

Response to Reviewer #1

We thank Reviewer #1 for her/his time and feedback on the manuscript. We notice that the reviewer mainly seems to be confused about the objective of the paper – we added some text into the introduction to clarify that. Reviewer’s comments are in black, and our response is in blue.

This paper deals with the two-step regionalization of a rainfall-runoff model:

- The first step lies in regionalizing various flow “signatures” (i.e. statistics which reflect part of the behavior of the catchment);
- The second step lies in using the regionalized signatures in order to constrain the search for an adequate parameter set.

In this paper, the search is made based on a Bayesian framework, and the reader gets lost in the details of the Bayesian methodology, and loses sight of the regionalization methodology. The methodology seems sound, the problem lies in the way the paper is written: the reader gets lost in the details of a statistical procedure, and we end up the paper with conclusions which only refer to details.

The objective of the paper is not to describe/develop a regionalization methodology per se, but to look at one of the important aspects of a probabilistic regionalization procedure that arises due to dependent information sources. This is clearly stated in the manuscript title and introduction by saying ‘(...) we introduce and test a method that considers multiple regionalized signatures, explicitly accounting for the signature error correlations. (...) The objective is thus to explore how to get fuller value out of a set of regionalized information than has been achieved in past applications.’ (Page 5393, lines 7-13).

We addressed the specific reviewer’s concerns below.

For example:

- the authors use a first step of synthetic signatures, in order to put aside part of the uncertainty. But where is the detailed analysis of the difference between the synthetic case and the actual case? Authors’ reply: Detailed analysis on how synthetic case compares with actual observed streamflow data for pairs of signatures is given in section 3.2.2, in particular in the second paragraph (page 5403, lines 4-16) and in Figure 2. For multiple signatures, detailed analysis is given in section 3.3.2, more specifically in the second paragraph (page 5405, lines 18-28), third paragraph (page 5406, lines 10-19) and last paragraph (page 5406, lines 20-23) of this section.
- the focus of the paper is put on the correlations between the different signatures, while there is no discussion of the actual value of the signature-based regionalization. Before worrying about the correlations, we should be at least sure that the two-step procedure is worth being followed (where is the demonstration that it is better than the one-step procedure?) Authors’ reply: Regionalized signatures have been widely used to constrain the prior range of streamflow simulations with large success (e.g. Yadav et al., 2007; Zhang et al., 2008; Bulygina et al., 2009). All these studies refer to the issue of correlations, but none of them propose a way to formally address it. Therefore we feel we are justified in focusing on the correlation. We do also illustrate the value of the signature approach in terms of the range of performances achieved through e.g. Figures 3, 4, 5 and 6, albeit not in comparison to alternative regionalization approaches. This is covered in earlier papers and in our Introduction.

I believe there is a lot of interesting matter in the research that produced this paper. But the first author definitely needs help in order to organize her results in a way to make them understandable to a wider audience. I would personally prefer a less ambitious analysis based on catchment similarity: how do correlated signatures allow to find the most similar catchments. The application to PDM could come after.

Authors' reply: We appreciate the reviewer's suggestion that highlights a potentially interesting research topic. However, we believe that addressing important, previously unaddressed questions concerning the regression approach to regionalization is an important research area. We recognize that the paper may take time to understand for readers unfamiliar with Bayesian conditioning; and we have tried to include enough description of the method, including appendices, and the key references, to help readers. We are sure the paper will be easy to follow to a wide readership with interests in model conditioning (see Reviewer 3 comments).

Minor remark: please justify how you have selected the catchments that you use from the entire MOPEX dataset.

Authors' reply: In section 2.3.1 we provide two references that describe the motivation for choosing the selected catchments: Almeida et al. (2012) and Almeida (2014). To highlight clearly the reasons for our choice of catchments, in the revised manuscript we have added the following text in Section 2.3.1:

"It has proven difficult to derive regionalization equations of acceptable prediction quality for all catchments in the MOPEX dataset (Almeida, 2014). This is due to the lack of descriptive power in the set of available catchment attributes, e.g. the attributes do not provide satisfactory information about catchment geology. To isolate the effect of variable geology on the regression equations, the selected 84 catchments are grouped based on the underlying geology, namely, Middle Paleozoic sedimentary rocks."

References

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