Ocean Science
Discussions

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comment

Interactive comment on "Winter stratification phenomena and its consequences in the Gulf of Finland, Baltic Sea" *by* Taavi Liblik et al.

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Comment: In fairness to the authors, the editorial staff should not have requested reviews for a manuscript in such a rough state. I think it could warrant publication at some point, but as it is, the manuscript is not even ready for submission. Overall, the manuscript reports observational and model results but it fails to put these results into context and it fails to provide any motivation for the study. The science appears to be sound, but it's not clear why it was done. The manuscript requires extensive editing for grammar and style. There are too many minor grammatical errors for me to keep track of. Tell the reader early on why your work matters and how it fits into a larger context. I am sure it is important, but as it is written now, the manuscript fails to convey that importance. I recommend reading Mensh and Kording (2017) Ten simple rules for

structuring papers. C1 -PLOS Computational Biology 10.1371/journal.pcbi.1005619

Reply: Thank you for your comments and recommendation.

Action: We wrote about the motivation at lines 28-36 and 75-83. To provide for a reader the importance of the paper in a larger context, we added a section to the beginning of the manuscript. We made another editing for grammar and style. The results chapter was shortened to keep it more condensed, introductory sentences were added to each section, to make it easier to read.

Comment: Given that the manuscript lacks a clear motivation, it is difficult to evaluate it using the journals review criteria, which are listed here: https://www.oceanscience.net/peer_review/review_criteria.html. The authors may also wish to use these criteria when revising their manuscript.

Reply: We have added a section to the very beginning of the Introduction to indicate what is the overall motivation of the study. Details about motivation (why stratification is important for the physics, biogeochemistry and biology) were given at lines 28-36 (previous submission). Action: We added a section to the beginning of the section. We checked the criteria before revising the manuscript.

Comment: + 'Phenomena' is typically the plural form of phenomenon (https://www.merriamwebster. com/dictionary/phenomenon) So the title should read ': : : phenomena and their consequences : : :' or 'Winter stratification and its consequences'

Reply: Thank you for the note.

Action: We changed it to "phenomenon".

Comment: + Introduction- the first paragraph of the introduction should state the main goal or problem that the manuscript aims to address. As it is written now, the first paragraph is full of many details about the seasonal cycle of stratification in the Baltic Sea but we are left guessing as to the importance of these details. Please tell the reader

the main point or what particular issue your manuscript addresses in the first few sentences and then move on to specific information that the reader needs to understand what has been done, and what is new.

Reply: Yes, this paragraph can be added in the beginning.

Action: We added: "The upper layer stratification is an important characteristic in the dynamics of the pelagic ecosystem. The formation of the wintertime haline stratification in the upper layer of the large basins of the Baltic to our knowledge is not thoroughly investigated. The present study focused on the formation of wintertime haline stratification caused by the inflow of freshwater and wind forced circulation in the Gulf of Finland. The observed haline stratification explained early phytoplankton dynamics."

Comment: + The motivation for this manuscript is not stated until line 75 - "Details about the formation of the haline stratification in the larger areas of the Baltic Sea during wintertime is mainly unknown." This is the new topic that you address. Please make that clear in the first paragraph and then tell us about what is known. When it's the other way around, we're left wondering why you are telling us all this information and where it is going.

Reply: Yes, it can be mentioned earlier.

Action: Please see our previous responses.

Comment: + The OSTIA product is not technically remote sensing data. It is gap-filled remote sensing data that also uses in situ observations. The most recent citation for OSTIA is Good et al. (2020) The Current Configuration of the OSTIA System for Operational Production of Foundation Sea Surface Temperature and Ice Concentration Analyses. Remote Sensing. 12:720 doi:10.3390/rs12040720 C2

Reply: Thank you for the information.

Action: We removed "remote sensing" from the text in several places and added the reference.

Comment: + Regarding the OSTIA data- from the text it's not clear if you used daily OSTIA fields or mean SST for the entire period from 2010-2019. Can you please clarify?

Reply: We use daily OSTIA fields. We clarified this in the data and methods part.

Action: It reads now "OSTIA (Donlon et al., 2012; Good et al., 2020) daily mean sea surface temperature (SST) data for the period 2010–2019 were obtained from the Copernicus marine environment monitoring service products..."

Comment: + Section 1.2- why use nautical miles? The journal requires the use of metric units. https://www.ocean-science.net/for_authors/manuscript_preparation.html

Reply: Metric units for the GETM run are and were also written in the text, but were missing in one place. We used nautical miles as those are also commonly used in the modelling community – the original grid is planned in nautical miles (either 1 n.m. or 2 n.m., in our case 0.5 n.m.) and it makes sense to indicate this. See e.g. https://os.copernicus.org/preprints/os-2020-28/, https://os.copernicus.org/articles/15/1399/2019/ or https://os.copernicus.org/articles/15/1691/2019/.

