hess-2015-53 Author's Response to Anonymous Referee #1

"Large-scale hydrological modelling by using modified PUB recommendations: the India-HYPE case" by I.G. Pechlivanidis and B. Arheimer

We would firstly like to thank Referee #1 for his/her interest to our paper, and for expressing a positive opinion on the significance of our investigation, and recommending the paper to be eventually published in HESS.

Referee #1 provided useful comments, which will allow us to submit an improved manuscript and we do agree to add some more material to the paper. We suggest to insert a new subsection at the end of the Discussion as "5.4. Catchment functioning across gradients", in which we will show the benefits from applying the same hydrological model in multiple catchments. We will then add an example of the knowledge we gained from modeling 6000 catchments across the entire subcontinent. We will insert two figures showing the spatial patterns of flow similarities based on model results. We hope that this will address the referee's quest to provide more hydrological insights of the entire subcontinent and illustrate the usefulness of multi-basin large scale modelling.

The figures will illustrate: 1) how we improve our understanding of the hydrology and the spatial variability of flow responses (based on flow signatures), and 2) the flow characteristics in the hydrological regions across the subcontinent. To make the figures, we have extracted daily discharge series from every single subbasin and calculated 12 flow signatures (Mean annual specific discharge (mm yr^{-1}); Range of Pardé coefficient (-); Slope of FDC (-); Normalised low flow (-); Normalised high flow (-); Coefficient of variation (-); Flashiness defined as 1-autocorrelation (-); Normalised peak distribution (-); Rising limb density (-); Declining limb density (-); Long term mean discharge (m^3/s); Normalised relatively low flow (-)) for every single subbasin. We then clustered all 6010 subbasins based on their flow signature similarity; applied a *k*-means clustering approach within the 12-dimensional space. Following a silhouette analysis, we identified 6 different classes of varying size. We did this clustering analysis on two steps of the model setup, i.e. steps "Prior", and "Regional" (final parameter values); names correspond to the model calibration steps in Figure 9 of the manuscript.

The discrepancies of the two figures (Figure A1) show what we learned going from a median KGE performance of 0.16 to 0.64 (which was asked by Referee #1). We then present the range of the 12 flow signatures in each cluster (see Figure A2) to show the functioning across gradients (as requested by Referee #1). We will add an analysis of dominant flow signatures for each of the clusters in the text of this new subsection. We think that this additional material/analysis will considerably improve the manuscript and its scientific values, and hope that the editor approves these changes for the final version to be published.

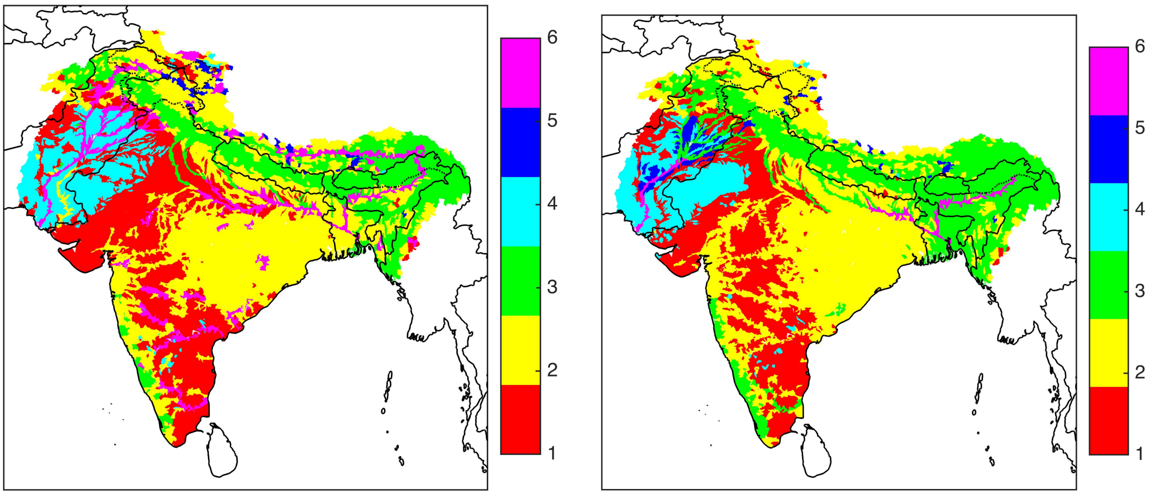

Figure A1. Subbasin clusters based on streamflow signatures at different stages of model setup: a) Prior, and b) Regional. Names correspond to the model calibration steps in Fig. 9.

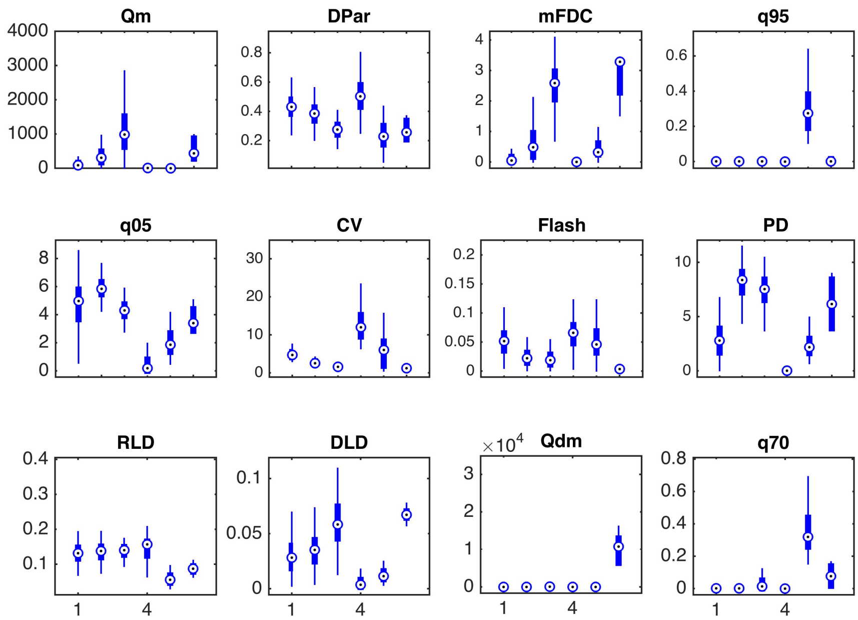

Figure A2. Distribution of signature value for each cluster (after the regional calibration step). Qm - Mean annual specific discharge (mm yr^{-1}); DPar - Range of Pardé coefficient (-); mFDC - Slope of FDC (-); q95 – Normalised low flow (-); q05 – Normalised high flow (-); CV - Coefficient of variation (-); Flash - Defined as 1-autocorrelation (-); PD – Normalised peak distribution (-); RLD - Rising limb density (-); DLD - Declining limb density (-); Qdm – Long term mean discharge (m^3/s); q70 – Normalised relatively low flow (-).