

Interactive comment on “R²D²: Accounting for temporal dependences in multivariate bias correction via analogue ranks resampling” by Mathieu Vrac and Soulivanh Thao

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general comment:

The paper presents an interesting advancement in multivariate bias correction, that aims at incorporating the temporal dependence structure on top of the inter-site and inter-variable dependence structure. In general, I think it is important to advance on statistical methods that are able to deal with highly structured climate model output, including different variables, spatial context and temporal autocorrelation. I am not aware of any other method with similar aims, however, my knowledge of the literature in the area of bias correction is not too strong.

C1

The authors use only one run from one global climate model. Since there are no set hyperparameters that tailor this method specifically to IPSL, there is no evidence that this method is not generalisable. As a proof of concept, in my opinion, it is sufficient to work with one climate model only.

comments on the method:

The authors describe from line 437 that adding more sites to the conditioning dimension improves the results, however, at the cost of uneven distribution of the selected timesteps. As stated in line 290, this does not necessarily lead to a larger bias introduced. However, the authors do not recommend choosing a conservative “compromise setting” with not too little and not too many sites used, to hedge both against missing transitivity effect and uneven timestep distribution. I wonder if such a cautionary note should be introduced, that the readers are aware that you can “overfit”? Or do the authors disagree with this statement?

I am a bit confused on how the authors treat the precipitation data. Since precipitation is not normally distributed and often zero, the ranks should exhibit many ties when searching for analogues. How is this problem approached? Additionally, in section 4.3.1. the marginal properties of the corrected data are characterised by the difference of the mean and the standard deviation to the reference dataset (Figure 7). I assume these statistics could be more insightful if the precipitation would be divided into two variables for analysis: (1) if it rained and (2) how much it rained. This could show more in detail possible biases that are corrected or introduced by this method.

Just as a side note, the concatenation of a historical run with an RCP8.5 run (described from line 87) could in worst case lead to a jump in the data. Maybe the authors would like to check whether this is the case and whether this impacts their autocorrelation results.

comments on the results:

C2

The results of the temporal correlation are only shown for winter. I assume this is because the correlations have shown to be higher in winter (see for example line 243), or because the authors argue that this is the most difficult case, but a clear statement arguing for looking at the winter case only in Figure 1 and 2 would be desirable from my point of view. Additionally, since this is a proof-of-concept for a newly developed method, it is interesting for the community to see whether the improvements seen for the temporal autocorrelation are constant or variable throughout the different seasons.

Throughout the text, six results are mentioned that are not supported by the figures, indicated with a “(not shown)” after the result. I would argue the Appendix has space enough for all these results. I would especially be interested in the analysis of the standard deviations of the marginals and the reasoning why the spearman correlation couldn't be used (the paper describes some problems in North Africa, line 381).

comments on the text readability:

The authors manage to describe quite clearly and elegantly their approach throughout the paper, with some minor readability flaws: From line 142 the concept of “Block-A” and “Block-K” is explained. The explanation of the “Block-K” concept and why it is necessary could be a bit more elaborated. In line 189 and further down in the text the word “recopy” is used. What does it mean? How is it different from “copy”?

technical corrections:

line 16 gazes -> gas

line 18 use of “climate change” and “climate changes” in the same sentence. Clarify difference between these terminologies or rewrite

line 142 the sentence starting with “Moreover” is a bit convoluted

line 217 you never use the term “copula effect” again

consider adding links to the respective subfigures in section 4.1.2 for clarity and easy

C3

lookup

line 232 hose -> those

line 268 & section 4.2 do reference temporality and model chronology refer to the same thing? If so, consider only using one of the terms

line 437 particularly clear and concise summary

Interactive comment on Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2020-132>, 2020.

C4