Hydrol. Earth Syst. Sci. Discuss., 8, C1735–C1738, 2011
www.hydrol-earth-syst-sci-discuss.net/8/C1735/2011/

Hydrology and Earth System Sciences Discussions

Interactive comment on "Quantifying the contribution of glacier runoff to streamflow in the upper Columbia River basin, Canada" *by* G. Jost et al.

M. Zappa (Referee)

massimiliano.zappa@wsl.ch

Received and published: 25 May 2011

General remarks:

This paper addresses a recently very fashionable aspect of practical application of hydrological modeling experiments, namely the quantification of glacier contribution to total runoff (Huss, 2011). This topic is quite "hot" since administrations and hydropower need to know how much water might not reach the rivers if glaciers would disappear. Some approaches have been presented recently that make use of both glaciological and hydrological information for calibration of hydrological models (e.g. Stahl et al.,

2008; Konz and Seibert, 2010 and Schaefli and Huss, 2011).

The proposed "guided GLUE" approach is a very slight variation of the approach presented by Stahl et al. (2008, for which by the way I also served as a reviewer). The current application is focused on a much larger river basin, does not infer climate change scenarios, present verification with respect to snow water equivalent and, foremost, present simple but appropriate considerations of uncertainty in the model parametrization. Another novel aspect is the use of evolving glacier areas during calibration (Page 4982, lines 10-12).

The results section is rather straight-forward. I like the quantification and declaration of possible errors in the estimations of SWE with snow pillows.

The discussion is on the same line of the results and presents only one (own) reference to current research in this topic. The paper ends with two sentences rephrasing the first lines of the introduction and with some well known perspectives concerning possible climate change implications (see: Barnett et al., 2005 and Bloeschl and Montanari, 2010).

Major Issues

1) The novelty of the simulation exercise is rather limited. I acknowledge that using changing glacier areas in the control period is a new aspect, but the authors make no effort to show, that this is really helping the calibration process by making a calibration WITHOUT updating the glacier areas. So, please demonstrate in your reply the added value of glacier areas updates for the calibration of your model. This might be key feature giving your paper visibility in the scientific community

2) The authors stated in the first lines of the introduction that glaciers might vary they contribution to total runoff according to the current weather situations. I don't find in the results much about proxies indicating the relation between climate and contribution of glacier melt to total discharge (e.g. see Zappa and Kan, 2007). The stakeholders

of such studies would surely appreciate to learn under which special conditions they have to expect a smaller or larger portion of glacier melt in the runoff hydrographs.

3) Soft glaciological information (7 to 9 km3 volume change) is used to condition the calibration. I wonder if similar information is available also for (parts of) the verification period. This would demonstrate whether the selected parameter sets really suits as predictor for glacier melt contribution.

Minor comments:

1) The references presented supporting the quality of the HBV-EC (Page 4984, line 19) are difficult to obtain.

2) Scale issues in comparing models and SWE observations are a permanent problem in quantitative verification of hydrological model. The authors handle this with two lines (Page 4991, lines 3-4). You might expand on this starting from the work by Bloeschl (1999).

Final considerations: The manuscript is for sure a valid effort on conceptual glacio-hydrological modeling. The novelty of the study is rather limited. The manuscript sounds more like a re-arranged technical report to a stakeholder, than a new insight for science. However, the presented setup has surely potential to be used for research. The authors should just address the gap in science they highlighted ("Changing glacier surfaces during model calibration") and present a proof, that this is a useful approach to consider when applying hydrological modeling over several decades. I would be happy to re-consider this manuscript after major revision in this direction.

Best regards

Massimiliano Zappa

References:

Barnett, T. P., Adam, J. C., and Lettenmaier, D. P.: Potential impacts of a warming

climate on water availability in snow-dominated regions, Nature, 438, 303–309, 2005.

Bloeschl, G. and Montanari, A.: Climate change impactsâĂŤthrowing the dice?. Hydrological Processes, 24: 374–381. 2010.

Bloeschl, G.: Scaling issues in snow hydrology. Hydrological Processes, 13: 2149–2175, 1999.

Huss, M.: Present and future contribution of glacier storage change to runoff from macroscale drainage basins in Europe, Water Resour. Res., doi:10.1029/2010WR010299, in press.

Konz, M. and Seibert, J.: On the value of glacier mass balances for hydrological model calibration, J. Hydrol., 385, 238–246, 2010.

Schaefli, B. and Huss, M.: Integrating point glacier mass balance observations into hydrologic model identification, Hydrol. Earth Syst. Sci., 15, 1227–1241.

Stahl, K., Moore, R. D., Shea, J. M., Hutchinson, D., and Cannon, A. J.: Coupled modelling of glacier and streamflow response to future climate scenarios, Water Resour. Res., 44, 1–13, 2008.

Zappa M, Kan C: Extreme heat and runoff extremes in the Swiss Alps. Natural Hazards and Earth System Sciences, 7:375-389, 2007.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 8, 4979, 2011.