Comment on “Understanding why the volume of suboxic waters does not increase under climate change in an Earth System Model” by A. Gnanadesikan & J. John.

Leticia Cotrim da Cunha

Dear authors,

I’d like to apologise for the delay in sending the decision on your manuscript.

I very much agreed with both reviewers comments on the first version of your manuscript, and I appreciated your efforts in replying to the reviewers, and sending the revised version of your manuscript.

The title is now more concise, and I feel this manuscript could be a good contribution towards understanding the effects of climate change and the potential deoxygenation of the oceans. However, before the final decision on the publication, I would like the reviewers to give their second opinion on the revised version of the manuscript. I am sending here too my suggestions to the authors, mainly on the “format” of the manuscript.

COMMENTS:

As said above, this paper brings up an interesting discussion on the effects of climate change and the potential ocean deoxygenation, using an Earth System Model to assess this question.

1. I suggest the authors to use throughout the manuscript text either “dissolved oxygen” or simply “O_2” when referring to the dissolved oxygen concentrations and/or sea-air fluxes. I know that currently we all say simply “oxygen”, but the above notations are more appropriate to a scientific manuscript (“oxygen” could also refer to the element O, and not the gas O_2).

2. I suggest the authors to better organise the Methods section. I am aware of their previous work using climate models and running them to the IPCC AR4. However, for a “first time reader”, it is absolutely not clear:

    a. What is the name of your model? The name ESM2.1 appears only in the second paragraph.

    b. Chlorophyll: it is more useful to say first what the ESM2.1 uses as parameterisation, instead of explaining which chl parameterisation is used by the CM2.1.

    c. The correct link to WOA01 is http://www.nodc.noaa.gov/OC5/WOA01/pr_woa01.html

    d. It is not very clear how the runs are initialised, as well as the names for each run. Here you say you focus mainly in the AR2, but in the text there is reference to other scenarios, and this is really confusing. Could you prepare a table with the names and “conditions” used in each run (linear decrease in emissions, no increase in emissions, etc.)? How long were the model scenarios run? 100 years or 300 years?

3. I would ask the authors to better define in the manuscript what is considered the threshold for hypoxia and suboxia. In section 3 (results), the definition given in paragraphs 1 and 2 is exactly the same “O2 > 2 mL L-1 ~ 88µM”. This would really improve understanding the model results and which volume of seawater (the hypoxic or suboxic?) does not increase under global warming.

4. About the overprediction in the volume of suboxic (?) waters: do the numbers presented here correspond to the 61 Mkm^3 estimated by the model (which scenario)?

5. About figure 1c: please use the figure (and its caption) to support your results/discussion, but avoid describing it in the manuscript text itself (like in page 3, bottom of column 1).

6. Page 3, 2nd paragraph: I suggest the author to re-write the sentence “… the model does a good job…”. It doesn’t sound appropriate for a scientific

manuscript – even if the model indeed reproduces well primary production estimates from satellite.

7. Page 4, 1st paragraph: what is the unit for “ideal age”? 1 yr yr-1 has no units!

8. Page 6, column 2, 3rd paragraph, 1st sentence: please refer to comment 6 about the appropriate language for a scientific manuscript (“The question of how robust these results …”).

9. Organisation of table 2: could you please add the mentions “Heat fluxes”, “Water fluxes”, and “Integrated buoyancy fluxes” to each section of the table? (In italic, for instance)

10. Figures: could you please add the units (e.g. O_2 µM, Temperature °C, heat flux W m-2, and so on) to the colour scale on the right side of each panel?