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Interactive comment on "Open ocean dead-zone in the tropical North Atlantic Ocean" *by* J. Karstensen et al.

Anonymous Referee #2

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Review of 'Open ocean dead-zone in the tropical North Atlantic Ocean' by Karstensen et al.

This article shows recent evidences of very low oxygen concentrations in the eastern tropical North Atlantic. The authors try to link these low levels of oxygen to mesoscale eddies but it is not very clear the message they really want to convey.

I consider this manuscript fits well within the scope of Biogeosciences. It deserves to be published after minor review once the relationship between the oxygen concentrations with mesoscale eddies is properly discussed including some hypothesis of potential mechanisms that may explain this connection.

My specific comments are presented below:

1. Abstract: 'high productive cyclonic and anticyclonic-modewater eddies': this is not very clear to me. Not all eddies are productive,. . .. The impact of mesoscale eddies on biology is quite complex and should not be oversimplified. I refer the authors to some recent literature (see a non-exhaustive list at the end of the review).

2. Section 2.1: I have to admit that my background on oxygen concentrations in the Atlantic is limited but I think that there are some missing details in the paper that should be included. For example, please show in a figure the calibration between point observations and optode.

3. Section 2.3: SLA acronym is not defined before. Certain points are omitted in this description. It should be mentioned what SLA product is used. Delayed time or real time? How many satellites are merged? What is the length of the time series? The eddy detection and tracking method depends of various parameters. I suggest to perform a sensitivity analysis to those parameters as well as the comparison to other methods (e.g. Chelton et al. 2011 –already cited in article- ; Halo et al. 2013; Nencioli et al. 2011).

4. Page 6: 'Anticyclonic . . ..': the authors should discuss about the potential governing processes that may explain the impact of anticyclonic modewater eddies on primary productivity.

5. Page 7: the amplitude of the eddy is rather low, almost at the limit of altimetry accuracy. I suggest showing a few maps of SLA to double check if this feature can be considered as an eddy or not. Have the authors compared the output of their eddy tracking code with the equivalent provided at http://cioss.coas.oregonstate.edu/eddies/?

6. Page 8: 'geostrophic currents reflect only 10 to 20 %'. . .. I guess this is due to the smoothing that is applied to the altimeter maps and also to its low resolution. It could be useful looking at the formal error maps given by AVISO (I suppose the authors use this data provider), which may give some insights on the coverage of altimeter tracks in the area and period of study.

7. Page 8, first paragraph: In my opinion, this is a naïf interpretation of the role played by eddies on oceanic productivity. Horizontal advection and trapping are relevant mechanisms for explaining those centers of maximum chlorophyll. Indeed, eddies may effectively redistribute phytoplankton horizontally, as they can transport properties in their cores for long periods of time (D'Ovidio et al., 2013, Capet et al., 2014). Other mechanisms such as internal dynamics (explained at a first order by Quasi-geostrophic approximation), and for instance Ekman pumping may contribute.

8. Page 8, 'proper reference velocity': this is not clear to me. Does it refer to the reference level needed to compute dynamic height? Please rephrase.

9. Page 10, Discussion: 'While methods for ... well established': I do not completely agree as there are important disparities between the outputs of different eddy trackers (e.g. Souza et al. 2011); 'details on vertical stratification'...: some recent papers explore this issue (Zhang et al. 2013; Capet et al. 2014). 'Nevertheless, ... with floats': this sentence is not well formulated. Please rephrase.

10. Page 11, Conclusions: internal dynamics governed by QG dynamics might also be relevant and can have an impact on primary production (e.g. Pascual et al. 2015)

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