

Nonlin. Processes Geophys. Discuss., referee comment RC2
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Comment on npg-2021-5

Anonymous Referee #2

Referee comment on "A study of capturing Atlantic meridional overturning circulation (AMOC) regime transition through observation-constrained model parameters" by Zhao Liu et al., Nonlin. Processes Geophys. Discuss., <https://doi.org/10.5194/npg-2021-5-RC2>, 2021

General Comments:

This paper addresses regime transition in AMOC through state and parameter estimation, via application of the EAKF. While the idea of parameter estimation is not new in ensemble-based data assimilation and there are many published papers addressing it, I believe that the novelty of the paper is the application of EAKF to regime transition in AMOC. Still, the paper needs to explain what the main findings are and how those findings could improve our knowledge about AMOC. In addition, I have some specific comments requiring clarification of the parameter estimation approach and the EAKF equations.

Specific Comments:

(1) Please explain how equations (1)-(4) were derived from the EAKF. Also, please explain exact meaning of each variable. For example, is $\Delta\beta^p$ a value of the parameter β , or prior ensemble perturbation of the parameter β ? Is Δy_i^p prior ensemble spread or prior ensemble perturbation? In addition, all vectors and matrices need to have clearly defined space (e.g., observation or state space) and dimensions (e.g., N_{obs} , N_{state} , N_{ens} , $N_{\text{obs}} \times N_{\text{ens}}$, ...).

(2) What dynamical model was used to propagate parameters in time? Was it identity model? Is there a more suitable model than identity? Please provide a brief reference review about different models used so far in literature and justify your choice.

(3) Have you applied any covariance inflation? Please explain.

(4) Please address the issue of ensemble spread vs. forecast skill. Are they correlated in your experiments? Is ensemble spread over-estimated or under-estimated? Are ensembles collapsing?