Nonlin. Processes Geophys. Discuss.,
https://doi.org/10.5194/npg-2018-52-RC3, 2018

Nonlinear Processes in Geophysics
Discussions
Open Access

Interactive comment on "Non-Gaussian statistics in global atmospheric dynamics: a study with a 10 240-member ensemble Kalman filter using an intermediate AGCM" *by* Keiichi Kondo and Takemasa Miyoshi

Anonymous Referee #3

Received and published: 6 December 2018

The authors have previously performed experiments with the LETKF and a medium-complexity AGCM. Previous studies have focused on the effect of localisation. In the present study the authors focus on the Non-Gaussian features of the distribution of certain variables.

I think this is an interesting topic, and the manuscript can indeed become a useful contribution to the community. To be fair, just the fact of having a 1024-member ensemble is a very rich source of information. The manuscript is in general quite clear and well-written.

Printer-friendly version

Discussion paper

I have the following comments with respect to the manuscript.

1. First of all, it is not clear to me how many of the experiments were performed in SPEEDY and how many of the experiments were performed in NICAM. The paper is mainly focused on SPEEDY and the experiments in NICAM are only mentioned in passing in the very last section of the paper. Is this because they were fewer and/or less detailed? Or were exactly the same experiments done in both models? If so, why did you choose SPEEDY?

2. I agree with the other reviewers in the sense that more diagnostic metrics need to be considered besides RMSE of the analysis mean. These include: rank histograms, reliability metrics and scores. Also, the relationship between RMSE and spread can be quantified to check for the 'health' of the ensemble system (this is related to the rank histograms too).

3. I was very interested to see how clustering can occur in these models, and particularly excited about the fact that the set of outliers contained more than one element! In previous works (Amezcua et al, 2012; Anderson 2010) only one outlier was found. I wonder if you could say more about the size of these sets, and the way these outliers appear and disappear as the system evolves. I guess this has to do with the distribution of maximum and minimum of a sample depending of both (a) the parent distribution and (b) the sample size. Is there anything you can mention about the distribution of the sample maxima?

4. It is natural to study skewness, kurtosis and KLD as the authors have done. This has been done in a univariate manner only. Can a multivariate analysis be performed? There are some ways to compute higher order moments for multivariate distributions (e.g. Mardia 1970). I am not asking to compute these if it is too hard to do it, but I am wondering if anything could be gained.

5. The LOF method is slightly confusing and I thank the authors for adding the figure to explain it, but I wonder if there is any way to make it even clearer.

6. SPEEDY is a very "simple" (not in a bad way) model with very low resolution in time and space. It is not surprising, hence, that the source of non-Gaussianity is the parameterisation related to rain. Still, I think the analysis (including the two figures) is important. However, it should be emphasised this conclusion in valid from SPEEDY. Small scale physical processes can generate non-Gaussianity, but they are not represented in SPEEDY. I wonder if you can say anything about this with the results from NICAM?

7. In the Ensemble Kalman Filter/Smoother, one can separate the sampling effect as having two parts, which can be approximated as being additive (Sacher and Bartello 2008; Amezcua and van Leeuwen, 2018). The more indirect part comes from the gain K coming from the sample. It is a nonlinear function of the sample covariance: b^2/(b^2+r^2) in the univariate case. I wouldl like to know more about the quality of K as the ensemble size changes. Note that this is related to the quality of sample B, but the 'convergence' to the true K may be slower do to the nonlinearity of the relationship.

8. A very simple comment about figure 5: I think it would be easier to visualise if the y-axis had logarithmic scale.

Interactive comment on Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2018-52, 2018.