

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

A. Paulmier et al.

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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.

GENERAL COMMENTS

“Herewith, I include the review of the manuscript “CO₂ Maximum in the Oxygen Minimum zone (OMZ)”. The objectives for this work was to study DIC and oxygen structures formed in the Chilean offshore and a discussion were developed for similar structures for other OMZs. The analysis is base on 4 cruises between 2000 and 2002 and

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a monthly monitoring station to document spatial-temporal variations detailed in Paulmier et al. (2006). The author show OMZ off Chile associated with high DIC and define a carbon maximum zone (CMZ) over the whole OMZ thickness. The authors aloud that all OMZs form CMZs with similar biogeochemical characteristics. In my opinion the material regarding the relationship between OMZ with CMZ contribute to our understanding of the processes that occur in different OMZs. I suggest to be accepted for publication in "Biogeosciences" with some minor revisions.”

SPECIFIC COMMENTS

“Abstract: I suggest rewriting the last paragraph (up to lines 14) doing emphasis base in the result the main message and conclusion.”

We re-wrote in particular the last part of the abstract, trying to get closer to the main message of the results and of the conclusion, taking into account the comments of both Referees.

“Introduction: It will be nice if the author Include more important details about Chilean rich DIC and Low oxygen water condition and about the Humboldt regions studies related with denitrification.”

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

“Methodology: I suggest adding more general detail about the approach about water mass analysis application. Author refers to the Paulmier et al., (2006) but can be useful for reader to see and resume on this the paper.”

We added some more details about the water mass analysis application at the end of the Methodology section, specifically from Paulmier et al. (2006).

“Results:1) Figures recommendations: I suggest increasing the size label in all the

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figures. In addition the small figure designed inside the Figure 1f it's hard to see for size but also because not latitude and longitude axes were include. The authors refer in result to geographical position for example "The DIC structure, observed at 21oS from the shelf to off-shore (Iquique: Fig. 1a and c) but also at 30o S". I also suggest for Figure 5 to change the font clear color for black (example slope and N values)."

We fully agree with Referee #2: we increased the size label in all the figures, and also the figures themselves, in particular for Figure 1. For Figure 1f, we added the latitude and longitude, and increased the size. For Figure 5, we changed the font clear color for dark grey.

" 2) In page 6360 line 18: Writing fix, the format must be as "DIC Classical out of OMZ" but in the manuscript DIC is as superscript. The same mistake is located in line 9 from Fig.1 description."

We disagree with Referee #2 about this detail. The concentration of DIC due to the existence of the CMZ is equivalent to the DIC concentration in average in the OMZ minus the DIC concentration classically found out of the OMZ, as written in page 6360 Line 18 and in Fig.1 caption Line 9: $DIC_{CMZ} = DIC_{Average \text{ in OMZ}} - DIC_{Classical \text{ out of OMZ}}$.

" 3) In section 3 the last nine lines can be move to the methodology section. In these lines the author explains the strategy for the global scale analysis."

We agree with Referee #2, and moved these lines about the strategy for the global scale analysis concerning the different considered OMZs to the Methodology section.

" 4) For section 3.2 related with CMZ-Global analysis, I suggest to move the description in how was done this approach to the methodology section."

We agree with Referee #2, and moved the description of how was done this approach in terms of upper and lower vertical levels determination to the Methodology section.

" 5) In page 6361 line 3: The author refer a low DIC range of (between 1900 and 2100 C4190

$\mu\text{mol/kg}$) for OMZ's as a general values. However the values came from figure 1 from Chilean coast. I just suggest to specify that the range is an example (A value of ~ 2100 can be the result of upwelling event in ETNP)."

Our text was not clear enough here. We refer to the low DIC range in surface from the mean profile of all the main intense OMZs (from Figure 2a, and not from Figure 1). We thus explicitly added "from" Figure 2a.

" 6) In page 6361 line 15-17: I suggest avoiding local processes as river input and instead can be considered a CMZ from BB in another station more comparable."

We added more precision for this last sentence to be clearer. In any station of the BB, we will find low DIC concentration in surface, probably due to the specificity concerning the existence of very large rivers in the BB which may have not only a local but also regional effect in all the BB.

" 7) Page 6364 lines 9 to 27. I suggest to add a discussion for another zoom $\sim 1000\text{m}$ where is much clearer the circulation effect and where the differences are more clear."

