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Comment on gmd-2022-160

Joakim Kjellsson (Referee)

Referee comment on "The Baltic Sea Model Intercomparison Project (BMIP) – a platform for model development, evaluation, and uncertainty assessment" by Matthias Gröger et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2022-160-RC2>, 2022

"The Baltic Sea model inter-comparison project BMIP - a platform for model development, evaluation, and uncertainty assessment" by Gröger et al. 2022

The manuscript presents a MIP for Baltic Sea models, which to this date has not existed before. So far, 4 models are participating, but 2 come in different resolutions which gives 6 in total. There is also a 7th model but the data availability from this model seems to be very limited as it is not presented in most plots. The models are forced by the same surface fluxes (atm. forcing and river input) and this surface forcing is presented as well. All models are compared to available observations and reanalysis products and some striking differences are found.

I think the paper is overall very interesting and well written. I would recommend it for publication after some minor comments below are addressed to make it more readable.

Overall:

The authors rarely use the word "bias" in when discussing the differences between obs and model results. For example, line 309 says "positive anomalies in comparison with BSH climatology", but this occurs several other times in the manuscript. I would use the word "bias" more often to make the text easier to read.

The resolution and/or size of almost all figures (3,5,6,11,14 seem the worst) is pretty poor. Perhaps the final layout will be different, but I struggled to even find the results in some figures when on printed paper. Model names are hard to read in Fig 5, and the lack of a coastline or filled continents in Fig 11 is odd. I would recommend making the figures larger (maybe taking up a full page), and that the authors add coastlines or filled land in Fig 11.

Detailed comments:

Page 3, Line 75: The additional reference to Myrberg 2010 is superfluous in my mind since it was given already in the previous sentence.

Page 5, line 158: I am very curious to know more details about the atmospheric forcing that is used here. I'm not familiar with UERRA. The website listed is not actually a set of instructions, but instead just a website for the project. Also, I would prefer if the authors spent some time in the main text of the manuscript to describe the data rather than point the reader to an external website. □ "The authors should describe: 1) What the shortcomings are and what the corrections are. 2) What radiation was used? 2m temperature etc can be taken from analysis fields, but radiation and other fluxes must come from forecasts. In my experience, one would typically use the difference between the +6 and +12h forecasts of radiation, but I'd like to know what the authors do here. 3) Are any corrections needed for radiation? The commonly used DRAKKAR forcing set 5.2 (https://www.drakkar-ocean.eu/publications/reports/report_DFS5v3_April2016.pdf) had to do quite some corrections to the radiation fields. 4) Is there any effort in the data set to ensure that the surface water budget is closed, i.e. $E-P-R = 0$ over some time scale, or is this done by the individual models?

Page 6, line 171: "The GETM_1nm and GETM_2nm domain is limited to the southern Kattegat" this makes it sound like the model domain only covers the Kattegat, which I'm sure it does not. The sentence should rather be "The GETM_1nm and GETM_2nm domains cover the Baltic Sea including the Kattegat while the two MOM domains also include parts of the Skagerrak. Both the NEMO and HBM domains encompass the Baltic and the North Sea, for which they also use tidal forcing on the lateral boundary condition."

Page 8, line 256: "it is limited to regions where the coastline is mainly oriented along an east/west axis as in the Gulf of Finland". Does this mean the method is only applicable there? I think maybe you mean that the method is most applicable when the coastline is north/south, and not so well applicable where it's east/west? The authors discuss the biases in upwelling along the Swedish coast (mainly meridional) and the Gulf of Riga (zonal and meridional) so if the method is less reliable for a specific direction, it could explain some of the larger biases they find.

Fig 3. Perhaps the figure could be made to take up a full A4 page. It is very small and labels are difficult to read.

Fig 5: This figure would also benefit from being larger.

Page 14, line 380: "NEMO_2nm showed that salinities were lowest in the deep later but highest in the upper layers". This makes it sound like NEMO and GETM simulate fresh bottom and salty upper ocean, which is surely not the case. I think the authors mean to say that NEMO and GETM are fresher at depth and saltier in the upper ocean compared to the other models.

Fig 6: This figure needs to be made larger. It is at times difficult to see the differences authors are referring to in the text.

Fig 9: Please make the model names larger (can hardly be read when on printed A4 paper). Also please add a vertical line in the top-left subfigure to indicate in what year the reanalysis ends, and please explain this in the figure caption as well.

Fig 11: Why is MOM_1nm and GETM_2nm not in this plot? Was the data not available? I think the authors computed the upwelling themselves using the temperature, i.e. it is not an online diagnostic, so it should be possible to do for both MOM and GETM as well. Or do those model runs, which differ only in resolution from their twins, produce the same result? I would think upwelling can be sensitive to the horizontal resolution. Also, I would strongly recommend adding filled land or coastlines in this plot to make it easier to view.

Figs 11,12. It strikes me that NEMO simulates a very different pattern of biases, and much smaller biases in upwelling overall. I understand the authors do not want to deep dive into why this is, but I think some speculation on why NEMO is so different could be warranted. The final answer could be left for future work.

Fig 13: Why is GETM_3nm not in this plot?