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Interactive comment on “Simulating the effects of phosphorus limitation in the Mississippi and Atchafalaya River plumes” by A. Laurent et al.

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In order to justify the choice of the boxes for averaging model results, I recommend that the authors provide some figures showing the spatial variability of model results (for instance chl_a) that will help to justify the selection of regions. These maps can be compared with satellite images allowing to assess (using some error statistics) the ability of the model to represent the spatial variability of chl_a (this is important since the model is 3D and in the manuscript no spatial maps are shown). Moreover, some more justifications need to be given for keeping only the observations of Sylvan et al. compared to other studies that used them successfully.

The manuscript presents an extended version of the model published in Fennel et al 2011. Therefore, we can expect that the authors show that adding a phosphorus

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limitation improves the performances of the model. A suggestion would be to compare the simulated chl_a and nutrients obtained with and without the phosphorus limitation with available data (e.g. spatial maps of chl_a computed with and without PO₄ limitation, nutrients). This will help convincing the readers that phosphorus limitation is necessary in order to adequately represent the dynamics of the system. This is important, since the authors mention in the abstract and discussion that due to phosphorus limitation the distribution of benthic fluxes changes and hence the distribution of hypoxia. Therefore, we need to be convinced that the modifications of benthic fluxes obtained by adding PO₄ limitation is more realistic (this is indeed not accepted that because the model is more complex it will be more reliable). We can note that benthic outfluxes simulated without a phosphorus limitation are still in the range of observed values. Moreover, do you think that the variations on the export flux obtained by adding a phosphorus limitation are significant in comparison notably to the error you have in the model? This is not obvious to compare fluxes at the base of the euphotic layer with benthic outfluxes, please comment on this.

Paragraph 4: Please specify how varies spatially the denitrification rate in the model and how it has been estimated. This is indeed an important parameter that can change the N:P ratio and hence the limiting element and the conclusions.

Minor comments Figure 2: please specify what are the data (nutrients loads or concentrations?) In the text, reference to Figure 2 comes after reference to Figure 3.

Please use DIP for dissolved inorganic phosphorus throughout the manuscript.

A table summarizing the values of the parameters would be helpful. Notably how is computed kPO₄?

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