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Reply on RC2

Yingli Zhu and Xinfeng Liang

Author comment on "Characteristics of Robust Mesoscale Eddies in the Gulf of Mexico" by Yingli Zhu and Xinfeng Liang, EGUsphere, https://doi.org/10.5194/egusphere-2022-789-AC3, 2022

We removed the notion of “robust” in the revised manuscript to eliminate the confusion. Mesoscale eddies were selected by combining three previous eddy detection algorithms so that we had more confidence in the selected eddies than those given just by one algorithm.

As to your concern about the Eulerian method of detecting mesoscale eddies, we give the following explanations. First, the definition of mesoscale eddy in this study is different from coherent Lagrangian vortices, and our focus is not on the coherent Lagrangian vortices. We considered the mesoscale eddies detected with Eulerian methods that may change form and exchange material with background fluid. In addition, we did not consider the coherence of eddies based on the condition that the rotational velocity of the eddy exceeds its translational velocity and U/C was only used to characterize the advective nonlinearity in this study. For those who are interested in the mesoscale features with closed streamlines, the characteristics of eddies detected with the Eulerian methods are still useful. For example, a recent study has used one Eulerian method to examine the eddy surface characteristics and vertical structure in the Gulf of Mexico from 2016-2018 and found distinct mesoscale features in the eddies with closed sea surface height contours (Brokaw et al., 2020).

In addition, we are fully aware of the limitations of different Eulerian eddy detection methods, which we clearly stated in the text. In fact, mitigating those limitations is one of the major motivations of this study and that is why we put a lot of effort to combine different eddy detection algorithms to select eddies. In addition, although eddy detection methods are likely not perfect, they have been widely used and greatly advanced our understanding of the dynamics and impacts of mesoscale eddies over the past few decades. The Eulerian methods of detecting eddies are still under development and used in recent studies. For example, one Eulerian method was still used in the eddy trajectory product released by AVISO (Pegliasco et al., 2021a, 2021b; Pegliasco et al., 2022). Based on Eulerian methods, many eddy characteristics in other oceans and the global ocean were reported in recent studies (e.g., Escudier et al., 2016; Schütte et al., 2016; Keppler et al., 2018; Laxenaire et al., 2018; Pessini et al., 2018; Trott et al., 2018; Mason et al., 2019; Martínez□Moreno et al., 2019; Chen et al., 2022; Atkins et al., 2022; Evans et al., 2022; López-Álzate et a., 2022). Last but not the least, some of our findings being consistent with previous studies, which you considered as a negative point, actually indicate that our approach works just fine.
Regarding the novelty, we would like to argue that there are two open and important

questions examined in this study. The first question is that most previous studies only focus on the Loop Current Eddies (LCEs) and Loop Current Frontal Eddies (LCFEs), while characteristics of other types of mesoscale eddies in the Gulf of Mexico (GoM) have not been comprehensively described. The second question is that the seasonal and low-frequency variability of eddy number and amplitude of all types of eddies in the GoM have not been fully reported. Our study provides useful results to address those two questions.

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