

***Interactive comment on* “Ensemble Kalman filter for the reconstruction of the Earth’s mantle circulation” by Marie Bocher et al.**

Anonymous Referee #2

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This paper on the testing of an Ensemble Kalman Filter (EnKF) for mantle convection circulation, using twin experiments is well written and relatively clear. The results are valuable and will eventually lead to more precise assimilation data of the Earth’s mantle into mantle convection models. I am suggesting relatively minor corrections (no further simulations), but rather some improvements for clarity and presentation.

The comments are:

1. The discussion of the error plots was at times confusing. In some places you simply refer to errors, when you could mean the difference between the true state and the assimilation, or sometimes the innovation (equation 36 for example, which isn’t really a forecast error). Please be clear about what error you mean each time you use this term.

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2. I was surprised by how little the errors dropped in Figure 1, until later in the results and discussion it became apparent that only small regions have most of the errors (like the plumes, ridge or subduction). It would be really helpful to plot the average error over these regions rather than the entire domain (where the temperature field is fairly constant for long periods). I think this would give a clearer picture of the errors between the various experiments.
3. It would also be really useful to see how the velocity field responds to the assimilation, because this is the part of the state directly related to the surface velocity. I realize that it is not a prognostic variable, but it is an important part of the state.
4. Please define the vector $\{\mathbf{1}\}$ in equation 18.
5. The text is pretty carefully edited for writing and typos. I just found a couple of things: line 12 , change explicitely to explicitly (though this suggests that you didn't run a spell check, so there might be more). And page 13, line 3, the word "embarassingly" is probably not appropriate.
6. Please clarify what you mean by state space localization, page 10, line 16.
7. Some of the figures need larger fonts on the captions, particularly Figure 6. And if possible, use the Greek symbol for pi.

Interactive comment on Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2017-7>, 2017.

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