General comments:

The authors made significant improvements in this revised manuscript and responded to most comments. However, they failed to address some of my comments. In addition, there are still some flaws in the revised manuscript.

Specific comments:

I would suggest the authors to also include the open boundary conditions of biological component.

P9 Line158 of the revision-tracked manuscript: The stratification would result in the shallow mixed layer.

P9 Line172 of the revision-tracked manuscript: Please give the definition of the euphotic layer: the depth where the light intensity is 1% of the surface?

P16 Line276-277 of the revision-tracked manuscript: This sentence is confusing. I would suggest to change the 'associated with' into 'accompanied by'.

P17 Line293-294 of the revision-tracked manuscript: The contrasted seasonal response to the LCEs cannot be recognized by the surface chlorophyll. This is one of the main conclusions of this manuscript.

P17 Line300-304 of the revision-tracked manuscript: As in my first general comment, I am concerned about the biological model performance in the subsurface and the potential influence of this model weakness on the main conclusion: the increased winter chltot within the core of the LCEs. As the authors mentioned in their response, the vertical profiles of chlorophyll vary a lot in the winter: some individual profiles are well mixed without the DCM while others are 'stratified' with the distinct DCM. Based on Damien et al 2018 to which the authors referred their model validation, the averaged winter profile shows a distinct DCM at about 60m with the $[Chl]_{DCM}$ ~50% higher than the $[Chl]_{surf}$. All of these clues suggests the significance of 'stratified' chlorophyll profiles in the winter of Gulf of Mexico. The failure of the biological model to reproduce these important 'stratified' profiles may have large influence on the results. At least, the results of this paper do not apply to these 'stratified' winter profiles. I am not asking the authors to re-run the model or to accept my opinion, but I hope that the authors can fully discuss it in their manuscript and be cautious about their conclusions.

P24 Line 405-407 of the revision-tracked manuscript: Where is the euphotic layer? Could the authors plot it along with the nitracline? The authors mentioned it earlier in their revised manuscript that the euphotic layer can reach between 120 and 150 meters in the Gulf of Mexico. If it applies here as well, the nitracline is still within the euphotic layer.

P26 Line 448-452 of the revision-tracked manuscript: Please refer to Figure 9

P27 Line 466-467 of the revision-tracked manuscript: It is hard to see the differences in the decoupling of production and grazing between the eddy core and background GOM (e.g.

GRZtot:PPtot both about 0.95 on February) from the figure. I would suggest the authors to provide the mean values and the standard deviation, and to reduce the y-axis scales of the figure.

P27 Line 472 of the revision-tracked manuscript: The major source of recycled nutrients should be the remineralization.

P28 Line 474-477 of the revision-tracked manuscript: How did the authors draw this conclusion from Figure b1 which show the biological source and sinks of NO3? Could the authors explain it clearer.

P30 Line 511-524 of the revision-tracked manuscript: This paragraph discussed the relative importance of two mechanisms (eddy pumping and eddy-wind interaction) in the winter and should not be in this subsection (Section IV. 4 How to explain summer productivity). I can understand that it is an extension of the discussion on two mechanisms, but I hope that the authors can re-organize it better.

Maybe because I am not a physical oceanographer, what is the definition of eddy-Ekman pumping? Is it Eddy-wind interactions? Please make it clearer.

P30 Line 519 of the revision-tracked manuscript: the word ‘seasonal’ is duplicated. Please remove one.

P34 Line 610 of the revision-tracked manuscript: I guess this should be 80%:20%, right?

Caption of Figure B1: ‘minus’, not ‘menus’