Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2019-155-RC2, 2019

Biogeosciences Discussions
Open Access
EGU

Interactive comment on "ENSO-driven fluctuations in oxygen supply and vertical extent of oxygen-poor waters in the oxygen minimum zone of the Eastern Tropical South Pacific" *by* Yonss Saranga José et al.

Anonymous Referee #2

Received and published: 5 June 2019

Review: "ENSO-driven fluctuations in oxygen supply and vertical extent of oxygen-poor waters in the oxygen minimum zone of the Eastern Tropical South Pacific" by Saranga et al.

Summary

The authors investigate the variability of oxygen poor waters (OMZ) in the eastern tropical South Pacific with a focus on the effect of ENSO events. They use a regional high resolution (1/12 deg) ocean model which is driven by boundary conditions derived

Printer-friendly version

Discussion paper

from reanalysis products and validate this simulation with observations. The authors argue that the simulation represents the observed variability off the shelf of Peru well and then proceed to analyze the variability of processes which oxygenate these waters. The study concludes that the advective supply of oxygen from the subtropics plays a key role in explaining the OMZ expansion during La Nina and contraction during El Nino.

The approach of driving a regional model with high resolution is promising, and the validation suggests that key dynamics are well represented. The result, that the subtropics are very interesting but require some more work to be fully convincing. In the current state the study suffers from missing detail in explaining the methods and requires improved presentation of visuals and less verbose text. I thus recommend to accept the study subject to major revision.

General remarks

The main point of this study - that advection from the subtropics drives variability in OMZ volume - is derived from an analysis that is not described clear enough in the text. The authors define a 'common' volume based on the extend of the suboxic waters, but I was not able to clearly determine the location of this volume from the text. Is it the full volume shown in Fig.5? Does it extend over the Equator? I recommend dedicating a separate section in the methods to describe (and maybe add a Figure) and show the volume. It would be particularly interesting to see how the volume evolves over time.

Related to the above, the authors need to show clearly how the advective contributions were calculated across the surface of the SW volume. Presumably the tracer fluxes are split into x,y,z coordinates somehow (are they remapped on a z grid or are they left on the native sigma grid? The time averaging becomes crucial in these types of analyses (for an example see e.g. Bryan and Bachmann 2014) and needs to be mentioned in the paper. Do the authors quantify a diffusive tendency or does the divergence of the advective supply agree well with the total oxygen tendency in the volume?

Printer-friendly version

Discussion paper

As mentioned by Reviewer #1, the only quantity evaluated is the pure advective flux of oxygen. The authors argue that the EUC is the main supply of oxygen in the mean state (but doesn't drive ENSO variability). If resolved perfectly in time, the advective supply of oxygen should vanish! Any exchange across the boundary would be driven by diffusion (see again Bryan and Bachmann for more details). If I would thus interpret the results as mostly driven by eddy diffusion (which is resolved in this setup and thus shows up as advective contribution). This would fit with the view in the literature that the poleward boundary of the OMZ is mostly ventilated by lateral diffusion (e.g. Gnanadesikan et al. 2013, Czeschel et al. 2010). It would be nice to attempt to decompose the advective transport into large and small scale components. At the very least these aspects need be discussed in more detail and also mentioned in the methods.

Finally I think the visual presentation could be significantly improved. I had much trouble following the results section since I had to change Figures/pages all the time. I suggest to combine these timeseries into a larger single panel (perhaps smooth them to eliminate noise and make the ENSO signals more clear). An alternate suggestion would be to present these results as a normalized composite around El Nino or La Nina. There are some other aspects that can improve presentation, which I will describe below. Finally, I think a cartoon/schematic could help the reader grasp the concepts described when reading the paper.

Optional Style remarks

For the sake of readability I suggest not to indicate the single plot elements [e.g.(see Figure.1, red line and grey patch)], but instead rely on clear figure legends.

