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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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Review Summary

Sun at al. presented a new approach utilizing river width from remote sensing sources as a means to parameterize rainfall-runoff model predicting river discharge in ungauged basins. The proposed approach is sound and novel by breaking from earlier attempts to use remote sensing data directly to infer river discharge. The paper would

be more convincing if the authors repeated the same parameter optimization exercise with observed discharge and demonstrated that the “behavioral” HYMOD parameter sets are in the same range as the ones resulting from the optimization for river width. This test would answer questions that the authors themselves raised on page 3817 line 20.

In general, I would argue that limiting the plausible parameter values based on some understanding of the geography of the modeled basin is probably a better approach than letting GLUE identify widely different parameter value combinations resulting the same hydrographs. The equifinality of the different parameter combination does not mean that each combinations are equally good. Rather indicates the lack of information to pick the unique right one.

I recommend the paper for publication after moderate revision.

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Notes

Page 3804, line 1: Rainfall-runoff models should be able to provide reasonable discharge estimates (with accurate climate and precipitation forcings) without heavy tuning. The problem with lump parameter models is that the parameters loose their physical meaning, which in return needs to be calibrated by other means.

Page 3805, line 1: The reference bellow, would be more appropriate instead of Fekete and Vörösmarty, 2007. Vörösmarty, C. J.; Askew, A.; Barry, R.; Birkett, C.; Döll, P.; Grabs, W.; Hall, A.; Jenne, R.; Kitaev, L.; Landwehr, J.; Keeler, M.; Leavesley, G.; Schaake, J.; Strzepek, K.; Sundarvel, S. S.; Takeuchi, K. & Webster, F. Global water data: A newly endangered species AGU EOS Transactions, 2002, 82, 54,56,58

Page 3806, line 15: Ideally one would choose physical parameters that can be measured or estimated without calibration. Calibration appears to be a last resort, which

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turns the understanding expressed as a physical model into a black box model that may have good skills in reproducing hydrographs but little or no skills explaining the hydrological processes.

Page 3807, line 1: I think, the strength of this paper lies on using river width from remotes sensing for calibration instead of tracking flow regimes.

Page 3808, line 25: Recent paper by Dingman (2007 sited by the authors later) showed that these empirical formulas are consistent with power-function approximation of riverbed cross-section combined with the Chezy or Manning channel flow equation. By taking the present study to incorporate river channel shape instead of the empirical relationship between discharge and river width would allow the authors to make their results physically more meaningful.

Page 3809, line 13: The authors should carry out their parameter estimation both for Q = f (I, nu) and W = g(I, theta), where the difference between nu and theta are the added parameters translating discharge to river width. By doing so, the authors could demonstrate that the two optimization yields similar “behavioral” solutions for the parameter sets in nu.

Page 3811, line 8: I strongly dislike the notion that two vastly different parameter set would yield equally good simulations. While the resulting discharge (or river width) might be the same one of the parameter set (or both) must be completely wrong and give the right result for the wrong reason. I think, the parameters should have some range of plausible values as a function of river basins properties (topography, network density, etc.) which should narrow the range of parameter values.

Page 3813, line 20: The authors don’t have to make this assumption if they tested both Q = f(I, nu) and W = g(I,theta).

Page 3815, line 5-14: The power-function approximation of the river channel actually can explain the sensitivity of river width to changes in discharge. When the exponent

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of the power-function is high the river channel shape approaches U-shape (rectangle) when the river with might barely change with discharge. When the exponent is one, the river channel is triangle so river width and depth changes equally with discharge. When the exponent is less than one, the river with changes more rapidly then depth as discharge changes. Combined cross-sections of braided rivers can be approximated with single power-function river channel with exponent less than one (explaining why Smith et al. 1995 found braided streams better targets for remote sensing).

Page 3815, line 22: The purpose of three quick flow tanks instead of one with different decay coefficient is unclear.

Page 3818, line 1: The uniformity of the model parameters that could lead to "good" model performance is actually disturbing. This uniformity seems to indicate that the parameter estimation is overdetermined, so some other information would be needed to properly parameterize HYMOD.

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