Response to Reviews on "Merging of a mesoscale eddy into the Lofoten Vortex in the Norwegian Sea captured by an ocean glider and SWOT observations", by Damerell et al.

Throughout this response, comments from reviewers are given in *black italic*, our responses are in green, and quotes from the paper are in blue.

Reviewer 2

This paper presents in situ observations of a vortex merger in the Lofoten Basin, based on a combination of glider and altimetric data. The contribution of this study to scientific progress is substantial and twofold. First, it provides a 3D in situ observation of an asymmetric vortex merger in the ocean with unprecedented resolution. Second, it offers new insights into the mechanisms that sustain the quasi-permanence of the Lofoten Vortex, confirming that vortex mergers play a crucial role, as previously suggested.

I recommend this article for publication in Ocean Sciences, with only minor revisions to improve the clarity of the presentation.

Thank you for your very positive and helpful review. We have attempted to address your comments below.

General comments:

-The manuscript does an excellent job of reviewing and presenting current knowledge on Lofoten Vortex dynamics. However, it lacks even a brief introduction to the broader context of vortex mergers. Since the 1980s, oceanographers have extensively studied vortex mergers (e.g., Polvani et al. 1989, https://doi.org/10.1017/S0022112089002016). This study is highly significant for that research community, as it provides a rare 3D in situ observation of a phenomenon usually examined through idealized simulations.

I recommend adding a short paragraph in the introduction to introduce this field of study, as well as incorporating a discussion of the present observations in the context of vortex merger research. The authors could refer to the literature cited in Carton et al. 2016.

Thank you for this suggestion – this was indeed a noticable gap in the Introduction. We have now added the following paragraph in the Introduction (lines 111-119):

Vortex merging is an active field of research, though mostly through numerical simulation given the difficulty of in-situ observations of such transient processes. During merging, two like-signed eddies (i.e., both anticyclonic or both cyclonic) come into close contact with each other and then merge to form either one larger eddy or two asymmetrical eddies, depending on initial conditions (see, for example, Dritschel, 2002; Meunier et al., 2002; Reinaud and Dritschel, 2002; Bambrey et al., 2007; Özugurlu et al., 2008). While most studies of this process consider isolated vortex mergers, i.e., omitting the influence of environmental factors such as neighbouring eddies or large scale currents, de Marez et al. (2020) deduced that merging is influenced by the β-effect and surrounding eddies. Efforts to include more physical effects in studies of vortex mergers are often impaired by the lack of observations of these processes. The LV offers an ideal location to capture in-situ observations of such events. However, prior to the current study, we not aware of any direct in-situ observations of a merger event.

-The manuscript's clarity could be improved by using shorter, more concise sentences throughout the text. Also please check the synthax and the vocabular you use for the vortex merger; examples, L301 "more strongly anticyclonic" is poorly said, or L304 "dissipating [...] while reinforcing[...]", no it's an exchange of mass.

We have attempted to modify the text as you suggest. In particular, the Introduction has been extensively rewritten to improve flow and clarity.

-Could the authors consider adding subsesction in the result section? It would greatly improve the clarity of the different messages of the manuscript

We have added subheadings as follows:

3.1 Late winter conditions in the LV

3.2 Comparing centre positions

3.3 Merger with Eddy B

3.4 Probable merger event in March

3.5 Impact of the April merger event

-In my opinion, if Figs. 5,6,7,8 were placed in appendix, the manuscript would gain clarity. Then, putting in regards Figs 4 and 9 would be easier, and enough to describe the merger.

We have moved figure 6 to the appendices because it showed the same data as figure 4, just against density instead of depth, and we only refer to that figure twice. However, we disagree with moving the rest of the figures because we think they are important to the narrative and readers would just be flipping back and forth between the appendices and the main text. The vertical profiles of (new) Fig 5 are very important in identifying and discussing the effect of the merger on hydrography. We are particularly fond of (new) Fig 6 as this figure is central to the story and shows the progression of the vortex and Eddy B in relation to ADTa fields and the glider observations.

Specific comments:

L7 (and all the manuscript) : in-situ/in situ -> \textit{in situ}. Also italized all latin expressions (e.g., i.e.,...)

We are following the Ocean Science author guidelines, which say that common latin expressions such as et al., e.g. and in situ should not be italized.

Fig. 1: it could be useful to add a schematic of LV and small eddies shed from the NwASC in Fig. 1

We have added the mean location of the LV to figure 1 and indicated the eddy shedding from the NwASC.

Authors could use the newly released v2.0 of SWOT data for the study

We have updated our SWOT data to v2.0 and reproduced all the related figures.

A T/S diagram for each realisation could be added in Fig. 4, where the water masses "inside" LV and Eddy B are identified.

Thank you for this useful suggestion. Figure 4 is already slightly too large for the page, so it was not possible to add T/S diagrams to that figure. We decided instead to add T/S diagrams in two ways. Firstly we added T/S diagrams of the average profiles (core, outer and Eddy B) to figure 5 because figure 5 shows the average profiles in the core, Eddy B, and outer region, which can now be easily compared with the T/S diagrams of the average profiles. Secondly, we have added a new figure in the appendices, figure B2, which shows T/S diagrams for the data shown in figure 4, i.e., for realisations 1, 3 and 5 using the full data instead of average profiles.

The authors are not clear (or maybe I missed it) in exlpaining why the azimuthal velocity of the LV is way larger in realisation 3 than realisation 1

Thank you for pointing this out. This is likely because of the probable merger of eddy A in March, but we forgot to say so before. This has been added (lines 379-381):

The LV's azimuthal velocity increased considerably between realisation 1 and realisation 3, from 0.4(±0.05) m s−1 to 0.6(±0.07) m s−1 (Fig. 4j and k). This kind of "spin-up" is an expected outcome of an eddy merger (Trodahl et al., 2020).