

RC1: 'Comment on egusphere-2025-1592', Anonymous Referee #1, 23 Apr 2025

Review of “Synoptic observation of full mesoscale eddy lifetime and its secondary instabilities in the Gulf of Mexico” by Charly de Marez.

This is a concise, well written paper summarising observations of a loop current eddy’s life cycle in the Gulf of Mexico using high resolution altimetry from the relatively recently launched SWOT satellite. Direct observation of key dynamical processes such as eddy shielding, high-mode instabilities, and dipolar interactions were made possible by the resolution and coverage of the SWOT data. Although short and highly focused, this paper provides significant insight into processes which likely affect eddies throughout the global ocean. Some minor improvements to the text and figures are needed, but once completed I would recommend this paper for publication.

We thank the reviewer for their careful reading and insightful comments, which helped improve the clarity and depth of the manuscript, our answers to all the questions raised in the review can be found below written in blue.

Comments on figures

All figures: the Ocean Science style guide says panel labels should be enclosed in brackets on the figure. We modified the panel labels accordingly.

Figure 1:

Fig 1l looks a lot like figure eleven in this journal’s typeface – you could miss the letter l out of your panel labels and just go j, k, m. We modified the labels accordingly

I can see why you’ve chosen to display this the way you have – you get all of it on one figure, and the days you want to emphasise are larger. However, I think skipping between the larger and smaller panels does disrupt the flow for the reader because now you don’t just start at top left, work across the row, go down one row, work from left to right, etc. Given that you currently only have two figures in the whole paper, I suggest you consider stretching this out - perhaps three figures each with six panels of equal size, for example? We agree with the reviewer that this sub-panel design could disrupt the flow. However, we choose to keep only two figures in the whole manuscript to stick to the OS Letters format.

Are you sure the colour scale is colourblind-accessible? And personally, I find diverging colour scales which aren’t centered at zero rather confusing.

We thank the reviewer for this important check. We passed the figure in <https://www.color-blindness.com/coblis-color-blindness-simulator/> to check for color blind accessibility and it

seems that is ok. If the reviewer think it is not, we would be grateful they indicate it to us. Concerning the diverging color, we chose to present the result this way to emphasize the satellites/LCEs and their opposite vorticities.

I think the AVISO SLA is maybe a bit too pale. For example, I really can't see LCT_1 on panel m, it just looks white. You could make the AVISO SLA quite a bit less pale while still maintaining a good contrast between it and the SWOT SLA. We understand the referee, and we believe that in panel m we cannot see the LCT_1 because it is in the "white range" of the colormap. We choose to let this tone for the AVISO data to not mislead readers on what part of the data is interpolated or not, and also acknowledge that the colormapping is modified for the AVISO SLA in the caption.

Panels b, c, d, e, h, i, j, k, n, o, p, q have text above them which is far too small to read – I had to zoom in to 200% to see it was their dates. Since they're not all regularly spaced in time, the reader needs to be able to see the dates. We increased the date fontsize accordingly. These panels also lack axes labels, and panels n and p have arrows which are not explained in the caption nor explicitly mentioned in the main text. We added description of the axes label in the caption and the discuss the arrows in the text at lines 75,79.

The labels LCE_0 , LCT_0 , LCE, VS, C_1 , C_2 , C_3 , C_4 and LCT_1 are not explained in the caption, nor have they been mentioned in the main text at the point where you first refer to this figure. I see that there's a lot of explanation in the main text of these labels, and it's understandable that you don't want to put all of this in the caption, but perhaps you could say something like "The labels LCE_0 , LCT_0 , LCE, VS, C_1 , C_2 , C_3 , C_4 and LCT_1 will be discussed in the main text." We thank the reviewer for the suggestion and we added this mention to the caption.

You don't need the colourbar three times on one figure, but you do need to label it. We added a label to the colorbar, and removed the duplicate.

Figure 2:

On figure 1, you said "The black contour marks the LCE detection from gridded altimetry, while thin gray contours represent iso-SLA lines from SWOT passes at 5 cm intervals". Here on figure 2 you say "Black contours indicate iso-SLA lines from SWOT passes at 2 cm intervals", but it looks like you still also have the black contour which is the LCE detection from gridded altimetry, even though this isn't mentioned in the caption. We indeed forgot to mention the LCE detection contour in the caption. We corrected it accordingly.

