

Detailed responses to reviewer 1 (reviewer comments are included in black, responses in blue font)

Overview

Thank you for the opportunity to review the manuscript titled “Role of phosphorus in the seasonal deoxygenation of the East China Sea shelf.” I think the manuscript addresses an important problem and has the potential of becoming a worthwhile contribution. The approaches are robust, and the results are elegantly presented. I have offered below a couple of comments, which hopefully can improve the manuscript.

Response: We appreciate the constructive feedback. Below we provide a detailed response for each comment.

General comments

Comment:

1. Introduction: Suggest adding some more background/literature information on the relative importance of P limitation, N limitation, and light limitation in coastal environments, including literature specific to the Changjiang Estuary. This can help the readers set up expectations and better appreciate the results presented in the later sections.

Response: Thank you for the suggestion, we will provide additional discussion of the literature in the Introduction of the revised manuscript.

Comment:

2. The entire modeling analysis and results are focused on DIN and DIP. What are the roles of other subspecies of N and P? I am not suggesting the authors to re-do the work with TN and TP, but some discussion on the relative importance of DIN (DIP) vs. nondissolved N (P) can be beneficial. This is especially true for the proposed N+P dual nutrient reduction (28% and 44%). A 28% reduction of TN is not equivalent to a 28% reduction of DIN. The same argument is true for P.

Response: Changjiang TN concentration is dominated by nitrate, particulate and dissolved organic N contributing only 8–13 % (Große et al., 2019). Therefore, we focus on DIN (DIP) in our reduction experiments. We will add some discussion about this assumption and the potential effect on our results.

Große, F., Fennel, K. and Laurent, A.: Quantifying the Relative Importance of Riverine and Open-Ocean Nitrogen Sources for Hypoxia Formation in the Northern Gulf of Mexico, *J. Geophys. Res. Ocean.*, 124(8), 5451–5467, doi:10.1029/2019JC015230, 2019.

Comment:

3. The analysis of loading reduction scenarios makes the paper stronger and more management relevant. One suggestion is to present the loading reductions in the context of major sources for this system. What are the main contributors of riverine TN and TP loads? How would the proposed reductions be achieved by management actions by

targeting those major sources? Some recommendations based on literature and/or the authors' experience with the watershed will be helpful.

Response: We will provide a bit of discussion to put our results in the context of nutrient management.

Comment:

4. The majority of the analysis is based on established models. I do not have any issues with the modeling framework, but some statements on the model assumptions and uncertainties are recommended. In addition, have there been any bioassay sampling to verify the model-derived N or limitation status?

Response: We will provide some discussion of model assumptions and uncertainties. Unfortunately, we do not have bioassay data to compare with simulated P limitation. Instead, we show that the model reproduces both nitrate and phosphate distribution where cruise data are available.

Comment:

5. For the correlation result (Section 3.2), please specify what correlation method was used and justify the choice.

Response: We added the term "Pearson's correlations" in sections 3.1 and 3.2.

Comment:

6. This research is comprehensive and should have broad relevance. Some discussion that compares the results with other systems or transfer the insights to other systems will be very helpful.

Response: We will add a paragraph on the relevance to other systems.

Comment:

7. Figure 1: How were the six zones determined. Please clarify in the caption and methods.

Response: The following sentence will be added at the end of section 2.2:

"For analysis, the shelf region adjacent to the Changjiang Estuary (CE) is divided into 6 zones. Zone 1 represents the Jiangsu coastal area ($z < 25\text{m}$, $31.70 < \text{lat} < 33.50$). Zones 2 and 3 are the northern and southern hypoxia cores, respectively, defined in Zhang et al. (2020). Zone 4 represents the Yangtse Bank area ($z < 50\text{m}$, $30.75 < \text{lat} < 33.50$), whereas Zone 5 ($30.75 < \text{lat} < 33.50$) and 6 ($28.52 < \text{lat} < 30.75$) represent the northern and southern deep shelf waters ($50 < z < 100\text{m}$), respectively."

Comment:

8. Please be mindful on the use of significant digits. For example, $68.0 \times 10^3 \text{ km}^2$ (Line 155), $75 \times 10^8 \text{ mol N}$ (line 336), and other occurrences.

Response: Done.