Ocean Science
Discussions

Interactive comment on "Could the mesoscale eddies be reproduced and predicted in the northern south China sea: case studies" *by* Dazhi Xu et al.

Anonymous Referee #1

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The related studies about the mesoscale eddies in the SCS have amount of achievements, especially owing to the altimeter data widely applied, for understanding the dynamic and the interactions with the environmental current circulations on large scale. The article of "Could the mesoscale eddies be 1 reproduced and predicted in the northern south China sea: case studies" would like focus on two anticyclonic eddies in the northern SCS (NSCS). By helps of a HYCOM-EnOI assimilation system, they found the key of the predictable issues about the eddy generation, evolution and propagation paths can be done well only when the eddy amplitude is larger than 8 cm. Clearly, this topic is interesting for deep understanding the real factors to limit the eddy's forecast performance. The used methods, the related experiments, the main conclusions in

this study are creditable. But there are obvious some errors in text and figures/tables, this version needs to be more clear to state the findings and the concerned writings, although don't need to add more experiments.

The main comments and some found errors are listed as follow. 1) Under the current introduction, the reasons why to choose the two eddies in the north SCS are not clear enough. It means the necessity and the representative still need to be highlight. For example, complement the more details about these two eddies: the lifetime (Section 3.1); all the related references; methods and main points in Wang et al. (2008) and then relate to the aims in this study.

2) The eddy amplitude of 8 cm is a main finding in this study. For my opinion, it should have a relation with the SLA error in this system. Before the comparison of the eddy paths under different conditions, it is important to evaluate your simulated SLA (like in As_exp) to know how about the uncertainty. So one paragraph should be added.

3) It is important to clearly define how to objectively evaluate the eddy reproduction is well. In this study, the compared result is referred to the buoy trajectory and the detected by altimetry. Clearly, the related formula as possible can relate to these two elements. It will be helpful to simple and conclude in Table 2 and 3. For instance, P6 L230 "From Fig. 4 and Table 2, we can see that the generation and movement of AE1 can be well reproduced by the CSCASS . . ." add the related error statement and then objectively to know reproduced well or not.

4) P 1 L 51: ". . . high resolution satellite images or numerical model simulations (Yang et al., 2000), . . ." needs to add more reference about the recent key findings about mesoscale eddy both from satellite and modelling like as following:

Fu, L.-L., D.B. Chelton, P.-Y. Le Traon, and R. Morrow. 2010. Eddy dynamics from satellite altimetry. Oceanography 23(4):14–25, https://doi.org/10.5670/oceanog.2010.02.

Morrow, R. and Le Traon, P.-Y. Recent advances in observing mesoscale ocean dynamics with satellite altimetry. Adv. Spa. Res. 50, 1062–1076 (2012).

Frenger, I., Gruber, N., Knutti, R. & Münnich, M. Imprint of southern ocean eddies on winds, clouds and rainfall. Nat. Geosci 6, 608–612 (2013).

5) L 52: "... the operational forecasts of the mesoscale eddy still poses a big challenge because of its complicated dynamical mechanisms and high nonlinearity (Yuan and Wang, 1986; Li et al., 1998)." These references are not suitable because they are not related with ocean operational forecast and were published more than 20 years out of representing the recent knowledge.

Some references are recommended as follow: De Vos, M., Backeberg, B. and Counillon, F.: Using an eddy-tracking algorithm to understand the impact of assimilating altimetry data on the eddy characteristics of the Agulhas system. Ocean Dyn., https://doi.org/10.1007/s10236-018-1174-4, 2018.

Robert H. Woodham, Oscar Alves, Gary B. Brassington, Robin Robertson & Andrew Kiss (2015) Evaluation of ocean forecast performance for Royal Australian Navy exercise areas in the Tasman Sea, Journal of Operational Oceanography, 8:2, 147-161, DOI: 10.1080/1755876X.2015.1087187

Treguier Anne-Marie, Chassignet Eric P., Le Boyer Arnaud, Pinardi Nadia (2017). Modeling and forecasting the "weather of the ocean" at the mesoscale. J. Marine Research, 75(3), 301-329. http://doi.org/10.1357/002224017821836842.

