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Interactive comment on "Deep drivers of mesoscale circulation in the central Rockall Trough" *by* T. J. Sherwin et al.

Anonymous Referee #1

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This paper presents results from a study of mesoscale circulation in the Rockall Trough, eastern North Atlantic, based on data from a five-month glider mission, one research cruise on board the RRS Discovery, and satellite altimetry. The manuscript contains a thorough comparison of depth-averaged current from the glider and the geostrophic surface current derived from satellite altimetry, and presents some interesting findings about the mesoscale variability in this region.

GENERAL COMMENTS/QUESTIONS

1. There is a lack of references to recent literature on the use of gliders, in particular other studies comparing glider and altimetry data. Some papers of interest are for example Alvarez et al., 2012; (Davis et al., 2012), Bouffard et al., 2010; Hátún

et al., 2007; Ruiz et al., 2009.

2. The motivation of this paper should be spelled out more clearly. The subpolar gyre is mentioned in the introduction, but it is not clear if the mesoscale variability in the Rockall Trough links back in a significant way to the larger scale circulation. If this study is mainly important on the local/regional scale then the glider observations could be put into context for example by saying something more about the long-term time series from the Ellett line (mentioned briefly in section 3.1) .

3. The choice to use only gridded altimetry data: could anything have been gained from using along-track data? Other studies have used both gridded and along-track data. Were there any tracks that could have been used in this study (suitable in time and space)?

4. Have you considered using the glider C, T, P measurements to calculate an estimate of dynamic height (relative to say 1000 m), for comparison with the dynamic height from altimetry? There is no level of no motion in this range and as you mention in the discussion, the mesoscale features can extend below 1000 m, so getting geostrophic currents from the hydrographic (glider) data might not work but perhaps the hydrographic data could be used to help you analyse the cause of differences between glider drift currents and satellite-derived surface geostrophic currents?

SPECIFIC COMMENTS/QUESTIONS

Abstract I suggest briefly mentioning already in the abstract where the Rockall Trough is located, broadly speaking (north-eastern North Atlantic).

Section 2 Background As mentioned above, this section could be more specific on why the Rockall Trough is of interest. For example, you could refer to Hátún et al., 2005 (now cited only in sec. 4.3 regarding EKE) or other literature for the idea that the salinity of the Atlantic inflow to the Nordic Seas is in part determined by the location of the NAC relative to topography in/near the Rockall Trough, this being a main passageway for these inflows.

Section 3 Methods What bathymetry data were used (e.g. for figures 2 and 4)?

Section 3.4 Data analysis Spatial mean EKE, does this mean you use spatial variances of u and v (variance relative to the spatial mean over 9°-13°W and 56°-58°N respectively)?

Section 6.1 Correlations between in situ and altimetry-derived current components: the closer correlation between eastward than northward components is somewhat surprising especially since the northward component is stronger (generally calculation of current velocity from satellite altimetry works better in regions of strong currents). You later explain that the dominant cause of the bad correlation for the northward component is an error in the slope current. It might still be worth looking at how the correlations (zonal and meridional) compare with other studies. There is a large body of literature comparing in situ and altimetry-derived currents - are there any general findings of zonal agreement being better than meridional (or the other way around)? And can you speculate in a reason for why this large error in the slope current occurs? What is the typical Rossby radius of deformation here, and how does it compare to the resolution of observations? Can we expect a significant level of noise from small-scale phenomena here?

Section 7. Discussion

- P2626, L1-5: Interesting results. I wonder what this finding means for the historical and continuing regular observations along the Ellett line – is this monitoring less meaningful in terms of interannual variability and long-term trends, if local circulation patterns play such an important role?

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- P2625, L5-10: If I follow this correctly, you argue here that the observed eddies are too deep to be wind-forced, so their origin is more likely to be instabilities in the NAC front or the slope current. From this you go on to make your conclusion 1 (in section 8) that the eddies originate from the NAC. (Why not the slope current?) Can you strengthen the argumentation about the origin of the observed eddies? Any possibility of for example comparing water masses in/outside of eddies from glider data??

Figure 1 Consider labelling the Malin Shelf, which is mentioned in text.

Figure 4 Add a colour scale bar (or similar; alternatively label more contour lines). The x axis needs a label (deg. W).

Figure 5 What does it mean that some glider tracks go further south than the dashed lines showing the zonal averaging bins – are data south of 56° 30' N excluded from averaging?

Figure 6 (1) The caption refers to "a" and "b" but I see no such labels in the figure(s). (2) You could adjust the subplot axes positions in this figure to reduce the amount of white space between subplots. Right now the text (axis labels and "0.2 m/s" next to the scaling arrows) in especially the right hand column is tiny; this could be improved with more efficient use of page space. (3) The caption talks of a dotted red line, but I see red dots plus a whole red line - what do they mean? (4) The colour scale is not very clear, most of the sections are a more or less uniform cyan to me. Maybe this is exactly the point, to show how homogeneous the water column becomes. Then I would recommend using a white-to-[some colour] colour scale so that the low densities present in the first three plots are in colour, and later plots are mostly white / light colour as the density contrasts disappear (obviously in this case, the ADT line should not be yellow but dark). I think this might be clearer to see and interpret (and if nothing else, saves ink when printing) (5) Perhaps add a colour scale bar?

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Figures 7 and 9 It says figure 9 has the same colour scale as Fig. 7, but there is no colour scale bar for either? The numbers in figure 9 are tiny.

MINOR POINTS

- All in-text references seem to be in brackets – check use of "citet" vs "citep" if using LaTeX.
- Velocity units: mixture of m s^{-1} and cm s^{-1} in text (and also in figures)
- Units in figure axes labels: I had to look this up, but as far as I could see (at physics.nist.gov), when you follow the convention of using "/" between a quantity and its unit, it is still customary to use round brackets around the unit, e.g. ""Depth /(m)" or "Speed /(cm s^{-1})"
- In section 6.2 it says data are averaged into 10' of longitude bins. That is not exactly the same as the 0.1° or ca 6 km mentioned in section 3.4 (10' longitude here should be more like 10 km?) so what is actually shown in Fig 5?
- Section 4.2 (a) "along flank of the Rockall Trough" - should it be "along the western flank"? (b) Malin Shelf – see comment at Figure 1 (probably not everyone knows where it is). (c) "Its source" instead of "it source".

References mentioned above

Alvarez, A., Chiggiato, J., and Schroeder, K. (2012). Mapping sub-surface geostrophic currents from altimetry and a fleet of gliders. Deep-Sea Research I.

Bouffard, J., Pascual, A., Ruiz, S., Faugère, Y., Tintoré, J. (2010). Coastal and mesoscale dynamics characterization using altimetry and gliders: a case study in the Balearic Sea. Journal of Geophysical Research.

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Ruiz, S., Pascual, A., Garau, B., Pujol, I., and Tintoré, J. (2009). Vertical motion in the upper ocean from glider and altimetry data. Geophysical Research Letters.

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