

## ***Interactive comment on “R<sup>2</sup>D<sup>2</sup>: Accounting for temporal dependences in multivariate bias correction via analogue ranks resampling” by Mathieu Vrac and Soulivanh Thao***

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The paper handles the difficult issue of climate model bias correction extensions to tackle the adjustment of temporal, spatial and inter-variable dependency biases. Based on a previously proposed technique by the authors, named R2D2, different variants are designed and tested with one climate model simulation and one reference dataset for temperature and precipitations. The methodology is meaningfully exposed and the results are clearly commented. This constitutes an important and valuable contribution to this question of bias correction, which remains a key issue in climate impact studies. Especially, the temporal evolution of the variables is often an important feature for

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climate impact models, which even require a finer timestep than daily (up to hourly).

My main comments are the following: - When using CDFt for the univariate bias correction of rainfall, how are no-rain days handled? This may explain the degradation in the temporal autocorrelation after 1dBC, which is not seen for temperature. The adjustment of the number of rainy days, besides that of the rainfall amount, is one of the main problems in impact studies. - Section 4.2 discusses the rank association between the corrected and the raw model simulation outputs. Indeed, there is no reason why the model should reproduce the observed chronology, since it represents another sequence of variability. However, some level of correction of the model chronology may be needed (in association with the variables interdependencies for example, as treated here). The problem then is the lack of an adequate reference. . . - In section 4.3.2, it is noted that “the empirical copula between temperature and precipitation is not exactly the same during the two time periods used alternatively for calibration and validation”. This may be worth exploring further: how stable is the association with time? How long has the considered period to be in order to faithfully estimate the association? How can climate change alter it? This problem is properly mentioned in the discussion, but could be raised here. - In the conclusion, the improvements in the temporal evolution brought by the variants of R2D2 proposed here are emphasized, but still, they do not reach the rather good level obtained with 1dBC. Hence, in many impact studies, a correct chronology of the variables is of major interest, especially if long duration occurrences of extreme conditions are of concern. This could be stated more clearly.

Minor comments: p2 l36: “whose the target is the whole univariate distribution”: I would write “whose target”; the same applies to p7 l184, p9 l263 p4 l101: ““successive conditional”: too many quotes p8 l232: “as hose from the IPSL dataset” as those p10 l302: “Finally, When adding time lags in the conditioning dimensions”: no capital letter needed for “when” p10 l302-303: “both for temperature and precipitation, (R.1.1.0,R.1.5.0, R.1.100.0, R.2.1.0, R.2.5.0, R.2.100.0): isn’t it rather R.1.1.1, R.1.5.1, R.1.100.1, etc. . . ? The same stands for the following sentence: “This is especially true,

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for R.2.5.0,” R.2.5.1? p13 l378: “We then compare these correlation values with them from the references.” With those from the reference? Supplementary Material: Blank lines appear in some maps, what does it mean? The scales in figures 17, 18 and 19 differ, which make it difficult to compare. This is the same for the precipitation figures. It may however be difficult to use the same scale for all plots, but when possible, it’s easier for the reader.

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