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Hydrology and Earth System Sciences Discussions

Interactive comment on "Towards improving river discharge estimation in ungauged basins: calibration of rainfall-runoff models based on satellite observations of river flow width at basin outlet" *by* Wenchao Sun et al.

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General comments:

The authors present a methodology for calibration of hydrological models in ungauged basins by introducing river width instead of discharge as cumulated reference at the basin outlet. The methodology uses published and established methods of determining river widths from satellite imagery and empirical relationships between river discharge

and width and combine them in a well known approach of model calibration and uncertainty assessment (GLUE). Through the GLUE method they showed that model calibration using river widths is possible, but also identify uncertainties in parameter estimation.

In general I appreciate the presented work pretty much, because it has the potential to fill the data gap that poses a major problem in hydrological modeling in ungauged or just poorly gauged basins. In fact it is about time that a work like this is published, because the potential of satellite imagery for river width determination, both in terms of precision and timely coverage, has been increased largely in the past decade.

I can follow the argumentation and the proofs given, so there is no major general criticism from my side. However, I would like the authors to elaborate the possible applicability and limitation of the approach in more detail. This should be done by a general characterization of river cross section profiles. The authors touch this briefly in the discussion by stating that the approach works even for cross sections with a low width exponent, but general characteristics of cross sections are not introduced properly (section 2.1). Typical cross section profiles would be:

- High banks -> low b-value
- Low banks, wide floodplains -> large b-value
- Dikes or high banks which can be overtopped-> inhomogeneous rating curve if overtopped

These typical cross section could be illustrated by sketches along with characteristic discharge-width relation graphs ion section 2.1. By doing so, the applicability and limitations of the approach could be discussed more comprehensively, allowing for better assessment of the applicability of the method for interested readers and their study

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area. Also, by showing the actual cross section profile at Pakse (high and comparatively steep banks, see http://ffw.mrcmekong.org/stations/pks.htm) in this context, it would be easier to follow the discussion about the general applicability.

Specific comments:

- In the introduction and discussion it should be mentioned, that remotely sensed inundation extends are meanwhile frequently used in the calibration of hydraulic models, as e.g. in the paper of Montanari et al. 2009. The proposed method is thus an analogy for hydrological models.
- P. 3810, bullet point 1: It should also be noted that the hysteresis in the Q-H-relation and thus also in the Q-W-relation is also not considered (as in all empirical descriptions of the relation).
- P. 3814, section 3.2: Why is the reach for determining effective river width not extended to the location of the gauging station? This is not intuitive, so better explain.
- P. 3818, section 4.2: In the discussion about the estimation of river discharge and the validity of this method, it should be noted, that hydrological models I general have problems in simulation correct flood peak discharges. This has many reasons, like the temporal and spatial resolution of the rainfall input and the model, calibration relative to mean discharges (as implicitly using Nash-Sutcliffe performance), improper representation of hydrological processes, threshold behavior of the water switching to different processes in extreme events, etc.. Considering this and the fact that with the proposed model mostly the flood peaks are not simulated well, the discussion of the validity of the model cold be even more positive. For this purpose, it would also be beneficial to present a model simulation calibrated o the actual discharge time series. Therefore I would like the authors

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to include such a simulation using the same rainfall input. This doesn't necessarily have to be done be a full GLUE procedure, a "standard" single objective calibration without uncertainty analysis would do.

- P. 3819, l. 9-15: please include a figure showing both Q-W-relations to illustrate the difference and note that the regression in Figure 4 is also uncertain. This can be illustrated in a figure showing the relation from the regression with uncertainty bounds and the relation from the "best" model calibration. It would be recommendable to put all this in the present Figure 4, but move it to this section.
- P. 3820, l. 26-27: Again, here it could be mentioned that the simulation results are not perfect because of the calibration against river widths, but also for other reasons. But therefore the simulation calibrated against discharge needs to be included.

Technical issues:

- P. 3808, l. 10: "correct" should replaced by "an appropriate", especially when using GLUE for calibration.
- P. 3808, l. 14: better write "It can be expressed as" instead of "it is"
- P. 3808, l. 24: "river width can be formulated as", in order to indicate that an empirical relationship is used instead of hydrodynamic equations
- P. 3811, l. 1: it should read "relative root mean square error". Also, because RMSE is the usual acronym for root mean square error, I would suggest to use another acronym, e.g. rRMSE.
- P. 3818, l. 26: it should read "... is valid, the method can be reliable"
- P. 3819, l. 22: please write "... proposed method could even be applicable..."

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Interactive Comment

- Figures 4,6,7: please add vertical grid lines for better visualization and comparison between figure (6 & 7)
- Figures 6 & 7: harmonize the graphical representation of the uncertainty bands for the different likelihood thresholds
- Figure captions 6,7,8: it should read "... from parameter sets with associated likelihood values..."
- Figure caption 8: please change to "... efficiency of simulated discharge for..."

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 3803, 2010.