

Interactive comment on “In situ measurement of the biogeochemical properties of Southern Ocean mesoscale eddies in the Southwest Indian Ocean, April 2014” by S. de Villiers et al

Anonymous Referee #3

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The authors provide CTD and bottle data along three transects in the Indian sector of the Southern Ocean encompassing three different types of eddies: a young warm-core eddy, a more mature warm-core eddy, and a cold-core eddy. The authors compare and contrast the chemical and physical properties of these three eddies and draw conclusions about the reasons for their differences. This dataset is exceptional because the station locations were chosen to specifically target these eddies and the dataset includes biogeochemical data. This type of sampling is rare owing to the complexities associated with shipboard sampling in the Southern Ocean and this dataset will undoubtedly be useful to the oceanographic community. The data are easily accessible

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at the location noted in the manuscript. I support the publication of this article after addressing the following minor comments:

- For non-experts, the authors should explain the general circulation of cyclonic versus anti-cyclonic eddies with references to downwelling and upwelling, and counterclockwise and clockwise.
- The author draws some conclusions about the eddy properties that are not supported by the dataset. I would recommend that the author either include more references to support these conclusions, or not draw these conclusions.

Specific/technical comments:

P810 L9- Delete ‘... into the Southern Ocean.’ The Southern Ocean begins far north of the Polar Front.

P811 L18- change ‘Indian Ocean sector of the Southern Ocean’ to ‘Indian sector of the Southern Ocean’

P812 L13- you already defined SSHA and this time you hyphenated sea-surface where before you did not. Which is it?

P812 L21- you already defined SSHA so you should use it instead of SSH anomalies

P812 L23- instead of ‘SSHA values’ say ‘SSHA’s’

P812 L25- same as above

P813 L1- instead of ‘direction of anti-cyclonic and cyclonic flow’ just ‘direction of flow’

P813 L11 – change ‘decided on’ to ‘chosen’

P814 first paragraph- Later in the paragraph you say that you ‘had to’ use the moon pool CTD and that over-the-side deployment had been ruled out by weather, but it does not make sense why the over-the-side CTD with fewer (and smaller) Niskins would be preferable. Maybe clarify this.

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P814 L4, L17- what are the 'standard depths?' If you don't want to list them you could place them as small black dots on your section/contour plots so that readers know where you have bottle data.

P814 L10-15- Include information about both the accuracy and the precision if you have it.

P814 L16- clarify which company? The company that makes the turbidity sensor?

P814 L16- Add information about the fluorometer here as well since you are going to reference it later

P815 L3- Do the chlorophyll samples have to be frozen before they can be analyzed or are they just frozen so that they can be stored until analysis? If appropriate, delete 'prior to analysis' and instead say 'for storage until analysis'.

P815 L6- Perhaps reword this sentence to make it clear that the spectrophotometer mentioned was used to determine the standard value, and then the standard was analyzed on the Turner 10-AU for calibration.

P815 L20- I don't think that this dataset explicitly tells you anything about origin or history. I would instead say something like '... and heat content, of cyclonic and anti-cyclonic eddies at different stages in their maturity.'

P815 L24- Instead of 'average value' use 'average values'

P815 L26- 'Nutrients an chl a shown in' should be 'Nutrients and chl a are shown in'

P815 L26- I think it's safe to compress this clause to 'Figs. 2d-f, 4, and 5.'

P815 L26- Instead of 'The data... ', 'These data... '

P815 L26- This makes it sound like you're going to make a list but you just have one bullet point sentence and in this bullet you only compare the young vs. the old warm-core eddy. I think that you could break this one bullet point down into several, and add

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some bullet points comparing/contrasting the cold-core eddy as well, or just remove the bullet and place the information into the meat of the paragraph.

P816 L1- This is the first time that you call the young warm-core eddy by the name/station E3-3, and you go on to use these names in the figure descriptions as well. Perhaps call them by their "E-names" throughout the manuscript or not at all.

P816 L1- You are very specific about the temperature difference, but not specific enough about the salinity difference.

P816 L3- delete the comma and make it '...2 lower than that in its older equivalent

P816 L4- perhaps start the sentence with 'In contrast, the upper ocean water...'

P816 L4- Again, call the eddies by their station names here

P816 L9- instead of 'respectively, but significantly' say 'respectively, but has significantly'

P816 L13-14- I assume that you are referring to changes in time or with maturity, so instead say 'Increasing levels of silicate in warm-core eddies as they mature are presumably...'. Also, I assume that the vertical mixing you're talking about is actually upwelling so perhaps you could be more specific about the dynamics of warm-core eddies. For someone who is not an expert they might not be familiar with eddy circulation. Also, to which silicate-rich water masses are you specifically referring?

Table 1- you mention the station names for the two warm-core eddies but you don't mention the station for the cold-core eddy.

Figure 1 (b)- reword this section. Instead say 'The CTD station locations along transect lines E1 to E3 are shown in black dots superimposed upon a satellite altimetry map; red indicates positive SSH anomalies and blue indicates negative SSH anomalies.' Also, add the degrees South symbols to (b).

Figures 2, 4, and 5- All of the axis labels (x, y, and z) are too small to read. The

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units for phosphate, nitrate, and silicate should all be using the Greek symbol for 'mu' and not the 'u' for micro. For the plots of transect E3 shown in subplots C and F you actually only have three stations worth of nutrient and chlorophyll data (E3-2 through E3-4 spanning between 29.5 and 31.0 degrees East) yet you plot the values westward to station E3-1 at 28.3 degrees East. I would suggest shading the region between 28.3 and 29.5 degrees East in a dark gray color show that you do not have any data there. Also, since you use red, blue, and green lines to denote the different eddies in figure 3, it would be helpful if you used these same vertical lines in figures 2, 4, and 5. Also, the last sentence about the data availability is unnecessary since you explain this in the text.

Figure 3- Add degrees symbols to the legend and be consistent with spacing.

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