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Discussions

Interactive comment on "Diagnostic calibration of a hydrological model in an alpine area" *by* Z. He et al.

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General comments

This paper presents a step-wise calibration approach for a precipitation-runoff model (THREW) applied to a case study in the Tianshan Mountains (China). The paper is well written and structured. The identification of the different dominant runoff processes for the step-wise calibration is very simple (a separation by date to distinguish snow-influenced periods from others, two separations based on air temperature) but sound and certainly transferable to other case studies. The literature review of the paper should however be strengthen to support the viewpoint of the authors that "the signatures in common use today insufficiently exploit the hydrograph information in the time

dimension or in relation to the dominant runoff generation mechanisms" (p. 1256).

Another potentially weak point of the study is the fact that only 4 model parameters are calibrated. Accordingly, the overall model performance, after calibration, is rather low. This should be discussed in more detail.

In conclusion, the paper is suitable for publication in HESS after major revisions considering namely the detailed comments hereafter:

Detailed comments

Abstract

- Does not give any details on how the process separation is achieved and no conclusion on how the method performs

Case study

- It would be useful to shortly discuss the hydrological regime and tell the reader why it is qualified as "alpine"
- What do you define as "storm" water (p. 1260)? Runoff that is resulting from rainfall that has fallen during this event? How do you know where the water actually comes from?
- Resolution of the used MODIS data (p. 1260)?
- I do not understand how the glacier area is derived

Methodology

- It should be mentioned somewhere that ice melt has a separated degree-day factor (now mentioned only in calibration section, p. 1269)

- Should ice melt periods not be identified also on the presence / absence of snow?
- Model: how is the water balance closed if the snow-covered area is updated based on observed MODIS data rather than computed from simulated snowfall and melt?
- P. 1270: I do not understand the sentence on low influence of infiltration on stream discharge; where does the baseflow come from?
- Interception p. 1270: it does not only occur on trees (see the work of H. Savenije); how can interception be negligible in a catchment where precipitation is locally as low as 180 mm?

Results

- The calibrated degree-day factor for snow is extremely low (0.9 mm/C/day), is this realistic for other discharge periods (other than the one used for calibration) or should you have a time-variable degree-day factor?
- The obtained Nash values for daily discharge are very low for such a regime with a strong annual cycle (Schaefli and Gupta, 2007). A value of 0.79 for the calibration period is already low, 0.61 for the validation period is very low (in my experience, a model that predicts half of the observed flow every day still can still give a Nash of 0.6 for such regimes in the Alps); it is also visible from Fig. 10b that the model seems, overall, to not do a very good job. Any more detailed comments on this (considering also the cross-validation)?
- P. 1274: it is argued that the calibrated parameter dimension is sufficiently low to have identifiable parameters; but the low number of calibrated parameters leads to such a low degree of freedom that the model cannot do a good job, any comments on this?

- P. 1274: why should the step-wise calibration method be less sensitive to the chosen calibration data than an automatic method?
- What criteria did determine the number of calibration iterations (p. 1271)?
- It would be nice to have an idea of the model sensitivity rather than a single simulation; given the low number of calibrated parameters, this should easily be possible and would help understanding the model behavior better.

Conclusion

- Given that the proposed method only separates between rainfall and snow / ice melt driven processes, why would it a priori be limited if applied to catchments with Hortonian overland flow?

Literature review

- The literature review seems incomplete with regard to step-wise calibration in general and of precipitation-runoff models for high mountainous catchments in particular. The paper by (Schaefli et al., 2005) presents a step-wise calibration method with a similar objective as in the present paper. There are certainly other papers that proposed such a step-wise approach (check e.g. (Huss et al., 2008) or the work of (Pellicciotti et al., 2005).
- There is one reference (van Straten and Keesman) for the ability of regression-based calibration methods to identify the roles of various model components (p. 1255). Could you give a more “precipitation-runoff modeling” oriented reference?
- FDCs have also been used for model calibration, see (Westerberg et al., 2011)

- There are probably many more references for step-wise calibration and calibration on dominant runoff mechanisms (rather than just Boyle et al. 2000). It would be interesting to have a more complete discussion of the statement that “the signatures in common use today insufficiently exploit the hydrological information in the time dimension or in relation to the dominant runoff generation mechanisms.”. (p. 1256).

Other detailed comments:

- P. 1256: what is the measurement dimension “M”? Is it equal to the number of time series? If yes, why?
- Table 3 does not highlight the calibrated parameters

References

Huss, M., Farinotti, D., Bauder, A., and Funk, M.: Modelling runoff from highly glacierized alpine drainage basins in a changing climate, Hydrological Processes, 22, 3888-3902, 10.1002/hyp.7055, 2008.

Pellicciotti, F., Brock, B., Strasser, U., Burlando, P., Funk, M., and Corripio, J.: An enhanced temperature-index glacier melt model including the shortwave radiation balance: development and testing for Haut Glacier d’Arolla, Switzerland, Journal of Glaciology, 51, 573-587, 2005.

Schaefli, B., Hingray, B., Niggli, M., and Musy, A.: A conceptual glacio-hydrological model for high mountainous catchments, Hydrology and Earth System Sciences, 9, 95 - 109, 10.5194/hessd-2-73-2005, 2005.

Schaefli, B., and Gupta, H.: Do Nash values have value?, Hydrological Processes, 21, 2075-2080, 10.1002/hyp.6825, 2007.

Westerberg, I. K., Guerrero, J. L., Younger, P. M., Beven, K. J., Seibert, J., Halldin, S., Freer, J. E., and Xu, C. Y.: Calibration of hydrological models using flow-duration curves, Hydrology and Earth System Sciences, 15, 2205-2227, 10.5194/hess-15-2205-2011, 2011.

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