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## ***Interactive comment on “Circulation, eddies, oxygen and nutrient changes in the eastern tropical South Pacific Ocean” by R. Czeschel et al.***

### **Anonymous Referee #1**

Received and published: 23 February 2015

Main comment: This paper presents a set of observations collected during an oceanographic cruise off Peru in November-December 2012. The zonal circulation in the south eastern Pacific has been measured, as well as the alongshore flow off the Peru coast. The trajectories and properties measured by drifting floats launched in the area are also described in detail. In the end of the paper, circulation trends are estimated by comparing the data with those of previous cruises (Feb 1993). Nutrient and oxygen trends are also inferred from the present and previous measurements. This paper is following a suite of several papers presenting invaluable observations recently collected off Peru during a series of oceanographic cruises. The data certainly deserves to be published as there has not been many papers presenting recent observations in this upwelling region which has peculiarities because of its very intense oxygen minimum zone. However, the present paper is mainly a repetition of a previous paper by

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Czeschel et al. (JGR, 2011, doi:10.1029/2010JC006565.) which presented data from a previous cruise with quasi similar transects. It was structured similarly, described current sections, floats trajectories, etc.. Despite the similarities between the two papers, there is almost no discussion of the new results in the light of the previous findings of Czeschel et al. (2011). Moreover, while the quality of the figures is good, the text is extremely difficult to read. It lacks structure, there are lots of repetitions, there are no transitions between the paragraphs, parts of the manuscript are really unclear. A lot of it deserves rewriting (see my detailed comments below). Therefore I believe that the paper could be significantly improved by (i) introducing a more developed section with a detailed discussion of the previous findings of Czeschel, (ii) careful rewriting of several paragraphs. Thus, I am in favour of a major revision.

Detailed comments: p2207, L4-5: There are a number of studies and measurements of the EUC near 95°W. Cite other references please, not only the most recent one of Stramma et al. Also, I think that some context should be provided for the OMZ (why is it important to study them, etc.).

p2207: The description of the current system is quite dense and hard to follow. This paragraph would be easier with a figure summarizing the current knowledge of the equatorial current system and also by being more general without citations of short-term observations during recent oceanographic campaigns (e.g. in November 2003, in February 2009,..) which provide information on the variability, not on the mean circulation.

L26: “the coastal geometry”: I am not convinced that the coastal geometry plays a role here, please be more specific.

p2208, L14: do you mean that there are three types of eddies in general or in particular in this region?

p2208, L6-24: This paragraph needs rewriting. It appears more like a list of previous findings on eddies in the region than a bibliographical review. There are eddies, but

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why is that important?

p2208, L25: No transition there, this needs rewriting! Please provide some context for the study of oxygen trends.

p2209, L16-20: sentence is too long and clumsy, please rephrase.

p2211: What is the parking depth of the floats equipped with Seabird sensors? It would be nice to visualize where the floats were deployed in Figure 1. This would provide a better understanding of the sampling strategy.

p2213: I find the discussion about the EUCs and EUCd unclear. Here we see only one branch of the EUC in Figure 2, why not label them EUCs or EUCd as described in the text? Also, I do not understand what the SECC stands for in Figure 2. It looks to me as a third SSCC, as it is located at depth. Could you explain that more precisely in the text?

p2213, L16-20: avoid repetition of EUC flux “between 2°N and 2°S and 200m depth”. Also, in this paragraph, information on the transport and on the depth of the EUC are mingled, which is rather confusing. The end of the paragraph is unclear. Is the data presented here consistent with previous observations, or is it consistent with the model results? Please rephrase, this is quite difficult to follow.

Figs 3b-c-d: the oxygen concentration encountered near 16°S-24°S, 87W-85W is much lower (in dark blue: 0- 10  $\mu\text{M}$ ) than the climatology (100-200  $\mu\text{M}$ ) at 200m depth. How do you explain this? Could there be a problem in the data? This is not mentioned in the text.

