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Discussions

Interactive comment on "The life cycle of submesoscale eddies generated by topographic interactions" *by* Mathieu Morvan et al.

Anonymous Referee #2

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In this idealized numerical study inspired by inset observations of the mesoscale eddies in the Gulf of Oman, the authors use a submesoscale resolving model to investigate the formation and life cycle of submesoscale vortices and their impact on the Persian Gulf water and the Red Sea water.

The geometry is idealized to parallel north and south walls with topographic slopes, with a row of mesoscale vortices in between. The initial condition is inspired by a Physindien11 observational campaign.

Two mechanisms are explored for the generation of submesoscale vortices, both related to the flow interacting with the topographic slope. The first mechanism is frictional vorticity generation in BBL, and second due to topographic Rossby waves breaking when a mesoscale anticyclone interacts with the topographic slope. Submesoscale

eddy lifecycles are discussed with several numerical examples, and their impact on particle dispersion within the Gulf is also discussed. I enjoyed reading sections 3.3, 3.4 and 3.5 and understanding the implications of submesoscale eddies to the dispersal of PGW.

There is some evidence shown into sections (2.1 and 3.1, and Figure 2) to motivate the numerics, but in the rest of the paper, there is no inter-comparison with the observational data.

The presentation of results in the paper is convincing though I would like the authors to address the following questions before I can recommend publication:

1. Section 2.1 and 3.1: Did the Physindien 2011 campaign show evidence of submesoscale flows? While there is some evidence in the GO13 (figure 2c) section to support the filaments of Persian Gulf Water flow in T and S, but there is no velocity information presented from the corresponding ADCP sections. I would like the authors to present some velocity information from the observational campaign in section 2. What scales do you see (after suitable averaging in the ADCP section? The accuracy of horizontal velocity components is mentioned, but no data is shown from the ADC section so this is superfluous information. 3. Do you see any evidence of submesoscale vortices in the velocity structure from the observations? At what depths? How high were the 2-d vorticity that you could observe in the ADCP sections? At what depth?

4. What do the Observed KE spectra show at various depths for the sections shown in Figure 2. In the ranges that overlap âĂŤ how do the spectra from the model and the observations compare (in terms of slopes, etc.?)?

5. Page2, Lines 27-28: The simulations you are doing are very idealized and you are using the observations as an inspiration, so saying that the simulations "specifically designed to resemble the local geography of the Gulf of Aden and the Gulf of Oman" is incorrect. The geometry is very idealized, and the Gulf is variable in width unlike your simulations and has many other geographical details. You need to modify this

sentence to reflect this.

6. Page 3, Line 17: The accuracy of ADCP u,v is mentioned to be 0.5cm/s. With what averaging? No ADCP section is shown, and no averaging information is mentioned, so this information is not useful to your reader.

7. Figure 2a). Change the color for the GO13 section, it is very hard to see the line corresponding to GO13 in this panel.

8. Figure 3. We can see intense vorticity variations in this figure at sub-mesoscales. Does the density stratification vary on these scales? You should present either density or Nˆ2 from EXP1,2 and 3 at these depths as well âĂŤ are these vortices seen in the density structure as well?

9. Page 8Line 15, and Page 9 Line 1-5: We know from your initial conditions and from the observations that the flow is stratified. Why does the “homogeneous” fluid TRW match the observed phase speeds? What is the phase speed if stratification was taken into account?

10. Section 3.5 and 4: Particularly for the last part of section 4, the presentation of the text needs to be improved, and I have offered several suggestions in the attached annotated version of the ms.

Please also note the supplement to this comment:
https://www.ocean-sci-discuss.net/os-2019-3/os-2019-3-RC2-supplement.pdf

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