We thank the reviewer for the constructive comments and suggestions that are very helpful to the revision of our manuscript.

Detailed response to all comments are given below (responses are shown in blue)

Anonymous Referee #1

General Comments

Congratulations for the research work, there is a large amount of work summarised in a clear and well structured document.

Specific Comments

1. Page 4, Line 23: The description of the 1-D model does not refer to any other study, Does this mean that the model was developed for this research? Is there any reference for validating this 1-D model?

Response:

The 1-D model was configured and coupled with the 3-D model as detailed in Hu and Li (2009). The 1D-3D coupled model has been validated and applied to study the water-nutrients-sediment budgets (Hu and Li, 2009; Hu et al., 2011), the oxygen budget (Wang et al., 2017), and the nutrient fluxes between the sediment and overlying waters in the Pearl River Estuary (Liu et al., 2016) . In the revised manuscript, we will include more details of the 1D-3D coupled model to make it clearer. References for the validation are given below.

2. The configuration description of the 1-D model is quite small in contrast with the ones for the 3-D model and the water quality model.

Response:

As suggested, we will include more descriptions of the 1-D model in our revised manuscript.

3. Page 7, Lines 13 and 14: mention any quantitative description for the temperature and salinity validation as it is done for the tide.

Response:

As suggested, we will include some quantitative description for the temperature and salinity validation in our revised manuscript. More detailed validations can be referred to the Section 3 in our previous study (Wang et al., 2017).

4. Model Validation section: No validation mentioned of the 1-D model

Response:

In this study, we use the 1D-3D coupled model with a purpose to account for the interactions of hydrodynamics between the river network and the estuary. The 1-D and the 3-D model were run in parallel and they exchange model quantities across the coupling interface. The eight outlets (shown in Figure 1 in original manuscript) are the exchange interface of the 1-D and 3-D models, which serve as the lower boundaries of the 1-D model and at the same time the upper boundaries of the 3-D model. At each time step, the 3-D model utilizes the simulated discharges obtained from the 1-D model as the river boundary forcing, and sends the simulated water levels to the 1-D model as the downstream boundary forcing as a feedback. Therefore the eight outlets are very important for the assessment of the coupled model performance. We have validated the simulated water

levels and/or river discharges against observations at eight outlets in years 1999 (Hu and Li, 2009) and 2006 (Wang et al., 2017 and P7 line 8-11 in the our manuscript). Note that the validations at eight outlets are for both 1-D and 3-D models. In our revised manuscript, we will provide more details of the 1D-3D coupled model-configuration and validations to make it clearer.

5. Section 2.2: Are there any other hypoxia events reproduced by the model throughout the period Nov. 2005 to Dec. 2006, apart of the summer 2006? Are these events observed or not observed? Is the hypoxia event of summer 2006 the only event simulated by the model?

Response:

As shown in Figure r1, our model simulates hypoxia from April to October in 2006. In the simulation, the hypoxia starts to develop in April, peaks in August, and disappears in October. However, oxygen observations are only available in July and August 2006 when hypoxia are observed, while for other months no observations are available for validating the model simulated hypoxia. This is one of the main reasons why in the manuscript we only focused on July and August in 2006 to study the impacts of riverine inputs on hypoxia and oxygen dynamics in the Pearl River Estuary. Additionally, previous reported hypoxia also mainly occurred in July and August (Cai et al., 2013). Plus, from the aspect of the river discharges from the Pearl River network, these two months are typical wet seasons with the monthly-averaged total river discharges over 20,000 m^3 s^{-1} and the year 2006 is a wet year with the annual averaged total river discharges exceeding10,000 m^3 s^{-1} (Figure r2).

We agree that it would be an interesting topic to study the annual cycle and multi-years variations of hypoxia in the Pearl River Estuary. However, it will be quite hard to study the annual cycle and multi-years variations of hypoxia in this region due to the insufficiency of observational data. And to our knowledge, there are currently few studies on these two topics. Nevertheless, we believe that our study can provide some scientific basis and guidance for further modelling or observational studies on the hypoxia in the Pearl River Estuary.

