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Interactive comment on “The surface thermal signature and air–sea coupling over the Agulhas rings propagating in the South Atlantic Ocean interior” by J. M. A. C. Souza et al.

Anonymous Referee #1

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This manuscript is very interesting as it focuses on the relatively unexplored topic of ocean-atmosphere coupling over mesoscale eddies. In particular, I believe that air-sea exchanges in terms of momentum, heat and freshwater flux over Agulhas rings are interesting to quantify, given their potential effect on the Atlantic stratification and Meridional Overturning circulation. The authors focus on the momentum exchange and find that SST anomalies drive wind stress patterns that in turn cause Ekman pumping in the ocean and upwelling of colder waters towards the surface, in what I seem to understand as a positive feedback mechanism.

I think the manuscript is fairly clear and the type of figures/analyses is generally well chosen to get the message across. On the other hand though, I feel like the results

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and conclusions are weakened by the fact that most of the analysis is performed as an average over all the 16 observed rings and over the whole time period covered by the rings. As I read the manuscript, I found myself wondering about the spatial region covered by the rings, their temporal evolution in terms of temperature anomaly and vertical structure, and the time evolution of the wind anomaly, wind curl and divergence. In particular, it would be of interest to see 1) that indeed a typical Agulhas ring core is associated with a cold anomaly away from the ring formation region and how this anomaly evolves in time and space, and 2) that this anomaly is associated with (and possibly maintained by) the T' -wind stress curl coupling and the Ekman pumping mechanism.

Therefore, I feel like the manuscript and its conclusions would benefit from the following:

-) a figure showing a map with the 16 rings tracks and possibly another panel with the ARGO profiler positions. I know that a similar figure is included in the Souza et al 2011b paper, but it seems appropriate to have it here also.

-) showing details, at various times, from 1-2 rings (perhaps one ring covering the whole South Atlantic path and one ring covering a much less extended region in the meridional direction, to see the impact of latitude). These details could include, at different snapshots: x,y plots of T' , V' , wind curl, wind divergence and w_{Ek} (similarly to Figs. 5,6,11); and x,z plots of T' and mean stratification from the ARGO floats (similarly to Fig.4, but with the inclusion of the mean stratification to show how effective the w_{Ek} is to upwell colder water from below).

Other comments/questions:

1) How is the ring core defined at depth?

2) Could you justify your choice of spatial filtering (over temporal filtering or averaging) to identify the anomalies? In the 2011b paper, for example, I seem to understand that

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the anomalies are computed by simply subtracting the long-term time average.

3) page 2334, line 17: how is the 'mean' wind calculated?

Also, it would be nice to show this mean wind in the x,y plots.

4) About Fig. 1: I don't find the two thin lines (max and min T') very illuminating because they don't say much about the spatial structure of T' . Perhaps one could add the evolution of T' averaged over the ring core?

5) page 2337, line 14: the two sentences 'but also the relative..' and 'The spatial pattern for the wind...' seem vague and confusing. Please rephrase/elaborate.

6) page 2339, line 15: how is the mean wind speed calculated here? and the latitude?

7) paragraph between the end of page 2339 and the beginning of page 2340: can the authors better explain the observed anticorrelation with latitude in the present study?

8) at various points in the manuscript, I would use 'wind curl' instead of 'wind rotational'.

9) page 2340, lines 24-26: it is mentioned that Chen et al. (2003) don't find the latent heat flux mechanism to be important, but nothing is said about what they do find important for the coupling.

10) Figs 7-8: please add caption for the histogram panels.

11) Some typos or english incorrections:

- page 2328, line 4: 'merged wind product'.

- remove 'the' before Agulhas rings or before Fig. at various points in the manuscript: page 2328 line 22, page 2335 line 25, page 2336 line 4, page 2339 lines 16 (the Table), 17,21,25 (the latitude), page 2341 line 24, page 2342 line 1, page 2343 line 2.

- page 2329, lines 12-13: 'help detect ... and better quantify..'

- page 2330, line 3: 'The objective of this study is to characterize..'

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- page 2333, line 3: 'over the large mesoscale Agulhas rings..'. Lines 16-17: 'A good agreement with previous work was achieved, with 'typical' Agulhas rings shed every 2-3 months and with a diameter of 150-200 km'.
- page 2334, line 22-23: 'referred to as the largest mesoscale eddies in the world by Biastoch et al. (2008). They play an important role..'
- page 2335, line 21: 'This makes it difficult..'. Line 26: 'persistent cold (negative) T' at the eddy center..'
- page 2336, line 14: 'the Argo floats is the product...'
- page 2339, line 7: 'due to the increased turbulence..'
- page 2340, line 14: 'This further impacts..'. Line 24: 'feedback mechanism that strengthens..'
- page 2346, line 14: the year for the first O'Neill paper is 2012.

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