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Hydrology and Earth System Sciences Discussions

Interactive comment on "Multiobjective calibration of the MESH hydrological model on the Reynolds Creek Experimental Watershed" *by* A. J. MacLean et al.

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Summary:

The authors present a nice and interesting study dealing with multi objective calibration of the MESH model for joined predictions of stream flow and snow water equivalent in the Canadian Reynolds Creek water shed. I feel that a joined treatment of water and energy cycles in catchment is one key to achieve progress in the catchment hydrology, especially to understand which landscape attributes control "catchment functions" (drainage, energy exchange, accumulation of water) in different contexts. I thus like the

proposed study very much. The proposed combined objective function (combination of Nash values) is simple but nevertheless effective. The presented results provide clear evidence that the combined objective function allows assessment of a pareto optimal solutions that allows both a good match with of stream flow and on average the snow water equivalent.

Evaluation: Despite my sympathy for the presented study I feel that the authors miss several opportunities for interpreting/presenting effects of different calibration variants on other processes of the hydrological cycle (especially the energy balance). I further miss a critical evaluation of using the Nash with strongly seasonal data, and of the model itself. The study is further too brief neither the parameters that have been calibrated nor the ranges of the values are presented or discusses. I thus recommend acceptance after major revisions that should address the following major and minor points to optimise the study for the readers.

Major points

- Coupling of land surface models that rely on coupled 1 D Richards eq. and soil heat eq. with what the authors call "a routing scheme" is not that straight forward. For instance the land surface model of the French weather service has been recently coupled with TOPMODEL. The land surface model regards matric potential as driving force for soil water flows, TOPMODEL neglects this totally and regards processes of the u-zone as infinite sequence of steady states. This incompatibility causes problems in merging soil moisture dynamics in both modes (from my own experience). Please provide details about the routing scheme implemented in MESH, the soil moisture accounting and explain how this problem was solved.

- NASH values are not the best choice when dealing with strongly seasonal data as you do here, because the average annual cycle is deterministic! The true base line for a prediction better than the mean is not a zero NASH but the average annual cycle of SWE and stream flow (This is why the non calibrated model explains 19% of the

streamflow and 40 % of the snow pillow). Model goodness should thus be compared to the NASH that is achieved by using the average annual cycles

- I think the authors miss the opportunity of discussing the effect of different calibrations on more processes and state variables (especially energy fluxes and soil moisture). The Pareto optimal solution can be regarded as more trust worthy to estimate the internal dynamics in the catchment. Why not discussing these effects? I think the readers will learn whether internal dynamics will change for different setups. This is important to assess models structural uncertainty.

- Just reporting that 80 parameters were calibrated is, for, me not really a quality criterion of a model study. Which parameters where the sensitive ones, which could be set to default values. Which of those parameters are in principle observable, which not? Please remember that we have something like a PUB problem.

Minor technical points:

Study site

- Please provide additional data on soil hydraulic parameters, soil distribution etc. give a brief characterisation of the climate setting with numbers (this is an Earth system journal)

- Same for the water balance Model calibration

- Snow is described by a sophisticated model that contains aging, the full energy balance, liquid water balance? What are the sensitive parameters here? Snow albedo?

- Did you indeed calibrate plant parameters like root depth, if so did you find realistic values consistent which the morphology of the plants? Please discuss this?

- How did you constrain you parameter sets, just referring to other studies rises could give the impression that this is not really new. Please provide the details that are necessary for the reader to reproduce how you achieved your results.

- Please avoid jargon like standard interpolation techniques and give precise information how you interpolated input data, whether the underlying methods have been tested by a cross validation test for the predictive power.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 2121, 2010.