MyScience Cruise

Eddies in the Southern Atlantic

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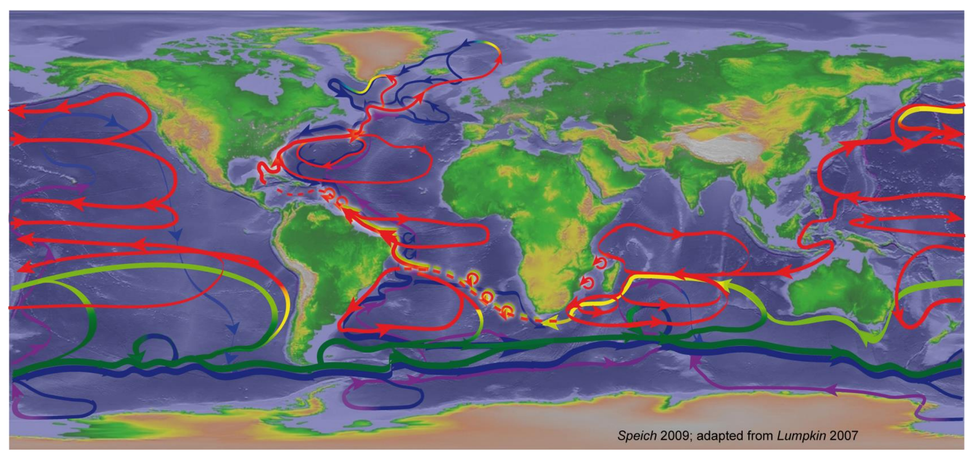
Introduction

The Southern Atlantic (SA) plays a key role in the global ocean circulation as heat is transferred northward to feed the meridional overturning circulation. We do not now that much about the role of eddies in this transportation of energy but studies suggest that the Algulhas Leakage is an important factor (Beal et. Al, 2011).

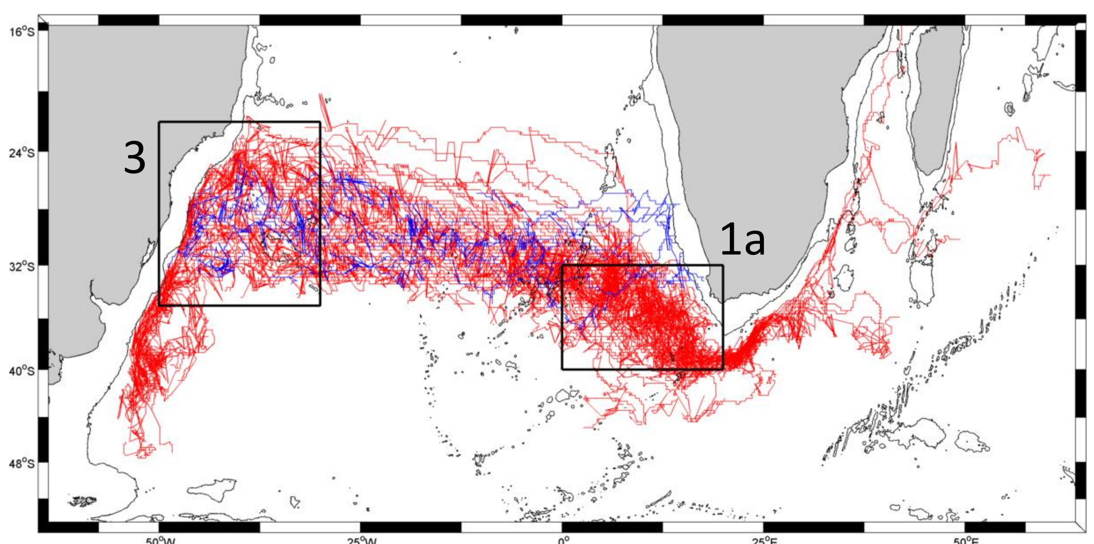


This study tries to analyse the number and the movement of eddies across the southern Atlantic. Thereby it does not only focus on Agulhas Rings but on anticyclones and cyclones in general. Attributes like starting position, amplitude height and mean track were analysed.

Method

This study compares eddies in two areas in order to analyze the transport of water via eddies through the South Atlantic.
All eddies that travel through the Cape Basin (Area 1a) and through "Area 3" are compared to those who only travel through "Area 1a" (see figures for explanation of Areas).
The statistic takes into account only those eddies that are detectable for a period longer than 60 days.

