) Figure 2: unclear to me which is which and where is winter and where is annual net bal. Boxplots may indeed be a better choice.

17) Fig. 3: use one legend for all graphs (change in symbols/colors is confusing). The caption should first state what is shown, then what the specific case is for a) and for b). This should also be corrected for some of the other captions, some of which are a bit confusing.

18) Fig. 4: the two graphs look exactly the same? Correct one shown?

19) Fig.6: use 'date' on all time axes, not 'day since an arbitrary starting date'. I suggest to separate d and e, use the same x axis and add a y=0 line to d).

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 8661, 2010.