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Nonlinear Processes in Geophysics
Discussions
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Interactive comment on "Simulation-based comparison of multivariate ensemble post-processing methods" *by* Sebastian Lerch et al.

Anonymous Referee #2

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In this paper, a comprehensive simulation study is implemented, comparing multiple multivariate statistical post-processing methods which all combine standard univariate post-processing with one of four techniques to reintroduce spatial, temporal or inter-variable dependencies. It is well-written, an important contribution given the variety of techniques available and potentially very useful to identify optimal operational post-processing strategies for varying types of data. Just a few clarifications and changes are needed.

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General comments

- I would have liked to have more focus (or at least comments) on the effect of ensemble size and dimension. The here chosen ensemble of 50 members is at the upper limit of what is now operationally produced, with the majority far below this number. Of course it is important for the study to have a sufficient number of data points so as to produce significant results, but it would also be interesting to look at settings with a smaller number of ensemble members. Also, the number of dimensions ranges from 4 to 5, which would correspond to looking at consistency between a few weather variables, but would usually be too low for a setting where preserving spatial or temporal features are important. I wonder if the findings would be different for smaller ensembles or higher dimensions.
- I find it very interesting that the performance of certain methods is sometimes very different when $\rho > \rho_0$ than in the opposite case. Do you have any explanation for this?

Specific comments

1. Line 71 and Line 153: The correlation matrix here is not necessarily the identity matrix, so I don't think it is a standard normal distribution.
2. Line 74: I would mention here that m is the number of ensemble members.
3. Section 2.2: There is a mixture of x and X used to define samples and ensemble forecasts, but I was confused why this distinction is made within the notation, it seems inconsistent.

4. Lines 184-186: For the other settings it is mentioned to which weather variables these settings could apply. It would be nice to add something like this to Setting 1, as well.

5. Line 242: The notation in this setting is different from the others and this is confusing. Here, the forecasts and observations are marked with x and y, whereas the other settings use o/0 to mark the observations.

6. Line 276: Is there a specific reason, why d is 4 in this setting and 5 in the others?

7. Lines 292-293: Some of the matrices are in bold face, some are not.

8. Figure 1: I am a bit surprised to see that GCA is performing that much worse as compared to the other post-processing methods (in a univariate sense). There are even cases where the performance is equal or possibly worse than for the raw ensemble. Do you have an idea why that could be?

9. Lines 328-330: Can you explain a bit further what you mean by "optimal in the terms of the CRPS"?

10. Lines 334-335: Naturally, scenario D has the smallest improvement compared to the others. Does that also mean that the scenarios are on the same absolute skill level after post-processing?

11. Footnote 4: In my opinion it would be clearer if you refer to ECC-Q as EMOS-Q in this section as well.

12. Lines 415-430: Can you refer to the figures in the appendix that show these results by number?

13. Line 446: "the VS might be better able to account..." This is confirming a known result, therefore "might" is a bit unsuitable.

Technical corrections

1. Line 327: I would move the sentence beginning "Note that" to footnote 4, as it directly relates to the changes in the marginal distributions mentioned there.
2. Line 356: I find this sentence a bit confusing. Should there be a comma before "the less information"?
3. Line 386: Missing comma before "where".
4. Lines 415 and 441: I would add "parameter" after "observation location".

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