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Biogeosciences Discussions

Interactive comment on "Response of Export Production and Dissolved Oxygen Concentrations to pCO_2 and Temperature Stabilization Scenarios" *by* T. Beaty et al.

Anonymous Referee #2

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General comments:

I'm not sure what insights this study can offer on the mechanisms that will regulate the expansion of OMZ in a future warmer climate. Not taking into account changes in stratification and circulation is already a strong limitation, one acknowledged by the authors but I'm not sure it is an acceptable one. Said so, I think the paper is well written and clearly exposed but I also think that the authors could have tried to turn the limitation of not being able to take into account changes in physical transport into an advantage. This could have been done by better separating the changes induced on the OMZ by temperature-driven decrease in solubility of O2 from those induced by temperature-driven changes in the cycling of organic matter. Such separation is not

really achieved for the following reasons:

1- Shouldn't the purpose of the reduced-biology experiment that of being compared to the CO2-radiative experiment to separate the effects of T-driven solubility changes from those deriving from increasing export production? This is not achieved because for the reduced-biology experiment CO2 is kept at pre-industrial level. Therefore, I struggle to see the purpose of this experiment. If more simulations can be performed I suggest to run an experiment in which export production is kept at preindustrial level while O2 solubility is allowed to respond to increasing temperature derived from increasing CO2 radiative forcing.

2- The increase in export production in the Pacific strikes me as a little curious. Is there so much nutrient left at the surface in the control simulation? Because to increase the export production so much by just increasing temperature there's a need for available nutrients at the surface. Maybe a map showing the difference of surface nutrients between control simulation and WOA13 could help to understand this response. In general, I think the authors need to explore more in depth what is causing this increase in export production. For example: Is remineralization dependent on temperature in the model? If so, it could be that increasing T makes for a shallower remineralization recycling more nutrients above 400m depth. This would also explain why O2 consumption decreases deeper down (Figure 8) and more with higher increase in T. There might be a re-circulation loop of nutrients that get trapped in the equatorial circulation. A plot of changes in PO4 would clarify this.

I think the paper should be re-thought and enriched, if possible, with results from new simulations and a more thorough analysis of the responses of the model.

Specific comments:

1-Throughout the paper references to the figures are missing (or at least very infrequent).

2- It would help to synthesize sections 4.1 and 4.2 with figures showing differences between model and observations on a common grid.

3-Page 9, line 4: what is that does not deepen?

4-Maps of changes of distribution of OMZ with CO2 increasing would probably be more illustrative than profiles as those shown in Figure 4.

5-Section 4.6: title here comes a bit as a surprise, reduced atmospheric concentration of O2 not mentioned before.

6-Page 12, lines 11-13: Is the reduced biological pump experiment run at steady-state? Is CO2 allowed to escape the ocean?

7- Page 134, lines 11-14: Could you elaborate this? Why would stronger upwelling be related to slower shoaling of OMZ?

8-Page 16, lines 21-23: Not clear what you mean here.

9- Put variable and units in colorbars of figures.

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