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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Multivariate stochastic bias corrections with optimal transport" *by* Yoann Robin et al.

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1 Major remarks

The authors introduce a new method of stochastic bias correction, which is based on optimal transport. The new method can be used for multivariate cases, and it is also extended for non- stationary applications. When showing results, the methods yields reasonable results. As the methods is also supposed to be fast, it is a valuable contribution for bias correction applications where more than one variable shall be corrected and that aim at keeping interdependence structures between the corrected variables. Unfortunately, I can judge neither whether the method is soundly derived nor what the method is really doing. Section 2 (and partially also section 3) comprises a

heavy formalism and is not human readable without a profound statistical background, which, I assume, most HESS readers like me do not have. Even though I am familiar with bias correction methods, e.g. based on quantile mapping, I got lost in section 2. On the one hand, by using this heavy statistical formalism, nomenclature and terms, the paper may be better suited for a mathematically or statistically oriented journal. On the other hand, the new method is interesting for the hydrological and climate impact modelling communities, so that I suggest a major rewriting of this section. This should be done in a way by using a more descriptive approach, which can be understood by readers who are not experts in statistics. This approach may include some simple examples to explain specific terms of the method whose use is unavoidable. These examples may comprise demonstrating explanations for a case where precipitation and temperature are corrected at the same time (In this way linking to the application of the method in Section 4.). Some more technical parts, which are necessary for the mathematical derivation of the method, may be put into the appendix to support also those readers who are interested in the mathematical details. I also miss a discussion of the method and its results in comparison to other studies that considered the joint correction of precipitation and temperature, e.g. Piani and Härter (2012) or Räty et al. (2018).

- Piani, C.; Haerter, J.O. Two dimensional bias correction of temperature and precipitation copulas in climate models. Geophys. Res. Lett. 2012, 39.
- Räty, O.; Räisänen, J.; Bosshard, T.; Donnelly, C. Intercomparison of Univariate and Joint Bias Correction Methods in Changing Climate From a Hydrological Perspective. Climate 2018, 6, 33.

In case (see above), major revisions will be conducted, the paper may be accepted for publication.

1.0.1 Response

It is always difficult to find the right balance between statistical formalism and pedagogical aspects. While Reviewer 2 enjoyed reading our manuscript for its concise and light mathematical contents, it is true that the lack of a simple example limited the accessibility to readers with a more applied background. In this context, we have decided to add an illustrative example, see the updated section 2.1 and the new Figure 1, that, hopefully, provides the basic visual elements to understand 1d quantile mapping as an optimal transport problem. We hope this change, while keeping a clear formalism, will allow more readers to follow the main idea at hand.

1.0.2 Modification

A new sub-section 2.1 has been added. This explain how our bias correction method is built on an example similar to temperature, and the meaning of the notations. Furthermore, we have added a discussion on how our method compares to others in the conclusion.

2 Minor remark

2.1 p. 13 - line 16

It is written: "The closest neighborhood method is used." I assume you mean the "nearest neighbor interpolation". Please rewrite accordingly.

2.1.1 Response

We agree with the reviewer

2.1.2 Modification

The change has been done.

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