Action: We added metric units also for the COPERNICUS reanalysis product.

Comment: + What are your open boundary conditions? Relaxation? How is riverine input treated in the model? How did you spin up the model?

Reply: Thank you for the remark, we have made adjustments in the model description. The boundary conditions for different parameters differ in the model. Observed sea surface height is set to the boundary with Flather (1994) radiation scheme, while the temperature and salinity are relaxed to climatological profiles (Janssen et al. 1999) along the open boundary. There is also a sponge layer with 3-points for the latter.

Riverine water has a constant salinity 0.5 g/kg due to numerical reasons. We are pretty sure that the model can handle also lower values, but at least in the used experiment,

it was 0.5. As the temperatures for different rivers are not known and therefore hard to prescribe, the model uses target cell value. Riverine water enters as a change in the sea surface height – the volume of entered water within one model iteration divided by target cell area will give the additional change in the SSH.

We use re-analysis product from Copernicus Marine Service as the initial temperature and salinity. By definition, it is supposed to be the best available possibility to get 3D field of T/S as it "interpolates" observations using the state-of-the-art method. In reality, one can always argue whether it is the "best" way. Nevertheless, we assume that the re-analysis product has all correct salinities and temperatures for different basins and is already baroclinically balanced. Our simulations start from the motionless state but as the Baltic Sea is shallow and wind-driven circulation prevails, the model will quickly adjust to forcing. Lips et al (2016) showed that the volume-averaged kinetic energy reaches correct values within 5-days. In summary, we do not think further spin-up is necessary for the simulations.

Action: We have considerably modified the section 1.2.

Comment: + Results- since the response of the water column was very similar in each winddriven event, perhaps describe the general behavior first - strong winds, well-mixed water column, low chl-a.

Reply: We considered this but realized that it is better if this comes after we have described the observations. Strong westerlies- well mixed water column relation is given in the introduction and the possibility of the formation of the shallow halocline is also mentioned there.

Action: No particulate action here, but we think other changes (complementing intro-duction, and introducing each section in the results chapter) help a reader to follow the results.

Comment: + Line 219 - "Since freshwater originates from the east: : :" Is this statement

supported by data or is it speculation? If it's speculation, please move speculative arguments to the Discussion.

Reply: We expected here a reader noted from the introduction that the riverine water enters the gulf mainly from the eastern part of the gulf. Anyhow according to the other reviewer comment we realized this section is repeating the previous section, so we decided to remove it.

Action: We removed this section.

Comment: + Instead of describing what was observed in each dataset, use all the data to describe the stratification phenomena of interest. You are using widely accepted methods so there is no need to justify their use. Communicate your point clearly and succinctly

Reply: We describe the phenomenon in the order of subtopics. In the first two sections, we describe the stratification phenomenon along the gulf, its vertical structure and impact on Chl a. Next, we describe the surface characteristics (measured by the ferrybox two times a day), which give us a more detailed understanding of the temporal developments of haline stratification formation. In 3.2 we make statistics of the process based on the model and historical CTD data to put our results to a broader context. We added introducing sentences before sections and renamed chapter 3.1. to make it easier to follow for a reader.

Action: We renamed the 3.1 title and added introducing sentences to each section to make it easier to follow for a reader. Likewise, we have shortened section 3.1 considerably. We also removed figure 7 after comment from another reviewer.

Comment: + Line 295 - this also appears to be speculative and should be moved to the discussion

Reply: We change the first sentence of this section to make it less speculative. There is a strong correlation between ice coverage and the NAO index in winter according to

literature. But we agree, since the section includes references to previous studies, it rather belongs to the discussion.

Action: We moved the section to the discussion.

Comment: + Figure 2 is not necessary. Simply state the r$\ddot{E}\c{E}$2, p value, and n in the manuscript

Reply: We agree.

Action: We removed the figure and added a sentence about it to the manuscript.

Comment: + Figure 5 contains too many subplots. It's cluttered and difficult to take in

Reply: We agree, this figure needed improvement.

Action: We remade figure 5. We hope it looks better now.

Comment: + Figure 9 also contains too many subplots. Perhaps create an animation?

Reply: We agree, this figure needed improvement. We believe it is better to keep it in figure format though.

Action: We modified the figure. The axis labels were removed (except in one plot) and the plots are now more zoomed in to the area of interest. We believe after these changes the figure is much easier to read.

Interactive comment on Ocean Sci. Discuss., https://doi.org/10.5194/os-2020-40, 2020.