

Nonlin. Processes Geophys. Discuss., referee comment RC2
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Comment on npg-2021-11

Anonymous Referee #2

Referee comment on "Ensemble Riemannian data assimilation over the Wasserstein space" by Sagar K. Tamang et al., Nonlin. Processes Geophys. Discuss.,
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This paper introduces an optimal transport framework for updating discrete representations of posterior probability density functions during ensemble data assimilation. This work further provides proof-of-concept assimilation experiments comparing the algorithm the authors introduce (and call EnRDA) to standard DA methods (3D-var, particle filters, ensemble Kalman filters). The authors mention two serious issues that will need to be overcome for EnRDA to become a viable strategy for users in the DA community: 1) the high computational expense (that scales super-cubicly with the ensemble size) associated with computing optimal transport maps and 2) the need for the observation operator to be bijective, e.g. all state dimensions must be observable.

Some minor comments

- The reader would benefit from more discussion of the Sinkhorn algorithm and how/why gamma is chosen as well as how eta is chosen in practice. On line 290, you mention that these parameters are set by "trial and error". Can you offer the reader more guidance on how to make these choices in practice, even if ad-hoc? Do these or should these parameters vary at different assimilation time steps? On line 290 you have gamma=3 and in the caption of Figure 5 you have gamma=0.003. Are both correct? Are these for the same DA experiment at different times? Or different experiments? This should be clarified in the text. In Figure 3 you demonstrate that one order of magnitude change in gamma results in quite different joint distributions with the same prior and observation pdfs. What does a 3 order of magnitude change in gamma do?
- The barriers to wide usage of this approach are quite high, yet if overcome the EnRDA could prove very a powerful DA method. As such I believe these barriers and the research advances needed to overcome them warrant a longer discussion than you offer in section 5.
- (Typographical mistake — you have two periods ending a sentence on line 398.)