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Interactive comment on “A 20-yr reanalysis Experiment in the Baltic Sea Using three Dimensional Variational (3DVAR) method” by W. Fu et al.

Anonymous Referee #2

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The authors make a 20-yr reanalysis experiment in the Baltic Sea by assimilating T/S profiles into operational ocean model with the 3DVAR method. The ocean reanalysis datasets are very important for many applications. For example validation of model performance. Now there are many studies of ocean reanalysis but mostly focus on the open oceans. And there are also many ocean reanalysis system like BLUELINK. However, the regional areas have few reanalysis studies. The manuscript try to construct a long analysis of T,S and SL and assess the valid of the assimilation system in the long period simulation. However the manuscript should be modified before considering publication.

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1) One of the purpose of the manuscript is to assess the effect of assimilation system on long period simulation. However, authors give every short depicts of the 3DVAR assimilation system. And the assimilation system only has been tested for a very short period run by zhang et al. (2011). so it is necessary to prove your system is valid in long period integration. I would suggest authors make some comparison with other assimilation system like EnKF or 4DVAR.

2) the equation 1 uses the error expression of observational operator. In the formula of 3DVAR, it is non-linear, and should not use its linear version in equation 1.

3) Here authors use a 3DVAR method with recursive filter in horizontally direction and EOF in vertically direction. This method isn't new. Some references should be cited in the manuscript e.g. 'Dobricic S, Pinardi N. 2008 An oceanographic three dimensional variational'.

4) In the SST verification, authors mention ' the large seasonal bias in the free run suggests the error from the forcing and /or heat flux parameterization used in the ocean model', author need more detail explanation to support this opinion.

5) Authors make the MLD comparison between reanalysis and free-run. This manuscript depicted the MLD has some changes between free-run and reanalysis. But it is hard to conclude which is better. Authors have no the sufficient support for the results. MLD is very important to the ocean dynamic. Therefore I would like authors can make some validation with climatology data or some other related references.

6) Authors only simply depicted the assimilation system setup and more focus on the description of the model setup e.g. forcing or lateral boundary conditions. However, the setup of assimilation system is very important to the reanalysis results. More information of the setup of assimilation system should be introduced e.g. the homogeneous or inhomogeneous of the parameter variance used for recursive filter in B matrix.

7) At the introduction, authors say ' reanalysis combining state of art models.....', what

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does the 'art models' mean.? Please make accuracy expression.

8) The assimilation is performed daily with the any available observations. Many reanalysis systems have used the time-windows. But it isn't clear whether or not the manuscript used daily observations or similar multi-day observations with time-windows. If authors use it, have authors already tested it how long of the time-windows should be used?

9) In the data preparation for reanalysis, authors excluded the data if "the differences between it and model data larger than three standard deviations". What is the three standard deviations?it implied that it has three threshold values to exclude observations. It is confusing here. If authors use one criterion, so why select the three standard deviations? Whether or not authors have tested it? what it happens if observations larger than 3 standard deviations have been used in the assimilation experiment.

10) For figure 1, the author say it is the domain of DMI-BSHcmod, why you text it 'HIROBM-BOOS (HBM)'. Are they different models or the same one? If not, which one you used? Furthermore, the figure 1 has very bad quality. It isn't clear which region the model domain covered.

11) Authors use a two-way nested model, have authors done some special work for it in the assimilation system? It is very important to the assimilation of the North Sea and Baltic Sea. If it has been done please depicts it in this manuscript.

12) The model domain covered both North Sea and Baltic Sea and the region of observation also covered the North Sea, but only the results of the Baltic Sea are discussed. Have you also assimilated the observations in the North Sea? If it has been done, whether it has help to enhance the quality of the assimilation of the Baltic Sea . Authors can make some experiments to test what happens if the observations haven't been assimilated into the North Sea.

13) The manuscript say the reanalysis can capture the inflow than free-run in 1993

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and 2003, however the free-run also depicts these process from Figure 7 . Comparing reanalysis and free-run with observation, the trend of the free-run is closer to observation. Furthermore, reanalysis has a bigger salinity change in 2007. Does it produce error inflow or outflow there in reanalysis?

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9, C632–C635, 2012

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