

Review:

Sensitivity of asymmetric Oxygen Minimum Zones to mixing intensity  
and stoichiometry in the tropical Pacific using a basin-scale model  
(OGCM-DMEC V1.4) by K. Wang et al.

submitted to GMD

This is the second review of the paper and the manuscript has improved significantly compared to the initial submission. However there are some remaining comments that need to be taken into account, before it can be considered for publication. The differentiation between physical, biogeochemical and coupled feedback mechanisms is still not shown in a sufficient way. The experimental setup allows to show the inter-dependencies between physical and biogeochemical processes in more detail than it is done. I would further rate this to be the main scientific impact of this study rather than allocating that to future studies. The general conclusion - physics have a big impact and there are complicated interactions - are too general and doesn't bring new insight into the topic. In particular processes in the depth range 400-700m, that are of key importance for the OMZ, are explained only in a perfunctorily manner. I would guess that a great deal can be done by changing Fig 10-12 and show here the same difference of simulations as done e.g. in Fig 9. Then you are able to differentiate between a change in the physical supply that results from a biogeochemical process and value/rate that against the change of the physical process and the combined change. The limitation of the study is clear, that only two processes are considered here, but the impact of these two processes should be fully investigated and explained here.

Further comments:

1. Abstract line 17 - this result is logically inconsistent: DO is more sensitive to biological processes between 200-700m and to physical processes between 400-1000m → so what is the case in the region between 400-700m which is the key region where models show large representation deficiencies?
2. ll 26-28 - cite missing - as the carbon cycle has raise much attention ...

3. ll 68-69: A motivation why these two processes are chosen is missing. In particular it should be mentioned that vertical mixing is not added to the model as a physical process in general, but only to two of the tracers, as well as the resulting consequences of this choice.
4. l 149: I guess this is a typo and the reference run is not model version V1.2, but V1.4
5. I have a problem with Fig 3 - the fitted functions seems a bit random ... I like the idea of taking two different sites to get an estimate, but the fit itself is not convincing, in particular for Fig. 3b. Is there some kind of weighting applied? What fitting method has been used? In addition, how does the kinetic function that is derived and added to equation 5 look like - what is the finally used equation for the introduced sensitivity simulations?
6. ll 172-173: I am struggling with the approach that additional diffusion is not added to all tracers in the model, but solely to DO and DON. This approach needs a justification. What are the potential consequences when adding the background diffusion only to DO and DON? How does it look like when additional background diffusion is added to all tracers in the model? In addition it is important to clarify this in the abstract as well as in the conclusions.
7. Fig 4: Is that averaged between 120°W and 90°W? Please specify.
8. From Fig 5 I cannot deduce that Km18.8Kb0.5 gives the best results as it is done in the text. I would agree for the correlation, but by eye it seems that this is not the case for the standard deviation. This needs to be specified/clarified in the text.
9. ll 193 - 199: Why did you choose the threshold 20 and 60 mmol m<sup>-3</sup>? You choose the same range for the added background diffusion as Duteil and Oschlies (2011) used, and they found a tipping point, where the suboxic volume starts decreasing when further increasing the diffusivity, but for a much lower threshold. Is that the same case for your model? What does that mean regarding your best choice?
10. Fig 6: Figure caption needs to explain the figure without referencing to the text.
11. ll 229-230: Same sentence as in the Abstract. Please be more specific for the depth range 400-700m. It's the key region of interest and currently it is treated not as such. Are both processes of equal importance, is one more important than the other or is this all just a result of how the background diffusion is applied?
12. Fig 9 shows differences in the northern and southern hemispheric responses in mid depth - why do you find this relatively large impact of the reduced O:C utilization ratio in the region of the northern OMZ?

13. Fig 10 caption - what is shown? An average between 120°W and 90°W? Black contour lines? Please be more precise. And I don't understand what you intend to show by the difference plots such as d-a, that is Km18.7kb0.5-Km18-Kb0.5+Ref- ... if the responses would be linear, then the result would be Ref ...
14. How is the physical supply estimated? I couldn't find the relevant information in the manuscript.
15. How is the biological consumption estimated?
16. ll 264-165: what are the various physical, biological and chemical processes? Please explain the potential processes that lead to the results shown in Fig 10.
17. l 281 - there is no Fig S2 - I guess you mean S1 ...
18. I would suggest that you refer all your difference plots to the reference run. So when you would like to show the impact of reduced O:C utilisation then you show km18.7-Ref (as you do), when you would like to show the impact of added vertical mixing (to DO and DON) then you show kb0.5-Ref and when you want to show the combined impact it's Km18.7kb0.5-Ref. That's how you started when showing changes in the oxygen concentration and it would make it much easier for the reader to follow.
19. l 284: How does Ref look like in this case - these difference of the difference plots should be close to Ref.
20. l 284-285: Fig 12 e and f: The small difference between these plots just shows that the applied changed add up almost linearly ... KM18.7-Ref is supposed to show the impact of the reduced O:C utilisation and the same is done by Km18.7Kb0.5 - Kb0.5
21. l 285-286: Why is this the case? Mixing depends on the gradient - how does the reduced O:C utilisation change that?
22. ll 289-290: I am not convinced that 12j is showing that - How does mixing look like in Ref?
23. l 303 and l 315 (probably also in other places): The use of "biological parameter" is incorrect, the parameters that are used in the model are, so far as I see spatially and temporally constant values, whereas the resulting tracer distributions show differences.
24. I appreciate the added sections 4.4 and 4.5. However the discussion is in the current version not very clear and easy to read and needs to be rewritten: Is this only taking the reference version into account? From which simulation are the DON concentrations taken that are mentioned here? Implication of current research should be the differentiation between the biogeochemical and physical impact in mid-depth (400-700m). Limitation of the study is that two explicit processes have been investigated. These should be set into relation to other processes of potential importance.