Biogeosciences Discuss.,
https://doi.org/10.5194/bg-2017-132-AC1, 2017

Biogeosciences Discussions

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.

Yafei Zhu et al.

yafei.zhu@monash.edu

Received and published: 28 June 2017

We would like to thank reviewer 1 for his/her thorough reading of our manuscript and for the thoughtful comments and constructive feedback which we believe has helped us to improve the quality of this manuscript. We have carefully reviewed the comments and have prepared the following plan to address them in the revised version:

1) 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.

We will add a couple of sentences to make it clear that all the scenario had the same initial condition which was derived for the base case. The scenario with no catchment nutrient loading showed that the sediment N (both organic and inorganic) depleted within a few month from the start of the simulation. This short transition period did not significantly affect the overall results. However, P may have a much longer residence time in the system. There are a few reasons for why we have chosen the selected period for scenario comparison: 1) a good set of monitoring data was collected during that period; 2) the span of the simulation covered both dry and wet periods; 3) and, we have a good knowledge of the sediment geochemistry over the same period.

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

We will add a few sentences to address this.

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

The model had organic matter in the labile and refractory portions. Because there was no C data from the catchment load, we estimate a C:N weight ratio of 10 for catchment C loads based on the recorded N loads. The C:N ratio can be a good indicator of the lability of organic matter. If we assume Redfield (C:N=5.7) material is

labile then 5.7/10∼=0.6 can be a good estimation of the labile portion for the catchment organic matter. The estimate was very close to the ones published for some other major rivers around the world (P5L21). The model does not close the computation based on C/N ratio but there was conversion from labile to refectory which is associated with mineralisation.

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

To be added.

5) 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 decribe 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 TCO2 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?

There is an equation (P9L33) that explains how the mass balance was worked out but we will add more descriptions to make it easier to understand. For the mass balance calculated here was not affected by burial. As organic matters will only be removed from the model by burial when the total depth exceeds a depth threshold (0.2m in this case) Since each scenario had the same initial condition, the TCO2 Fluxes in the zero catchment scenario can be a good estimate for what was contributed by refectory sediment C. We will make it clear that the mass balance was carried out for July 2011 to Jan 2012. The purpose of the mass balance was to compare the importance of catchment carbon and primary production to the development of hypoxia. The reason we chose this period was because during this period 1) large quantity of catchment

organic carbon was introduced by a flood 2) and hypoxia was developed in this period. Figure 5 present the results over the entire 2-year simulation. The percentage (either 0.38% or 15%) presented here were all relative. For example, let's assume the PP is 15 ton/month over 12 month, and the total catchment carbon was 100 ton/year but 80 ton was introduced within one wet month. Then the ratio of PP: Catchment C would be 12/100 for the 12-month period but 1/80 for the wet month.

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

We suppose hypoxia/anoxia would reduce the production of NO3 through nitrification and thus affect the denitrification process.

7) P2 L25 : " have been studied .. " -> could you briefly present the main conclusions of those previous study on the contribution of allocthonous/autochtonous organic matter to coastal hypoxia ?

To be updated.

8) P2 L10 space after "."

To be updated.

9) P2L02 lowercase "N"itrogen

To be updated.

10) P4L27 provide the reference for validation again.

To be updated.

11) P4L31 knowns->known

To be updated.

12) P5 l20 space before "."

To be updated.

13) 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 axis label of Fig 5)

To be updated.

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

It should be PON. To be updated.

15) 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 R2 referring to ? Please rephrase

To be updated. This is the trend line when plot TPP vs TCO2.

16) 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 ?

Strictly speaking, yes, the ongoing mineralization of refractory sediment stocks contribute majority of the SOD for the zero catchment scenario. This SOD was small but relatively constant over time. However, it was really stratification that prevented oxygen replenishment and induced hypoxia.

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

To be updated.

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

To be updated.

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

To be updated.

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

All biogeochemical processes including plankton uptake was disabled.

21) P8 L16: Please precise how is the 70% computed and to what the R2 refer.

This was calculated by plot TN remaining vs TN input, 70% is the trend line with a slope of 0.7.

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

To be updated.

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

To be updated.

24) P9 L 16 and following: Might be rephrased for clarity. For instance using the autochtonous/allochtonous nomenclature.

To be updated.

25) P 10 L8 .. contribute "by" less than 7% "to" the .. P10 L9 bottom water "Oxygen" depletion

To be updated.

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

To be updated.

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

To be updated.

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

Figure 6 will be deleted

29) Fig8 caption mentions again " and occurence of hypoxia .. of". Is that a Typo ?

To be updated.

Interactive comment on Biogeosciences Discuss., https://doi.org/10.5194/bg-2017-132, 2017.