Nonlinear Processes in Geophysics Discussions

Nonlin. Processes Geophys. Discuss., referee comment RC2
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Comment on npg-2021-8

Anonymous Referee #2

Referee comment on "Multivariate localization functions for strongly coupled data assimilation in the bivariate Lorenz 96 system" by Zofia Stanley et al., Nonlin. Processes Geophys. Discuss., https://doi.org/10.5194/npg-2021-8-RC2, 2021

The paper by Stanley et.al. develops multis-scale extensions to the traditional families of the parameterized localization functions such as the Gaspari-Cohn 5^{th} order polynomial. A key contribution of the paper is to note that each of these polynomial expressions can be represented as a product of the square-root kernels that can be cross-multiplied to achieve a positive-definite cross-scale localization. Authors, correctly, draw relevance of these new techniques to the problem of cross scale localization encountered in coupled data assimilation. Authors correctly choose the right type of the test problem that is useful-enough to test the mathematics of the developed extensions yet is not too complex to obscure the interpretation of the results. I agree with authors that there is no need to over-interpret the results of this simple experiment with regard to its relevance in a more complex ocean-atmosphere problems.

I found this article very relevant, well-written, with adequate experimental plan, and appropriate interpretation of the experimental results. I congratulate the authors on a nice contribution to the literature and suggest this paper for publication after minor revision.

Summary of suggested changes:

- This contribution parallels the work of Mark Buehner on multi-scale localization. I suggest that authors draw this parallel by referencing some of his work such as [https://doi.org/10.3402/tellusa.v67.28027]. By including these references, authors can then discuss how their work can also be related to the problem of multi-scale localization (e.g. such as assimilation in convective-resolving models).
- I made some minor suggestion to how authors might consider changing or extending other references in the introduction section (see pdf attached).

- I tried to read the paper from the perspective of someone who might want to implement some of the localization formulas discussed by the authors. I made some suggestions on clarifications. I highly appreciate that authors published the source code for their work. I suggest that authors mention that in the main body of the paper.

Please also note the supplement to this comment:
https://npg.copernicus.org/preprints/npg-2021-8/npg-2021-8-RC2-supplement.pdf