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Hydrology and Earth System Sciences
Discussions
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Interactive comment on "Improvement of hydrological model calibration by selecting multiple parameter ranges" *by* Qiaofeng Wu et al.

Anonymous Referee #1

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Overview

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This study touches upon the problematic of obtaining inadequate calibration results in hydrological modelling as a result of inappropriate parameter ranges. To address this issue the authors present a new approach to select parameter ranges based on probability distribution characteristics of the parameter space. The methodology is divided in three main steps: (i) determination of the probability distribution of the calibrated parameter values, (ii) adjustment of the initial parameter ranges of each parameter individually by finding the ranges of maximum and minimum probability density for a given cumulative frequency, and (iii) resolving the impact of the adjusted parameter range on other parameters and keeping the modified range only if it has a positive

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impact on the calibration of the other parameters.

In order to demonstrate the application of the proposed methodology the authors calibrated the Xinanjiang model for the Chaotianhe River catchment. Out of 10 model parameters that needed to be calibrated, the authors found that 3 parameters follow a normal distribution and the other 7 an exponential distribution. They then proceed to constrain the parameter ranges following the proposed approaches for each of the distributions and test a number of cases involving different combinations of parameters kept at the initial ranges and having optimized ranges. Finally, the authors conclude that the proposed approach make model calibration more effective.

General comments

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This manuscript presents a new methodology to determine adequate parameter ranges in order to improve calibration results in hydrological modelling. The topic is suitable and interesting for the Hydrology and Earth System Sciences readership. I have particular comments on the interpretation of the results, the magnitude of the impact of the proposed technique on the model calibration results, and the language. I think that the manuscript has a potential to make a good contribution to the subject area of hydrological modelling and I recommend that it should be accepted after moderate revisions based on the comments listed below.

Main comments

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1) Probability distribution functions considered in the study. In this study, the authors propose a method to constrain parameter ranges for parameters that follow uniform, normal, and exponential probability distribution functions. These are the probability distribution functions that the case study model parameters reportedly follow. Some of the claims are debatable. For instance, parameters CI and Kc are reported to follow

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normal distributions (page 7, line 29) based on the following statement (page 7, line 25): "It is obvious that the box and whiskers are symmetrical and the length of whiskers is longer than that of the box [...].". Looking at Fig. 5, however, the whiskers are not symmetrical and, on the upper side, not longer than the box, suggesting that the ranges of these parameters do not follow a normal probability distribution. Therefore, the method used to constrain the ranges of these parameters might not be the optimal, potentially changing the results of the study.

2) The authors report that parameter range selection has a direct impact on calibration efficiency and propose a new method to improve model calibration (page 1, line 12). The reported results, however, indicate that the improvement in the calibration efficiency by the proposed methodology is quite modest. For instance, in Fig. 9 different cases involving different combinations of parameters keeping the initial range and others having the "optimal" range are compared. The model efficiency different between case I (all the parameters set at the initial ranges) and any other of the considered cases is of the order of 0.002 at best. This suggests that the benefits of using the proposed technique are small.

3) The language should be improved to make the manuscript easier to understand and more compelling. More specifically, the following aspects should be revised: verb tenses (e.g. page 3, line 23-24: "single parameter is selected" - "correlation and sensitivity were estimated"; page 6, line 15: "The index Rc was quantified" instead of "The index Rc were quantified"), spelling errors (e.g. page 6, line 13: "contribute" instead of "contributes"; page 9, line 25: "of" instead of "pf"), and sentence structure (e.g. page 9, line 15 "[...] parameters [...] are of high sensitive to Ens"). I would strongly recommend the article to be checked for language.

Specific comments

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1) page 4, line 28 and page 6, line 2: "plenty of tests". The text suggests that the

authors defined their sampling size and cumulative frequency value through a process of trial and error. Since this might affect the subsequent results I think that evidence should be provided to support the authors' claims.

2) Page 8, line 34: "[...] there is considerable improvement [...}". "Considerable" is a vague word, please provide a quantitative measure of the improvement. Similar problem in page 8, line 12. Please revise the results section to ensure that no vague words are used.

3) Page 9, line 24: Seven cases are investigated with different combinations of parameter ranges. What is the rationale behind the chosen combinations? Please specify.

4) Figure 1: The chosen color scale makes the figure difficult to read in black and white. Please consider modifying it to facilitate reading the figure in printed form. The elevation units should be "m a.s.l." instead of "m". The lowest elevation in the catchment is reported to be 19 m below the sea level; is that so?

5) Figure 2: Please correct "cure" in the figure caption.

6) Figure 5: Since the figure represents normalized parameter values on the y-axis, it would be more informative to constrain this axis between 0 and 1.

7) Table 2: please provide units for all the parameters. In the case of dimensionless parameters indicate so.

8) Table 2, 3, 4: In order to facilitate the readability of the different tables it might be convenient to order the parameters in the same way in all the tables.

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