

Interactive comment on “Three decades of research on the greater Agulhas Current” by J. R. E. Lutjeharms

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The main question by the first referee was; "If the Agulhas Rings are shed anyway after a long time then is there an aggregate effect of Natal Pulses in enhancing the total (circulation of) rings shed and inter-ocean exchange."

This is an interesting question, but difficult to answer. One would assume that if there are frequent Natal Pulse events, more rings would be shed, but perhaps with smaller dimensions so that the total inter-ocean leakage would not be affected. The rate of progradation of the Agulhas retroflection loop into the South Atlantic seems to be (from remote sensing) to be fairly constant. This would imply that if more smaller or fewer big rings get spawned this would not make any difference to the total leakage.

The second referee has a large number of questions of which I answer those that

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pertain to the science. Others refer to better illustrations and to other references I could have used.

"Doesn't part of the 'final outflow of the system' water from the Agulhas enter the Atlantic and flow north as part of the MOC." Indeed it does, largely as Agulhas rings and their products.

"The Lee eddy is cyclonic or anticyclonic." The eddy in the lee of the Agulhas Bank is cyclonic and is not the same as a shear edge eddy, although there are modelling suggestions (Lutjeharms, Penven and Roy, 2003a) that the shear edge eddies may feed the lee eddy cyclonic vorticity.

"What is the 'shorter durability' [of Cape Basin cyclones] in months, say?" This is currently under investigation, but will probably not exceed 8 months or so.

"Are these cyclones the same as the lee eddy?" No, the lee eddy is the southernmost of such cyclones, but others are formed all along the west coast of southern Africa.

"Is the drift to the left of the average surface circulation or the average circulation over the depth of the ring?" The average surface circulations (Byrne et al., 1995) were based on the average hydrography combining historical data.

"What is a berg wind?" A berg wind is an offshore movement of air from the higher continental escarpment the air of which is adiabatically heated on moving to lower levels.

"What is the difference of between direct leakage and leakage due to rings?" There is evidence (e.g. Gordon et al., 1987) that Indian Ocean surface water may move across the Agulhas Bank into the South Atlantic Ocean without being incorporated into Agulhas rings. This has to date not been adequately quantified.

"Would any direct leakage break up due to instabilities into anticyclones which would be hard to distinguish from rings?" Direct leakage is so much smaller in quantity and dimensions that one assumes this will not be the case.

"What is the best estimate of (maximum) average Agulhas transport (70 Sv), average Agulhas leakage transport (17 Sv?)." These figures are roughly correct based on the latest observations and estimates.

"Does all this transport go into the MOC?" As far as we can tell to date all the leakage goes into the MOC?

"What is the (maximum) average ARC transport?" Based on very little hydrographic data [Lutjeharms and Ansorge, 2001] the volume flux of the ARC is about 55 Sv (to 1500 m) when it enters the Indian Ocean.

"Do these balance?" Considering the loss to the South Atlantic the figures fit to a first approximation.

It should be made clear that in a shortish review article it is impossible to present or portray all that is known about the Agulhas Current system, to generate many new images, to cite all known references or to answer all questions on the system. I would urge the interested reader to acquire a book "The Agulhas Current" recently published by Springer, Berlin that covers many more aspects in much greater detail than this brief review and the cites more than 820 relevant papers.

Interactive comment on Ocean Sci. Discuss., 3, 939, 2006.

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