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Interactive Comment

Interactive comment on "Spatial and seasonal contrasts of sedimentary organic matter in floodplain lakes of the central Amazon basin" *by* R. L. Sobrinho et al.

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Dear Referee #1

I would like to thank you for the constructive comments. I believe that, after the proposed corrections, the quality of our manuscript will be improved.

General Comments:

The principal objective of the present work is to quantify the fractions of the principal sources of SOM in floodplain lakes of the central Amazon basin. It is expected that the sedimentation of OM in this ecosystem is linked to the periodic floods (eg.: Junk, 2010).

In order to observe any possible changes in the spatiality and seasonality related to such link, we collected 57 surface sediment samples during four periods of the flood cycle (hydrological seasons) in the five major floodplain lakes (Figure 1). This sampling set provided approximately 10 samples per lake and 15 samples per season, collected in distinct sites of each lake. The number of samples are enough to make statistic comparisons (ANOVA) with the data found in the literature and to observe significant ($p<0.05$) changes in the spatiality (upstream-downstream) and seasonality. Differences among sites inside the lakes are definitely a relevant factor. To understand these differences, more studies in each lake must be performed. For that, a higher number of samples, including samples from flooded forest soils and non-floodable soils, is necessary. However, this is not the purpose of this work. Here, we intend to understand, based on quantitative background, the role of the periodic floods on the SOM.

The mathematical approach applied to quantify the sources of SOM was the end-member composition. Due to the complexity of the ecosystem and the behavior of each molecule in the environment, only the C:V ratio could be applied to an specific source (macrophytes). However, as observed in Figure 5, the riverine SPOM is a potential source of crenarchaeol to the SOM, since the soil has significant lower amount of this compound and the in situ production contributes to less than 15% in most sediment samples (IPL fraction). The data of crenarchaeol in the water column of the floodplain lakes are not available in the literature. Consequently, it is not possible to discriminate the riverine SPOM and the lacustrine SPOM based on this approach. It is unexpected that the primary production performed by the phytoplankton in the floodplain lakes is an expressive source of SOM, if compared to the others sources investigated in this work (eg.: Moreira-Turcq et al., 2013). On the other hand, the question about the OM transported from the river into the lakes is more relevant. Based on that, we applied the crenarchaeol to quantify the fraction of aquatic OM or, in other words, as an indicator of the SOM derived from the aquatic environment (river and lakes) but with more enphasis in the riverine SPOM.

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The rise and recede of waters in the floodplain lakes follow the river main channel, since they are connected. Thus, we understand that the data from Obidos are enough to illustrate the flood cycle and the periods when the sediments were sampled. A mathematical model would be very important to provide more accurate estimations about the sources of SOM. However, more data about the exchange of water and SPOM between the rivers, streams and lakes are necessary.

Specific Comments:

P4, L7: Correction: “Further, inputs of CO2 from plant respiration and reactive OM produced in floodplain lakes are significant sources of CO2 outgassed in the Central Amazon River.”

P5, L15: Correction: ”Lignin is a recalcitrant organic macromolecule composed of phenolic molecules and produced by vascular plants. The products of CuO degradation of lignin (Hedges and Ertel, 1982) have been widely applied as biomarkers to trace plant material to aquatic systems (Hedges et al., 1986; Bernardes et al., 2004; Aufdenkampe et al., 2007; Kuzyk et al., 2008). It can be an important component of fossil OC in floodplain lakes (Zocatelli et al., 2013) but also a relevant source for the outgassing of CO2 in the Amazon River due to environmental conditions (Schmidt et al., 2011; Ward et al., 2013).”

P17, L20-24: Correction: ”Consequently, the remaining 40–60 % of the SOM might be derived from other sources of OM such as the wetlands and terra firme soil (Eq. 3). The periodical floods link the floodplain lakes and the wetland vegetation and soil. Thus, the seasonal and spatial contrasts in the SOM are investigated in order to better understand the connectivity between these compartments."

P6, L4: The samples where collected during the four main periods of the flood cycle and in the same locations (Fig. 1). Thus, temporal changes observed in the biomarkers, which are characteristic of most samples, are interpreted as a consequence of seasonality.

