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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Ensemble forecasting with a stochastic convective parametrization based on equilibrium statistics" *by* P. Groenemeijer and G. C. Craig

Anonymous Referee #1

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Comments on Ensemble forecasting with a stochastic convective parameterization based on equilibrium statistics, by Groenemeijer, and Craig.

General comments: This manuscript deals with the very important topic of inclusion of model uncertainty in ensemble design. This topic is of great interest in both the weather and climate forecasting communities, thus the manuscript is very timely. It is focused and well written. My specific comments are minor (primarily asking for more background and explanation in places). I appreciated the candid description of the modifications necessary for implementation in section 2. This is the type of information that will be very useful for others implementing the PC08 or other stochastic schemes.

Specific Comments:

1. While the authors discuss previous work describing the design and implementation of stochastic forcing in ensembles, they do not discuss the impacts. I suggest that the current article would benefit from a brief discussion of previous results, e.g. those looking at stochastic forcing (or model uncertainty in general) on precipitation skill (or ensemble skill in general). A few suggestions of results that are relevant are 1) Buizza et al. (QJRMS 1999) who find that stochastic perturbations improve skill of probabilistic prediction of weather parameters such as precipitation; 2) Berner et al. (JAS 2009), who show that SKEB leads to improved rainfall forecasts in the ECMWF system; 3) Stensrud et al. (MWR 2000) who compare model physics ensembles with initial condition ensembles, and find model physics ensembles more skillful when large scale forcing of upward motion is weak, and initial condition ensembles more skillful when large scale forcing of upward motion is strong; and 4) Bright and Mullen (WAF 2002) who find a slight increase in skill and dispersion with the addition of a stochastic element in the KF scheme. I believe this addition will help motivate the work and place it in the context of current experimentation in the community.

2. Perhaps add a sentence to the middle paragraph of 30460 motivating the use of stochastic parameterizations. Why does one want to increase spread? Is it because current ensembles are under-dispersive? Is it because this will provide a more complete accounting for model uncertainty? (both?).

3. When the authors discuss the direct and indirect components of the stochastic parameterization-induced variability, they may also want to mention that stochastic forcing (or other types of model uncertainty) will have an impact on the initial condition perturbations if one is using a cycling scheme (such as an ensemble transform or ensemble Kalman filter). Reynolds et al. (2008 MWR) find the impact on the initial perturbation from stochastic convection to be very significant at short forecast times. The PC08 scheme might well have a bigger impact when using a cycling scheme, in which there is memory of the stochastic-induced differences from one cycle to the next.

4. Is there any sensitivity to the size of the averaging area (25 grid points for this study, discussed on page 30463)?

5. I found the discussion of the impact of the mean squared cloud radius on page 30464 quite interesting. What are the implications for those looking to implement this scheme in different regions, or perhaps in regions that include both warm ocean and continental environments (e.g., a domain that includes the middle of the US and the Gulf of Mexico).

6. I suggest mentioning the specific forecast hour shown in Fig. 3.

7. I suggest mentioning what type of case (strong, medium, or weakly forced) is shown in Fig. 4. Also, perhaps mention the amounts of cumulative precip in the different circled and boxed regions (it is a bit hard to see the differences in the circles between panels a, b, and c).

8. Top of page 30470 it is noted that the fraction of total variance is approximately uniform throughout the diurnal cycle. Perhaps mention what that fraction is (it look to be about 80%).

9. I think the suggestion of adaptive ensemble design put forward in the conclusions is quite forward-thinking. I would suggest that the goal could be generalized such that one optimizes the ability of the ensemble to capture important flow-dependent uncertainty (rather than just optimizing spread, although this might often be the practical result).

10. Have the authors looked at the impact of the stochastic forcing on the variance of fields other than precipitation? Perhaps this will be investigated in future work, but it may be instructive to mention some preliminary results, if the authors have them. One would expect significant changes to the precip should feed back onto the large-scale mass and wind fields at some point.

Technical corrections:

1. The sentence after equation (1) is incomplete (i.e., ends with “against the value of”)

2. I’d suggest changing “subject” in line 27, page 30465 to either “subjects” or “the subject”.

3. Page 30472 third line, I think there is an extra parenthesis after “(a”

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