

Interactive comment on “A trading-space-for-time approach to probabilistic continuous streamflow predictions in a changing climate” by R. Singh et al.

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REVIEWER: This is a very interesting article and provides another avenue for estimating the potential impact of changes in temperature and precipitation due to climate change on the hydrologic response of catchments. In particular, the approach applied to five watersheds across a range of aridity levels allows the authors to demonstrate that more arid catchments are more likely to show a greater response to a change in either temperature or precipitation compared to more humid catchments. The parallels drawn between the prediction in ungauged basins problem and the potential impacts

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of climate change problem are also useful insights.

RESPONSE: We thank the reviewer for the very positive assessment of our manuscript. We agree that the heterogeneity in the response across watersheds is an important finding.

REVIEWER: One quibble is that I don't really see this study as a trading-space-for-time approach. The differences observed between the catchments shows the value of considering a range of catchments, which are separated in space and show different aridity indices. However, the responses of these catchments are derived by examining responses over 5 different validation periods, and by examining the impacts of a range of artificially applied temperature and precipitation scenarios. I do not see then how the approach trades space for time, except in the analogies drawn between the climate change impact study and the prediction in ungauged basin study. Perhaps the title of the paper could be modified to reflect this?

RESPONSE: Previous studies have indeed used temporal variability of climatic conditions to transfer information in time. THIS IS, HOWEVER, NOT WHAT WE DO IN THIS MANUSCRIPT! We assume that parameters of a hydrologic model require calibration (or some type of conditioning), and we assume that we require model simulations for climatic conditions that are more extreme than those in our observational record. So how do we calibrate/condition a model in climatic conditions that we have not observed? This is where we use the similarity between transferring in space and time. We derive equations that show how certain streamflow characteristics (signatures) vary in space. We then assume that the climatically controlled spatial variability (e.g. on runoff ratio) across watersheds is similar to the one we would observe locally in a single watershed. This is the trading space for time idea. We hence calibrate (condition) the watershed model on the spatial regression equation of the signature for each climate scenario to account for the impact of climate on model parameters! We believe that this is an extension to the approaches proposed previously and that the use of a Bayesian framework enables us to consider uncertainty in the process as well.

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REVIEWER: However, either with a new title or the original, I recommend publication of this paper in HESS. It is very well written and does not require any modification to make it more comprehensible to the reader.

RESPONSE: We will re-write the abstract to make sure that the trading-space-for-time idea is highlighted more strongly.

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