Nonlinear Processes
in Geophysics
Discussions

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comment

Interactive comment on "Chaotic dynamics and the role of covariance inflation for reduced rank Kalman filters with model error" *by* Colin Grudzien et al.

Anonymous Referee #2

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Inflation has been a necessary evil for ensemble Kalman filters. Originally it was thought to be related primarily to the sampling error. Recent studies, however, showed that nonlinearity, formative/informative hyperpriors by Bocquet et al. 2015, and a reduced rank representation of a covariance matrix have a large influence on the stability of an ensemble Kalman filter. The latter one was thoroughly studied by Anna Trevisan and her collaborators for a perfect model scenario (the authors of the submitted manuscript make a good overview in introduction). A recently submitted, I believe, paper by Grudzien, C., Carrassi, A., and Bocquet, M.: "Asymptotic forecast uncertainty and the unstable subspace in the presence of additive model error" available only as an arXiv preprint arXiv:1707.08334, 2017, studies the influence of a reduced

rank representation of a covariance matrix for an additive model noise. The submitted manuscript is a continuation of the latter work, where the authors derive explicit equations for the error propagation in both filtered and unfiltered subspaces for linear and linearised models. The derivations are simple but have not been done for ensemble Kalman filters up to my knowledge. The manuscript has potentially a merit but needs to undergo major revisions.

Major comments:

1) In numerical experiments with a nonlinear model, I cite the authors: "At each observation time, before observations are given, the true trajectory is perturbed by additive Gaussian noise with a proscribed covariance Q, fixed in time". This set-up is for an additional observational error rather than a model error for a nonlinear case. Instead the "true" solution should be obtained from a stochastic nonlinear model integrated by the Euler-Maruyama scheme, for example.

2) The authors should compare their results with the ensemble Kalman filter with hyperpriors by Bocquet et al. 2015, as the goal of the latter paper was to remove the intrinsic need for inflation.

Minor comments:

1) How was the inflation factor α obtained? What is its value?

2) Additive inflation should be also studied. It is a simple extension which will, however, bring new insights.

3) The authors use complete observations. A study of incomplete observations is again a simple extension which will bring more merit to the manuscript.

Technical comments:

1) Italics is used too often in the text to give an emphasis, it should be avoided.

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