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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 #2

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General Comments

The authors present three ocean eddies which they recently have studied with shipboard measurements in the Southern Ocean south of Africa. A "young" anticyclonic eddy was measured with a north-south transect, a cyclonic eddy with an east-west transect, and a "mature" anticyclonic eddy with both, a north-south and east-west transect. Biogeochemical measurements were carried out next to physical measurements, which makes the presented data very valuable, given that first, biogeochemical quantities are poorly observed (especially in the Southern Ocean), and second that eddies are not specifically targeted in repeat hydrography programs or with float measure-

ments. The data can be easily downloaded from PANGAEA. I strongly support the publication of the paper and data after addressing a few points.

Major comments:

- To make their points convincing about the evolution of the eddies ("young" and "mature") and their propagation paths (e.g. the authors say the mature eddy originated in the north), the authors need to provide actual information about the life histories of the eddies. As the authors mention that they have carried out already a visual inspection of the propagation paths of these eddies, they could show them on the SSHA map and mark the eddies' origins and possibly final positions.

- To help the reader identifying the eddies in the Figures (which I find difficult currently as there is a lot of variability going on next to the eddies), I suggest in

  > Fig2, 4, 5 to insert estimates of the eddy edge (e.g. based on the SSHA data) left and right from the blue/red vertical lines which mark the eddy centers, or alternatively just show the SSHA as graph in a subpanel above the current Figures (SSHA vs latitude/longitude).

  > Fig3 to show additional profiles (one or two for each eddy) just outside/next to the eddies (e.g. in dashed) to make the ANOMALIES associated with the eddies more obvious; a similar Figure would be nice to see for all measured quantities, especially the biogeochemical properties.

- Background literature: please clarify what exists already with respect to ship-based observations of eddies. As you mention also the temperature/heat transport of eddies in your paper, you need to do this for both, physical and biogeochemical observations, just to mention two examples: Joyce et al 1981, DSR (http://www.sciencedirect.com/science/article/pii/0198014981900340), Ansorge et al 2010, Polar Biology (http://link.springer.com/article/10.1007

Specific Comments

- p810, L3 "cold-core": you characterize the warm-core eddies with "young" and "mature"/"old", how about the cold-core eddy?

- p810, L6 "for comparison": with what, model simulations? Please specify.

- p810, L12: you summarize the results for the warm-core eddies but do not mention the cold-core eddy – I suggest to add a sentence on it. Alternatively, you could rephrase L9 "Results show" to sth like "The major result is".

- p811, L20ff: you might want to cite Ansorge et al 2014, DSR2 (http://www.sciencedirect.com/science/article/pii/S0967064514001453)

- p812, L7ff "is a relatively new (commissioned in 2012) polar research and supply vessel, fully equipped for shipbased oceanographic research. Facilities include": unless you say why this is important information to the paper, it is not necessary to include, I suggest to replace by "is equipped with".

- p812, L18ff "MODIS-aqua satellite derived chlorophyll data [...] during the survey period": Delete- or else I am wondering why you have not included other data, such as microwave SST in your analysis?

- p813, L7-9: include information on where the eddies originated from, where they die and how long they lived (see major comment).

- p813, L14 "0.5": what is the reasoning for the spacing of the stations? 0.5 appears to be relatively wide to sample an eddy, similar L18, L21. I am fine if you just note that a higher spatial sampling frequency was not possible due to shiptime/weather/etc constraints and argue that the spacing is sufficient to resolve the general structure of the eddies.

- p814, L2ff "systems, a moon pool CTD with a 24 20-L Niskin bottle rosette, or alternatively a 12 10-L Niskin bottle rosette for": Could you briefly state for non experts

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(such as myself) what the (dis)advantages of the two sets are? Intuitively, I would have taken always the 24 bottle set to get more samples, however later on you note that you "had to" use the 24 bottle set because you were restricted to the moon pool because of weather conditions, sounding like this was a disadvantageous thing to do; i.e. also L6 "had to be conducted with the moon pool CTD", why is this undesirable?

- p814, L15: you mention the precision/accuracy of some of the observed quantities but not for others, could you be consistent? Please be clear about precision versus accuracy.

