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Biogeosciences Discussions

Interactive comment on "Destruction and reinstatement of coastal hypoxia in the South China Sea off the Pearl River Estuary" *by* Yangyang Zhao et al.

Anonymous Referee #1

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General comments:

In their manuscript Zhao et al investigate the effects of a typhoon on subsurface water reoxygenation following hypoxic condition off the Pearl River Estuary and the subsequent time scale of hypoxia formation. The author calculate the oxygen consumption rate in bottom waters using a three end-member mixing model. The subject of the paper is not novel but is an interesting approach and relevant for the region and the journal. The use of the model is interesting although the assumption about the "quasi-static bottom waters" is questionable and do not seem to fit with the observations (e.g. Figure 3, see specific comments below). The observations and analysis are fine but

too limited to fully support the conclusions. The authors rely heavily on the literature, whereas they could provide analysis or observations to support their interpretations. For example it would be interesting to see a sequence of oxygen vertical profiles, at multiple locations, when they look into the time-scale of hypoxia development after the typhoon. Volume might be an important factor at this time, although it is not mentioned because, as I understand, OCR is assumed to be uniform in subsurface waters. Does that imply that sediment oxygen demand is negligible? DIC observations are not used presently, although their analysis could strengthen the conclusions by relating OCR with respiration. Finally, part of the Discussion is a review of the literature (e.g. section 4.3) that is interesting but somewhat disconnected from the results presented. The discussion about hypoxia under future climate is highly hypothetical. Overall, the manuscript provides interesting results but could be significantly improved with more in-depth analyses of the observations. The quality of some figures could also be improved. Detailed comments are listed below.

Specific comments

L89: What are DIC and TA used for? How come you didn't use your DIC data to validate your estimate of OCR and to support your conclusions?

L101: did you collect chlorophyll samples? at what time of the day did you collect your chlorophyll profiles? did you notice non photochemical quenching near the surface and if so how did you correct the profiles?

Figure 1c: can you put shaded areas at the time of the cruises to be clear about the conditions during the sampling? Figure 1d: can you provide units and y-axis tick values? The length of the vectors don't seem to match the wind speed in the panel above. Also most vectors are oriented north-south and easterly winds vectors (associated with high wind speed) are small. Can you verify that the wind vectors are plotted properly?

L132: I have a hard time believing this assumption. Can you provide support to your claim? In Figure 3 bottom water conditions vary rapidly

Figure 3: This indicates the intrusion of warm/salty warters that participate to the re-stratification of the water column. What is the O2 and OM content of these waters? is OCR driven by sediment o2 consumption or just water column respiration? this figure indicates dynamic surface and bottom layers, not what it is described in the Results section (quiescent bottom layer). Do you know why O2 increases near the bottom? is there an advective source of O2 that is not taken into account?

L199: You should calculate stratification rather than citing others

L200: it didn't shift westward but was advected offshore indeed

L201: you are mixing discussion here

L241: but salinity (i.e. plume waters) will also control the wind intensity that is required to mix the water column

L246: Figure 2j,n shows stratification during leg 2, i.e. surface plume water, so the vertically homogeneous water column occurs before leg 2 (July 14-19)

L248: Figure 2l indicates a strong post-storm bloom that is not mentioned

L253: This should be true along the coast where the plume is trapped but not offshore

L254: This is discussed in a recent paper of the Changjiang estuary, you could have a look, I assume similar mechanisms occur in the PRE. https://doi.org/10.5194/bg-2019-341

L259: This is an interesting discussion but not supported by your observations so it feels a bit off topic

L291: what does that mean? that salinity was >xx in your samples?

L308: it is not a lower limit but an average estimate

L309: I am surprised that there was no advective sources/sinks of O2 given the observations in Figure 3

L313: You have to be clear how you use the terminology OCR. An increase in the OCR value (more positive) indicate a reoxygenetion.

L314: where is this shown?

L315: "decreased": so you mean less negative?

L317: you mean horizontal diffusion?

L316-320: your analysis is not well supported, can you discuss your results and be more quantitative? If not, please do not extrapolate

L324: Figure 3 indicates the intrusion of warm and salty subsurface waters at station F303 after the typhoon, can you comment on that and how it fits with your analysis?

L336: end of sentence: (Figure 5)

L338: those are really rough estimates. It is impossible to see what are the bottom O2 values in Figure 2 so it is difficult to judge your reasoning. Is the OCR=-15 value an average over the sampling area? bottom O2 values seem rather low over the entire area sampled during Leg 3

L341: Figure 3 shows that this is more variable than assumed here

L345: how did you come up to the value 183 from your assumption? do you assume mixing rather than water replacement during intrusion?

L346: This does not match your calculation above with the average OCR, why are you assuming the maximum OCR during spring?

L347: you should compare your values with similar systems, i.e. river-dominated estuaries (8-89 days). Also you could discuss your estimates in comparison of the PRE values provided in the reference.

L368-403: The last 2 paragraphs are not related to your results

L368: You did not mention/discussed the phytoplankton bloom in leg 2

L379: why?

Figure 6: I am not sure that annual averages are very pertinent, an average value per event might be more useful. For wind direction this could be presented as a pie chart. For wind speed, the time series is not very informative, may be think about an other way of presenting the results. This is somewhat included in Figure 6a but it would be interesting to know what is the maximum time between wind events for each year (or have some statistics based on your estimate of OCR). Also remember that hypoxia did not occur for most of the period shown here. panel c: please see comment regarding wind vectors in Figure 1, make sure those are right

L398: it depends on the direction, offshore intrusions would presumably bring lower O2 waters

L409: "lowest ever recorded"

L417: This is speculation, higher discharge may lead to lower nutrient concentrations in river waters, more export to deep areas where hypoxia does not occur

Minor comments/edits:

L80: can you provide the number of stations in parenthesis for each leg, it is difficult to estimate it from Figure 1b

L81: suggestion: "on the way back to port"

L155-164: You are mixing results and discussion

Figure 2: there is no point showing the river labels, they are way too small. Also the contour labels cannot be seen and the color bars are way too small. I suggest you move the colorbar to the top of each column and make it thicker with larger fonts An alternative suggestion is to split the figure into surface and bottom figures and flip the rows to columns to make larger panels

Figure 4: The labels and lines are very small

L312: not clear, the sentence should be rephrased

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