Our interest concerning the OMZ is here localized in the mean OMZ core around ~ 450 m deep. But, as suggested by Referee #2, the DIC deficit in the global mean CMZ-OMZ core thickness is much clearer for the AS CMZ around 1000 m deep since the AS OMZ core is $\sim 20\%$ deeper than the other OMZ cores (Paulmier and Ruiz-Pino, 2008). We added a comment concerning this point.

" 8) For section 4.2 in pages 6367-6369 I suggest to include a discussion about carbonate dissolution as an additional DIC source."

As suggested by Referee #2, we also mentioned, in addition to the sedimentary potential effect, the possible effect of carbonate dissolution as an additional DIC source and added comments about this hypothesis.

Please also note the supplement to this comment:

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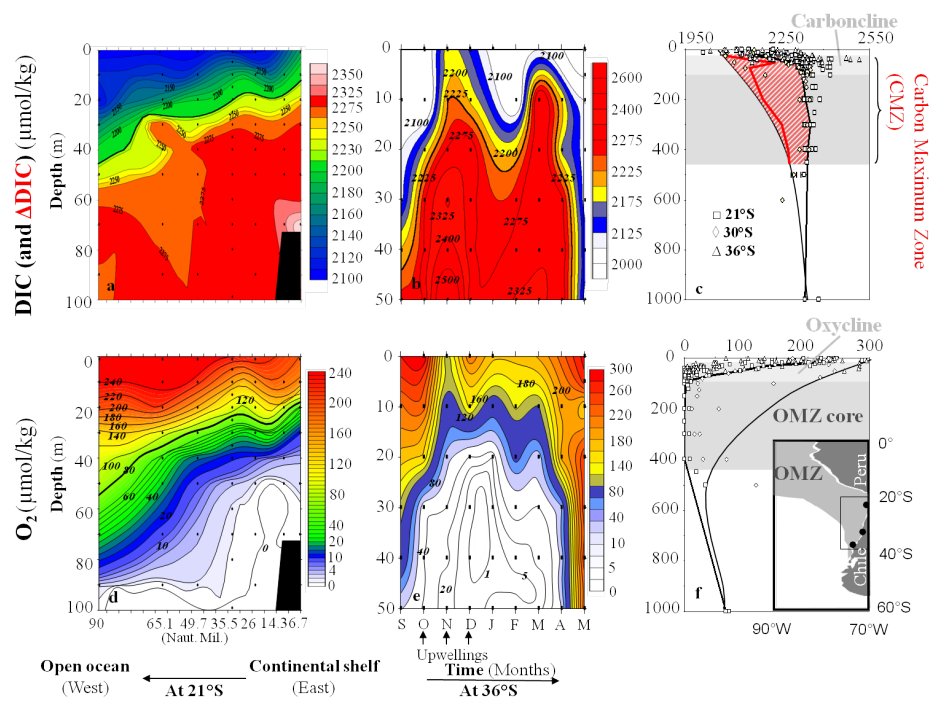


Fig. 1. Revised Figure 1

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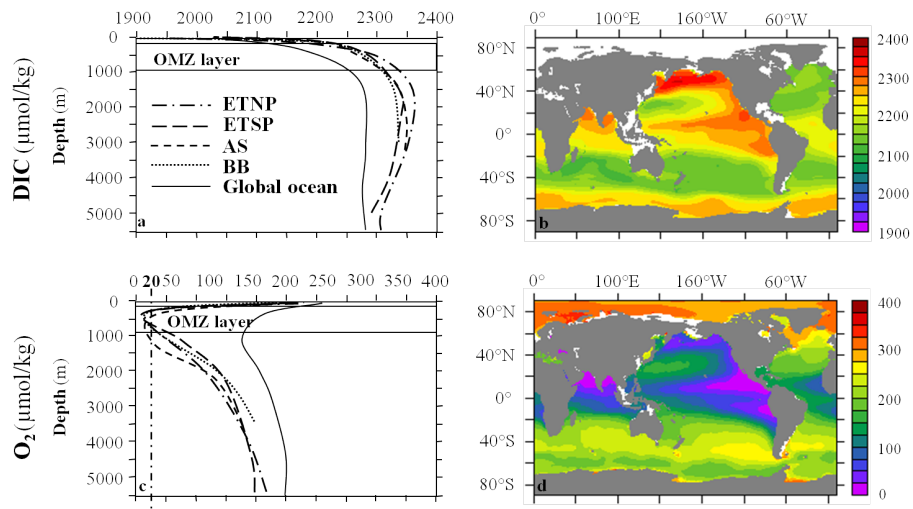


