



Interactive comment on “Ice volume distribution and implications on runoff projections in a glacierized catchment” by J. Gabbi et al.

T. V. Schuler (Referee)

t.v.schuler@geo.uio.no

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This manuscript (MS) builds on an extensive dataset of ice thickness measurements and investigates the effect of different extrapolation methods on the total ice volume and its implications for future meltwater projections. The finding is that different extrapolation methods result in different runoff projections in terms of peak discharge and its timing. As such, this is not surprising. Understanding the ice volume as a storage term in the water balance, it is obvious that differences in the volume stored will of course affect runoff projections. Nevertheless, it is important to have this effect quantified and the contribution of this study is the message that caution is to be used when projecting runoff from glacierized catchments.

However, a number of shortcomings has been identified which need to be fixed before the MS may become published. These shortcomings are divided in two groups, one related to the structure a of the MS and the second one to the presentation of the material. The MS should be structured to more clearly separate between description of methods, results and their discussion. Also, the methodology should be described such that the MS is self-contained; in its present form, the methodology is not reproducible without consulting a number of (cited) publications.

Criticism: In general, the MS provides very little information on GPR data and the associated uncertainties although these data are the backbone for the analysis presented here. For instance, the blurr of the bottom reflection in Fig2 indicates that uncertainties related to locating the reflector may be considerable. Also, as indicated in Fig3, some airborne GPR profiles have been ground-truthed. What were the results of the comparison? Further, I am missing an analysis of how the uncertainties of the measurements and those of the interpolation method affect the final ice volume and the related runoff evolution. The MS explores only the differences between the interpolation methods, but not the implications of uncertainties inherent even in the best interpolation scheme. However, this is something that I expected from the title of the MS. To keep the MS at manageable length, less focus may be given to the uncertainties in the forcing. As mentioned above, the MS in its current state is not self-contained. Sec 4 provides too little information on the methodology applied (GERM, delta-h approach etc). Although GERM and the delta-h approach are established methods (and referenced), self-containment requires adding a few more lines describing the principles behind, the assumptions involved and the parameters to be determined. The structure needs to be revised, to more clearly separate between description of methods, results and their discussion. This is particularly needed for Sec4 where sec 4.1 describes the methodology, but sec4.2 ff dives directly into the results. Description of results should use more careful wording, acknowledging that these are model results but not the definite truth. For instance, on P7516, L18ff: 'The changing climate. . .will affect. . .' could be put into perspective by adding an 'According to our model. . .'.

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In my view, provided that the MS is revised to rectify the mentioned shortcomings, it would add an interesting aspect to the discussion of how to project meltwater discharge from glacierized basins.

Minor points:

P7508 L13: '...that reliable estimates ARE essential', essential for what?

P7509 L15: ...'runoff projections', state the timescale of the projections (e.g. Until 2100)

L20ff: references to 'Chapter 3' etc...a paper is not subdivided in chapters but sections

L26: 'the impact of inaccurate estimations...' all presented estimates are inaccurate better talk about 'uncertainty' associated with each method.

P7510 L8: it is inconsistent to present the result of your ice volume estimation in the site description. This belongs to sec3!

L13: 'the local climate' apparently refers to a given location in your domain and should be identified

L27: 'More details ...are shown in Table2.' WRONG: Table 2 does not provide more details

P7511 L2: '...since...the 1980s' → since 1982

L3: the 'water conducting line' should be specified in Fig 1

L3/4: 'Runoff measurements...' ..is actually incorrect. Discharge is not measured but inferred from water level records etc.

L13: '...significant bedrock reflections' → clearly detectable reflections

L19: reference to Fig 3 before Fig 2 is referenced → change sequence of the figures?

L23: ...'straight profile ..'this sentence is difficult to understand. Was the GPR record not tied to a GPS record?

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L24: 'spatial filters' .why spatial?...do you mean special filters?

P7512 L10-13: I do not agree in that the 'reflection is clearly visible' in Fig2, instead it appears blurry.

L16: 'the literature DESCRIBES different...'

L20: '...we APPLIED the Ice-Thickness Estimation Method...'

L24/25: 'The ice flow is converted into ice thickness' sound more magic than scientific, consider: 'Ice thickness is derived from interting Glen's flow law...'

L26: 'This factor has to be calibrated...' How? To conserve the cross-sectional area occupied by ice, or to conserve maximum ice thickness, or..? there are many possibilities, please provide more detail here.

P7513, L1: 'We have USED our...TO identify...'

L1: stick to a consistent terminology: use either 'calibration factor' or 'correction factor', not both.

L5: reference to Table 4 before Table 3 is referenced, -> change order of Tables according to the sequence how they are referred to in the text.

