

Interactive comment on “A Bayesian Approach to Multivariate Adaptive Localization in Ensemble-Based Data Assimilation with Time-Dependent Extensions” by Andrey A. Popov and Adrian Sandu

Anonymous Referee #1

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Iteration: Initial submission

General Comments

This study presents a new method whereby a Bayesian problem is constructed for an adaptive Schur-product-based covariance localization method in ensemble Kalman filtering. There are some novel ideas that have been introduced, like the construction of Bayesian three and four-dimensional cost functions and their subsequent minimization to solve for “maximum likelihood” localization radii. The mathematical methodology in

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itself is straight forward for the data assimilation expert reader, but some assumptions and concepts need to be further explained to reach a broader audience. The topic of the manuscript is within the scope of this journal. However, the manuscript contains limitations that need to be addressed before it can be considered for final publication. Specific details are provided in the following sections. Therefore, my recommendation is that major revisions are required.

Specific Comments

1. The manuscript requires some rearrangement. It is unclear as to why the introduction began by describing a model. This part is more suited for the “Background” section.
2. The motivation, objectives, and methods of the study should be clearly stated in the introduction. Some of these are actually discussed in the “Conclusions.” Please make appropriate revisions.
3. Expand your literature review as to include other studies that have done applications of adaptive localization in ensemble methods.
4. P5: the uncertainty in space is represented by $\pi(x | y, v)$, but according to equation (12), it should read $\pi(x | y, v)$.
5. P6: for equation (15), you may want to add that the chain rule was also used, in case you want to reach out to students, as derivations might not be too trivial.
6. P7: equation (18) takes the form of an EnVar-like cost function. Comment on the applicability of your univariate or multivariate adaptive localization technique for hybrid EnVar data assimilation systems and also discuss limitations.
7. P9, L3-10: Clarify if univariate localization functions were used and whether the extension of the localization matrix was done in the present study. Would this help in making your methodology suitable for testing with more complex geophysical models?
8. P10, L11-17: How do oracles compare to optimal parameter estimation as employed in control theory, with many applications in variational data assimilation?
9. P11, L22: Comment on the choice of 10 members for the ensemble and clarify if varying this number can impact your results.
10. There are some mathematical notation typos, please revise all equations thoroughly, and make sure to conform to the mathematical notation standards of NPG for all scalars, vectors, matrices, etc.
11. Given the results with a simple geo-

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physical model, provide a brief overview on how this methodology could be tested with a complex numerical weather prediction model (e.g. regional/convection allowing models)? 12. Provide more quantitative estimates in the “Results” and in the “Conclusions” sections

Technical Corrections

Typos

1. P1, L2-3: change to “variables,” remove the period, and use lowercase for “Recognizing,” insert a period after “property,” and capitalize “adaptive”
2. P2, L5: revise the “in-text” citation, it should be: Le Dimet and Talagrand, 1986.
3. P2, L21: change to: the analysis cycles in space
4. P3, L2: add a comma before “such as”
5. P3, L19: remove “respectively” and insert it after P=... and preceded by a comma
6. P4, L1: add a comma before “which”
7. P5, L6: Insert a space before “.In,” add a comma after “paper,” and change to “Here, we consider”
8. P9, L20-21: change to “all that is required are,” and add a comma before which
9. P10, L2: remove comma before “are”
10. P11, L17: change to: “For the numerical”
11. P14, L14: remove “is” before “can discern”
12. P14, L28: replace “have” with “has”

Figures

It is nice to see how descriptive all figure captions are (which is usually not the case with most research articles). However, corresponding “in-text” descriptions are lacking, try to incorporate some of these explanation on the results section.

Interactive comment on Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2018-45>, 2018.