Hydrol. Earth Syst. Sci. Discuss., 7, C2199–C2204, 2010
www.hydrol-earth-syst-sci-discuss.net/7/C2199/2010/

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.

Wenchao Sun et al.

wsun.uy@gmail.com

Received and published: 9 September 2010

The authors thank Mr. Fekete for his constructive comments and suggestions. In the text below, we try to answer all the points motioned by Mr. Fekete. If the audiences consider that it is not enough, please do not hesitate to contact with us.

Response to the general comment

The authors agree that to demonstrate the results of calibration using observed discharge data would make the proposed method more convincing. The calibration based on daily observed discharge data of 1995-1998 was carried out under GLUE, using the Nash Efficiency as likelihood, the value of 0.75 as the threshold, and the same 50, 000 parameter sets being randomly generated. In the revised version of the manuscript, this part will be added.

The figure in the supplement shows the posterior parameter distribution of HYMOD by calibration against discharge. The comparison with calibration against river width indicates that the ranges of parameter Cmax resulting from both calibrations are roughly same (within the range of 100-500). This is one positive indication obtained from this comparison.

However, for the other four parameters, we can not draw such conclusion because in both cases, parameter sets with same relatively "good performance" span the whole parameter prior ranges. What we can tell is that for calibration based on discharge, the parameter values maximize the Nash Efficiency are located in some ranges that are narrower than the prior ranges, but not very distinctive due to equifinality. For calibration against river width, only parameter sets that have relatively good performance in both river width and discharge simulation can maximize the likelihood value, as shown in the Fig. 8 of the manuscript, which partially explain why the number of identified behavioral parameter sets is much less compared with calibration against discharge.

The equifinality mainly results from the fact that the calibration data are not enough to identify a unique best parameter set. It would be even worse for calibration against river width, because the amount of information for calibration is much less than continuous discharge data. However, calibration against river width is meaningful for rainfall-runoff modeling in ungauged basins.

Response to specific comments

»Page 3804, line 1: Rainfall-runoff models should be able to provide reasonable discharge estimates (with accurate climate and precipitation forcings) without heavy tun-

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

ing. The problem with lump parameter models is that the parameters loose their physical meaning, which in return needs to be calibrated by other means.

Response: The authors agree with this statement about lump parameter models.

»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

Response: After reading the paper recommended by Mr. Fekete, we agree that this paper is more appropriate that the originally cited paper.

»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 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.

Response: We also believe that, ideally, the physical parameter models should be chosen, and calibration may lose the physical meaning of the model. In the revised manuscript, this point will be stated clearly.

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

Response: Thank you very much for helping us to clarify the strength of the proposed method.

»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

HESSD

7, C2199–C2204, 2010

Interactive Comment

relationship between discharge and river width would allow the authors to make their results physically more meaningful.

Response: We have also considered using the method of Dingman (2007) to improve the hydraulic relation at the basin outlet. This would require that the river cross-sectional geometry is known, which may need field survey at the cross-section. The proposed method is designed for ungauged basins that no ground information about hydraulic condition at the basin outlet is available. Therefore, the empirical relation is treated as a last solution for such situation.

»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.

Response: The parameter estimation for both Q = f (I, nu) and W = g(I, theta) have been carried out as being mentioned in the response to the general comment.

»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.

Response: For two quite different parameter sets with same simulated discharge, without further information about the basin, it may be difficult to judge which one correctly reflects the situation of the target basins. We agree that the identified parameter values should be narrower than the prior range. But even for calibration using discharge, in many cases, the available observations for calibration are insufficient to avoid equifinality. In the revised manuscript, the term of "equally good simulation" will be changed

Full Screen / Esc
Printer-friendly Version
Interactive Discussion
Discussion Paper

into “equivalently accurate simulation”.

»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).

Response: The likelihood computed based on the performance of width simulation is used to define the degree of accuracy of river discharge estimation, which is based on the assumption being mentioned. This statement may help the audience to having a better understanding of the proposed method.

» 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 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).

Response: Theoretically, the range of the exponent is 0 to 1, which is an indicator of the sensitivity of river width variation to the changes of river discharge. In the revised manuscript, the meaning of the exponent will be explained more clearly.

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

Response: In our opinion, the reason of designing three subsequent quick flow tanks with same decay factor is trying to increase the nonlinearity of the system, at the same time, to keep the model structure simple (with only several parameters).

»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.

Response: We agree that HYMOD is less properly parameterized for calibration based on river width than based on river discharge, and with some other information, the parameterization could be improved. However, the proposed method is designed for applications in ungauged basins. It is supposed that the only available information of basin outlet is satellite observations of river width.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/7/C2199/2010/hessd-7-C2199-2010-supplement.pdf

---

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