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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "A methodology to obtain model-error covariances due to the discretization scheme from the parametric Kalman filter perspective" *by* Olivier Pannekoucke et al.

Anonymous Referee #3

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1 General response and main points

Overall I feel positive about the manuscript. The analytical work provides some interesting interpretations on the estimation of model error covariances. The numerical demonstrations are also interesting. However, there are a number of portions of the manuscript that can use clarification and greater consistency before it is ready for publication. Please see the main points to address in revision below, minor points are covered in section 2.

1. Equations throughout the discussion version are poorly formatted and awkwardly

split, this should be fixed for better readability. This could also use hyperlinking in equation references to make the document more easily searchable.

2. I agree with the other review comments that the definitions of quantities such as the model error ϵ^m_{q+1}, and their evolution equations, need to be more clear.

3. My understanding is that the CFL condition is stated as, $C = \frac{u\delta_t}{\delta_x} \leq C_{max}$ where C_{max} is typically taken equal to 1. The CFL condition is stated differently in lines 219, page 8, and 301, page 11, and it does not seem to me that these statements correspond to the above condition. Please check these lines for consistency.

4. In appendix B, lines 495 - 499, page 21: when going through the derivation of the modified equation for the Euler scheme, I find that $\kappa = \frac{u}{2}(\delta_x + u\delta_t)$ as the term $\frac{-u^2\delta_t}{2}\partial^2_x\tilde{c}$ appears on the left-hand-side of the equation on line 495. Please verify the equations for consistency and update the discussion in lines 238 - 246, page 9. Does this affect any of the numerical results such as Fig 1.b? Are there any other places where this would change the interpretation of the results?

5. The conclusion of the numerics is too short. The main point of the work, estimating the model error covariance via the PKF formalism is somewhat successful, and the limitation of the decorrelated error assumption is discussed. However, there isn't much quantitative analysis of practical use of this model error estimate. For instance, can the estimated variance in the PKF formalism be used as an upper bound for the true model error variance?

2 Minor Points

1. Page 5, lines 121 - 123: I find the parentheses in this sentence to be awkward, as it is easy to confuse their use as mathematical arguments. The conditional

statements for the forecast, respectively the analysis, should use commas to clarify the meaning of the text.

2. Page 10, line 255: see the typo “details.Note”.

3. Page 13, lines 343 - 344: the definition of $\widehat{\mathcal{N}}$ needs to be clarified. Currently the sentence doesn’t seem to be complete. I find the notations confusing here, where $\mathcal{N}$ is referred to as a model equation. In this context, what equations represent $\mathcal{M}$?

4. Page 15, line 385: see typo “legnth-scale”.

5. Page 21, Eq. C1: see typo x_{ki-1}.

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