

Interactive comment on “Role of sediment denitrification in water column oxygen dynamics: comparison of the North American east and west coasts” by L. Bianucci et al.

Anonymous Referee #2

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This paper deals with sediment processes affecting oxygen dynamics via the nitrogen cycle. The authors show that, where external inputs of nitrogen are large, there is little impact of denitrification, whereas if primary production relies heavily on recycled N sources, there is a huge impact. This is a well written paper on an important subject. I share with reviewer nr 1 a number of remarks, and have also some to add.

Major comments

1. Overall, I agree with reviewer 1 that the model is not well enough explained. I can live with a brief description of the pelagic model (“as they reproduce the biogeochemical characteristics from of its region”, p6, line 24), but how denitrification is described

C258

should be clear before the model results are discussed. Now I had to glue bits and pieces of descriptions that can be found in the “conclusions” (section 4). My impression is that there is no real sediment model but rather a reflective boundary (“instantaneous” remineralisation, line 26, p 6). Reviewer 1 has the impression it is a “vertically integrated model”, which is not quite the same, so what is it?. Even more important: how is the denitrification imposed upon this remineralisation?

2. For me how the oxygen budget is affected by the denitrification is difficult to grasp without seeing the concomitant nitrogen budget. Now this is described in very vague terms, e.g the ‘importance of external sources’ on the VIS. To fully appreciate the effects of the sediments on water-column processes more background information is needed for the two areas, also on nutrient levels – see next point.

3. The fact that there is no “direct” denitrification in the model is the weak point in the modeling exercise. I assume (but I do not have this information) that nitrate concentrations are much higher in the VIS than in the MAB, so I would expect significant “direct” denitrification here, in a way that the sediments are a sink of nitrogen rather than a source. Now, sediments can only be a source of nitrogen, as there is only coupled nitrification-denitrification. “direct consumption” of bottom water nitrate of course would have much larger effect on the nitrogen content of the water column in VIS, maybe to the extent that it *does* affect primary production (the more because sediment mineralization seems to be very important in this region – see fig. 4). This would in turn have a larger effect on the oxygen budget. The authors need to be more convincing than simply saying “given the external sources of new nutrients on the VIS, . . . not likely to affect significantly”.

4. The supposed scheme how denitrification can affect the oxygen budget seems to be unnecessarily complex (page 4). The importance of the three “processes” are not subsequently discussed as process 1, 2 and 3, so there is no need for this separation. If this paragraph is retained in this form in the paper, then I would advise to make a scheme of this. Also what is the use of contrasting between coupled nitrification-

C259

denitrification and “direct” denitrification if the model only considers the first (I think).

5. The manuscript is structured in a strange way. From line 26p5 -line10p 6, is the “conclusion” of the paper, yet it is in the introduction section. The conclusion section contains the description of the model and the discussion.

6. From this paper, I get the impression that there is no other modeling study that deals with the effect of sediment processes on the oxygen budget / hypoxia? In fact, there do exist modeling studies that have a better representation of the benthic nitrogen cycle and that also look at the effects of this on water column hypoxia.

Details Page 2 - line 8. We use “a “ coupled .. model – misleading as they are two different physical model setups and two different pelagic models

page 2 - Line 15. “denitrification efficiently decreases the pool of N , since recycled nitrogen supports most of the primary production”. What does this mean. Only after reading the entire manuscript can this be understood.

Page 2 - Line 24”this process” -> denitrification

Page 7. Nitrate is written HNO₃ for the denitrification, NO₃⁻ for the nitrification. Same for ammonium/ammonia. Be consistent.

P 7 - line 9The term “bottom oxygen” is very vague – is it the oxygen in the sediment / layer 1 m above the sediment - Is the term defined on line 19?.

Page 9 . I do not understand why the sediment mineralization is so much more important compared to pelagic mineralization in VIS. Based on the “presence of DOM in the VIS model (p6, line 20) I would have expected the reverse.

P 10 -Line 13. “Diminished “

Strange units for budget terms in figure 4. It says mmol O₂ /m², but it should include also time, as it is a budget Is this over the 75 days, one hour?

C260

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C261