Trajectories of eddies crossing the SA

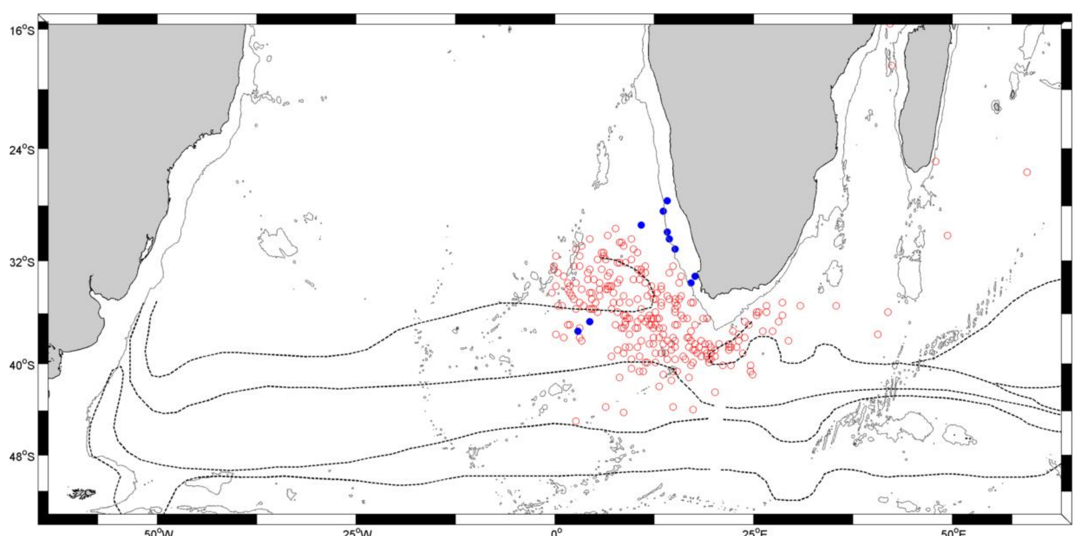


All Trajectories displayed in red belong to anticyclonic eddies. Those in blue are the cyclonic ones.
The eddies shown here exist in both Area 1a and Area 3.

Through this figure you can see that we tracked back anticyclones to areas east of the Cape Basin.

Original Position of eddies that cross the SA

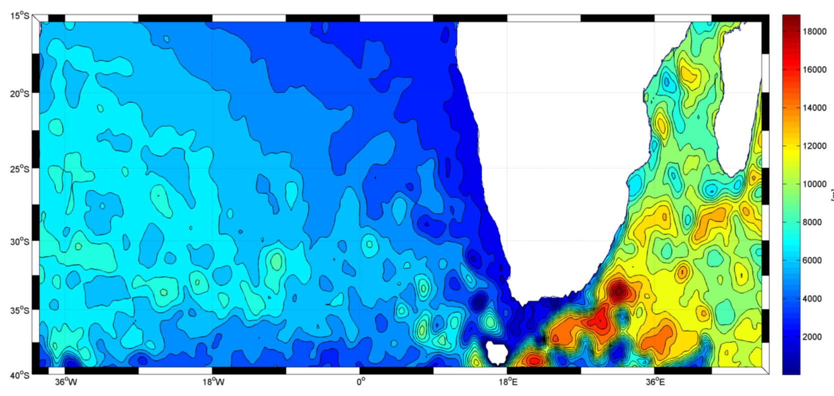
In this figure we show the starting position of the eddies that reach Area 3. Additionally the Southern Ocean hydrographic fronts from Belkin and Gordon (1996) are displayed.



Data

The data used for this study is collected via remote sensing by satellites. Daily absolute dynamic topography (ADT) maps of the sea surface were used to analyse eddies in the southern Atlantic. These 15 years of data (01.01.2000-31.12.2014) is distributed by Aviso.

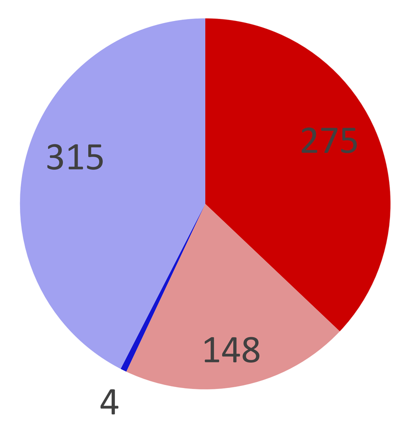
The identification algorithm of Alexis Chaigneau [Chaigneau2011a, Pegliasco et al 2015] is used to identify both cyclones and anticyclones. The algorithm basically assumes a geostrophic equilibrium for eddies. With this assumption streamlines are nearly equal to closed contours of SSH.



The tracking method has been recently adapted to ADT fields (instead of Sea Level Anomaly) and improved by including merging and splitting of eddies (Laxenaire, McS 2014). The method analyses satellite gridded daily fields to compute eddies displacements.

