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Geoscientific Model Development Discussions
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Interactive comment on "Randomly correcting model errors in the ARPEGE-Climate v6.1 component of CNRM-CM: applications for seasonal forecasts" *by* Lauriane Batté and Michel Déqué

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Reply to interactive comment by anonymous referee #1 by Lauriane Batté

We wish to start by thanking the reviewer for his/her constructive comments on our manuscript.

1) Reply to general comments:

"Unfortunately, the impact of the stochastic dynamic technique is small. I suggest to expand the discussion in the conclusions, why the impact is small and why the results of

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forcing with monthly mean tendencies is so similar to using 5d-consecutive tendencies."

Our hypothesis, based on this study and previous work on the technique, is that the main impact of our perturbations does derive from the systematic error corrections encompassed in the perturbation term. This is why on average, 5d-consecutive tendencies have the same effect on seasonal forecast quality than the monthly mean tendencies.

Regarding the limited impact in both setups on seasonal forecasting skill, this is most probably related to the weak constraint in our preliminary experiment. With a previous version of the model, other settings for the nudged preliminary run were tested, using a stronger constraint. However, our feeling was that since we were nudging towards ERA-Interim, using too strong a nudging could be a drawback, in the sense that we would be drawing the model away from its own equilibrium (and more towards that of the ECMWF model), and the terms would be less representative of long-term model errors. Were we to have a reanalysis based on the ARPEGE-Climate model, we could consider using stronger nudging and explore the impact this has then when applying the corresponding perturbations in seasonal forecast mode.

2) Reply to specific comments:

"Move discussion on page 13, l13-15 to conclusions and expand. Is there a pattern that SMM and S5D have similar impact on mean statistics, but S5D a larger impact on statistics involving the second moment?"

I have rearranged the conclusions to take into account this comment. Regarding the impact on statistics involving the second moment, our results with respect to weather regime duration, etc. suggest that differences are also small between S5D and SMM. This could be due to the fact that our nudging is quite weak and is a perspective for future work.

"It would be interesting to see a map of a particular 5D-tendency to get a feeling for the

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spatial correlation scales."

I included this in the supplementary information of the article as (new) figure S1, and commented this in the article (section 3.3).

"It might be helpful to plot the differences SMM-REF and S5D-REF for figures 5, 6 and 10 to see if there is a coherent regional signal. As the manuscript admits, the absolute plots look very similar."

Figure 5 shows the relative absolute bias of SMM and S5D with respect to that of REF in the middle and bottom rows (meaning that blue areas show where bias is reduced, and red areas where bias is enhanced, regardless of sign). Over the Northern Hemisphere extra-tropics, the main impression is that SST bias is reduced with our technique, whereas results are more contrasted for precipitation (patchy areas, general reduction of bias over the mid-latitudes, and increase in precipitation bias over the Arctic).

In my opinion, the different figures in figure 6 are not that similar, they show a substantial reduction of the Z500 bias over most of the Northern Hemisphere extra-tropics. As additional information, the figure 1 included in this comment shows the relative absolute bias for DJF Z500 over the re-forecast period for experiments SMM and S5D with respect to experiment REF. Similar information is available for the reader in the supplementary figure S2. I clarified the sentence referring to these results and figure S2 in the revised version of the manuscript.

Figure 10 now shows the CRPSS for REF with respect to reference data climatological probabilities, and CRPSS for SMM and S5D using REF as the reference ensemble forecast. This way, red (resp. blue) areas show where SMM and S5D have higher (resp. lower) skill than REF. No clear pattern emerges regarding skill improvements over the North Atlantic, although oftentimes SMM and S5D do improve model skill. One must bear in mind that skill is quite limited to begin with in the REF ensemble, as reminded in the manuscript.

3) Technical corrections:

Thank you for pointing out some errors left in the manuscript. Regarding the statistical significance, figures have been redone using larger stippling to highlight better the areas where differences/results are significant.

Regarding the reference p3, l21: the author's last name is "Salas y Melia", this isn't a typo.

4) Changes to the manuscript:

Changes to the manuscript can be tracked in the supplement to this comment, with red crossed text indicating suppressions and underlined blue text indicating additions with respect to the original submission.

Please also note the supplement to this comment:
http://www.geosci-model-dev-discuss.net/gmd-2015-270/gmd-2015-270-AC1-supplement.pdf

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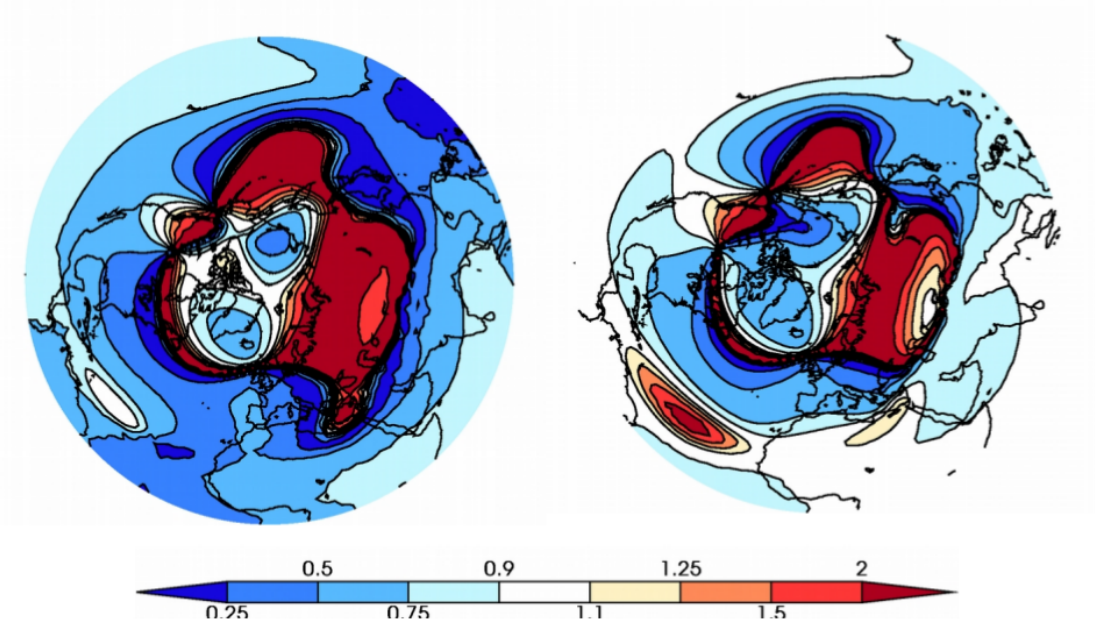

Fig. 1. Relative Z500 absolute bias for DJF 1979-2012 re-forecasts SMM (left) and S5D (right) with respect to REF. Blue areas show where bias is reduced regardless of sign.

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