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Biogeosciences
Discussions

Interactive comment on "Diapycnal oxygen supply to the tropical North Atlantic oxygen minimum zone" *by* T. Fischer et al.

Anonymous Referee #2

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Manuscript number bg-2012-470: "Diapycnal oxygen supply to the tropical North Atlantic oxygen minimum zone", by Fischer et al.

In this paper, the authors investigate the diapycnal process as a possible mechanism for the replenishment of consumed oxygen in the OMZ of the tropical North Atlantic Ocean. For that, they used different sources of data from CTD measurements, microstructure profiles, tracer release experiment and shipboard acoustic current measurements. The diapycnal diffusivity is estimated by 3 methods and two of these methods are independent. Finally, they estimate that the diapycnal process contributes about 1/3 of the total demand in oxygen using an oxygen budget. This paper is well presented. The calculations and hypothesis of this work are generally well discussed. This study is of importance for the actual challenging questions on the OMZs and its

supply via physical processes. It fits perfectly in this special issue on OMZs. However, the authors have to better replace their study in the context of the previous studies on this topic and within the challenging question on OMZs. For example, what new information does this study bring to the general community working on the OMZ topic? So I recommend the publication of this paper after revision and satisfying answers to the following questions.

Detailed comments:

P14292: Lines 13-15: In this abstract, as well as in the following of the paper, could the authors explain in more details the link between diapycnal diffusion, isopycnal diffusion, eddies, horizontal/vertical advection? What physical processes drive this diapycnal mixing in this studied area? it's a general comment on this paper.

P14292-P14294: Introduction: The authors have to replace their study within the previous studies on diapycnal mixing, especially for the OMZs. Also if this kind of study is new, they have to tell it and explain it (see my general comment).

P14293: Lines 10-11: In the introduction, at this stage, it is not obvious why the divergence of the flux (diapycnal and isopycnal) is the quantity to study. Please, explain it in the introduction or keep this detail for section 3.1 where you explain it.

P14295: Line 13: Could the authors specify the increase of volume as well as the decrease in oxygen minimum concentrations for the deep OMZ (450m) compared to the shallow OMZ (100 m)?

P14295: Line 22: Could the authors explain why they chose 60 micromol kg-1 as the threshold to define the OMZ? In other studies, different values are used to define the OMZ limit.

P14297: Line 5: "approximate estimates had to be used", Could the authors explain here the assumption made? If I understand correctly, the oxygen diffusivity is assumed equal to the mass diffusivity estimated in this study? The authors have to discuss this

assumption in the Results and discussions section. They have also to notice in their paper that the notation “K” stands for the mass diffusivity “Krho” in the following of the paper, except for KTRE which is the diffusivity of a passive tracer.

P14297 Lines 21-22: why not using the mmol/m3 as units for oxygen? If so, the water density will not be needed anymore in this equation. P14297 Line 26: same question, I do not understand why you do not use mmol/m3/yr as units for the diapycnal flux divergence. Please, change a-1 to yr-1 as well as in the whole paper.

P14298: Lines 7-8: How is the decorrelation scale of 0.5° determined?

P14298: Lines 12-21 Section 3.2: It seems a lot of data are available for this study for 3 different years: 2008, 2009, 2010. Is there a possibility to estimate the diapycnal diffusivity for each year? and study the variability of this diffusivity over the 3 years? What is the minimum number of data necessary to estimate this diffusivity?

P14298: Lines 21-24: same question for the seasonal variability. As 110 additional oxygen profiles are available for other months February, March and April for 2008, is it possible to use these profiles to estimate the oxygen diapycnal supply for example in April 2008 and compare it with the oxygen diapycnal supply in November 2008. I assume you will have to use the same diapycnal diffusivity estimated in November 2008 or over the whole period 2008-2010?

P14299: Lines 24-25, explain how this typical instrument noise is estimated?

P14301: Line 2, How are the results impacted by this choice of gamma value?

P14303 : Line 14: replace ‘gradc” by the appropriate mathematical sign (as for page 14297) as well as in the following of the paper.

P14303: end of section 3.4, it will be nice to compare the precision of these two estimated diffusivities KTRE and KMSS/ADCP.

P14303-14305 section 4.1: Is there a spatial variability of K in the studied area based

on the measurements?

P14305-14306: Is there another way to estimate the isopycnal oxygen flux and compare it with the estimation made in this study using the budget equation?

P14308 : Lines 3-11: As explained in the paper, consumption profiles are diverse and uncertain, so why do the authors just use one estimate? Could the authors use two others estimates for the consumption profiles (min and max) to evaluate the influence of the consumption uncertainty on their results (isopycnal oxygen supply)?

P14309: Line 20. Please, explain in one or two sentences why this diapycnal mixing in the study region is high. It’s due to which processes?

P14310: Lines 13-14, add a reference for the acoustic evidence of strong migrant activity.

P14310: Lines 18-29 and P14311 : Lines 1-3: See my first comment (abstract). The link between diapycnal diffusion, isopycnal diffusion, eddies, horizontal/vertical advection is not clear. So could the authors explain it in their paper?

P14310: Could the authors comment their results in the context of OMZs study? Does this study bring new information to the community? For example could we use this estimated diapycnal diffusivity in modeling study to improve the modeled OMZ? (see my general comment).

Fig1: -Put the different currents (NEC, NECC/NEUC), -Change WOA 77/60 for WOA 77/67 ?

Fig4: -Add an explanation for K, especially the boxes and the vertical black bars within the boxes in the legend - Add the deep oxycline and the deep OMZ core on this plot as in Fig7.

Fig7. Add the Central Waters on this plot.

Interactive comment on Biogeosciences Discuss., 9, 14291, 2012.