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Biogeosciences Discussions

Interactive comment on "Importance of intertidal sediment processes and porewater exchange on thewater column biogeochemistry in a pristine mangrove creek (Ras Dege,Tanzania)" *by* S. Bouillon et al.

S. Bouillon et al.

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Response to Referee#3

We are grateful to the referee for his/her constructive comments, and briefly discuss the issues raised below, with the original comments preceeding each response.

REF: This manuscript describes the effects of tidal fluctuations on water column characteristics in a pristine mangrove creek. Through the sampling of TSM, POC, and DOC, Ch4, and partial pressure of CO2 variations which occurred during a diurnal tidal period were examined. In addition, stable isotope analysis was used to gained

insight into the fundamental differences of both POC and DOC material exchange. In this mangrove tidal creek, which lacks upstream freshwater inputs, the authors discuss the possible importance of pore water seepage back into the water column during low tide as a main biogeochemical exchange point with the water column. Introduction: The introduction does a good job of outlining the main scientific "issues" in mangrove ecosystems: decline in total area, lack of nutrient budget information, effects of material export to off-shore habitats, etc. There is also a thorough review on the role of nutrient exchanges in the water column and the possible role of pore water in that exchange.

REF: P 320 Ln. 14 Why not cite McClaine et al 2003, this was an article on biological hotspots?

REPLY: We have added this reference in this section.

REF: P 321 Ln. 1 The manuscript states that little is known about belowground productivity, which is valid; but in the following statement about aboveground litterfall dynamics why not cite Twilley and Rivera-Monroy's research on mangrove litterfall in the Southern Everglades? This is a similar "pristine" ecosystem that might offer an interesting comparison to the research site in Tanzania.

REPLY: We fully agree, but this section has been removed (see replies to other referee reports).

REF: The authors make note to a larger research effort to study nutrient dynamics in mangrove systems in east Africa P322 Ln. 25. It would be interesting to learn more about what make s this study site unique as compared to other research locations in Africa and beyond.

REPLY: Again, we agree but decided to skip the reference to the broader context of the research project, in order to shorten the introduction [see also replies to other referee reports]. To answer the question, though, the study site studied here is by no means unique in the east African region - but in the framework of ongoing work

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on anthropogenically disturbed mangroves, it is used as a 'reference' site due to its pristine location, which result in low nutrient and no significant wastewater inputs.

REF: The word "pristine" was used several times, including in the title & P322 Ln29, to describe the study site. I wonder how subjective of a term this is. One reader's (or writers) idea of pristine would probably vary greatly from another's, and in the methods section does little to clarify the term.

REPLY: We use the term pristine since these data are part of a larger study comparing pristine and anthropogenically impacted mangrove sites in east Africa - a comparison of nutrient levels, heavy metal concentrations and bacterial pathogens (data on which have been gathered but are not presented in this context) confirm that this site is pristine. We have added a short note on this in the site description, and refer to Kruitwagen et al. (2005) to point out that other sites near Dar es Salaam are impacted.

REF: Methods: After reading through the methods section I was confused about where the sample station was actually located along the tidal creek. While high resolution sampling was conducted (over two days) why not give more complete info on sample locale.

REPLY: This is in line with the suggestion by other referees to provide some more details on the site. The sampling station was indeed a single fixed station (shown in Figure 1), and the revised version provides some more details on the sampling area in the Methods section.

REF: P. 323 Ln. 6 The term "midway" was used to describe sample location between the upper reaches of the creek and the marine opening. This left me asking the question of what distance was the site from direct marine influence? Without a spatial scale (meters) on the insert map of Figure 1, this information was hard to gauge. How far inland was the site from the terrestrial end of the creek? What was the landscape gradient (topographic) along the creek? Were there any geomorphologic features that might have helped to increase the water residence along the sample area that may of

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lead to the increased salinity values?

REPLY: We have added a scale on Figure 1. A separate study suggests that the residence time in the system is in the order of 2-3 days during the dry season - this is now mentioned in the site description.

