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

**M. Gregoire (Editor)**

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Dear Dr. Xue,

I have read your manuscript “Modeling Ocean Circulation and Biogeochemical Variability in the Gulf of Mexico” and I would like that you answer the following comments when preparing a revised version of the manuscript.

Thank you in advance

Marilaure Grégoire, editor handling the manuscript

Figure 1: It would be helpful if you could superpose a schematic description of the circulation features.

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Could you please detail how are the sediments represented?

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Equations 1 and 2 estimate the transport of DIN through the 50m-isobath. These equations estimate the contribution of advection. How is computed this advection transport? At each time step in the code and then you make an average or is it computed from averaged fields of U and DIN? IF yes, what is the time scale of averaging (frequency of model outputs). Second, what is the importance of the transport by horizontal diffusion?

Laurent et al 2012 show that phosphorus limitation occurs every year (at least between the period of simulation 2001-2007) in spring and summer with an impact on primary production and on the amount of export production to the sediments. However, the analysis of Figs. 3-8 clearly seems to show that your model is able to reproduce the nutrients and chlorophyll dynamics without this phosphorus limitation. Can you comment on that? Do you see periods of overestimation of chlorophyll by the model that can be due to the ignorance of a phosphorus limitation in the model (mainly end of spring as shown by Laurent et al 2012 BG with their 3D coupled model).

Validation of the model: did you try to validate the vertical profiles?

Page 16: which temporal mean has been removed? Annual/seasonal?

Subsection 4.3.1: What do you mean by denitrification. From the short model description it is not clear whether this denitrification refers to benthic denitrification or water column denitrification due to hypoxia in some places.

Figure 13: mol N is not the unit of a flux

I have tried to compute over the annual scale the nitrogen budget from for instance Figure 13, and I come to an unbalanced budget of  $-0.26 \cdot 10^9$  molN (I have not tried for the other figures). Am I wrong or is there a deficit of nitrogen over the year in this area as in TAVE, LATEX? I saw several explanations 1) PON does not include the transport of phyto and zooplankton, 2) averaging process see my comment above, 3) ignorance

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of the transport by diffusion, 4) a trend in nitrogen in this area. Over the shelf we come with a positive value of 0.91.

Tables 1 and 2: this not clear what is the additional information provided by Table1 compared to table 2.

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