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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

Anonymous Referee #3

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Discussion paper

"Randomly correcting model errors in the ARPEGE-Climate v6.1 component of CNRM-CM: applications for seasonal forecasts"

by
Lauriane Batté and Michel Déqué
GMD - Discussions, 2016

1 General comments

The manuscript describes an update to and extension of the stochastic dynamics technique introduced by Batté and Déqué (2012). The application presented is seasonal ensemble forecasting of 34 boreal winter seasons. The idea is to first calculate a database of approximate initial tendency errors for temperature, vorticity and specific humidity. This is done by weakly nudging the ARPEGE-Climate v6.1 model state towards ERA-Interrim re-analyses for all winter seasons, and then letting the nudging term be the estimate of tendency errors. Once calculated the nudging term is stored in terms of monthly means and 5 day means (two different approaches tested in the manuscript). During the seasonal ensemble forecast simulations for a given year initial tendency errors are then drawn randomly as stochastic forcing (perturbation). Only tendency

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errors from other years than the one in question is used for perturbation, i.e., a proper cross-validation technique is applied. The paper analyses and discuses the statistics of the model tendency errors, the model bias for the ensemble forecasts, and the quality of the forecasts as compared to a reference set of ensemble forecasts, which were not perturbed. A main issue is if an enhanced model spread can be obtained via the nudging, and, of course, if the skill of the forecast system is improved.

The main conclusions are that there is generally a weak improvement in forecast skill and model spread.

I believe there is a general problem with the use of the "initial" when τ is as long as 30 days. With such a weak nudging this term can not be said to represent initial tendency errors but rather long term secondary adjustments (that luckily seem to have some positive impact). This is of cause because, on a monthly time scale, initial forcing in terms of e.g. potential vorticicy will show up far away via Rossby wave dispersion. As an example consider the right column of Figure 2: These corrections could very well be due to "real" initial errors in the tropics. It is therefore suggested not to use the expression "initial" tendency errors. One could, e.g., call it model drift error.

The paper is well written and represents a significant amount of careful work. Although there seem to be some positive impacts from the introduction of the stochastics dynamics the results vary a lot from region to region. So, one cannot say that the technique is the wholy grale needed to improve seasonal forecast techniques. However, it is a relevant contribution that can be combined with other stochastic techniques.

The paper can be accepted when the following minor comments have been considered.

2 Specific comments

Page 1, line 12: Change "SMM" to "(SMM)" and "SD5" to "(SD5)".

Page 2, line 29: Change "In this method" to "In the method presented here"

Page 4, line 4: I presume you mean "not to perturb the divergent component" instead of "not to perturb the rotational component" (since vorticity represents the rotational part).

Page 5 ff: Probably not only the magnitude but also the shape of the spectra are quite dependent on τ. A short discussion on this would be relevant.

Page 8, Section 4.2: It would be relevant to show - or at least discuss - the bias in the initial nudged simulations as well. Ideally the mean error of these runs should be small. But with the large value of τ one would suspect that this is not the case.

Page 9, line 32: Replace "than adding" with "to adding".

Page 10, Eq. (8): It is suggested to move this equation down to where it is introduced in the text.

Page 11, line 32: "... not capture its interannual variability". One would guess that it could also be large if the model has a bias. Any bias could be subtracted before calculating RMSE. This would probably give considerably smaller RMSE's.

Page 13, lines 17-21: Also here it could be relevant to eliminate the impact of bias.

Page 14, line 3: You could provide a quantitative estimate of the uncertainties in the correlations!

Page 14, lines 22-23: Why is there no NMM in Table 2 (and 3)?

Page 15, Section 4.5.3: I think this section can be removed. It does not add much to the findings already described.