

Interactive comment on “Impact of mesoscale eddies on water mass and oxygen distribution in the eastern tropical South Pacific” by Rena Czeschel et al.

Anonymous Referee #2

Received and published: 16 March 2018

The manuscript explores the consequences of eddies transporting properties out of the low oxygen upwelling region associated with the Peruvian-Chilean coast and into the oligotrophic open S.Pacific. Transport by coherent eddies rather than by mean flow (or lateral mixing associated with turbulent flow around eddies) is potentially an important component of any attempt to budget properties within a region. Hence it is of significant interest in understanding the controls on a low oxygen region such as the one studied. While the authors bring a lot of detail to the study I feel that they lose track a little of this broader intention and don't really match up to their title as well as they could at present. My main suggestions are hopefully useful ones to bridge this gap.

C1

First, the fluxes associated with the eddies need context. The area of interest needs to be more clearly defined at the start and the reasons given for these choices. At present some of this key information is not presented until p15. The authors should then provide westward fluxes out of the region due to the mean flow. The westward mean current can be calculated from the mooring data. 'Outside' eddy profiles can be used for mean tracer properties (salt, temperature, oxygen) if there are concerns over simply averaging them introducing biases.

Second, the flux estimates need to include uncertainties. I'm not suggesting that the authors are in a position to accurately estimate the eddy transport - they themselves acknowledge that it is not possible given the small sample size. However, the numbers they give still need to come with likely uncertainties to be of wider use. Two several sources of uncertainty in particular come to mind:

- Definition of the eddy core - The mean diameter between filtered max north and south velocities is used so the standard deviation could provides estimates of uncertainty. I would also question whether the maximum velocities are good indicators of the eddy boundary. The position of maximum velocity is an area of considerable angular shear and hence potentially of lateral mixing. The extent of solid body rotation (i.e. the radius to which velocity still increases linearly) could be argued to be a better definition for the purposes of coherent eddy transport.

- Observations taken offset from the eddy centre - using an eddy thought to be sampled close to the centre would allow this to be assessed.

Third, judging from the movie there is not just variability in eddy properties passing through Stratus. There may be variability in the number and intensity of eddies crossing different parts of the north-south line through Stratus. This affects how well Stratus can be viewed as a position to monitor these eddy fluxes. The satellite data could be used to construct plots of numbers and mean anomalies of eddies crossing in a period versus latitude along this line. Ideally the plot would be flat give or take the inevitable noise but

C2

big peaks would suggest potential bias. For the existing analysis in the manuscript the authors need to show how sensitive their analysis of the satellite data is to the choice of 7 days visibility and 45-150km (p9, line 8)

I also have a number of more specific points:

- the paper would benefit from a schematic showing the regions and boundaries of interest plus mean (rather than eddy) fluxes
- the properties of the OMZ need to be stated early on - typical depth range, oxygen concentration, horizontal extent
- there is considerable blurring of results and discussion. For example p9, l21 to p10, l11 would be better in a discussion. Also, p14, lines 3 and 9 and other places.
- the authors rightly point out the difficulty in separating seasonal from other variability given the existing data but it would be good to see some discussion of what would be necessary to allow these to be separated in the future.
- the discussion of what has been lost on p16, lines 1-9 is a little confusing. Given the choice of the Stratus mooring effectively as a monitoring station on the boundary of the region it seems odd to discuss what has been lost when the eddies have reached this point rather than what they are carrying beyond it. What they've already lost is irrelevant to the budget given the focus on Stratus.

Minor stuff:

- p3, line 7: "in different"
- p6, lines 12-14: cut "has taken over...scientific content" as not relevant to paper
- p7, line 6: cut 'were'
- p8, lines 8-9: A fuller explanation of how this was done is needed
- p8, line 10: cut "of"

C3

- p10, line 22: "typical" by what metric?
- p10, lines 24 and 25 and Fig 3: this isn't very clear in the figure.
- p11, lines 5 and 20: why was 183m chosen?
- p16, lines 12-14: need a fuller explanation
- p17, lines 17-18: Chlorophyll concentration does not imply growth. Units of production are not mg/m³. The phytoplankton community could have grown or been entrained as far back as the formation region/time.
- p18, lines 5-11: ability to estimate Ro accurately is very dependent on the resolution of sampling. I would be more cautious unless you can show that your sampling resolution would not have biased the result.
- p19, line 4: reference needed for this statement on lateral mixing
- p19, lines 6-7. High velocity in itself is not a guarantee. The circular flow of an eddy needs to be taken into account as considerable rotational/angular shear will take place in high velocity areas outside the region of solid body rotation.
- p20, lines 12-18: this is not very clear e.g. "too high for heat" relative to what?
- p20, line 21: AHA twice
- p21, lines 5 to 8: if the eddies are exporting oxygen deficit from the OMZ region aren't they eroding rather than maintaining it?
- p21, line 14: highest amount globally? Based on what bearing in mind that proper diagnosis requires vertical profiles?
- p21, lines 22-23: Has this feature of the model been verified in any way?
- p22, lines 11-12: need explanation of what sort of mixing and a reference.
- p22, line 26: reference needed for the mean circulation values

C4

p23, line 5: " main contributor" is a strong claim. By what metric?

Supplementary material, fig S2: the caption needs to be clearer.

Interactive comment on Ocean Sci. Discuss., <https://doi.org/10.5194/os-2018-5>, 2018.