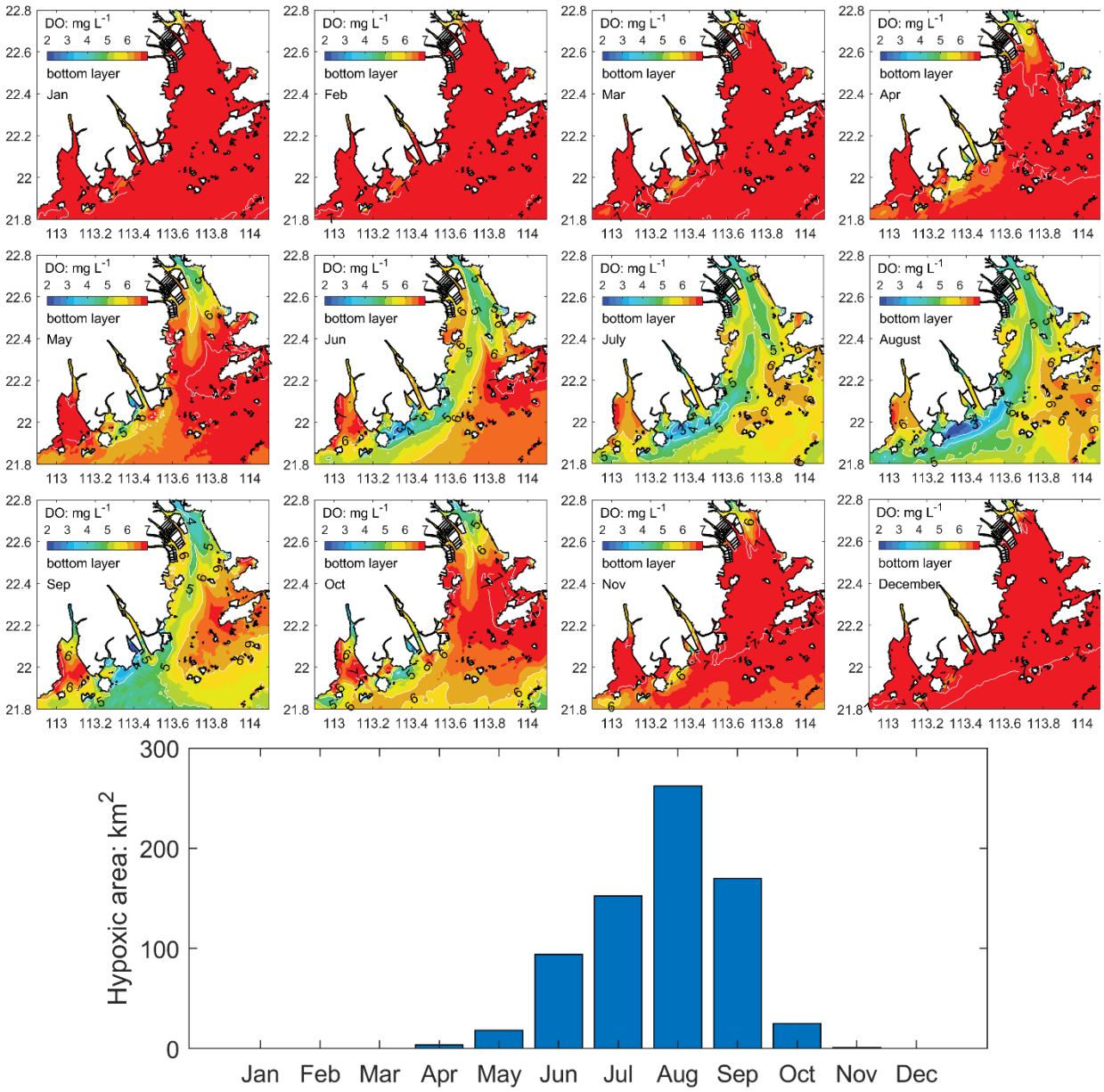

Figure r1. Distributions of the monthly averaged bottom DO and annual cycle of the hypoxic area in the Pearl River Estuary

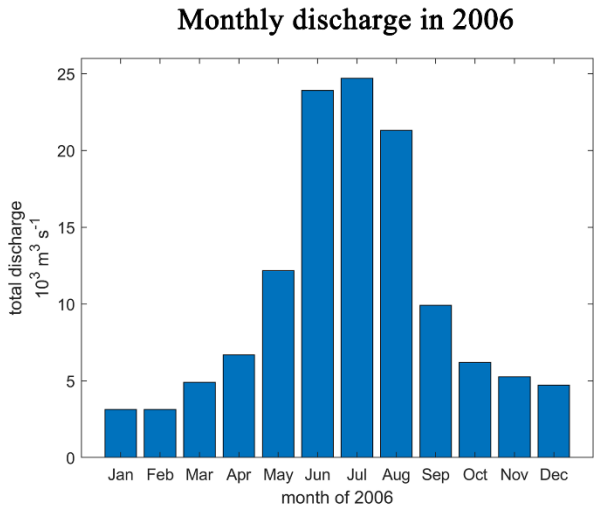

Figure r2. The annual cycle of monthly-averaged total river discharges in 2006

6. A map showing the location of the study area in a global context will be a great help for the reader which is not familiar with the study area.

Response:

We tried as suggested but found it hard to find the Pearl River Estuary in a global map. Alternatively, we will show the location of the Pearl River Estuary in the map of South China Sea in the revised manuscript. The revised figure is shown below.

