

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

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I have read the comments by Dr Schumann with great interest. He has been an expert on many aspects of especially the northern Agulhas Current and his contribution is therefore very valuable. I would like to reply as follows:

1. He states that the shelf edge south of the Natal Bight comes in two consecutive forms. First a two-step slope, with an break at about 500 m, and then a sharp drop-off downstream of there. This is a important point and may have substantial implications for the depth and the formation of the persistent cyclonic eddy found off Durban, as he points out. I am unsure how this could have a major effect on the formation of the Natal Pulse, but this needs to be investigated. In a brief overview of this kind, that is painted with a broad brush, I did not feel it incumbent to include such detail, but it could be done in a revision.

2. Dr Schumann feels I am making far too much of the upwelling at Port Alfred and states that there is upwelling inshore of the northern Agulhas Current along most of its length. I am afraid I do not agree. Most of the information we have is from thermal infrared satellite data and - to the best of my knowledge - this shows no sign of upwelling north of about Mbashe. The variability we see is largely due to the nature of our satellite observations of the sea surface only. The variability at the sea surface is mainly forced by the reigning winds. Observations at sea (Rouault et al., 1995) have shown how the upwelling at Port Alfred can be exposed or covered by a thin, warm surface layer from the adjacent Agulhas Current in a question of days. However, the question remains how persistent this upwelling is below the surface. There are very few good data to go by. All those we do have show a very high likelihood of finding upwelling of cold water onto the Agulhas Bank at Port Alfred. However, Dr Schumann is entirely correct in implying that we need many more data here. A French project has in fact been proposed to place current meters here for a lengthy period and this will hopefully show how persistent this upwelling is and how localised. Until these observations show otherwise, I will have to persist in my current conviction of an upwelling cell centred at Port Alfred.

3. Dr Schumann feels that talking about a "Port Alfred upwelling cell" misleads biological oceanographers into thinking that there is a break in biological shelf provinces there. This is correct, but in fact there is such a break. With very limited and not optimally placed observations, a clear change in fish distributions can be seen at Port Alfred for many species. Second, certain cold water benthic species that have no business to be there and that have not been found anywhere else along the Agulhas Current, are found on the shelf at Port Alfred (e.g. Liltved et al., 2000). Third, walkouts by crayfish due to excessively cold water are known sporadically to occur at Port Alfred, but to my knowledge not elsewhere along this coast. But the problem nevertheless remains that all this is based on a lot of anecdotal information and with more appropriate data our current conceptions (including mine) may well have to be adjusted.

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4. Last, Dr Schumann mentions that an image of the then known currents of the region has been published in his review that was published in 1998 in *The Sea*. Since then a lot of new information and knowledge has been gained and some of these are therefore reflected in my Figure 18. These include: a persistent lee eddy off the western edge of the Agulhas Bank (Penven et al., 2001), vortex dipoles being shed south of Madagascar (De Ruijter et al., 2004), intense eddies arriving in the subtropical eddy guide from the east (Schouten et al., 2002), the previously unknown eddy street in the Mozambique Channel (De Ruijter et al., 2002) and the Comores gyre.

Regrettably, in a very brief, largely historical, overview of this kind many important aspects have to be left out. What is considered to be important is of necessity a subjective matter based on the author's viewpoint. I would therefore encourage Dr Schumann to get hold of the book "The Agulhas Current" that has just been published by Springer in which there is much more detail and in which citations to his own important work are numerous.

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