

Interactive comment on “Exploring uncertainty in glacier mass balance modelling with Monte Carlo simulation” by H. Machguth et al.

Anonymous Referee #2

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This paper gives an interesting application of Monte Carlo method in order to assess the uncertainties in modeling glacier mass balance at the point on the glacier due to uncertainties in model parameters. The analysis is detailed and comprehensive, and the results are important contribution in the field of mass balance modeling. It also opens new questions which hopefully will be answered in the future work. I recommend publishing the paper with minor revisions.

My comments (for discussion) are the following:

Pg.451, lines 15-17: Temperature and global radiation are mentioned as the two key inputs in the mass balance models, however precipitation is also a key input (also given as an output from climate models). A comment on this would be appreciated.

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Pg. 455, section 3.2: It is not completely clear to me from the text if Pcorr is applied uniformly at all the stations or is tuned for each station individually.

Pg. 457, lines 10-15: It is a bit 'suspicious' that systematic error for temperature in only 0.3C. One would expect larger (maybe a degree) systematic error (please see the comment of Ruzica Dadic). Additionally, later on page 466, line 10-13 it is written that T_a at the AWS is calculated from T_a at Corvatsch, γ_{Ta} and the difference in altitude from Corvatsch and AWS. Does it mean that the error in the lapse rate is incorporated in the error of T_a which is used as an input to the model? If yes, the error in T_a should definitely be larger than 0.3C and is not independent from the error in γ_{Ta} .

Pg. 457, lines 22-25: Since P is tuned by means of Pcorr it would be good to include Pcorr also in the sensitivity analysis. It is of interest to a mass balance modeler how the uncertainty in Pcorr propagates in the uncertainty of the mass balance and how significant is this uncertainty when compared with the uncertainty in P. This question probably requires more analysis and should definitely be considered in the future work. This issue is important in modeling mass balance for glaciers with no mass balance observations and no weather station in the vicinity. In these cases the correction parameter for precipitation probably plays important role, especially if input data is used from reanalysis data sets or regional climate models.

Pg.461, section 4.2.8.: How is the snow albedo treated in the model and why is there no sensitivity analysis for it?

Pg. 465, line 10-15: The model response is evaluated to different levels of uncertainty in $S_{in,meas}$ and T_a . Since the mass balance model is most sensitive to the prescribed uncertainties in P and γ_{Ta} (Table 2) why not using also these parameters in the evaluation? It would be especially interesting to test the uncertainty to P since this variable is a common output in climate models.

Pg. 469, section 6.4: I suggest shortening or even excluding the introduction sentences

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(line 1-6) since they are already mentioned earlier in the text.

Pg. 469, lines 20-22: The sentence: 'In other words,...values are sensible.' does not read clear enough. Reformulation (just make it simpler) would be appreciated.

Table 2: It would be more effective for the reader if these results are plotted (e.g. bar plot), or if the results are sorted starting with the parameter with the largest uncertainty.

Pg. 470, Conclusions: Considering the future work mentioned in the text I would suggest additional question to be explored: What is more important/significant in the mass balance modeling (i.e. what is the mass balance more sensitive to): tuned parameters (as Pcorr in this method) or errors in the input variables/parameters? Application of Monte Carlo method is an efficient tool for providing this analysis.

Interactive comment on The Cryosphere Discuss., 2, 447, 2008.

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2, S251–S253, 2008

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