

### Responses to Anonymous Referee #3

Below the review is reproduced in black font and our responses interspersed in blue.

#### Comments:

Summary: The manuscript introduces and shortly evaluates a new setup of a coupled physical-biogeochemical model of the East China Sea. With this model the authors show that the model reproduces observed hypoxic events and that it closely relates to the river discharge of the area, and present an oxygen budget that includes physical and biogeochemical processes.

**Reply:** We appreciate the Reviewer's overall positive assessment and believe we can address the concerns raised below as described.

Major comments: 1. The manuscript is overall well written and the figures are representative and easy to understand. However, as the manuscript is built at the moment, I lack a red thread and a consistent story in there. The manuscript starts by focusing on observed hypoxic events but it does not really go into details describing the processes behind, and why it looks different from year to year. Then the manuscript goes into describing the passage of typhoons and their effects on the oxygen concentrations, and after into describing oxygen budget for the area. This latter budget seem to be constructed by using simulated means over the whole simulation period (a description of how the budget is calculated is lacking). I would suggest that the authors focus on describing the hypoxic events, and that they dig more into the processes behind these to understand why it looks different from year to year. The authors see that the extent of hypoxic waters closely relates to the river discharge. However, they do not explain whether the increase in hypoxic waters is related to a stronger nutrient loading and thus an increase in the primary production and remineralization, or whether it is related to a stronger stratification preventing the exchange of oxygen between deep and surface waters. This could be analyzed by calculating a budget as the one that is presented in Figure 7 for each year. Further, it would be interesting if the authors could describe why they see a difference in the phenology of the hypoxic extent, and what causes the seasonal and interannual variations in the extent of CDW?

**Reply:** We believe we can improve on our presentation in making clearer what the contributions of this study are and what the thread is throughout the manuscript. The budget does not use simulated means but is calculated based on daily model output. This will be clarified in the revision. We will also expand the analysis/discussion of processes behind the year-to-year differences in hypoxic events and their phenology. The question whether variations in hypoxia are driven by freshwater variations (i.e. stratification = physical processes) or nutrient load variations (i.e. production & remineralization = biological processes) is a tricky one because inputs of freshwater and nutrients are highly correlated (this is typical of coastal systems influenced by larger rivers with high anthropogenic nutrient loading). We will provide an annual budget as suggested by the Reviewer but given the high correlation between freshwater and nutrient inputs, we're not sure it will inform the question he/she raised.

2. At the moment I do not see what your story gains with the section on typhoons. These processes are acting on much smaller time scales, and do not seem to have a large influence on the seasonal variations that you say that you will study in the abstract and in the introduction. I may

be wrong, but in that case this should be clarified. If not I would suggest to remove this, or only briefly mention it and put the figure in the supplementary.

**Reply:** This is a fair point to raise. We will clarify the role of typhoons or remove this part in the revision.

3. Are there more observations that you could use for your evaluation? Are there for example profiles of temperature/salinity/oxygen/nutrients measured during the hypoxic events that you present?

**Reply:** We don't have profile information but fortunately we recently became aware of a suitable nutrient data set. We intend to add a model-data comparison of nutrient distributions to the revised manuscript, which shows that the model does a good job in reproducing the nutrient distributions.

Minor comments:

- the manuscript uses a lot of abbreviations that makes it difficult to follow. I would suggest to reduce them. You could remove abbreviations that are only used a few times, and keep those that are used all over the manuscript.

- use the word "evaluated" instead of "validated" all over the manuscript

- you need a section where you describe the observational data

- in the figures you have to specify what time-average you have plotted. Is it the modelled monthly means?

- page 1, line 16: replace "and reproduces" to "and it reproduces"

- in the introduction you could also add some examples from the Baltic Sea that also suffers from an increasing volume of low-oxygen waters.

- page 5. line 126: please specify how much 1/12 degree is in kilometres as these latitudes.

- page 5, line 128: do you have a reference for the MPDATA?

- page 5, line 134: I guess the atmospheric forcing also contains solar radiation?

- page 5, line 137: describe in more detail what the SODA dataset contains, is it hourly, daily, weekly, monthly ... data?

- page 5, line 144: please specify why you use daily river-runoff for this river and not the others. I guess it is because it is the major river in the area?

- Figure 1: what do the dots in the right hand panel show?

- page 7, line 173: is this instantaneous remineralization described in Laurent et al 2017? If not maybe you should describe it a bit more and why you have no burial in the sediments. What are the assumptions behind?

- page 7, line 179: Maybe you could put a map in the supplementary material showing the attenuation coefficient? Does it compare well with observations (if there are any)?

- page 7, line 180: 1 year seems a bit short as spinup. Don't you have anymore drift C3 BGD Interactive comment Printer-friendly version Discussion paper after this? What is the volume turnover time of the area?

- page 7, what is the output frequency of diagnostics from the model?

- page 10, line 223-225.

- Oxygen budget: you need to put some more details on how this is calculated. Is it calculated online or offline? If it is calculated offline, what output frequency do you use?

- Page 14, line 282: You have not explained what the abbreviation WR stands for.

- Page 15, line 307: why is the turbulent diffusion stronger in the Northern region?

- Page 16, line 341 and 348: Two sentences starting with "And". Sentences should not start with this word. Please reformulate.

**Reply:** These are all good points and all will be addressed in the revision. We appreciate the Reviewer being so thorough and constructive in his/her comments which will help greatly in improving the manuscript.