**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 have addressed 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 form 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 is 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 have taken the Reviewer’s suggestion to heart and substantially expanded the analysis of interannual and intra-seasonal variability. We agree that this was insufficiently developed in the previous version. We believe we now present a logical thread throughout the manuscript. The budget does not use simulated means but is calculated based on daily model output. Following the Reviewer’s suggestion, we have included the individual years in the budget plot as well. 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 now directly addressed. Interestingly, inputs of freshwater and nutrients are not correlated which allows us to separate the effects to some degree.

2. At the moment I do not see what you story gains with the section on typhoons. These processes are acting on much smaller time scales, and do not seem to ave 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 brefly mention it and put the figure in the supplementary.

**Reply:** This is a fair point to raise and we agree that this point was not sufficiently developed. We have added a systematic analysis of high-wind events in the revised version. It turns out that the frequency of high-wind vents is important not only in explaining short-term variations but also interannual differences.

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 (only surface and bottom concentrations for select properties) but fortunately we recently became aware of a suitable nutrient data set. We added a model-data comparison of nitrate distributions to the revised manuscript, which shows that the model does a good job in reproducing these.

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.

**Reply:** Agree. We are now limiting ourselves to a few acronyms that are repeated many times throughout the manuscript (ECS, CE, PP, OC, WOC, SOC and FW).

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

**Reply:** The two words are not synonyms.Whenever we use the term “validated” we mean to do so.

- you need a section where you describe the observational data

**Reply:** We included a new section on model validation that also describes where the data come from.

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

**Reply:** We don’t show any monthly means. We added more explanation to the figure captions to make this clear and clarified in the text that we have saved daily output.

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

**Reply:** We prefer the sentence as is.

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

**Reply:** The Baltic Sea is a very different system in that hypoxia and anoxia in its basins are essentially permanent. The hypoxic region in the ECS is in much shallower water, seasonal, and directly linked to the plume of a major river. The ECS is analogous to the northern Gulf of Mexico, and we draw comparisons between these two systems where appropriate throughout the manuscript, but we do not see the value in adding comparisons to the Baltic Sea.

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

**Reply:** Done.

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

**Reply:** Yes, done.

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

**Reply:** Yes, solar radiation is part of the heat fluxes (shortwave).

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

**Reply:** Monthly, now added.

- 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?

**Reply:** Yes, and because daily data are not available for the other rivers.

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

**Reply:** We changed this figure.

- 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?

**Reply:** Yes, it is described in detail on Laurent et al. 2017 and also in Fennel et al. 2006.

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

**Reply:** We already have many figures in the Supplement and the attenuation coefficient moves with the river plume, so one static map wouldn’t do much. No action taken.

- 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?

**Reply:** On this point, please see the results from an 8-year climatological run we have conducted in response to comments by Reviewer 2. The plot included in the response shows that the model is in dynamics steady state in the region of interest after one year.

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

**Reply:** We have daily output (and present daily concentrations and rates).

- page 10, line 223-225.

**Reply:** No action taken.

- 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?

**Reply:** We have stated in the model description that we use daily output.

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

**Reply:** We have eliminated the abbreviation.

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

**Reply:** This text is gone.

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

**Reply:** This text is gone.