Hydrol. Earth Syst. Sci. Discuss.,
doi:10.5194/hess-2015-499-RC1, 2016

Hydrology and Earth System Sciences
Discussions
Open Access
EGU

Interactive comment on "Downscaling GCM data for climate change impact assessments on rainfall: a practical application for the Brahmani-Baitarani river basin" *by* R. J. Dahm et al.

Anonymous Referee #1

Received and published: 23 February 2016

General comments

This study explores changes in precipitation over the Brahmani-Baitarani river basin (51 822 km^2) in India using three GCMs runs from CMIP5 and two basic bias-correction methods (delta change and linear scaling). Two key challenges that the study is addressing are the low station density and the lack of dynamically downscaled climate simulations. This paper provides interesting insights into challenges faced in regions of low data availability in the context of impact modeling. It could formulate general recommendations on the selection of bias-correction methods in those regions, but to

Printer-friendly version

Discussion paper

achieve this goal, I consider that further research and major modifications are necessary.

The authors rule out bias-correction methods more complex than delta change and linear scaling because of low data availability. The fundamental question this choice poses is: “What are the data requirements for different bias-correction methods, and in particular, how long should time series be?”. I argue that this question should be carefully addressed by the authors on the basis of i) the existing literature (e.g., Rajczak et al. (2015) and references therein), ii) general statistical considerations (e.g., how many data points are required to constrain the distribution of the tails, which can then be used for bias-correction) and possibly, iii) by conducting further numerical experiments (e.g. illustrate the risks of applying complex bias-correction methods with insufficient data by highlighting suspicious/unrealistic features in postprocessed time series).

Overall, the way the authors deal with extreme events lacks consistency. On one hand, they exclude a large fraction of the available bias-correction methods because of low data availability (P8L6-10). On the other hand, they use the same observations to fit a Gumbel distribution and estimate rainfall intensities associated with return periods of up to 100 years (P10L10, I suggest by the way that the authors provide uncertainty estimates of the intensity of these rare events). If this can be done, why not use this information to bias-correct GCM simulations? Similarly, the authors acknowledge that the postprocessing methods they selected “only concentrate on the correction of monthly mean rainfall amounts and can thus affect our analysis of changes in extreme rainfall indices”. I certainly understand that they are limited by the data, but I urge them to critically assess and discuss how much can be learned about extreme events when methods such as delta change and linear scaling are used. It is really a matter of communicating meaningful information, especially when the results are then used for decision making.

One way to overcome the lack of data is to make stronger links to processes leading to floods (see the related discussion on the consideration of misrepresented process

when bias-correcting models in Addor et al., 2016). It means identifying those processes (e.g. storm surges described on P10L16-23 or specific aspects of the monsoon), evaluate how they are captured by the models, and then, instead of simply looking at how precipitation is projected to change, look at how these processes are projected to change. Their scale is probably large enough to be captured by GCMs. If this link is made, then the low station density in the region would be less problematic and the study could be a major breakthrough.

Specific comments

The authors "focus on three models that nearly span the full range of annual mean rainfall projections available for India" (P4L19-20). Please also comment on how well they cover the range of projected changes in extreme events, which are also a main focus of the study.

P5L18-19: Why are the authors using 30 years for the reference period and then 40 years for the future conditions? This should be harmonized.

Section 2.3: Please briefly explain how orographic effects were accounted for when generating the APHRODITE data set. Were measurements from the three CWC rain gauges also used to produce the APHRODITE data set? Which period is covered by the three gauges? The authors write that "gauge observations could not be used as reference since they do not overlap with the full GCM baseline period" (P7L6-7), please develop.

P12L5-15: The differences reported between the two observational datasets are indeed large, it is in particular clear from Figure 4, although it is not completely surprising since the CWC curves are produced using solely three stations for 51 822 km^2. Yet I think the observational uncertainty should be better accounted for and displayed, as it influences the bias-correction and thereby the projected changes. Also, I understand that the "climatological data set" is APHRODITE, if it is the case, I would state it more clearly.

Technical corrections

P5L20-21: “Almost all CMIP5 models show good performance for surface air temperature simulations averaged over South Asia and the Indian Sub-continent”, please add a reference.

P4L9: need

P6L11-12: I suggest using “wide” instead of “full”

P6L19: What is Monsoon Asia?

P7L20: Out of curiosity: were RCMs ever run over India, for instance under SRES emission scenarios, and if yes, please provide references and discuss what this revealed.

P13L14: 900mm/month?

General comments on the figures: I encourage the authors to use colors, that is free of charge when publishing in HESS, and it would make their figures easier and more enjoyable to read. I recommend using full names in the captions instead of acronyms (e.g. MRD, HRD) and using a larger font size.

Figure 11: this figure definitively needs uncertainty bounds.

Suggested references

Addor, N., Rohrer, M., Furrer, R. and Seibert, J.: Propagation of biases in climate models from the synoptic to the regional scale: Implications for bias adjustment, J. Geophys. Res. Atmos., doi:10.1002/2015JD024040, 2016.

Rajczak, J., Kotlarski, S., Salzmann, N. and Schär, C.: Robust climate scenarios for sites with sparse observations: a two-step bias correction approach, Int. J. Climatol., doi:10.1002/joc.4417, 2015.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., doi:10.5194/hess-2015-499, 2016.