Answers to reviewer no. 2 (Dr. Vladimir Ryabchenko) in red

Thank you very much for the thorough review and good comments. We will follow your suggestions and will revise the manuscript accordingly

General comments

The presented manuscript analyzes and compares the results of two ensembles of scenario simulations (performed in projects ECOSUPPORT and BalticAPP / CLIMSEA) for the Baltic Sea including marine biogeochemistry performed using different Regional Climate System Models (RCSM). In addition to different RCSMs, these projection ensembles differ in the Earth System Model (ESM) forcing, the Baltic Sea ecosystem model, the greenhouse gas (GHG) concentration scenario, the nutrient input scenario, the sea level rise (SLR) scenario and the simulation period.

Despite the uncertainties related to global and regional climate and impact models, as well as the unknown pathways of GHG and nutrient emissions, which make it very difficult to compare these two ensembles of projections, the authors obtained a number of important new results. Among them, I note: 1) global mean SLR results in a more or less complete compensation for the Baltic Sea salinity reduction for the projected increasing river runoff, 2) the global SLR can be identified as a new driver that has a strong impact on bottom oxygen concentration, 3) most noticeable are the differences in projected biogeochemical variables between ECOSUPPORT and BalticAPP / CLIMSEA ensembles. The article is undoubtedly important and interesting for ESD readers not only with the presented results, but also with a discussion of knowledge gaps and prospects for further research.

The main, but, incidentally, a small drawback of the manuscript is not always a sufficiently detailed explanation of the results obtained, which is discussed below in specific comments.

Thank you for the comments. We will try to improve our explanations of the results based on your comments in the revised manuscript.

Specific comments

Abstract

In the abstract there is no description of the differences in setups in the two ensembles of projections (ECOSUPPORT and BalticAPP / CLIMSEA simulations). It would be nice to list them in accordance with Table 3.

We prefer not to add these technical information because the abstract is already relatively long (369 words). To explain the differences between the setups of earlier ensemble studies, much more text would be needed.

Main text

L.114-115

"An overview was given by (Schrum et al., 2016)…"

Reference is missing from the bibliography

Thank you. Added.

L.193-208, 866-874 (Fig.3)

Nutrient input scenarios in BalticAPP and CLIMSEA simulations are described using Fig. 3. The latter is of very poor quality and does not allow you to see the differences between the blue, green, orange and red curves (Fig.3, lower panels) corresponding different scenarios. The choice of colors appears to be unfortunate. In addition, plotting all the curves on one graph creates the impression of complete chaos, nothing more (although, perhaps, the authors wanted to show just that).

The ECOSUPPORT nutrient input scenarios (Gustafsson et al., 2011; their Fig. 3.1) are not displayed in the Fig. 3. At the same time, they are important (especially for the historical period) in order to better understand the differences in the projections of biogeochemical variables in the two Ñomparable ensembles, and it would be good to add them as a separate panel in Fig.3.

Figure 3 is taken from a recent publication in Communications Earth and Environment. It is not necessary to distinguish individual curves because only tendencies and spread are important. Some colors are not visible because curves are identical and displayed on top of each other. Thank you very much for the very good suggestion to add information about ECOSUPPORT nutrient loads. We will add an additional table for the changes in bioavailable nutrient inputs in the various scenario simulations. We will also explain the differences in the text in more detail.

L.460-463

The good agreement between simulated annual mean surface phytoplankton concentrations and reanalysis data everywhere (with the exception of coastal regions) is somewhat surprising. As far as the author of the review is aware, the deviations of the simulated chlorophyll concentration from the individual observations can be very large. Perhaps the agreement is due to the small number of observations and their corresponding small contribution to the results of the reanalysis?

You are completely correct. In the reanalysis by Liu et al. (2017) nutrient and oxygen concentrations are assimilated but not chlorophyll data. We will add a sentence explaining the finding.

L. 641-658

"3.2.6 Oxygen concentration and hypoxic area

Bottom oxygen concentration"

This subsection discusses the differences between ECOSUPPORT and BalticAPP ensembles in bottom oxygen concentration. Discussion of differences ends with the phrase:

"These results are explained by the historical nutrient input reductions and the slow response of the Baltic Sea". (L.658)

This unsatisfactory, too general explanation makes the reader think, and due to what differences in historical nutrient input this situation could have happened, and he turns to Fig. 3 and does not find there the necessary information about historical nutrient input in ECOSUPPORT (see above remark about Fig. 3). Further, an inquisitive, but already somewhat irritated reader continues reading and discovers a detailed explanation of the differences between ECOSUPPORT and BalticAPP ensembles in the biogeochemical cycling (for some reason, in the Knowledge gaps section) in lines 751-763.

In my opinion, it would be better not to test the patience of the reader and move this explanation to section 3.2.6. It would also be good to expand this explanation by indicating the difference in the initial conditions for biogeochemical variables between ECOSUPPORT and BalticAPP ensembles and how this difference affected the final results.

We agree with your comment. The text part will be moved and the differences will be better explained.