- p814, L16 "was measured": with which device/sensor?

- p814, L27 "above the fluorescence maximum": how did you know/estimate the depth of Fmax? From the following sentences I understand you had a fluorometer which measured continuously – you might want to reorder the paragraph that this becomes clearer.

- p815, L11/12 "cooled down": how do you know? If you had a look at satellite SST over the eddy propagation path I would see your point. Or else, as I suggest above (major comment), if you provide information about the origin of this specific eddy and the general approximate (climatological) temperature conditions in the area of origin.

- p815, L15/16 "temperature reaches maximum... of the water column": I expected that you would talk about the temperature MINIMUM here, as you describe a cold core eddy, i.e. the mentioning of the maximum temperatures confuses me-

- p815, L20 "contrasting origins and histories": I like this point, however, in my understanding, you do not provide the data/arguments for this statement (see major comment), but just information on the current characteristics of eddies in different locations; please provide information on the propagation paths of the observed eddies.

- p815, L21 "modeling of heat exchange...": such data does exist already, the biogeochemical data is the very interesting aspect of your data; unless you argue that you

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were the first to present the physical properties of eddies in that very location.

Technical Corrections

- p810, L11: define "chl", and be consistent throughout text, using either "chl" or "chlorophyll".

- p810, L24 "Wunch": "Wunsch".

- p810, L24 "global eddy volume transport": "global zonal eddy volume transport".

- p810, L25 "to that of large-scale": "to that of the large-scale".

- p810, L26 "It is now estimated": "It is estimated".

- p811, L6 "the significance of large scale coincident": "the significance of coincident".

- p811, L7 "and the dynamics of the eddy-driven nutrient pumps": unclear, please rephrase.

- p811, L17 "important mesoscale features": delete "important", or replace e.g. by "distinct".

- p812, L13 "sea surface height anomaly (SSHA)": replace with "SSHA" (as you have defined it 2 lines above).

- p812, L17 "typically include +/- 10 days of Topex/Poseidon [. . .] data": unclear, please rephrase.

- p812, L17 "which typically include": unclear what "which" refers to, i.e. if it refers to the viewer, replace "include" by "includes".

- p812, L21 "SSH anomalies": consistently use either SSHA or SSH anomalies throughout text.

- p812, L25: "larger": "large" or "intense" as it is unclear what the positive SSHA values are compared to.

- p813, L1ff "of anti-cyclonic and cyclonic flow around the features identified as respectively anticyclonic and cyclonic eddies from satellite altimetry. On the basis of satellite SSHA images (Fig. 1b), the": convoluted sentence, please rephrase; also, it is unclear what "the features" refers to.

- p813, L5 "with": unclear, possibly replace with "based on"?

- p814, L17 "analysis": "analyses".

- p814, L27: "sub-samples": where do the sub-samples come from? Have you split up each of the original samples taken at the three depths into sub-samples? If so, please say so.

- p815 L9 "for study": "for this study".

- p815, L26 "significance": "significant".

- p816, L4: delete "property".

- p816, L4: delete "adjacent".

- p819, caption Table1 "E1-6 is a mature warm-core eddy": E1-6 is the center of a mature warm-core eddy". Why do you not mention the cold-core eddy in the caption? Do you need that many digits for Latitude and Longitude?

- p820, caption Table2 "(surface to 100 m)": "(surface to 100 m depth)". You could include here once more the uncertainties of your measurements.

- p822, Fig2 caption "position of warm-core": "position of the center of warm-core".

- Fig1: missing color bar for right panel.

- Fig2, 4, 5: please enlarge the Figures and/or labels of these Figures, I cannot read the labels if I look at the Figures in actual size/100

Data

I suggest to

- label the stations in the text file the same as in the paper (E1-1 etc.).

- include information about the uncertainty of the measurements in the meta data.

- (to make it overly clear) to note in the column headers which quantities were measured based on samples from the Niskin bottles at the standard sampling depths and which quantities were measured "continuously", as this information implicitly contains information about the uncertainty of the data. Related to this I am wondering why you do not supply the bottle data of salinity and oxygen which you have used for the calibration?

Interactive comment on Earth Syst. Sci. Data Discuss., 8, 809, 2015.