

Interactive comment on “Distribution and origin of suspended sediments and organic carbon pools in the Tana River Basin, Kenya” by F. Tamooch et al.

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Reply to Anonymous Referee #1 Thank you very much for your insightful comments and suggestions. Upon request, am willing to upload the corrected version of the manuscript. Below please find replies corresponding with each comment, question or suggestion raised.

Interactive comment on “Distribution and origin of suspended sediments and organic carbon pools in the Tana River Basin, Kenya” by F. Tamooch et al.

Anonymous Referee #1

Received and published: 14 May 2012

C2011

REF: The manuscript provides and discusses a very interesting set of data from the Tana River, a relatively large river in Kenya, during different seasons. Patterns in suspended matter, carbon pools and their origin were studied along the full river continuum from headwater streams to lowland sites, ranging over an altitude of ~4000 m. The manuscript also addresses the impact of damming on the carbon and suspended matter transport, which is very interesting though not fully discussed. Generally, the article is surely of interest for the readers of Biogeosciences. However, I have quite a lot of (mainly little) concerns, which should be correctable and should be taken care of in a revised version of the manuscript. In many cases, it is referred to certain areas of the catchment, though it is not always clear, where the data was actually derived from. A better map indicating the different regions and also the reservoir names would be desirable. REF: It is in parts quite complicated to follow the presentation of the results. It should be avoided to refer as excessively to the supplement data, but to the manuscript figures instead. Data, which is solely presented in the supplement so far (e.g. soil depth profile data), and which is of importance for the discussion should be presented as manuscript tables. Figure numbers should appear chronologically in the text, though so far they are mentioned in a strange order: e.g. Fig. 2 is not mentioned before the discussion; Fig. 4b after Fig 5; Fig. 7 before Fig. 6.; Fig. 9 before Fig. 8. Some figures are not referred to at all, e.g. Fig. 6b, 7b. It would also be helpful to refer to those figures again in the discussion more often when mentioning results. There are also some redundancies in the results section. Efforts should be made to present the data in a more concise way. To give a general example: Page 2533, Line 16-18: “Concentrations of POC during the wet season (0.23 to 119.8 mg L⁻¹) were much higher than during the dry season (0.3 to 5.8 mg L⁻¹) and end of wet-season (0.4 to 12.6 mg L⁻¹.)” instead of: “Concentrations of POC ranged from 0.3 to 5.8 mg L⁻¹, 0.23 to 119.8 mg L⁻¹ and 0.4 to 12.6 mg L⁻¹ during dry season, wet season and end of wet-season, respectively (Supplement Table 1).” Moreover, some results, e.g. those on the pigment analysis, are not mentioned at all. Reply: The results section has been revised taking carefully removing all redundancies. Regarding your concerns on tables we feel the

C2012

data in the tables are quite large to fit within the scope of the manuscript and hence we propose to retain them as supplementary tables. The chronological order of the figures has been carefully revised to correspond with the flow of the text in the manuscript. .

REF: In the discussion chapter, there are some redundancies. The authors should try to condense certain paragraphs. E.g. The discussion about phytoplankton contribution in the OC pool is once on page 2542 and then again on page 2544. Similarly, the discussion about C3- and C4-plant contribution as indicated by $\delta^{13}\text{C}$ values is once on page 2541 and then again on page 2546/2547. It would be good, if those sections could be thematically combined. It should also generally be attempted to shorten the discussion. The discussion chapter may also benefit from some conclusive sentences at the end of the different chapters. More emphasis should be given on the impact of damming on the carbon and TSM distribution and potential consequences.

Besides that, there are a lot of technical errors, which are pointed out below in my further comments and recommendations by line number. Overall, I think that moderate to major revision is needed before possible acceptance of the manuscript.

Ref: Page 2524, Line 22: Rephrase, e.g. " $\delta^{13}\text{C}$ values in sediments from the main reservoir (-19.5 to -15.7 ‰ were higher than"

Reply: This has been corrected

Ref: Page 2524, Line 26: "signature" Reply: This has been corrected

Ref: Page 2524, Line 27: Remove "both" Reply: This has been corrected

Ref: Page 2524, Line 28: Insert "This was likely. . . ." after the ; Reply: This has been corrected

Ref: Page 2525, Line 1: Remove "both" Reply: This has been corrected

Ref: Page 2525, Line 6: Add a conclusive sentence Reply: The abstract has been re-structured.

