

Geosci. Model Dev. Discuss., referee comment RC1
<https://doi.org/10.5194/gmd-2021-100-RC1>, 2021
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Comment on gmd-2021-100

Anonymous Referee #1

Referee comment on "NEMO-Bohai 1.0: a high-resolution ocean and sea ice modelling system for the Bohai Sea, China" by Yu Yan et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-100-RC1>, 2021

Review of « NEMO-Bohai 1.0: a high-resolution ocean and sea ice modelling system for the Bohai Sea, China »

This article presents a new NEMO based configuration for the Bohai Sea, which is a small semi-enclosed and very shallow area in North Eastern China, located at the latitude of Beijing. It is to my knowledge the smallest area covered by a NEMO configuration. The authors particularly focus on the sea-ice characteristics of the area.

The concept is interesting, Beijing is located at a low latitude (Valencia in Spain, in European standards) where the presence of sea-ice is possible only due to a combination of cold continental winters, very shallow waters and low salinity in the Bohai Sea. This makes the Bohai Sea very sensitive to climate change from the atmosphere but also from the ocean point of view.

From a general perspective, I think the article in its present state does not explore such aspects thoroughly enough, which is a bit sad because I believe this aspect to be really interesting. Therefore I think this article could be published in GMD after major revision.

Also there are editing problems in pages 6-10 of the article, the authors made an online comment on this but only for an array, which does not improve the readability at all. I strongly advise to correct this to make the work of reviewers nicer to do.

Most important comments:

- First, could you present the Bohai Sea a bit better. Especially we would like to understand what makes there is sea ice in the Bohai Sea. Basically there would not be any sea ice in the deep ocean at such a latitude. Is there sea ice in the Bohai Sea because it is very shallow or because of the low salinity or both ? Basically, please provide a good hydrography of the Bohai Sea.

- The paper mostly deals with sea ice, and neglects the Bohai Sea circulation. Is it mostly barotropic and driven by tides or is there a contribution of baroclinic effects, is there haline or thermal stratification ? Basically, if the low salinity of the Bohai Sea is essential to explain the sea ice cover, then it is crucial to know what are the processes that drive the salinity balance of the Bohai Sea. Additionally could you provide estimates of how much flow comes from the Yellow Sea and leaves, is the circulation mostly cyclonic or is it not even geostrophic perhaps ? This point is important because we need to understand if the long term sea ice cover trends are only driven by atmospheric forcing, or if changes in ocean circulation and/or river runoff can also affect the sea ice cover through the long term changes of SSS. And of course, we want to know how the model compares with estimates of this circulation.

- Although the paper lacks a proper presentation of the Bohai Sea hydrography, there is an extensive presentation of ORCA025 used at the OBCs. Could you just replace it with a simple reference ?

- As mentioned before, the Nemo-Bohai settings are very difficult to read. But I understand you use the Blanke & Delecluse TKE turbulence scheme. This choice is a bit odd in such a configuration but perhaps does not matter too much if the tidal mixing kills any form of stratification, and therefore I would understand that this is not much of a concern. The background vertical diffusivity is also very high, but perhaps it does not matter too much for the same reasons. However, could you show some T/S profiles and comparison with data in some of the deepest areas ? Having the right density profile close to the OBCs is an important feature to get the right amount of estuarine circulation. This part would be of course a lot easier to understand if you have first presented a proper hydrography of the Bohai Sea as mentioned before.

- The validation part of the ocean follows the weakness of the paper I think, it lacks some interest of the ocean. Please provide statistics when they are useful, especially for SSH: standard deviation of both model and observations, correlation, and mean square root error. And in this part you can also provide a comparison with S/T profiles which will allow to check the turbulence and the circulation. Having statistics on salinity or temperature is not really essential if we don't understand why, and there are only measurement stations along the coast.

Basically please extend the validation of the ocean with explanation of the biases rather than a purely descriptive approach.

In section 4 come some results about hydrography, which we have to assume are correct based on a validation that is rather light.

The most interesting part of the paper comes in this section, but is not exploited at all. It is about the sea ice cover. Obviously there is no significant trend in sea ice cover or volume (or even a slight increase ?), but could you relate this with trends in atmospheric

forcing ? In such a shallow region, the sea ice cover should be highly correlated with the mean winter air temperature. Is it the case or are there other factors ? Could you plot trends in temperature and salinity in the Bohai Sea ? You could integrate the heat and salt content to do that for example, in the mixed layer (unless it is always mixed to the bottom). The climatological cycles are interesting, but the interest of having a long integration is to see trends and not only in sea-ice cover, and to understand what drives the inter-annual variability.

Some other comments:

- A general comment is that there are many English language mistakes, I had tried to pick them one by one and finally renounced. Please have the article checked from this point of view when submitting the revised version.

- Please check all the weird symbols in page 6-10.

- Please check all your units which are inconsistent, the right format for unit notation is for example $1.2 \text{ m}^3 \text{ s}^{-1}$

Meaning that there should not be any $\cdot \text{m}^3$ and s^{-1}

nor any multiply or / sign. Salinity should be in PSU. Please check with Copernicus if they ask for the exponent to be 10 or just the "e" letter.

- Line 349: "It is noticeable that modeled sea ice volume change is slightly later than the observed by satellite during early freezing period", please clarify

- Line 362 : Fig 9. shows the monthly seasonal cycle