Fig3: It would be helpful to add some arrows to show the location of the EUC, NICC, SICC on these Figures.

p 2215, L16: the shelf can not be seen in Figure 4 for the section at 7°S. How can the pCUC be “attached to the shelf”? For the section at 11°S, I do not think that the poleward flow west of  $\sim 79^\circ\text{W}$  can be counted as the PCUC. Not taking this flow into ac-

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count would certainly reduce the transport of the so-called PCUC in this latitude range, and make it more consistent with the poleward transport at other latitudes. It would also be interested and possibly useful to smooth these current sections and overlay with density or salinity as to identify the water masses transported by the so-called PCUC. In any case, it might help separate the actual PCUC which transports waters of equatorial origin from other poleward flow. At 16°S, the section might miss part of the poleward flow while at 14°S the current might be compared to the glider-derived velocity sections from Pietri et al. 2013, 2014, in this section or in the discussion section. Refs: Pietri et al., 2013: Finescale Vertical Structure of the Upwelling System off Southern Peru as Observed from Glider Data. *J. Phys. Oceanogr.*, 43, 631–646. doi: <http://dx.doi.org/10.1175/JPO-D-12-035.1> Pietri et al., 2014. Impact of a coastal-trapped wave on the near-coastal circulation of the Peru upwelling system from glider data, *J. Geophys. Res. Oceans*, 119, 2109–2120, doi:10.1002/2013JC009270.

p 2216, L28: why do the cyclonic loops lead to a shoaling of the oxycline? Do you mean that it is because the float is trapped in a cyclonic eddy? Please rephrase.

p 2217, L10: the movie is a supplementary figure. I do not think you should compare the movie and the Figure here, it sounds clumsy.

p2217, L11-13: Avoid repetition here. You have already said that the cyclonic structure generates an upwelling of the oxycline, thus a decrease of oxygen.

p2217, L16: “an anticyclonic eddy in October 2009, visible in the low oxygen layer located at 350m depth”. I do not understand the end of the sentence. Which Figure is there a reference to? Please explain how (on which Figure) you identify the anticyclonic eddy.

p2217, L22: The relation between oxygen changes at depth and anticyclonic eddies needs to be explained more clearly.

p2118, L3-10: The link between the region of study and other regions of the Pacific

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(Hawaii, South pacific gyre) is not clear at all. Please rephrase, this is confusing.

p2118, L10: “Net community production (NCP), which is equal to primary production minus respiration at all trophic levels, is difficult to measure”: this sentence is rather useless..what do you mean by “difficult”? The statement “Here we use the same method..” is misplaced. After it, you do not mention NCP but the annual cycles of other properties from Figure 8. This paragraph needs to be rephrased. The paragraph on the mixed layer oxygen should be better introduced. There is no transition and no thread in the paper! Overall the paper should be better structured (an independent section for NCP maybe).

P2118: from line 5 to the end, the text needs to be better structured. This is very difficult to follow. Several depth ranges are mentioned, there is repetition of the method used for NCP (slope from the oxygen data), there are some very unclear sentences (e.g. line 29). A rewriting effort is needed.

Fig11: I think it would be interesting to compare the oxygen change on isopycnals. Maybe a section with density as the vertical coordinate could help. This might help for the interpretation of the observed changes. Besides, it is not clear to me how the El Nino cold phase might affect oxygen concentrations at 86°W. Is it by offshore transport? What are the dynamical processes responsible for these changes?

p2221: L5: “southern hemisphere pacific..” : rephrase

L7-9: I do not understand this sentence. Is this really useful for the purpose of the paper? Please clarify or suppress it. Overall the IPO paragraph should be simplified and clearer.

L18-24: I do not understand the link between the transport of the EUC and the two other sentences. It is hard to follow the logic between these three sentences which seem to contradict one another: “however”, “But”, “Hence..”!

L26: What is the relation with the warming hiatus here? Why do you need to invoke it?

This is confusing.

L27: After giving an explanation of the large scale structure, there is no need to describe the mesoscale structure at the end of the paragraph, this only blurs the message.

p2222, L1-11: This paragraph on Redfield ratio is rather lame as linear trends, not Redfield ratios, are shown in Fig. 13 and table 1. How do you make the link between the region of study (87°W-84°W, 2°S-5°S) and the subarctic Pacific Ocean (cf the reference to Whitney et al., 2013) (L12 and p2223, L5)? Besides, how does the change of migratory habitat affect the nutrient distribution? Please clarify.

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