Ref: Page 2525, Line 22: Define abbreviation of organic C = (OC) or total organic C

C2013

(TOC) Reply: This has been corrected

Ref: Page 2525, Line 23: Why "i.e. C yields"? Reply: this has been deleted

Ref: Page 2526, Line 5: "suggest" Reply: This has been corrected

Ref: Page 2526, Line 8: Use primary or photosynthetic production instead of autochthonous, as this term is later defined in line 21 Reply: This has been corrected

Ref:Page 2526, Line 15: This sentence sounds quite random here Reply: This sentence has been deleted.

Ref:Page 2526, Line 28: Exchange ";" with "," Reply: This has been corrected

Ref:Page 2526, Line 29: "Besides the river continuum concept (Vannote et al., 1980),. . . ."

Reply: This has been corrected

Ref:Page 2527, Line 10: ". . .were limited to interactions with primary producers and invertebrates,."

Reply: This has been corrected

Ref:Page 2527, Line 22: Remove "while stable isotopes. . ." as it is redundant Reply: This has been corrected

Ref:Page 2527, Line 26: Remove "Organic C" as it is redundant Reply: This has been corrected

Ref:Page 2528, Line 13: Add commas Reply: This has been corrected

Ref:Page 2528, Line 15: ". . .hence qualifying as."

Reply: This has been corrected

Ref:Page 2528, Line 25: Use OC Reply: This has been corrected

Ref:Page 2529, Line 2-4: Remove Reply: This has been removed

Ref:Page 2529, Line 7: The river length of 1300 km appears to me quite a bit too long regarding the scale in Fig. 1 and internet sources. Please confirm numbers or state a reference. Reply: The total river length has been revised based on our own

C2014

digitalization of the actual river course, following the meandering to ~1100 km.

Ref:Page 2529, 2.1: More information should be given about the rain pattern (how much and where especially?). Reply: rainfall patterns are described in the revised manuscript

Ref: Also, please provide detailed information about river discharge here (instead of in the discussion chapter Page 2538, Line 3-6) and refer to Fig. 2. Reply: The description of discharge during our study has been incorporated in the results section since this is part of the results we obtained during our study.

Ref: More background information e.g. on land-use, vegetation, would also be desirable. Reply: A brief description of the vegetation cover in the basin has been incorporated in the manuscript as proposed.

Ref:Page 2529, Line 16: Remove “~” Reply: This has been corrected. Ref:Page 2530, 2.2: Please indicate how the samples were collected (e.g. from the shore or boat expedition?, with a bucket?...). Reply: This is now specified in the revised version: “Water samples were taken with a Niskin bottle at ~0.5 m below the water surface, or using a bucket when sampling from bridges along the main river”.

Ref: For POC and PN analysis, filters must have also been weighed. Were sediment samples also dried before grinding and weighing sub-samples? If so, please state that. Reply: Filters for POC and PN analysis were not weighed – data are based on EA-IRMS) analyses of the entire filters. Soil and sediment samples were dried first: this has been clarified in manuscript

Ref: What was the reproducibility of the POC and PN analysis? Reply: Relative standard deviations for calibration standards are typically <2% and always <5%. This is now clarified in the revised manuscript.

Ref:Page 2530, Line 1-3: Why referring now to four sampling campaigns instead of three as earlier? Indicate clearly that there were three detailed sampling campaigns

C2015

and one follow-up fieldtrip in 2011 in order to. . . . Reply:This is now clarified in the revised version.

Ref:Page 2531, Line 19: Use DOC as defined before Reply: This has been corrected

Ref:Page 2533, Line 1-2: Delete sentence as redundant. Reply: This sentence has been deleted. Ref:Page 2533, Line 7-15: Paragraph not clear. Fix grammar and make the reader known which rivers is referred to. Reply: This has been corrected Ref: Page 2534, Line 1-3: Are differences in POC/PN ratios between the sampling seasons really statistically significant? There is no p-value given and the standard deviations appear to me quite large. Reply: Yes, despite the large standard deviations, paired t-tests allowed us to verify that POC/PN ratios during the wet season are significantly lower than those observed during dry and end-of-wet season. P-value is now given in the revised version. Ref:Page 2534, Line 6: Refer to Fig. 4a Reply: We now refer to Fig. 4a

Ref:Page 2534, Line 10: Delete“for the three.” Reply: This has been deleted.

Ref:Page 2534, Line 16-20: Rephrase and make more concise Reply: This section has been rephrased

Ref:Page 2534, Line 26: Refer to Fig. 5b Reply: We now refer to Fig. 5b

Ref:Page 2535, Line 13: Use OC Reply: This has been corrected.

Ref:Page 2535, Line 17: Refer to Fig. 3: Reply: we now refer to the relevant Figure.

Ref:Page 2536, Line 12-14: increase/decrease is not well seen in Fig 8a Reply: The decrease is clearly statistically valid – although the Figure might indeed require a close look to find this pattern back – perhaps because of the relatively high values found for suspended sediments and reservoir sediments which blur the trend. We do not immediately see how we can improve this Figure, so have left it unaltered.