Panels a and d – is this exactly the same colour scale as in figure 1? It worth be worth either saying so in the caption, or altering the colourbar so it has the same tick marks as in figure 1, which will make it more obvious that it's the same scale. In any case, the AVISO SLA is clearly not as pale here as on figure 1, and it would be better if the two figures were consistent. The

colorbar were not the same, so we modified the colormapping of Fig. 2 for consistency. We now acknowledge this in the caption of Fig. 2.

Re the black contours which indicate iso-SLA lines from SWOT passes at 2 cm intervals – it looks like you’re only showing these in certain areas, i.e., outside the contour marking the LCE detection from gridded altimetry, but this isn’t stated in the caption. [It is exact, we only show contours in the range \$0 < \text{SLA} < 0.2\text{m}\$. We added this information in the caption.](#)

Panels b and e show “Geostrophic current magnitude derived from the denoised SWOT SLA”, but you clearly have data outside the SWOT swaths. Ditto panels c and f. [The background color is derived from AVISO SLA, we added this precision in the caption.](#)

In figure 1 your panel labels went left to right and then down to the next row. In figure 2 your panel labels go down the first column and then down the second column. It’s easier for the reader if you do them the same way in all figures. Ditto figure B1. [We modified Figs. 2, B1 accordingly.](#)

Panels b to f have no axes labels or visible tick marks. I think there are grid lines on all panels but they’re so faint they’re very difficult to see. Please make them like figure 1’s grid lines, and add axes labels. You don’t need axes labels on all panels but you do need x-axis labels on the bottom row and y-axis labels on the left-hand column. [We modified the figure accordingly](#)

Figure B1:

The colourbars and length scale are very difficult to see, even zoomed in. Please put them outside the panels.

The text at the top of each panel is also quite small and hard to read.

The dashed and solid contours on panels e and f are difficult to see – maybe use a contrasting colour?

[We modified the figure to gain visibility on all the points mentioned by the referee.](#)

Textual comments

Line 52: “This newly formed eddy was then trapped within a train of alternating-polarity eddies (Figs. 1d-f).” To my eyes, Fig 1d doesn’t look that different to panels b or c, so it’s not clear to me at what point you would start describing something as “trapped within a train of alternating-polarity eddies”. [Indeed, however, starting from Fig. 1d, a clear positive SLA signal remains at the LCE’s position, while negative SLA anomalies begin to develop both to the west and east of it.](#)

This marks the emergence of the alternating-polarity pattern typical of a vortex train, which is not yet visible in earlier panels. We clarified the sentence accordingly.

Line 128: Seaglidors is a specific brand name, the generic term is ocean gliders. We modified the text accordingly

Line 168: sutructures We modified the text accordingly

Line 171: which gridded altimetric product? Even if you don't want to show it, you could name it. We now mention the name of the product in the text.

Line 173: SWOT measurements are not instantaneous. It takes time for the satellite to orbit around the globe. Perhaps you meant that the measurements are near-instantaneous compared to timescales of interest? We agree with the reviewer, and modified the text accordingly using the reviewer's formulation.

Line 174: "time gaps between passes remain too small to affect our conclusions." Could you say a little more here about the timescales of interest? It is clear from figure 1 that changes do occur on weekly timescales.

It is true that Figure 1 shows changes on a weekly timescale, but the typical timescale of eddy evolution due to baroclinic instability is on the order of weeks to months, as illustrated in Appendix Figure B1. Given this, the ± 3.5 -day window used to combine SWOT passes is well below the relevant dynamical timescale and does not blur the key features of interest. We clarified this at lines 185-194.

Line 188: "simulations are ran over a year." This is bad grammar, please correct. We corrected the grammar

Line 190: "Timesteps are adjusted to respect the CFL criterion." You don't say what this criterion is, or what CFL stands for, or provide a reference. We have clarified what the CFL criterion is, spelled out the acronym, and added a reference in the revised manuscript, see lines 205-206.

Line 191: "the smallest as possible" – either "the smallest possible" or "as small as possible". Plus "similarly as in" is bad grammar. Perhaps just "as small as possible (Callies et al., 2016)." We modified the text accordingly

Line 192: delete "similarly". We modified the text accordingly

Line 204: "We chose $R = 100\text{km}$ " because? Because it is the same size as the LCE studied here. Note that this parameter does not have an impact on the conclusions we rise. We clarified this in the text.