

## ***Interactive comment on “Effects of changes in nutrient loading and composition on hypoxia dynamics and internal nutrient cycling of a stratified coastal lagoon” by Yafei Zhu et al.***

### **Anonymous Referee #1**

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The present study use a 3D hydrodynamic-biogeochemical model implemented and developed for the Gibbs lakes (previously published) to investigate different nutrient catchment scenarios and assess the relative contribution of nitrogen VS phosphorus and inorganic VS particulate catchment loads in controlling the onset and development of hypoxia in this region. The model complexity is adequate to address this issue (eg. include benthic component, resuspension and bioirrigation dynamics) and the choice of the scenario is sound.

The highlighted importance to consider the composition of catchment loads, in particular to characterize the bioavailability of particulate compounds, and the described mechanisms showing the intertwined influence of both P and N inputs on hypoxia

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makes this study an important contribution to the management of eutrophication in coastal areas. The abstract is succinct and reflects well the main findings of the study. The introduction is appropriated, but some conclusions of previous work should be more detailed. The methods (model description) requires a bit more details on key issues affecting the discussion (eg. benthic aspects), and on the scenario implementation (initial conditions, period considered for statistics). The readability of results section might be improved. Some section of the discussion should expand slightly on the different element addressed, ie some points are addressed very specifically without having been introduced before ( eg. P10 L 23-25).

I recommend the publication of this work after consideration of those comments and the remarks below, which I believe can be met with minor modifications.

#### MAJOR COMMENTS

\* Sect 2 Could you clarify if "balanced" Initial Conditions for the sediment (ie, as produced following the methodology described in p 4 L 19-24) were derived for each scenario, or if all scenario starts with the same IC. In the latter case (same sed ICs for all scenario), there would be a transient period during which sediments supports the nutrient delivery, and I wonder about any temporal trends in the indicated results (ie, would the same response to catchment scenario be obtained if rates were computed over different period of the simulations). Could the author comment on this aspect and provide a justification for the period selected as a basis for scenario comparison (ie; the numbers provided in Figs 4-12) In the former case (different ICs, specifically balanced for the different catchment scenarios), I don't understand the content of P7 L 6-8.

\* Sect 2.2 It would be good to have a few lines on the functioning of benthic-pelagic coupling in the model.

\* P5L9 I don't understand the justification given for the estimation of the labile fraction of particulate organic input. What relates the 60% evaluated between the C/N ratios for labile OM and catchment OM, and the 60% deduced for the ratio between labile

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and refractory component. Wouldn't there be a need to assign some C/N value to the refractory component to close this computation?

\* P5 Last paragraph: Please provide in the text the period over which statistics presented in Figs 4-12.

\* P9 L27 : It is very difficult to understand the development given here without a few lines in the model description of how the sediment module works. I think it would be much easier to describe this mass balance with a few equations. A few points : \* Zhu et al 2016 mention burial: How is burial considered in the present mass balance ? \* The fact that TCO<sub>2</sub> fluxes in the zero catchment scenario quantify the contribution from the refractory sediment stocks only is again related to the IC question above, please clarify. \* L31: Why a different period is considered here (July2011 -> Jan2012). This also relates to the first question. Also on Fig. 5 the tot PP for the no-catchment scenario seems to be around 15% of the base case, and not 0.38% ? Could you explain?

MINOR COMMENTS \* P2 L5 : How does hypoxia or anoxia enhance the recycling of N ?

\* P2 L25 : " have been studied .. " -> could you briefly present the main conclusions of those previous study on the contribution of allochthonous/autochthonous organic matter to coastal hypoxia ?

\* P2 L10 space after "."

\* P2L02 lowercase "N"itrogen

\* P4L27 provide the reference for validation again.

\* P4L31 knowns->known

\* P5 l20 space before "."

\* Sect 3.2 : Please provide an explicit definition of "hypoxic area". For instance P6L15 "area covered", means area where hypoxia prevails for more than 24h? ( deduced from

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axis label of Fig 5)

\* P6 L18 : Why is DON mentioned here. Sect. 2.2 precise DON and DOC are not represented in the model?

\* P7 L9-10 : "The ratio ..41)" : I don't understand this sentence. What do you mean. This ratio was 33% instead of 8.5 % at Lake King. What is the  $R^2$  referring to ? Please rephrase

\* P7 L21-22 . In the case were all scenario starts from the same ICs (see main question 1), could it also be due to an ongoing mineralization of refractory sediment stocks ?

P8 L5: Those "mechanisms" were not mentioned in the results, nor are they clearly described in the following. Clarify or remove this sentence.

P8L6 " the model simulated the transport " -> "we used the model to simulate the transport .. "

P8 "land use" -> could you expand a bit the discussion here ?

P8 L15 : were all biogeochemical processes disabled to estimate transport or only plankton uptake ?

P8 L16: Please precise how is the 70% computed and to what the  $R^2$  refer.

P8 L15-17 : Please rephrase. The reader can understand the message with the next sentence but it is not clear in the present form

P8L18 : please provide explicitly the definition for TN export rate.

P9 L 16 and following: Might be rephrased for clarity. For instance using the autochthonous/allochthonous nomenclature.

P 10 L8 .. contribute "by" less than 7% "to" the ..

P10 L9 bottom water "Oxygen" depletion

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P10 L23-25, please clarify or better integrate in the current discussion.

Fig 5 -> reallocate the definition given in the axis label ( min 24h ..) to the caption or the text (or both)

Fig 6 is maybe not essential, and could be described in words.

Fig8 caption mentions again " and occurrence of hypoxia .. of". Is that a Typo ?

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