

Interactive comment on “CO₂ maximum in the oxygen minimum zone (OMZ)” by A. Paulmier et al.

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Received and published: 6 December 2010

We thank the referee #1 for her/his very thoughtful and constructive comments that, we think, helped us to improve the manuscript. Following the suggestions of the referees, we have made changes which are presented in details in the text below. You will also find a copy of the manuscript with all changes noted in yellow.

MAIN COMMENTS

“The manuscript appears to be a useful contribution to our understanding of the global OMZ dynamics. This material may also be useful for constraining of the global climate models that presently try to incorporate OMZ dynamics for assessing the fate of the future oceans. Therefore, I suggest its publication in “Biogeosciences” with some minor

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revisions. However, I have a main concern about the manuscript. It builds up the analysis on the basis of a composite data set by lumping four crises data together. On the other hand, looking at the annual variations at the 36oS station (Figs. 1b, 1e), one can see that (i) both DIC and O₂ exhibit strong summer-to-winter seasonal variations, (ii) the upper boundaries of OMZ and CMZ are close to the surface (varying in the 20–50 m range seasonally) and therefore OMZ and CMZ dynamics are strongly coupled to the euphotic zone dynamics. This implies that general description that was put forward in the manuscript based on the composite data is expected to be subject to seasonal changes and may not be a temporally uniform character. This may be one difference of this region from the other OMZs of the world oceans, which are located at much deeper levels and less affected by temporal variability of water column biogeochemistry. The issue of temporal uniformity/variability of the OMZ-CMZ deserves additional discussion in the manuscript.”

We fully agree that the sampling at 36°S in the OMZ off Chile is covering strong summer-to-winter variations and that the upper OMZ-CMZ is close to the surface in the euphotic layer. We also agree that other OMZ regions located at much deeper levels may be less affected by temporal variability of the water column biogeochemistry. The main idea of the paper is to analyze the DIC structure associated with the OMZ: i) locally and with more details in the eastern South Pacific OMZ region off Chile, based on a sampling covering a modest temporal variability at 36°S, a good cross-shore spatial at 21°S but very poor temporal variability, and a very poor long-shore variability between 21°S and 30°S sites in 2002. However, this sampling allows the covering of different configurations and intensity for the same mechanisms (i.e. upwelling and primary production). ii) globally for the main intense OMZ and integrating the temporal variability, based on world ocean databases and climatology (GLODAP and WOA2005 products). We agree that the approaches locally in the OMZ off Chile and globally for all the main intense OMZs are not providing the same information, especially in terms of temporal scale, but this analysis shows that the same CO₂ maximum structure is associated with the OMZ globally as well as locally. Unfortunately, the seasonal changes

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of the OMZ-CMZ and the associated mechanisms reported locally can just be suggested, but not be investigated with the current available global databases. We have paid more attention on this aspect in the revised version (cf. in Abstract, Introduction, Results and Discussion sections).

SPECIFIC COMMENTS

“Some minor comments on the manuscript are as follows: 1) I found the "Abstract" too general. It does not really reflect the spirit of the work.”

We re-wrote the central part of the abstract, trying to be more specific and closer to the study developed further in the text, taking into account the comments of both Referees.

“ 2) "Introduction" section provides a two page-long description on general features of the OMZs of the world oceans. It is fine, but one or two additional paragraphs may be useful to summarize the previous works on the Chilean OMZ as a prelude to the present work.”

We significantly added more information and details concerning the Chilean OMZ context and knowledge (in terms of carbon and also related with denitrification), taking into account comments of both Referees, in particular in two additional last paragraphs.

“3) It will be useful to give more information on the timing of the cruises and the background knowledge on the main general physical-biogeochemical oceanographic characteristics for each of the cruises. This may be helpful for the analysis of CMZ based on the composite data set in the subsequent sections.”

We thank the referee for this instructive comment. Specifically, in the Introduction and Methodology sections, we added more detailed text in the timing of the cruises, the background knowledge on the main general physical-biogeochemical oceanographic characteristics for each of the cruises, and also details suggested by Referee #2.

“4) In Fig. 2, the authors used a profile that is referred to as "mean global profile". It is presumably the mean global profile based on the all available data sets for the oxygen

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minimum zones. Does it also include data from oceanic sites without oxygen minimum zones?”

Yes, the “mean global profile” is based on the available datasets in and out the oxygen minimum zones. We explicitly added this information in Fig. 2 caption.

Please also note the supplement to this comment:

<http://www.biogeosciences-discuss.net/7/C4183/2010/bgd-7-C4183-2010-supplement.pdf>

Interactive comment on Biogeosciences Discuss., 7, 6353, 2010.

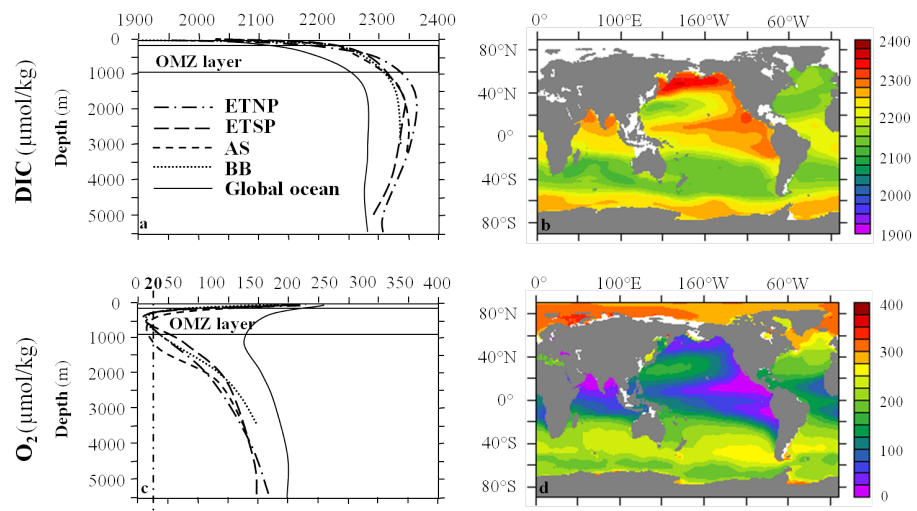


Fig. 1. Revised Figure 2