Nonlinear Processes
in Geophysics

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Discussions

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**Interactive
comment**

Interactive comment on "Impact of Optimal Observational Time Window on Coupled Data Assimilation: Simulation with a Simple Climate Model" *by* Yuxin Zhao et al.

Anonymous Referee #1

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This study investigated the impact of observational time window (OTW) on coupler data assimilation using a simple climate model. The topic is interesting. It has shown a lot of interesting results. The experiments were well designed. The structure of the paper is good too. I can receive the big picture of the study. However It need some improvement on the details and presentation.

1 the title do not fit. You are not discuss the "Impact of Optimal Observational Time Window' but "Impact of Observational Time Window". It may be " Impact of Observational Time Window in Coupled Data Assimilation with a Simple Climate Model"

2 The concept of OTW in this study validates the observations in a time window to the center of the window (analysis time). It is very useful technique for data assimilation

(DA). More or less it has been applied in the assimilation with real observations. Here the OTW in this study is applied in 3-dimension DA but not 4-dimension DA, which need address in the introduction. The citations of OTW are not very relevant (Page 2, line 13-15). I could not find the clear concept of OTW and how they applied in data assimilation. SO you should address the technique details in the paper. I guess that you treat all the observations independently and assimilate then sequentially using their original error scales. another approach is to assimilate the average values of the observations in the OTW. It is worth to compare these two approach in the study.

3 From your result I can not connect the de-correlation time with the optimal OTW directly. The optimal OTW is much short than the de-correlation time. Like in figure7, the correlation is 0.995 for the optimal OTW. Please revise the abstract and conclusion. The time scales of the variables really can not provide the useful information to quantify the optimal OTW. I suggest you remove or shorten the discussion and analysis related to the time scales of the variables.

4 The time (s) of observations in the OTW are different from the assimilation time. The temporal offsets introduce the represent errors for the observations, which need to be consider during analysis. If not, EnKF overweights the observations The analysis will not be optimal and the analysis ensemble spread will has negative biased. Please address this part and justify your assimilation.

4 It is hard to find the assimilation intervals for different components. Please address them together in experiment setup (2.3). I noticed that the OTW is longer than the assimilation interval, which means that you assimilate the same observations multiple times. In the perfect framework, it should degrade the filter performance from my understand and the information theory. Can you explain why you can achieve a good analysis under that circumstance. For a biased model framework, people do use observation multiple times to compensate the negative bias of forecast ensemble spread. So it make sense to see the optimal OTW in biased model cases are longer than that in perfect model case.

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5 The section 2.2 of "Ensemble coupled data assimilation" is incomplete. People will not understand your equations without trace back to your references. Please provide the completed two steps of EAKF.

6 Page 9 the last paragraph. The discussion of OTW with 4D-var is very confusion and hand-waving. The OTW in 4D-var is very different concept than yours. You should remove it.

7 Figure 4(a & b) show that the lower bound of RMSE reaches to 0. That does not make sense. Please check.

8 Figure 4 and Figure 5 show that the ensemble spread is significantly smaller than the RMSE. Please address the reasons and the effect on the assimilation.

9 P11 Lin13 I can not buy the statement of " since more observational information is needed to compensate the model bias and recover the characteristic variability." The reason should be " the forecast ensemble in a biased model underestimates the forecast error, which results the EnKF underweight the observations. Therefore one can improve filter performance by using observation multiple times"

10 A reading proof is required to improve the manuscript. There are too many typos and grammar errors. For example Page 2 Lin 33 The "ensemble filter" should be "ensemble Kalman filter" Page 6 Lin 13 "but they are started from different initial states." can be deleted Page 6 Lin 15 "observation" should be "truth" Page 6 Lin 33 "the coupling co-efficient C1is sensitive to model stability" should be " the the model stability is sensitive the coupling coefficient C1" Page 7 Lin3-5 The whole sentence need rephrase. You can just mention that " Following Zhang and Anderson (2003) an ensemble size of 20 is applied in all experiments in this study." Page 7 Lin9-11 "absolute error" is not under-standable. I guess that is " the absolution values of error" . The experiments are not described clearly. Please rewrite. Page 7 Lin28 the sentence is not completed. Page 7 Lin 30 Please also give the equivalent time of atmosphere (1-2 model month?). The deep ocean should be 50 model year.

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