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Interactive comment on "Seasonal dynamics of carbon and nutrients from two contrasting tropical floodplain systems in the Zambezi River Basin" *by* A. Zuijdgeest et al.

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Dear dr. Bouwman,

Thank you for your efforts in reviewing our manuscript. Your comments from a modeler's perspective are much appreciated. Below you will find our responses to the issues you raised (paragraphs starting with »), and the way we have incorporated your suggestions into the manuscript (in parentheses). The updated manuscript (track-changes Word document) and the updated supplementary material have been combined into one file, and added to this comment as a supplement.

Seasonal dynamics of carbon and nutrients from two contrasting tropical floodplain

systems in the Zambezi river basin Authors: Zuijdgeest et al. This is an interesting study which compares the role of floodplains on biogeochemistry in two segments of the Zambezi river. The paper is well-structured, and presents results that could add much to our understanding of how floodplains and their soils and vegetation function in river biogeochemistry, how dams and reservoirs can impact this functioning. The way the authors have summarized their main results in Figure 7 is excellent. However, there are a few problems for me as a modeler to fully understand the discussion.

The first problem is in the sampling procedure. It is not clear to me how exactly was sampled: only one sample per season, or is the result presented an average of more that one sample? Also, years for different years are presented in one single Figure, e.g. Figure 3 18O data. Perhaps the authors could add a remark to justify this. If discharge is variable, the river loads will also vary, and perhaps the authors could add information on the variability of the discharge in Figure 2.

» Along the floodplains, samples have been collected during various field campaigns on various locations along the floodplain (see Fig. 1 for details). If a system was visited more than once during a specific season (most noticeably the Kafue Flats during the wet seasons 2009 and 2010, with a preliminary study in 2008), the analyses for samples from the same location were averaged. This was justified by the similarity between results from the different years, as presented by Zurbrügg et al. (2012) and Zurbrügg et al. (2013). While this procedure has introduced additional variability in the absolute magnitude of the numbers presented, the trends were retained. In the manuscript a sentence has been added to section 3.1 ("The similarity of the results from different years (Zurbrügg et al., 2013;Zurbrügg et al., 2012) allowed combination and averaging of the data sets in order to obtain generalized patterns for the two systems and seasons.") and the standard deviations for the discharge measurements have been included in Fig. 3. Additionally, it is possible to consider the variability in discharge for the data series presented in Fig. 2. While this might include a time component in its variability (global climate change, El Niño events, the updated figure includes the

BGD
12, C6084–C6089, 2015

standard deviation over the 18-year period.

And what is the range shown in Figure 3? Is this the standard deviation calculated from all observations along the floodplain? Please provide this information.

» We think you are referring to Fig. 4 rather than 3, as there is no standard deviation presented in Fig. 3. The range shown in Fig. 4 is indeed calculated from all observations along the floodplain during a specific season, and the boxes represent the first and third quartiles, and the median (which has been added to the figure caption). The information has been provided in the text as "For comprehensive comparison of the concentrations of carbon, nitrogen, and phosphorus species along the two floodplains during contrasting seasons, all measurements along the floodplain have been considered, irrespective of spatial trends (Fig. 4). The occurrence of large spatial variations along the floodplain, or between the months sampled (see Supplementary Information) between the different years, resulted in larger ranges."

The second problem is in the terms used. In some cases it is wet/dry season (e.g. Table 1) and in other cases it is peak and base flow (title of Table 1). I suggest to use terms consistently (dry/wet season) as for example base flow may be confusing to people with a hydrology or other background.

» This suggestion has been implemented, though the expression "peak flow" remains in use when considering the timing of processes, or when referring to results from literature.

The third problem is that it is not explained how river loads were calculated. Is this simple discharge times concentration? Is this justified, i.e. is the sample from the middle of the well-mixed channel representative of all water in the river? Also here perhaps a brief justification could be added, or at least a remark that this is a cause of uncertainty.