REF: P. 323 Ln. 9: Sampling was conducted towards the “end of the dry season” what is the precipitation pattern at this time? The specific timing of this sampling, since - it was only over the course of two days, in relation to freshwater precipitation inputs, may have significant implications on the short term salinity changes noted at the study site. Was there any precipitation during the experiment? A more informative study site description would help to answer these questions and give the reader a better grasp as to the uniqueness of the study site.

REPLY: There was no precipitation during the sampling period or the preceding days - this is now mentioned explicitly in the revised version.

REF: Results: P. 325 Ln.6: I am a bit confused with the terms “inner and outer” in relation to different parts of the tidal creek and how salinity varied between sites. I was under the assumption that there was only one sample location.

REPLY: The data presented here are indeed from a single sampling location (indicated on Figure 1). However, the salinity recorded during low tide reflects those of the upper/inner part of the creek, whereas the high tide salinity reflects that of the outer part of the creek, i.e. oceanic water coming in. We have also done some water column analyses at different sites within the system which confirmed this. We turned this section around, and now first mention the results from the tidal cycle.

REF: Discussion: Overall, I found the discussion broken up and difficult to follow. The individual points that were made were valid; however their organization could be refined.

REPLY: This was also suggested by the other referees, and we have re-structured the

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Discussion accordingly.

REF: P.326 Ln.23 “Assuming that pore water seepage is the main source of the elevated salinity.” This pore water salinity scenario makes sense, but the text does not do much too truly convince the reader that this is indeed what is occurring. In the introduction several citations were listed which state that there is pore water seepage into the water column-this might be a good time to revisit those findings for comparisons.

REPLY: We now refer to these references in this section.

REF: P.326 Ln.25 How was the calculation for the pore water contribution “pore water contribution was approximately 30%” determined? There is a great deal of data presented in Table 2, specifically, estimates of pore water contributions to the creek water column at low tide. Two things: why not discuss the importance of the other percentages 19% and 87% listed? Secondly, the terms high and low used to describe pore water salinity are confusing when those terms are also used to differentiate tidal stages (high and low tide).

REPLY: We have added that the contribution was calculated based on the porewater and high tide salinity levels as end-members. The upper and lower limits are merely given to indicate the range of possible estimates - we do not feel these need to be discussed in more detail. We agree that the use of high and low may be somewhat confusing - there is not much alternative, though, and we have changed this to ‘high values’ and ‘low values’- the Table uses the term “flood” and “ebb” to refer to the tidal stage, so we assume this should suffice.

REF: It would be nice to spend more time in the discussion comparing these data to other study sites. How would these results vary in an impacted mangrove system or in a system with decreased freshwater inputs due to anthropogenic influences?

REPLY: This would be a nice addition, but we feel that this would add sustantially to the overall length. We have a similar datset from a nearby anthropogenically impacted

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site, but will discuss this separately - the combined amount of data would have made it too lengthy to discuss in a single well-focussed paper.

REF: P. 328 Ln.6 there is mention of isotopic mixing; it would be interesting to actually see a simple mixing model presented that would specifically state what percentages the marine and mangrove pools are contributing during both low and high tide. This would help to bolster the tidal influence story and clearly state the different component pools of organic carbon.

REPLY: The Y-axis on Figure 6 can be interpreted as a relative measure of the contribution of the marine and mangrove end-members.

REF: In the discussion it would be interesting if these findings were put into the context of the literature, not only for mangrove ecosystems, but coastal wetland ecosystems in general. This would also help the section read more like a discussion of the findings and not a regurgitation of the results.

REPLY: Although we agree with this, we feel that the Discussion is already sufficiently long and complex (all referees suggested to shorten it), so we would prefer to stick to the currrent focus, rather than adding more.

REF: Mention of crab burrows appears at the end of the discussion as a possible source of increased solute exchange. It would have been nice to read more about this earlier in the discussion.

REPLY: We have moved this part to the first section of the the Discussion.

REF: Section sub-headings would go a long way to help organizing the discussion and to clarifying the manuscript. For example 13C data is spread over several paragraphs of the discussion, if possible, group these findings together for a more cohesive presentation.

REPLY: We have included sub-headings in restructuring the Discussion.

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