Optional: I think the flow of the text could be improved by rearranging or combining the Results and discussion section. Instead of describing all results first and then interpreting the mechanisms in the discussion, I think it is better to discuss results as they are presented.

Specific remarks

Printer-friendly version

Discussion paper

Text (line number indicated as "page.line") :

2.8 Yang et al, (2017) GBC could be relevant here.

3.6 I am not familiar with sigma coordinates, but 32 levels seems like a low resolution given the high lateral resolution. Could the authors provide rough estimates how thick grid cells are in the water column?

3.28 Are these products all publicly available? It would be nice to provide links or even better DOIs to the datasets.

3.20 and following I think the authors could be more specific and show a difference or at least provide some numbers (e.g. the Root Mean Square difference). Is this agreement better than what one could expect from a coarse simulation or a typical coupled climate model (e.g. CMIP5)

4.9 'Vertically, both simulated and observed temperatures decrease with depth'...it would really surprise me if that wouldn't be the case. Maybe remove?

4.10 'presents' seems odd in this context.

4.17-20 I do not see what the authors mean with this statement. Where do I see these differences?

4.28-30 Could the authors explain why they chose this narrow range of 90-100m? How does this look for e.g. thickness of the SWL.

5.11 I suggest writing these statements out. These [statement(opposite) are linked to a(b)] are hard to read.

5.18 and Fig. 4. I am again not sure what the volume is over which this was analyzed. Is it from the coast to either one of those black lines in Fig.5?

5.19 The authors say: "This shows that enhanced oxygen supply reaches the core..." It is not clear to me if that means that the core OMZ is displaced (out of the control

volume) or actually oxygenated.

6.9-15 See above. I think this should be moved to the methods, but definitely needs more detail.

6.17 How much do the results depend on SODAs ability to simulate a proper EUC response during ENSO if the EUC sets the mean oxygen ventilation? (Busecke et al. (2019), GRL and Coats and Karnauskas,(2018) Journal of Climate) might be relevant. Here I am very confused about the definition of the control volume. If there are separate offshore and onshore estimates, there must be one fixes boundary? In that case the OMZ could simply move in or out of the volume. Pleas clarify as suggested above.

6.34 This statement is just dropped and left there, even though I find it very interesting. This would mean that the OMZ is not only modulated by ENSO dynamics but also other internal variability?

7.9 The authors use pathways and directions like North, South etc. It would help to illustrate them in a schematic (see above comments)

8.23 The introduction of the Atlantic seems to come out of nowhere. Since this is not part of the modeling experiment please move to discussion to avoid confusion.

9.3-6 Not sure I follow this argument. Again a schematic would help.

10.2 Are the configurations of this particular experiment archived somewhere? Which version of the code was used? This needs to be expanded to provide reproducibility. I would prefer if the analysis code is archived (e.g. figshare or zenodo).

10.3 This seems insufficient to me. Can the authors archive key files (e.g. time-series data and data to produce maps) to a service like figshare or zenodo?

Figures:

- I would urge the authors to refrain from using the jet colormap. It is not perceptually uniform.

Fig.1:

- Please use a diverging colormap for velocities to make the sign shift clearer (see colorbrewer, palettable (https://jiffyclub.github.io/palettable/) and others for good colormaps depending on the software used) - c-f. Pleas unify the x coordinate, either degree or km - c-d. These appear to be 'squished' - Please indicate the section in the map in a/b

Fig.2:

- Again x-labels are inconsistent - It might be beneficial to plot a difference instead of the total field (or overlay that as contour). With this coarse contour spacing its hard to see. - Again indicate section on map.

Fig.3:

- and following. Why do the authors use a barplot for the NINO3 index and lines for the other...this confused me. - The dashed lines are very hard to read. Pleas plot thicker.
Fig.5:

- Can the authors add the change of upper and lower boundary of the OMZ during these times? Would be interesting to see where the change comes from.

Fig.6 7:

I think it would be great to combine these into less panels (as mentioned above).

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2019-155, 2019.

Printer-friendly version

Discussion paper