» Loads were indeed calculated as discharge x concentration. We have found that

BGD
12, C6084–C6089, 2015

there was little variation with depth and between the middle of the channel and close to the edge of the main channel. The latter we have measured during the 2013 campaign in the Barotse Plains, the former has been determined early in the project, during the initial Kafue Flats campaign in 2008. This information has been included in the Supplementary Material. In the manuscript, the paragraph introducing loads now starts with the following sentence "Loads were calculated from the discharge and concentration data for the respective species, as the water column was well mixed (see Supplementary Information for details)."

Finally, it is not clear what the term net export represents, and how this compares with the load. This is confusing because both terms are used within the same paragraph in section 5.2. The authors need to explain how net export (Table 1) was calculated. Can net export be deduced from Figure 5 from the difference between distance 0 and the endpoint?

» The following explanation has been added in section 4.2: "Net export was determined as the difference between the load at the downstream end of the floodplain and the load at the upstream end of the floodplain (Table 1)." Parts of section 5.2 have been moved to section 4.2 to present these results in the results section rather than in the discussion, as suggested by the second reviewer.

Minor issues

Please check the references. I saw one missing reference (Melack et al., 2009).

» This has been added.

The paper by Mayorga et al. (2005) is on the Amazon, so how can it have data for the Zambezi river.

» This should have been Mayorga et al. (2010) and has now been corrected.

Instead of Yasin et al. (2010) please use the original publication where the observed river yield was taken from (probably Hall et al. 1977).

BGD
12, C6084–C6089, 2015

» This has been changed.

I see some unclarities in section 4.3: line 12 “became enriched” and line 13 “lower”. Compared to what, or is it enriched with increasing distance, or in time?

» This sentence compared the wet season values to the previously mentioned dry season values, and has been changed to “The organic matter in the Barotse Plains became more enriched in 13C during the wet season compared to the dry season, while in the Kafue Flats lower δ13C values were observed during the wet season than during the dry season (both significant, $p < 0.05$)”.

» Furthermore we would like to inform the reviewer about some more substantial revisions of the manuscript that have been made based on the comments of reviewer 2. The key issues addressed were:

» Updating the color coding for the figures, and replacing the exact numbers on export and removal rates in Fig. 7 with proportional arrows for particulate and dissolved organic matter;

» Moving and extending the description of Table 1 from section 5.2 to section 4.2;

» The discussion on hydrology (section 5.1) has been extended with a short section on the amount of water moved from the rivers to the floodplains;

» Section 5.2 has seen major revisions, to focus more on processes responsible for the export and retention observed;

» Section 5.3 has been re-arranged into two sections, separating dissolved and particulate organic matter into sections 5.3.1 and 5.3.2, respectively. Both the C:N ratios and the stable carbon isotopic signatures are combined to present a more integrated view of sources of particulate organic matter. Unlike in the initial manuscript, we now no longer distinguish between C3 and C4 vegetation, but rather between permanent and seasonal floodplain vegetation;

BGD
12, C6084–C6089, 2015

» Both the conclusion and the abstract have been shortened and more generalized.

References:

Mayorga, E., Seitzinger, S. P., Harrison, J. A., Dumont, E., Beusen, A. H. W., Bouwman, A. F., Fekete, B. M., Kroeze, C., and Van Drecht, G.: Global Nutrient Export from WaterSheds 2 (NEWS 2): Model development and implementation, Environmental Modelling & Software, 25, 837-853, 10.1016/j.envsoft.2010.01.007, 2010.

Zurbrügg, R., Wamulume, J., Kamanga, R., Wehrli, B., and Senn, D. B.: River-floodplain exchange and its effects on the fluvial oxygen regime in a large tropical river system (Kafue Flats, Zambia), Journal of Geophysical Research, 117, G03008, 10.1029/2011jg001853, 2012.

Zurbrügg, R., Suter, S., Lehmann, M. F., Wehrli, B., and Senn, D. B.: Organic carbon and nitrogen export from a tropical dam-impacted floodplain system, Biogeosciences, 10, 23-38, 10.5194/bg-10-23-2013, 2013.

Please also note the supplement to this comment:
http://www.biogeosciences-discuss.net/12/C6084/2015/bgd-12-C6084-2015-supplement.pdf

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Interactive comment on Biogeosciences Discuss., 12, 10545, 2015.