C2016

Ref:Page 2537, 3.5: Description of age calculation may be more appropriate in the Methods section Reply: We have moved this to the Methods section, as suggested.

Ref:Page 2538, Line 3-6: Move to Results chapter Reply: Line 3-6 have been moved to the Results section, as suggested.

Ref:Page 2539, Line 4-10: This discussion is not clear to me: Why does it imply that the river bed must act as a sink of TSM at other times? Can the TSM not just be derived from the collapse of incised and unstable river banks as stated later? Reply: Yes – our main point here was to indicate that resuspension of sediments stored within the riverbed, as suggested earlier based only on dry-season data, likely does not suffice. We have tried to clarify this point in the revised version.

Ref:Page 2539, Line 20-24: Since values differ between bank sediments and SPM of the lower Tana, it should be made clear that bank sediments are an end-member that mixes with TSM from upstream. Adding TSM values of the upper Tana to Fig. 11 may improve the understanding of end-member mixing (see below). Reply: Data from riverine sediments have been added (as suggested by Referee#2), but we do not feel that data on suspended matter from the headwaters are very relevant to include, since most of this material is trapped within the cascade of reservoirs (see discussion).

Ref:Page 2541, Line 9: Delete (MAP) as not stated later any more Reply: corrected.

Ref:Page 2541, Line 21-24: It is not clear, whether this statement applies to the upstream or downstream sites, or to both Reply:: this applies to the upstream sites, which is now mentioned explicitly in the revised version.

Ref:Page 2543, Line 1: Insert. “the” deepest sediment core. Reply: this was corrected

Ref:Page 2544, Line 28: “due to” Reply: This has been corrected

Ref:Page 2545, Line 17-25: Change order. First describe the situation in the study area and then set it in context with global values. Reply: the order of statement has

C2017

been corrected

Ref:Page 2545, Line 29: “A. amethystinus” Reply: This has been corrected

Ref:Page 2546, Line 1-2: What do the authors exactly mean by this statement? Reply: We mean there is limited release (desorption) of DOC from the mineral matrix and vice-versa, i.e. little sorption of DOC onto the mineral phase (conversion into POC). This is now clarified in the revised version.

Ref:Page 2546, Line 7: Use OC Reply: This has been corrected

Ref:Page 2546, Line 13: “TOC:PN” generally: use PN or TN consistently the same as the way of indicating ratios (e.g. DOC:POC or DOC/POC) for all parameters “Reply” corrected, all parameters checked for consistency

Ref:Page 2546, Line 10-12: This may also explain the increase in DOC concentrations in lower altitudes. “Reply” sentence inserted

Ref:Page 2547, Line 8: “two” Reply: this has been corrected

Ref:Generally: All units need to be checked and made sure that they are used consistently (e.g. always mg l⁻¹ and not sometimes mg L⁻¹ or mg l⁻¹), and that there is a blank between numbers and units. Reply: All units have now been counter-checked

Ref: Fig. 1 An overview map would be desirable including information about latitude and longitude. At least refer to latitude and longitude in the text. Please indicate the position of the dams and reservoirs and especially those that were sampled in the map. If possible, a profile (distance from river mouth vs. elevation of the sampling station) would be a good addition. Reply: Latitude and longitude have been added to Figure 1 in the revised version. A longitudinal profile figure has also been included clearly indicating the headwaters, Masinga Reservoir and Tana River mainstem.

Ref:Fig. 3 The additional separate sector of 3a is not really needed in my opinion. Consider adding a figure of the POC (mg l⁻¹). Reply: We prefer to keep the insert of

C2018

Figure 3a, as the data can otherwise be misleadingly interpreted as showing a consistent increase in TSM during all seasons. The insert shows that the pattern during the wet season is much more erratic and does not show a smooth, gradual downstream increase. We understand the question regarding adding a Figure with POC data, but since the pattern is essentially similar to the one for TSM (as mentioned in the text) and the already high number of figures, we prefer to leave this out unless the handling editor suggests otherwise.

Ref: Fig. 10. Data could be combined into one graph. Reply: This Figure has been replaced with an alternative Figure.

Ref:Fig. 11. Consider adding TSM data from the upper Tana River to this graph in a different color in order to emphasize the mixing behavior. Reply: see reply to earlier comment: Data from riverine sediments have been added (as suggested by Referee#2), but we do not feel that data on suspended matter from the headwaters are very relevant to include, since most of this material is trapped within the cascade of reservoirs (see discussion).

Interactive comment on Biogeosciences Discuss., 9, 2523, 2012.