

We thank Referee #2 for the useful comments and suggestions.

The main revisions includes:

1. All figures are redrawn accordingly.
2. We clarify the data and method with more details and formulas.
3. The sensitivity of result to parameters are discussed in a new subsection.
4. The possible vertical process are also discussed in a new subsection.
5. The changes according to Referee #1, #2, and editor are marked with red, blue, and green, respectively.

Specific comments :

Q:- About the method : I couldn't find how h_1 and h_2 were determined in the text. How the interface of the eddies were chosen according to its vertical structure? Data and Method section needs to clarify this point, and also readers would appreciate to see the vertical structure of the eddies/background as an illustration and visual check.

A: We add the detail in section 2.3. The upper surface $h_1 = \frac{\rho_1}{\rho_1 - \rho_0} A$ and the lower surface

$h_2 = \frac{\rho_1}{\rho_2 - \rho_1} A$ satisfy $h_1 \sim h_2 \ll H_1$.

Q:- It is not clear how eddy properties are considered below the surface. If I understand correctly what is here done, eddy properties inferred from surface observations are taken as average over the layer defining the eddy. If this can be acceptable for surface anticyclones, I wonder if this assumption not too strong when considering subsurface eddies with subsurface velocity maximum? What is the depth a typical subsurface eddies in the South China Sea? Alternatively, velocity fields from ocean re-analysis can be used in the considered layer.

A: Yes, eddy properties inferred from surface observations are taken as average over the layer defining the eddy. The eddies are not in the South China Sea, but in the western tropical Pacific. Such thick of subsurface eddies are from previous observation [Li et al., 2017] and numerical simulation [e.g. Wang 2017].

Q:- H_1 is chosen as a constant value, but in the real ocean, this likely not true and can lead to substantial variation in eddy properties. The reference provided to justify this choice are from different places with different stratification. How sensitive are the result to the choice of H_1 ?

A: The sensitivity of result to H_1 is discussed in a newly appended section 4.1.

Q:- How are the lateral boundary of integration chosen? This is not details neither, and, I presume, can lead to significantly different results. Again, how sensitive are the results to the choice of this parameter?

A: The sensitivity of result to lateral boundary is discussed in a newly appended section 4.1.

Q:- The paper lacks of a statistical generalization of the results. Have you studied other examples of merging before choosing to focus on the two presented in the paper? I presume that once the work is achieved for two examples, it can easily be applied on others examples. Otherwise, based on only two examples, the conclusions about generalization of the conservation rules, and splitting, needs to be mitigated.

A: Thanks for your comments, we have added the discussion of results in this new version.

Technical corrections :

Q:119 "by trapping them", please rephrase
A: "by trapping those tracers along with the water"

Q:120 "the most energetic component in the ocean", please provide reference
A:Thanks, reference added.

Q:122 "eddy's life-cycle and transports."
A:Thanks, suggestion followed.

Q:124 "than before", please be more precise (than pre-existent eddies, than the sum of the two original eddies...)
A:Thanks, "than the sum of the two original eddies".

Q: 125 "by Gill and Griffiths", Is there no reference for this work?
A: The reference is "GILL, A. E. and GRIFFITHS, R. W. 1981 Why should two anticyclonic eddies merge? In Ocean Modelling, 41. Unpublished manuscript."

Q:128"Pandora's box",
A:Thanks, suggestion followed.

Q:140 & 300 "are less than", please specify ("less numerous") and correct in the whole manuscript
A:Thanks, suggestion followed.

Q:145 "field", please prefer research cruises to "voyage"
A:Thanks, suggestion followed.

Q:160 "eddy merging", please rephrase "after two typical eddy mergers", merging is not a noun...
A:Thanks, suggestion followed.

Q:165 "for the global"
A:Thanks, suggestion followed.

Q:180 "as previously used", please provide reference
A:Thanks, suggestion followed.

Q:189 "eddy area but eddy radii is an extensive quantity", please rephrase this is not clear
A:Thanks, suggestion followed.

Q:192 "compositing", this is not a verb, please rephrase
A:Thanks, suggestion followed.

Q:196 Do you mean " too small and can be ignored"?
A:Thanks, suggestion followed.

Q:1106 PV anomaly? Please provide a reference or a demonstration that the average circulation is equal to the surface integrated PV anomaly.

A: $\xi - f \frac{h_1+h_2}{H_1}$ is PV anomaly (Gill A.E., p 192). Then

$$\Gamma = \iint \left(\xi - f \frac{h_1 + h_2}{H_1} \right) dx dy = \iint \left(\frac{f + \xi}{H_1 + h_1 + h_2} - \frac{f}{H_1} \right) (H_1 + h_1 + h_2) dx dy$$

Q:1110 Where is the x- and y-axis origin?
A: the x- and y-axis origin at eddy center.