L8: reference to Fig3: fig3 doesn't show volumes, better refer to Tab 4

L18: remove 'only' (subjective rating)

L24/25: '...applications TO...are described BY...'

Here, it would be helpful to know more about the model: the principles behind, the assumptions involved and the parameters used. A table presenting the values of the calibrated and preset parameters is necessary to fully evaluate the model performance. Here, the authors have made assumptions on the relationship between meteorological variables and glacier mass balance, on the response of glacier geometry to changes in mass balance and on the generation of runoff.

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P7514, description of model forcing: please state the spatial resolution of the domain and the modeling time step. From the context it becomes clear that the model was applied to a historical period 1900-2009 and a projection from 20XX -2100, this should be clearly indicated here.

L7: concerning lapse rates: what is the temporal resolution of lapse rates? Same as model time step, seasonal or a constant? Provide more detail.

L8ff: 'precipitation time series ...are computed...' how? Provide more detail.

L18ff: this sentence is hard to grasp. Add more information on this procedure.

L21: '100 different time series'. explain your motivation for doing so and provide more information on the procedure. Did you conduct 100 realisations of the model using the different series as input? The mean/median of the ensemble of results is then considered as the most likely situation for the projection?

P7515, L1-5: again, a table presenting all parameter values would be helpful.

L5ff: Glacier evolution: some words about the methodology and its use are required before diving into the results

L13: '...in total ice mass' (not 'masses')

L14: 'Independent of the size...' (erase 'ly')

P7517 L1: '...decrease...BY...' (not 'of')

L24: 'In contrast...', there is no contrast. Link the sentences for instance using 'Further...'

L26: '...The runoff FROM...' (not 'of')

P7518 L2: '...the ice thickness to be DETERMINED...' (not 'delineated')

L2: '...quite accurately'. Do you have a sense of the accuracy? Can you quantify it? (for instance by comparison to ground GPR)

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L7: ‘...five different ice thickness DISTRIBUTIONS’ (not ‘distribution estimation procedures’ which is awk)

L7: add a reference to Fig8

L17: MACRO-scale (not ‘marco’)

P7519 L9: ‘The different ice volume distributions significantly affect...’

L13: reference should be to Fig10 instead of Fig6

L20: remove ‘specific’

L22: ‘...AT low altitude’ (not ‘in’)

P7520 L4/5: ‘...emphasizes the importance of...’ importance for what?

L7: ‘Inaccurate estimations...WILL CAUSE...’

L19ff: ‘...sensitivity of the correction factor on the ice volume..’ the opposite is true: the ice volume estimation is sensitive to the correction factor!

L23: ACCURACY (misspelled: accruacy)

P7521 L4: ‘geometry of the bed topography’ is a pleonasm. Use either ‘geometry of the bed’ or ‘bed topography’

29ff: ‘melt parameters are sensitive for runoff projections’, the opposite is true: runoff projections are sensitive to changes in the runoff parameter values.

P7522 L4: ‘temperature distribution has a big impact...’ one more reason to better explain how the temperature was distributed! (more details about lapse rates etc...)

L28: ‘...further increases the complexity of the accumulation pattern’

L29ff: this is a model description and should be placed in the corresponding section

P7523 L7: ‘...by which ... were determined’

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L10ff: present the result of volume estimation after the first sentence of this paragraph

L13: this is not a prophecy but a model result. put into perspective by adding an 'According to our model. . .'

L20: 'Reasons . . . ARE. . .'

Reference list: the citation formats for the following entries is quite unusual and should be rectified: BFE, CH2011, IPCC, RST, VAW

Tables:

Tab4: the uncertainty presented with the values for V(1), what does it represent? (standard deviation, mean error. . .?) where does it come from?

Also the presented value for the correction factor c: is that a mean value for the glacier? Can you provide an uncertainty value for c?

Figures:

Fig1: caption: '...The inset on the bottom RIGHT...' (not 'left') '...shows the location of the catchment WITHIN SWITZERLAND'

Fig2: why are the elevation values on the y-axis negative?

Fig4: what does the shaded area represent? The median (line) and the 5% and 95% percentiles of the ensemble of model results?

Fig7: caption: '...AVERAGED over. . .'

Fig7 label the individual figures with a-e

Fig9, caption: '...derived FROM the GPR measurements. . .'

Fig10, caption: refer to Section 5 instead of Chapter 5

Fig10: the runoff projection for V5 starts at a lower level than the others, suggesting a smaller glacierized area. Later on the runoff related to V5 is the highest and reaches

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its peak last, indicative of a larger ice volume than the other estimations. Smaller area but larger volume—> overestimated ice thickness? Any comments on this?

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 9, 7507, 2012.

HESSD

9, C2778–C2785, 2012

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