

Biogeosciences Discuss., author comment AC4
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Reply on RC3

Rey Harvey Suello et al.

Author comment on "Mangrove sediment organic carbon storage and sources in relation to forest age and position along a deltaic salinity gradient" by Rey Harvey Suello et al.,
Biogeosciences Discuss., <https://doi.org/10.5194/bg-2021-159-AC4>, 2021

We appreciate your positive and constructive review. Indeed, the data we have generated allowed us to come up with new insights for the studied mangrove ecosystem. Concerning the provision of sediment age, we have performed several radiometric analyses but could not extract usable information as our study sites are heavily bioturbated by mangrove red crabs which effectively reworks the vertical sediment profile. The distinction between old and young mangrove sites, as mentioned in the manuscript, was done through remote-sensing analysis. We will provide more data on this in our supplementary information.

We provided the itemized responses below for your specific comments.

- The objectives of the study are clear and followed standard protocols to achieve the objectives. The categorization of sites based on historical LANDSAT satellite images is also acceptable. However, the sites classified as young witnessed colonization in the last three decades (after 1993). So, the younger sites are not actually young and are established forests now; they are just relatively younger than other sites. I request the authors to address this point in detail for clarity.

RESPONSE: Thank you for this remark. We agree that technically, our 'young' sites could not be biologically categorized as young. We will explicitly clarify this in the manuscript when explaining the use of the terms 'young' and 'old' sites for the first time, but we will still use the terms 'young' and 'old' to refer to the age gradient as the sites referred to as 'young' are still significantly younger than the sites referred to as 'old'.

- The authors discussed the factors responsible for variation in SOC stock and sources between young and old sites and among the position. However, from the data, it is apparent that there are significant differences in SOC stock and content between marine and estuarine mangroves. So, I request the authors to address the point in the discussion. Further, I suggest the authors discuss the contrasting behavior of upstream old and young sites concerning sites of intermediate and downstream location.

RESPONSE: Thank you for the suggestion. We will put more emphasis in the discussion addressing these differences between estuarine and marine mangroves in addition to what we already mentioned in lines 403-407. With regards to the notable difference in the results obtained in the Upstream (young and old) sites versus the Intermediate and Downstream locations, we believe that this is mainly due to the difference in the plant

species present in the sites. As written in the manuscript (Lines 166-169), there is a strong dominance of *Rhizophora somoensis* in the old sites and *Avicennia germinans* in the young sites of the intermediate and downstream sites (with higher salinity), whereas both the young and old sites of the upstream zone (with lower salinity) show a high diversity of mangroves (*Rhizophora* and *Avicennia*) and an understory of freshwater plant species. We will also address this contrasting behavior between sites in the discussion section.

- If I am not wrong, from the figure it is apparent the younger sites are on eastern banks and old sites are on western banks, but the GPS points given in Table S1 provide the opposite information. Is it possible that the GPS points are misplaced in Table S1, check!

RESPONSE: Thank you for the keen eye! Indeed, we have checked and for some reason, the coordinates in Table S1 are incorrectly ordered. We will certainly adapt this change in the revised manuscript.

- In the discussion, authors state that the in younger marsh sedimentation is higher than the older marsh and extended the analogy to the studied mangrove system. As the younger mangrove grew on the tidal mudflat (I believe), Am I right in assuming that the sedimentation rate would have been similar with or without mangrove. What role the mangrove played in increasing the sedimentation rate?

RESPONSE: Thank you for this question. We believe that sedimentation rates wouldn't have been similar with or without mangroves. The presence of mangroves, in general (young or old), increases sedimentation rates as compared to bare mudflats by effectively reducing hydrodynamics from waves and currents with their complex vegetation structures (particularly their root systems) and thereby promoting the settling of suspended sediments from the water column during tidal inundations of the mangrove forest. Yet we expect there are differences between sedimentation rates of young and old mangroves, and we expect these are mainly due to their positions relative to the tidal frame. Older mangroves have already accumulated more sediments than younger mangroves and therefore we expect the older mangroves have obtained already a higher surface elevation within the intertidal zone as compared to the younger mangroves. Consequently, we expect that the younger mangroves, with lower elevation, are experiencing nowadays more tidal inundation, and therefore higher suspended sediment inputs and higher sediment accretion rates, as compared to the older mangroves. This hypothesis is discussed in the manuscript and is proposed as a potential explanation for the lower SOC concentrations and stocks in younger mangroves as compared to older ones, as a consequence of dilution of the SOC by higher rates of mineral sediment accretion on the younger sites (lines 349-381).

- By comparing the sediment cores from younger and older mangrove systems, are not you comparing two different time periods? For example, sediment at 50 cm depth at younger mangrove may represent much younger time period than at older mangrove. While making an interpretation, particularly related to relative contribution of allochthonous and autochthonous carbon contribution at a particular time period, how do you reconcile this fact. I think authors should think this through.

RESPONSE: Thank you for this comment. We have indeed thought this through. We acknowledge the possible differences in sediment age and sediment accretion rates in the

young and old sites. As we discussed in the manuscript (lines 349-369), we expect that sediment accretion rates on the young sites have been larger than on the old sites. This means that it may be expected that the sampled sediment columns are indeed deposited over shorter, more recent time periods in the young sites as compared to the old sites. We proposed this as one hypothesis for the differences in OC% and $\delta^{13}\text{C}$ between young and old sites. We also made a point in the discussion that we lack actual data on sediment accretion rates and therefore SOC accretion rates (lines 484-487).

- The authors state that the sediment $\delta^{13}\text{C}$ values of the sediment cores are 6-10‰ higher relative to the average vegetation of the sites. If I am seeing it correctly the total variation in $\delta^{13}\text{C}$ across all reservoirs are in the range of - 32 to -24 per mil. Where is the difference of 10 per mil?

RESPONSE: Thank you for this observation. You are correct. The 10 per mil difference considers the raw dataset and not the average $\delta^{13}\text{C}$ of the vegetation samples. We will certainly clarify this in the revision.

- Also, authors state that $\delta^{13}\text{C}$ values of the older sites (at the Intermediate, Downstream and Marine sites) are more negative than the younger sites. I am not sure if this is unequivocal. Pl. check.

RESPONSE: We refer to Table S2 in our supplementary information for the specific average $\delta^{13}\text{C}$ values. Based on the data in this table, it can be seen that the statement in question is indeed correct.