Q:1112 u and v refer to surface eddy velocity but considered as average swirling velocity of the eddy, right?
A: Yes.

Q:1116 Why is there no (H1+h1+h2) factor in the integral?

A: We assume that only h_1 and h_2 change during the merging process but H_1 does not change during the merging process. So only the potential energy associated with interface is considered [e.g., Lumpkin et al., 2000].

Q:1114 Please provide the expression of the reduced gravity.

A: suggestion followed.

Q: 1116 Please provide a definition and expression for κ . Again this is for a surface parameter I presume.

A: Yes, it is a surface parameter. And suggestion followed in Eq. (2).

Q:1126 Please provide number in meter too for h_2 .

A: suggestion followed.

Q:1127 "the parameters of both eddies"

A:Thanks, suggestion followed.

Q:1135 & 184 "experienced changes"

A:Thanks, suggestion followed.

Q:1158 "described in the previous"

A:Thanks, suggestion followed.

Q:1161 Please provide number in meter for h_1 and h_2 .

A:Thanks, suggestion followed.

Q:1156-161 Consider moving some of this part to methods with more detailed explanation on the choice of the density interface ρ_0 , ρ_1 and ρ_2 .

A:Thanks, we have added more details in method.

Q:1165 "came close to each other with a"

A:Thanks, suggestion followed.

Q:1166 "this subsurface merging event"

A:Thanks, suggestion followed.

Q:1175-177 Is it a stacking process? or the two cores coalesce? How the vertical structure of the eddies evolve during the merger?

A: It is two cores coalesce. The stacking process is quite different from the two cores coalesce in that the area of "merged eddy" in stacking process is significantly smaller than the total area of two eddies. We did find examples of such stacking process.

Q:1185 This is wrong, now h_1 is same order as h_2 .

A:Thanks, suggestion followed.

Q: 1198 and following : What the +/- corresponds to? Please be consistent with number of significant digits between parameters (sometimes 3, sometimes 4, I would give 2).

A: Thanks, we have modified them.

Q: 1203 Please provide a reference

A:Thanks, suggestion followed.

Q:1209 "as mentioned previously"

A:Thanks, suggestion followed.

Q:1219 "merging" "non-negligible"

A:Thanks, suggestion followed.

Q:1241 "sported"?

A:Thanks, suggestion followed.

Q:1242 "in the northern ocean"?

A:Thanks, "in oceans of the northern hemisphere. ".

Q:l245-247 How is the eddy gravitational PE background sea level computed? Please provide the formula applied here to infer the numbers.

A:Thanks, we add the formula in Eq. (10).

Q:l258 "rarely-evoked" "poorly-known" "underrated"

A:Thanks, suggestion followed.

Q:l264-265 Please rephrase this sentence is not clear.

A:Thanks, suggestion followed.

Q:l266 "enstrophy decreased"

A:Thanks, suggestion followed.

Q:l272 "in the inverse energy cascade"

A:Thanks, suggestion followed.

Q:l275 "mostly baroclinically"

A:Thanks, suggestion followed.

Q:l280 "persists"

A:Thanks, suggestion followed.

Q:l285 "observation of two cases of eddy merger"

A:Thanks, suggestion followed.

Q:l286 "fitted to"

A:Thanks, suggestion followed.

Q:l289-290 " Thus, parts of these ... in future." What do you mean here?

A: Removed.

Q:l297 H1 is fixed here...

A: Yes, modified.

Q:l308-309 Why eddy splitting will work similarly than merging? Splitting can have very different causes (instability processes of the eddy itself, or interaction with external flow) and might not work the same way as mergers work. The authors should prove or illustrate their statement with an example, or remove the last column of table 1 and mitigate their conclusions.

A: Thank for your comments. We have modified by following your suggestion.

Q: Figure 1 : The top panels are suited to introduce the 2-layer model, while the bottom panels already detail some results. Please split into two figure with one put at the end of the manuscript with the conclusion. In (b) please draw isopycnals as lines, the colors are confusing. Please also specify H0 and H2.

A: Suggestion followed.

Q: Figure 2 and 4 : Please mark the eddies described in the text (AE1, AE2, A1, A2 and A)

A: Suggestion followed.

Q: Figure 3 and 5 : Please give more details, what is "A2+A2+ob" for instance? Hard to know without reading carefully the paper.

A: Suggestion followed.