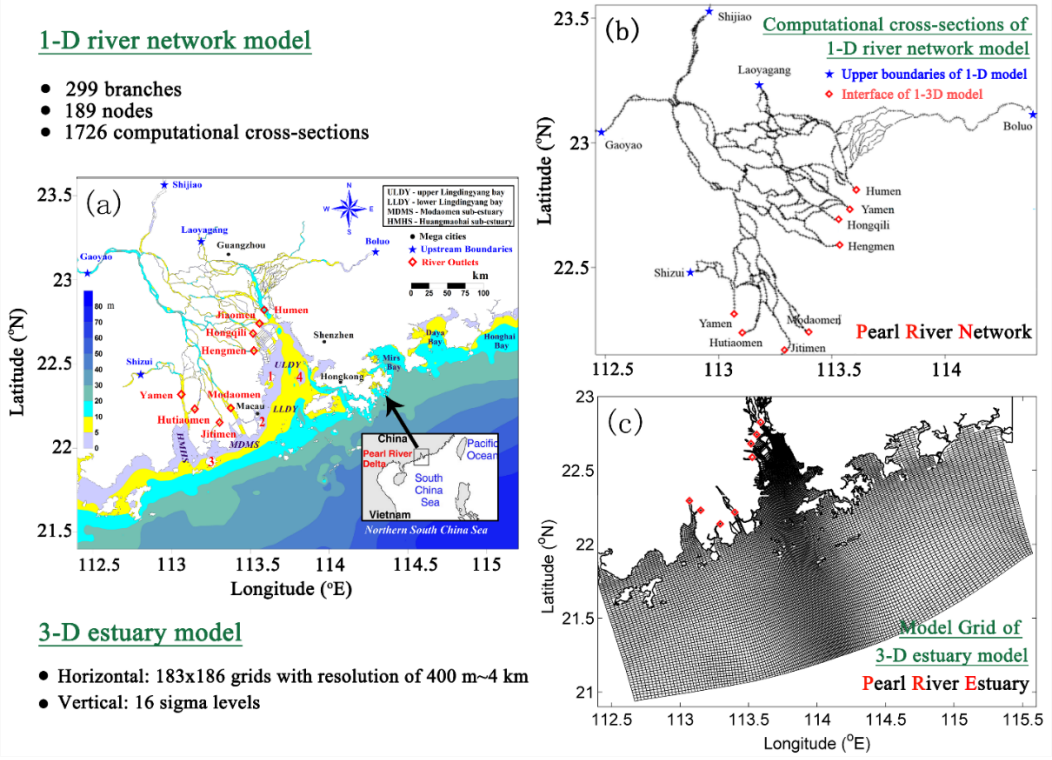

Figure r3. Maps showing (a) the Pearl River Delta with the Pearl River network and the Pearl River Estuary, (b) computational cross-sections for 1-D river network model, and (c) model grid for 3-D estuary model.

Technical Corrections

• Page 2, Line 17: Why the reference is made on Italic font (Diaz and Rosenberg)

• Not sure which the format for the references within brackets:
Page 2 Lines 19 and 20
Page 5 Line 19
Page 6 Line 8

Response:

We will double check and correct the format of references throughout the manuscript.

• Page 10, Line 8: where is the definition for **Cont**? I see there are the names for each simulations. Could be possible to mention this before start describing each of them? (The 7 simulations are named as . . . and summarized in table 1)

Response:

As suggested, we will define the name for each simulation before describing them in the revised manuscript.

• Figure 1a [page 24]: It could be just the pdf copy, but the y-axis (latitude) top and bottom labels are missing a 2 (23.5 and 21.5)

Response:

We have revised the figure, please see Figure r3..

Suggestions

• Page 2, Line 13: Enhance instead of exaggerate

Response:

Revised as suggested.

• Page 5, Line 8: There is a reference for the Mellor-Yamada model but not for the Smagorinsky-type formula. It should be a reference for each of them as they are in the same sentence (line).

Response:

We will add the reference in our revised manuscript.

• Page 7 Line 7: Could be possible to specify if the summer is on the north or south hemisphere? It is in the north hemisphere but the suggestion points to be specific as the moths to consider are not the same ones.

Response:

We will modify the sentence in the revised manuscript as 'The coupled physical-biogeochemical model has been validated against available observations in July and August 2006 in Wang et al. (2017)'.

• Page 18, Line 4: anthropogenic perturbations instead of just perturbations

Response:

As suggested, we will use the term 'anthropogenic perturbations' in the revised manuscript

Reference

Hu, J. and Li, S.: Modeling the mass fluxes and transformations of nutrients in the Pearl River Delta, China, J. Mar. Syst., 78(1), 146–167, doi:10.1016/j.jmarsys.2009.05.001, 2009.

Hu, J., Li, S. and Geng, B.: Modeling the mass flux budgets of water and suspended sediments for the river network and estuary in the Pearl River Delta, China, J. Mar. Syst., 88(2), 252–266, doi:10.1016/j.jmarsys.2011.05.002, 2011.

Liu, D., Hu, J., Li, S. and Huang, J.: Validation and application of a three-dimensional coupled water quality and sediment model of the Pearl River Estuary, Huanjing Kexue Xuebao/Acta Sci. Circumstantiae, 36(11), 4025–4036, doi:10.13671/j.hjkxxb.2016.0145, 2016 (in Chinese with English abstract).

Wang, B., Hu, J., Li, S. and Liu, D.: A numerical analysis of biogeochemical controls with physical modulation on hypoxia during summer in the Pearl River estuary, Biogeosciences, 14(12), 2979–2999, doi:10.5194/bg-14-2979-2017, 2017.