

## ***Interactive comment on “A comparison between parameter regionalization and model calibration with flow duration curves for prediction in ungauged catchments” by D. Kim et al.***

### **Anonymous Referee #1**

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This study compares two regionalisation methods for runoff predictions: the traditional spatial proximity and the model calibration against regionalised flow duration curves. I found this study has a very limited contribution to the predictions in ungauged basins (PUB). The major reasons are as follows:

1. There are numerous studies carried out by using various methods for PUB. The hydrological modelling uses spatial proximity, physical similarity and regression to regionalise its calibrated parameter sets to ungauged catchments. There are several studies that used flow duration curve methods for runoff predictions (Shu and Ouarda, 2012; Zhang et al., 2015), which just use observed runoff and catchment attributes to predict runoff time series, but does not need to involve any hydrological modelling.

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This kind of research is totally ignored by the authors. These researches use the three steps to predict daily runoff: (1) building FDC method (geostatistical methods, statistical methods, etc); (2) estimating flow quantile based on some assumptions; (3) predicting runoff time series. The predictions results are very impressive (see Zhang et al., 2015). 2. It is not surprise at all to see the calibration against regionalised flow duration curves performs worse than the traditional spatial proximity approach for runoff time series predictions since it does not include any runoff timing information, which is the key for runoff time series predictions. 3. The sample number used here is too small. There are only 45 catchments used to evaluate regionalisation skill. Therefore, it is hard to get a generalised conclusion. Moreover, the authors only picked up 28 with good calibration of GR4J and FDC, making the sampling number extremely small. 4. The objective function. The selection of objective functions has very important implication on the conclusions. The authors used the classic NSE for hydrological modelling calibration/regionalisation. It will be inevitable that the predictions from spatial proximity regionalisation are better for high flow, but poorer for low flow. For a comprehensive evaluation, an objective function that compromises high flow and low flow (i.e. Box-Cox transformed streamflow) should be used.

Based on the above-mentioned reasons, I do not recommend this manuscript to be published in the prestigious hydrological journal: HESS.

Follows are specific comments: 1. Introduction. It is not comprehensive. Lots of methods used for building FDC in ungauged catchments are not introduced. Lots of studies using FDC to predict runoff time series are ignored (see the above-mentioned are just some examples). Lots of spatial proximity regionalisation studies are not included. The authors should have a comprehensive literature review from ISI Web of Knowledge. 2. It is very confused for the streamflow gauges used. The authors state that the 45 streamflow gauges used in this study are with negligible regulations (river diversion and dam operation), but they also state that “... operationally recorded at 16 multi-purpose dams for the Water Resources Management Information ...” Is it really all the

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gauges are with negligible regulation? 3. Are all gauges not nested? Please clarify. 4. Cross-validation and regionalisation. I am not against the cross validation (2011-2015 for model calibration and 2007-2010 for model cross validation). For regionalisation, I suggest to use the full period of dataset. Bury in mind, there are only nine years data for each gauge. 5. GR4J requires precipitation and potential evapotranspiration for model inputs. It is not clear how the potential evaporation is calculated. 6. Objective function. To have a comprehensive evaluation of these two methods, please also include a Box-Cox transformed streamflow objective function. 7. First paragraph in section 3.3.1. Please include more references for the three regionalisation approaches. 8. Equation (4). How is the constant  $3.171 \times 10^{-5}$  derived? 9. The methods mixed with results. Half of section 4.2 should be moved to methodology 10. Use all gauges for regionalisation. Please use all 45 gauges for the regionalisation. It makes no sense to me to exclude the 17 catchments with low NSEFDC ( $<0.80$ ). You can setup prerequisite for PUB. It is not fair for another approach. 11. Figure captions. It is hard to follow figure captions. Please spell out all the abbreviations. I spent lots of time to figure out these abbreviations.

References: Shu, C., Ouarda, T., 2012. Improved methods for daily streamflow estimates at ungauged sites. *Water Resour. Res.* 48, W02523. <http://dx.doi.org/10.1029/2011wr011501>.

Zhang YQ, Vaze J, Chiew FHS, Li M, (2015). Comparing flow duration curve and rainfall–runoff modelling for predicting daily runoff in ungauged catchments. *Journal of Hydrology*, 525, 72-86.

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