Ocean Sci. Discuss.,
https://doi.org/10.5194/os-2017-31-RC1, 2017

Ocean Science
Discussions

Interactive comment on "Application of EnOI Assimilation in BCC_CSM1.1: Twin Experiments for Assimilating Sea Surface Data and T/S Profiles" *by* Wei Zhou et al.

Anonymous Referee #1

Received and published: 23 August 2017

This manuscript investigates the impact of ocean data assimilations on seasonal forecasts in an idealized twin-experiment framework using an Ensemble Optimal Interpolation (EnOI) data assimilation method in the Beijing Climate Center Climate System Model (BCC_CSM1.1), a new generation of climate forecast system under development at the Beijing Climate Center. The authors assimilate various combination of pseudo observations to evaluate the performance of data assimilation system. They conclude that the joint assimilation of all variables (SST, SSH, SSS, and T/S profiles, produce better results than assimilating them separately.

There are several aspects of this study that are of concern. The authors use a widely

used twin-experiment framework to test their system. However, the implementation of the twin-experiments is questionable. The authors only perturb the initial condition. They use a forced ocean for their experiments and no perturbation is added to the forcing. This experimental framework used by the authors doesn't provide a realistic framework and it is not clear what we can really learn from the experiments describe in this manuscript. In this framework, if CTR is integrated forward in time for a long enough time, it will converge to TRU with or without data assimilation because the 2 experiments use the same forcings. The authors also use unrealistically large error in their initial condition, making it "easy" for the data assimilation to show improvements. The authors claim in the conclusion that experiments with more realistic errors also show improvements of the analysis. These experiments will probably provide more reveling materiel regarding the DA performance than the one currently describe in the manuscript.

The author use their own definition of "persistence". In the manuscript persistence is defined as a repeat of the subsequent 12 months. Persistence usually assumes that the conditions at the time of the forecast will not change in the future. The authors should justify in more details why they choose not to use a standard persistence forecast. It makes interpreting the results difficult for the reader in my view. For example, in Fig. 3a, all the simulations, including the perturbed experiments without data assimilation systematically outperform the persistence forecast, even at lead zero. What does this mean?

Finally, I don't understand the point of all the results / discussion on the forecast experiments. It makes no sense to make a seasonal forecast in a forced ocean framework. Seasonal forecast can only be made using a couple model. We don't have observation of the future to drive the ocean model. The so-called forecasts are all strongly constrain by the identical atmospheric forcing, and this is why they all follow a very similar trajectory. The answer will be very different in a couple framework. It is not clear to this reviwer how the results presented in the manuscript can be used to infer the impact of

data assimilation on seasonal forecast as the authors claim. This would require a more realistic framework in my view.

For the reasons detailed above I cannot recommend the manuscript in its current form for publication in Ocean Science.

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