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Atmospheric Measurement Techniques Discussions

Interactive comment on "Correlated observation error models for assimilating all-sky infrared radiances" *by* Alan J. Geer

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General Comments: This paper presented an observation error model that combines the interchannel correlations with the situation dependency as a function of symmetric cloud proxy variable required for the all-sky assimilation. This might be the first reported application of the correlated errors to the all-sky assimilation that provides the benefits to both the analysis and the NWP forecast accuracy. The need to inflate the trailing eigenvalues has been clearly explained through the concept of the eigendeparture and eigenjacobian, and the manuscript is well written. Specific comments:

These positive comments are very helpful and much appreciated.

4.1 *In the eigenspace spanned by the eigenvectors, the eigenvalues of the error co-*

variance matrix are the equivalents of the error standard deviations which can be seen from the expression (6) on P9, so smaller the eigenvalues, larger the weights given to the eigendepartures. In this sense, the robustness of the error covariance matrices estimated based on different data samples and different version of systems should be assessed not only by the leading eigenvalues and eigenvectors but also by the trailing eigenvalues and eigenvectors. Both Fig.3 and Fig.4 indicate that the matrices examined have the relatively large differences in their trailing eigenvalues and eigenvectors. The data assimilation system might be very much sensitive and behave different because of these differences. Therefore, I suggest to run an additional experiment on top of the experiment "All-sky adjusted 1.0" or "All-sky adjusted 0.37" with any 45r1 all-sky error covariances to verify the robustness of the original 43r1 covariances that were used in all of the cycle experiments presented in this paper. My concern is the estimates might not be as robust as they look like in the sense that the extra tuning by trial and error might be still needed whenever to upgrade to a newer version of the matrix.

This is an important point and supported also by Fuqing Zhang. It is worrying that there seems to be such a need for trial and error retuning of error variances and eigenvalues, and possibly we might have to keep on doing this after significant model or observation changes. The proposed experiment is a good idea and clearly it is to hard to quantify what size and type of differences in the trailing eigenstructures would be important without experiment. However this might be the tip of the iceberg, and the issue of eigenstructure stability may deserve substantial further work beyond what can be included in the current manuscript. Further, the proposed experiment will take a long time to run so I would not want to commit to including it in a revised manuscript. I would start the experiment with the hope of reporting the results later. Hence the following proposal:

Manuscript change: Further discuss the stability of trailing eigenstructures in Figs. 3 and 4. In the conclusion call for further work investigating the stability, and acknowl-

edge this remains another possible explanation for the benefit of adjusting the trailing eigenvalues.

Technical corrections

4.2 *P30L15, P33L8 and P41L25: all 'eigenvectors' should be replaced with 'eigenvalues'*

Manuscript change: These issues will be fixed

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