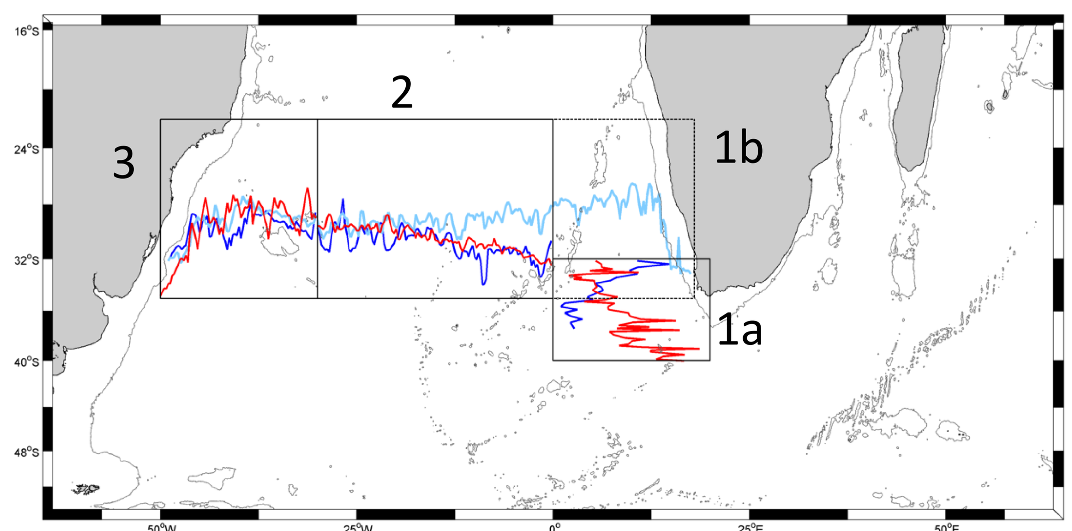
Distrubution of Eddies

Distrubution of Eddies that travel through the Cape Basin Area.



Mean Track of Eddies that cross the SA

In order to analyze the mean track of the eddies we divided Area 1a into Latitude Segments and Area 2-3 in Longitude Segments. Afterwards we calculated the mean Longitude/Latitude for each Segment.



Additionally we analyzed the mean track of cyclonic eddies from Area 1b to 3.

	Mean **Amplitude** starting pos.	Mean **Radius** at starting pos.	Mean **track length** in Area 1a*	Mean **track length** in Area 2*	Mean **track length** in Area 3*
Anticyc. in Area 1a & 3	0,06	42,25	1,60	0,80	1,10
Anticyc. just in Area 3	0,03	37,11	0,21	0,29	~
Cyc. in Area 1a & 3	0,01	35,38	1,00	1,50	0.85
Cyc. just in Area 3	0,04	36,09	0,63	0,28	~

*Normalized mean track length multiplied by 100

Summary and Outlook

- Most of the anticyclonic eddies that cross the South Atlantic (SA) originate from the Algulhas retroflection and the Cape Basin (both North of the Southern Subtropical Front).
- The normalized mean track length and mean velocity shows that these anticyclones are the most energetic in the Cape Basin where they merge and split. After passing the Walvis Ridge the mean tracks shows a relatively direct propagation to the west.
- The total numbers show that there are slightly more Anticyclones than Cyclones in the Cape Basin Area (1a). But the ratio between those who reach Area 3 is completely different for anticyclones and cyclones.
- Our results showed that this was not the reason because there are no cyclonic eddies crossing the SA but because of the chosen area of origin. Most of cyclonic eddies that cross the SA originate in Area 1b, the upwelling region east of Africa (143 in total).
- For the future it is important to get to know more the vertical structure of anticyclones and cyclones crossing the SA. This is crucial for answering questions like with which eddies and water masses do they mix? What water masses do they transport apart of that of their origin?

Reference

Beal L.M., et al., (2011) On the role of the Agulhas system in ocean circulation and climate. Nature 472, 429–436. doi: 10.1038/nature09983; pmid: 21525925, **Belkin, I. M., and A. L. Gordon** (1996), Southern Ocean fronts from theGreenwich meridian to Tasmania, J. Geophys. Res., 101, 3675–3696, doi:10.1029/95JC02750, **Chaigneau, A., M. Le Texier, G. Eldin, C. Grados and O. Pizarro** (2011), Vertical structure of mesoscale eddies in the eastern South Pacific ocean: a composite analysis from altimetry and Argo profiling floats, *J. Geophys. Res.*, 116, C11025, doi:10.1029/2011JC007134, **Laxenaire, R.**, 2014 : *Structure and evolution of mesoscale eddies achieving the Indo-Atlantic exchange from observational and model data. Rapport de stage de Master 2*, Université de Bretagne Occidentale, **Pegliasco, C.**, A. Chaigneau, R. Morrow (2015), Main eddy vertical structures observed in the four major eastern boundary upwelling systems, *J. Geophys. Res,* **Speich , S., Garzoli, S., Piola, A.** and the SAMOC community. (2010). A monitoring system for the South Atlantic as a component of the MOC. In *Proceedings of OceanObs'09: Sustained Ocean Observations and Information for Society (Annex)*, Venice, Italy, 21-25 September 2009, Hall, J., Harrison, D.E. & Stammer, D., Eds., ESA Publication WPP-306.

MyScience Cruise: Cape Town – Rio de Janeiro
29th February – 18th March 2016, M124

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