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P7, L21: The study does not intend to describe the biogeochemistry of each lake but estimate the fraction of the main sources of SOM and to understand the link between the SOM and the periodical floods in the central Amazon basin.

P8, L19: Correction: "In order to assess contribution of inorganic nitrogen (NH_4^+ + NO_2^- + NO_3^-) to TN, TN (wt. %) and TOC (wt. %) were correlated ($R^2 = 0.89$; $p < 0.001$; $n = 57$). The interception of the trend line in the TN axis (0.06) was interpreted as the percentage of inorganic nitrogen. Thus, this correlation showed that. . ...."

C:N=TOC:TON

P9, L13: It was added after the CuO oxidation. (Hedges and Ertel, 1982; Goni and Hedges, 1992)

P12, L6: No. The correlation was used only to estimete the percentage of inorganic nitrogen.

P15, L17: This subject is discussed in the text based on the (Ad:Al)v results (P15, L21). The effects of degradation can alter the composition of lignin phenols of each source and also in the sediment samples, where the (Ad:Al)v values are high. However, we could not find an appropriate approach to quantify this process. Based on that, we considered an error of 10% in our estimations of each fraction.

P16, L20: The crenarchaeol (iGDGT) is not indicative of soil. Correction (P5, L25): "A comparison between lignin phenols and brGDGTs as markers for terrestrial OC has been performed before in marine and lacustrine systems. . . "

P17, L24: Based on the results calculated by equations 1 to 3, it is possible to estimate the fraction of the aquatic OM, macrophytes and consequently, wetlands and terra firme soil.

P17, L20: The equation 3 calculates the fractions of wetland and terra firme soils.

P18, L8: The samples were collected in months intervals. So, if any temporal change is observed, it means that these changes occur in months and not years.

P20, L15: The crenarchaeol can be found in every environment. However, based on the literature and in our results, this compound is mainly produced in the riverine SPOM. Thus, we conclude that this should be the main source of this compound to the SOM.

P20, L16: This conclusion is based on the end member approach and the hydrology of the ecosystem. The end member approach estimates that the riverine and lacustrine SPOM contributes to 20-30% of the SOM. In the RW season, the flux of SPM increases from the river to the lakes, which can be interpreted as an important source of SOM in this period (eg.: Bourgoin et. al., 2007; Bonnet at al., 2008). An increase in the lignin results is also observed in this season. However, this is the rain season, which induces the soil runoff, litter fall and transport via streams. Apart of it, another increase in the FW season is observed in the lignin phenols and brGDGTs, when the flux goes in the opposite direction. Thus, these observations lead to the conclusion that these seasonal changes observed in the SOM, are mainly related to the connectivity between the lakes and the wetlands and not between the lakes and the river channel.

Correction (P17, L20): "Previous works postulated that Andean and low land soil material is mainly transferred to the lakes via river main stream, in particular, during the RW and HW seasons and that would be the main source of SOM of the floodplain lakes (e.g., Victoria et al., 1992; Bourgoin et. al., 2007; Moreira-Turcq et al., 2004; Bonnet at al., 2008; Mortillaro et al., 2011)"

P20, L25: We consider that the sediment samples collected in each hydrological season represent the characteristics of the SOM in the respective season.

P21, L2: Based on the results of equations 1, 2 and 3.

P21, L6: Both wetlands and terra firme soils can be relevant sources of SOM. It is natural to think that the wetlands are the most important among them, since it is nearer to the lakes and direct linked to them due to the periodic floods. However, the end member estimations are not conclusive about the fraction of each of these two sources to the SOM.

P21, L15: The samples were collected according to the hydrology and represent each of the four main hydrological seasons of the flood cycle.

Technical Corrections:

We agree with most of the technical corrections proposed by Referee #1 and they will be corrected accordingly. However, these observations should be considered:

P7, L18: This is a reference code for the CARBAMA project.

P10, L25: Agilent 1100 series LC/MSD SL, Alltech Prevail Cyano column (150$\times$2.1 mm; 3μm)

p12, L20: "Significant" means $p < 0.05$ as decribed in session 3.6

References:

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