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Interactive comment on “Anticorrelated observed and modeled trends in dissolved oceanic oxygen over the last 50 years” by L. Stramma et al.

Anonymous Referee #1

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The manuscript “Anticorrelated observed and modeled trends in dissolved oceanic oxygen over the last 50 year” compared the oxygen trends in the global ocean over the last 50 years from a compilation of dissolved oxygen measurements at 300 dbar with a numerical biogeochemical Earth System model. The paper is well written and relevant in showing how difficult it is to reproduce the observed changes of the ocean properties, in this case oxygen, with a numerical model. Moreover, it is one of a few studies that show changes in the oxygen from observation for the entire global ocean for such a long time scale. The figures support well the analysis although a bigger font could be used, and the contour lines in the maps can be made thinner or removed in order to better see the color pattern. There are some major and minor comments that I would like the author to clarify before publication:

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Major comments:

1) How the standard error was computed? Did the author account for autocorrelation? It would be good if the authors would describe a bit more in detail about the statistical approach used to compute the errors, and also in case they didn't, to take into account that although the data might be independent the trends can still show, to some extent, serial correlation. If this correlation is not taken into account, the significance of the trend is overestimated and we might see a trend where actually there isn't any. One should consider this when compute the standard error.

2) Why the choice of using just one single layer at 300 db. Could be that the limitation at this particular layer can cause some of the discrepancy observed with the model simulation?

3) The authors can explain why they used the WOA 2009 to compute the local DO anomaly and not just use their own data. Is there a risk to increase the uncertainties and/or to detect erroneous changes if the WOA and Hydrobase have different sets of data and been undergone to a different quality control procedure? Maybe the WOA and Hydrobase use the same set of data and have similar quality control. If this is the case, it should be clarified in the manuscript.

Minor comments:

4) The introduction is clear and well structured, however it gives too much emphasis to the OMZs. Since the analysis is global, on my opinion the description of the OMZs can be shortened.

5) Was the model validated, if so should be clearly mentioned in the method. Moreover I would like to know how the global oxygen distribution for the layer 300 dbar into the model looks like compared to the observations.

6) In the section 3 what are the uncertainties of the reported trends?

7) Page 4604 line 28 until page 4605 line 1: The sentence is a bit generic since John-

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son and Gruber (2007) related the oxygen changes to the NAO for a different time periods and Frölicher et al., (2009) assessed that the NAO account for only 30% of the total variability in the subpolar and subtropical North Atlantic.

8) Page 4606 line 21 Regarding the data from the 1925 – 1927 Meteor Expedition, are the data quality controlled with the same criteria used for Hydrobase?

9) Page 4609 from line 3 to the end of the paragraph: How the three effects, solubility, biotic oxygen consumption and changes in transport and pathway processes, are calculated? This could be better explained in the manuscript.

10) Page 4611 from line 15 to line 20: I don't see an agreement between the simulated oxygen changes with a pCO₂ sensitive C:N ratios and the oxygen changes from the data. The first seems to agree better with the pattern observed in the simulation with constant C:N ratios.

Technical comments:

Page 4598 lines 23 until 28: The sentence is too long and can be split.

Page 4599 line 5: “an excessive diapycnal mixing” instead of “of excessive diapycnal mixing”

Page 4599 line 14: “mixing intensity” instead of “mixing intensities”.

Page 4601 line 17: “smoothed” instead of “smoother”

Page 4601 line 28: “19” instead of “nineteen”

Page 4606 line 5 “. . .the Southern Indian Ocean, resulted in periods of decreasing and increasing oxygen trends (Mecking, personal communication, 2012), indicate the trends. . .” instead of “. . .the Southern Indian Ocean resulted in periods of decreasing and increasing oxygen trends (Mecking, personal communication, 2012) and indicate the trends. . .”

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Page 4606 line 15 “WOCE” instead of “World Ocean Circulation Experiment”

Page 4607 line 6 in the title “Modeled” instead of “Modelled”

Page 4608 line 3 “OMZ” instead of “oxygen minimum zone”

Page 4614 line 16: “30°E and 160°E” instead of “30 degrees E and and 160 degrees E”

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