6) P3 L87: "... thus is essential for the prediction of mesoscale eddies (e.g., Xiao et al. 2007; Xie et al., 2011; Xu et al., 2012; Xie et al., 2018)". The concerned assimilation works done in the NSCS needs be commented, and then to be pointed the disadvantages to relate the aims in this study.

Xiao, X., Wang, D., Yan, C., and Xu, J.: The assimilation experiment in the southwestern South China Sea in summer 2000, Chinese Sci. Bull., 51, 31–37, 2007.

Xie, J., Bertino, L., Cardellach, E., Semmling, M., and Wickert, J.: An OSSE evaluation of the GNSS-R altimetery data for the GEROS-ISS mission as a complement to the existing observational networks, Remote Sens. Environ., 209, 152-165, doi:10.1016/j.rse.2018.02.053, 2018.

Xie, J., Counillon, F., Zhu, J., and Bertino, L.: An eddy resolving tidal-driven model of the South China Sea assimilating along-track SLA data using the EnOI, Ocean Sci., 7, 609–627, doi:10.5194/os-7-609-2011, 2011

7) P5 L131: Are there some cases using this detection scheme in the SCS? Yes, give the reference, otherwise provide a simple snapshot to show its ability.

8) Table 1 lists the designed experiment time. For instance (my personal point), the experiments designed by the eddy strength should be highlighted using one figure to replace the table. On this figure, the eddy strengths of AE1 and AE2 are curved as a function of the date, and the experimental date at beginning also are marked on by vertical lines.

9) Table 2: The dates of the first weeks need to be stated. What the differences between "Amplitude" and "Intensity"? As the statement of P4 L127 "the intensity of the mesoscale eddy must be greater than 2 cm;", how the observed amplitudes of AE1/AE2 less than 2 cm? Are they the error or others? And to compare the amplitudes in the first and the second weeks, can comment the big gap?

10) Use the same color in the panel f of Figure 9-11 as the other panels of Fig. 6-8: the blue (red) is forecast (observation), and using full or empty mark to distinguish AE1 and AE2.

11) There are interested finding in Figure 12: at the first stage of AE1 and AE2 the distance error looks decreasing; at end stages the distance error increasing with time. Can you explain the former?

12) In Figure12, add another referenced eddy distance line from As_exp. It will be

interesting to compare these two lines to show the predictability if without data assimilation.

13) Recommend to replace the title by "Could the two anticyclonic eddies during winter 2003/2004 be reproduced and predicted in the northern south China sea?"

Technic comments:

Figure 3 is too ambiguous.

P1, L62: "... (Fig. 1). Forced ..." the intensity of the mesoscale eddy must be greater than 2 cm;

P5: The paragraph introduces the ocean model should be shorten like deleting the lines of 140-150.

P7 L 170: "... as a surface forcing from Legates and Willmott (1990)." Legates, D.R., Willmott, C.J., 1990: Mean seasonal and spatial variability in gauge-corrected, global precipitation. Int. J. Climatology, 10, 111-127.

P7, L172: missing the reference of "Han (1984)".

P7, L 183: EnKF as the first place should give the detailed name.

P9, Section 3.1: The AE2 lifetime was not clearly stated so the first (last) identified date needs be mentioned.

Table 3: "... distance of eddy centers between the observation SLA's ..." are missing on the content. So double cheek the consistence in caption.

Figure 12: The cyan line is hard to see so change it to be black. The histogram should use the rectangle to present well other than circle and triangle. L631:"The red and green histograms indicated the AE1 amplitudes from observation and prediction respectively."

The wrong order of the references is clear like: P18 L 414 Bleck et al. (2002); P18

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L421 Counillon and Bertino (2009); P18 L433 Hamilton et al. (1999); P19 L444 Kara et al. (2002); P20 L475 Rio et al. (2014); P20 L487 Woodruff et al. (1987)

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