

Interactive comment on “Modeling ocean circulation and biogeochemical variability in the Gulf of Mexico” by Z. Xue et al.

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We are very grateful to our reviewers: Dr. Matthew Haward and Dr. Sergio deRada for their constructive comments and suggestions, all of which will be incorporated in our revision. Please find (1) our responses to the reviewers' comments, as enclosed below.

Response to Reviewer#1 (Dr. Matt Haward) 's comments:

1) The use of "ton" as a unit of mass is problematic without a clear definition. It is used in the text and in figures.

We will convert all usage of ton into mol to make the manuscript more consistent (also in Figures).

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2) Page 7793 Section 3., line 7, You say 0.5 and 0.9 – to me it looks like 0.7 and 0.95 Agree and will be corrected.

3) Page 7795 Section 4.1, line 19, You say _80% and reference Table 1. I get $(4.63/6.53)=71\%$. I must not know how to calculate the number correctly. Please provide an example calculation.

We will correct this typo. The 80% is based on the nutrient budget (Table 2) instead of the flux (Table 1). In Table 2: $108.86/135.87=80\%$, and we will note this in the revised text as well.

4) Page 7798 Section 4.2, lines 6-8 “Compared with the DIN, : : .” I can't see this in Figure 12.

We will adjust the color scale in Fig.12 to address the variability in PON transport.

5) Page 7798 Section 4.2, lines 6-11 Discussions about surface water and deep water movements seems out of place when talking to Figure 12 which is depth-integrated results.

Fig 12 shows the integrated results to quantify the nutrient flux through the entire water column. Indeed our model results indicated that the PON transport mainly happens in upper water column, whereas DIN transport occurs mainly in lower water column. We note that a similar nutrient transport pattern has also been reported in the Middle Atlantic Bight (Fennel et al., 2006).

6) Page 7803 Section 4.2.4, line 1, “In summary, our calculations : : .” The way this sentence starts makes it sound like lines 1-17 should be in Section 5 Summary and Conclusions. I think Lines 1-17 are really a new section, say “Section 4.2.5 Shelf-Wide Results”.

Agreed and a new section-4.2.5 “Shelf-Wide Results” will be added.

7) Figure 2. The shelf line and distance along it (0-4000 km) needs to be discussed in

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the text. It would be useful to mention in the text where the mouth of the Mississippi River is in terms of this distance. It would be useful to indicate this position on Figure 12 d.

Agreed. More text will be added in to the caption of Figure 2 as well as the location of the mouth of the Mississippi River.

8) Tables 1 and 2 need to be described in Section 4. Table 1 and Table 2 have exactly the same titles – but they contain different information. More description would be helpful to the reader, such as; the river input values are observed, the other values are from the simulation, and why input-loss doesn't balance. (For example shelf-wide, annual budget 142.88 input 141.97 loss)

Agreed. We will add more clarifications for Tables 1 and 2 as well as their difference into Section 4.2. The explanation of the difference between input and loss term (<1%, ascribed to computational error) will be added to Section 4.2.5 as well.

Technical corrections P 7786 Introduction line 17, and several other places “e.g. ” is missing a comma P 7790 Section 2.1, line 9 <http://www.esrl.noaa.gov/psd/> is the new URL P 7793 Section 3., lines 9-16 Fig 5 is not called out anywhere. Here is a good place. P 7797 Section 4.1, line 17, should be “nutrient, phytoplankton, and zooplankton” P 7797 Section 4.1, line 18, should be “76%, 50%, and 80%” P 7801 Section 4.3, line 12, I think “confirm” is the wrong word, “reproduce” is better. P 7803 Section 5, line 24., “sea surface height” – as was used in the abstract, not “sea-level”. Figures 9 and 10. Captions should be “(d)” not “(4)”. Figure 13. You are using “fall” in the caption “autumn” in the figures. Tables 1 and 2. In the caption at the bottom it should be “loss” not “lose”.

All technical corrections will be implemented.

We thank Dr. Matthew Haward again for your thoughtful comments and suggestions that helped us improve this manuscript.

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Response to Reviewer #2 (Dr. Sergio deRada)'s comments

Reviewer #2 suggested we focus more on Gulf of Mexico and reduce the Atlantic – related content. After some considerations, we still would like to maintain both contents because:

a) Our model domain covers both the Gulf of Mexico (GOM) and South Atlantic Bight (SAB) and it is crucial to validate our model performance in both regions;

b) Conditions in the SAB could serve as a comparison with those in the semi –closed GOM. We are working on another manuscript focusing on the SAB nutrient dynamics, and are going to refer the contexts in this manuscript.

1) Page 5 line 4, the usage of ton needs to be converted to mol N;

Agreed and will be revised accordingly. Please also see our response to Reviewer #1's comment #1.

2) Page 6 line 10. “In this study” is replaced by “Here”.

Will be corrected.

3) Page 7 line 10, “HyCOM” is replaced by “HYCOM”.

Will be corrected.

4) Page 7 line 14, which version of MY?

We used Mellor and Yamada Level-2.5 Closure.

5) Page 8 line 6

We would like to keep the discussion of “Nitrogen Cycling” here as an explanation of why phosphate cycle is not included in our model.

6) Page 9 line 8, about the biological parameters

We used the same parameters as those in Fennel et al. (2006, 2010, 2011). We

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decided not to list them in this manuscript for the purpose of brevity and conciseness. All the 20+ parameters plus references therein are given in Fennel et al. (2006, 2011).

7) Table 1 and 2.

We agree that the tables are most important results in this study. More clarifications will be added into the text. Please also see our response to Reviewer #1's comment #8;

8) Fig.3.

As indicated in the text, "a 36-hr low pass filter was applied to both observed and modeled sea level time series to facilitate comparisons". And the statistics (r-value, standard deviation) can be better assessed in Taylor diagram (Fig.4). Here we intend to show the model is able to capture even synoptic scale events in the coastal region.

9) Fig.5

Reference to Figure 5 will be added in the text.

10) Figs. 6 and 7.

The reason why we did not perform any low pass filter to these variables is because the in-situ observation is too sparse. We think daily output from the model would reproduce a more realistic representation of variability captured by sporadic in-situ observations.

11) Fig.8.

Agreed. We will revise the figure to show 50m and 200m isobath. We will also label the distance along the 50-m isobath to facilitate the discussion related to Fig.12.

12) Fig. 12.

Agreed and will be revised. Please also see our response to Reviewer #1's comments #7;

13) Merging Figs. 13 -16 into one figure

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We have tried to show results of the entire Gulf in a single figure for each season. However, in that configuration the mesoscale circulation pattern and wind field within each sub-region are too small to be seen. We'd like to keep the current figure format for better illustration and discussion.

We thank Dr. Sergio deRada again for your thoughtful comments and suggestions that helped us improve this manuscript.

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