Fig. 2. Revised Figure 2

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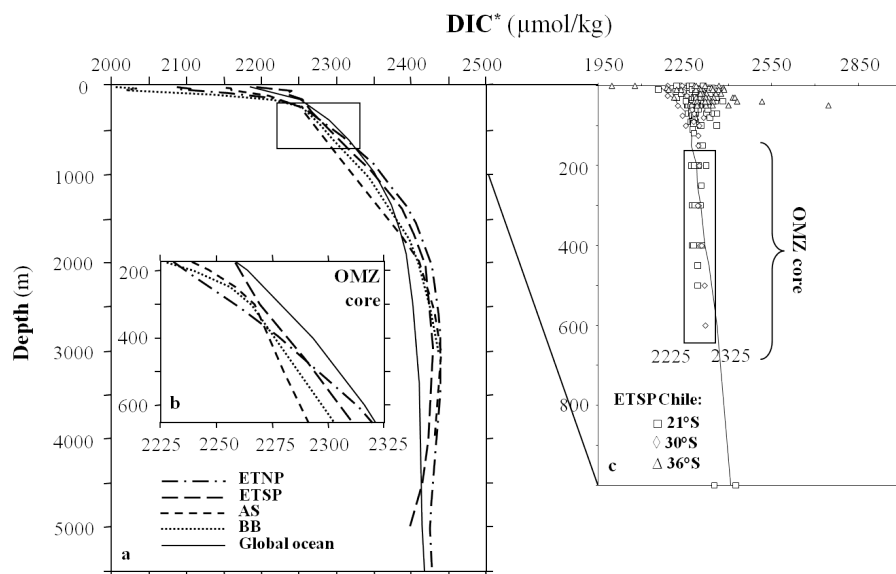


Fig. 3. Revised Figure 3

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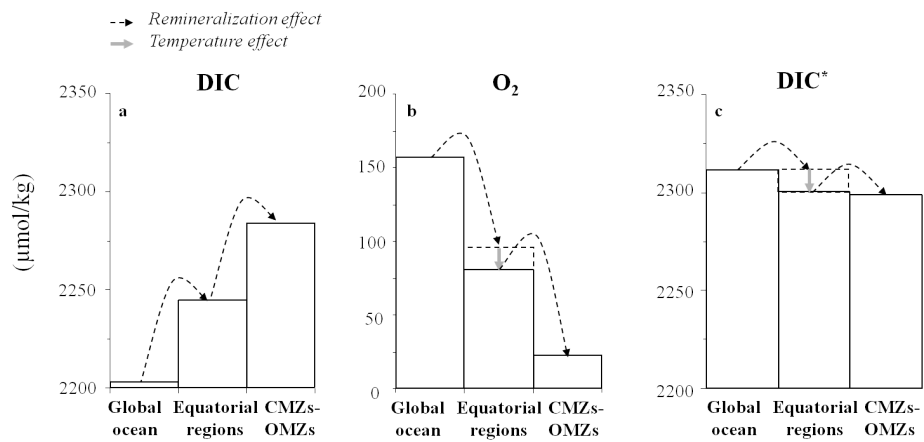


Fig. 4. Revised Figure 4

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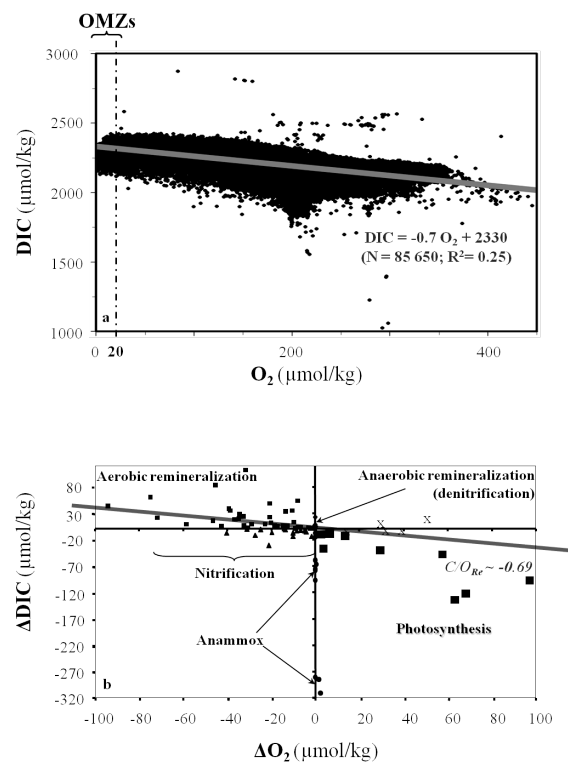


Fig. 5. Revised Figure 5

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