Biogeosciences

Discussions

Open Access

EGU

Interactive comment on "Historic carbon burial spike in an Amazon floodplain lake linked to riparian deforestation near Santarem, Brazil" *by* Luciana M. Sanders et al.

Anonymous Referee #2

Received and published: 8 August 2017

This study investigates changes in organic carbon burial in an Amazonian floodplain lake in response to deforestation and urban development. The authors conclude that OC burial was strongly affected by initial deforestation and development close to the river and lake margins, but not very strongly during later deforestation which took place further away from surface waters.

OC burial in lakes in an important but understudied carbon flux, and as such, studies like this are needed, particularly if coming from an understudied area of the world. Also, methodologically this study seems sound, and the conclusions seem plausible and supported.

I have, however, one major concern regarding the dating methods and the subsequent calculation of OC burial rates. The authors use two methods, measurement of plutonium (Pu) from atmospheric fallout after nuclear bomb testing, and measurement of 210Pb which is a naturally occurring atmospheric radioisotope. The Pu method returns a sediment depth corresponding to pre-bomb testing (∼1950), and therefore an average sediment accumulation rate since this time. The Pb method, on the other hand, can resolve changes in sediment accumulation rate over time, if combined with an appropriate model (e.g. the CRS model). Since OC burial is calculated as sediment accumulation rate * OC content * dry bulk density, the authors should use the Pb data. Instead, they calculate an average long-term mean sediment accumulation from the Pu and Pb data, and use this fixed, constant value for calculation of OC burial over time. It is not correct to present data on the temporal change of OC burial rates (Figs 6 and 7) that are based on keeping the most important term (sediment accumulation rate) constant.

I would like to encourage the authors to recalculate the OC burial values based on the Pb chronologies, and also to present these Pb chronologies in a graph. Alternatively, they should provide arguments as to why their approach is warranted.

In the following, I provide some more detailed comments.

87-101 This is the site description, and it should be moved to methods. Instead, elaborate here more about the ways you think deforestration and exploitation can affect OC burial in lakes, and mention and cite previous findings on this topic explicitly. Also, it would be good to see a clearly formulated, testable hypothesis spelled out in the Introduction.

L115. How was the acidification done? There are papers showing that different acidification methods affect the stable isotopic signature differently.

L 120. What was the motivation to use both Pu and Pb dating methods? Why not Pb alone? It seems that the Pu method is not suitable for resolving changes in sediment

accumulation rate over time, which is the purpose of this study. Is the sole purpose of the Pu method to derive an independent estimate of long-term average accumulation?

L194. Fig 43 must be a typo.

L204-206. Unclear what this means, and what the equation describes.

L217. Were the OC burial rates reported in the paragraph calculated using the CIC or CRS model on 210Pb data?

L221-225. This sentence is difficult to understand and long. Rephrase, please.

L228. I do not understand this reasoning. You have calculated 210Pb chronologies, and the activity profile (Fig.4) does show indications of changes in sediment accumulation rate over time. So why do you use an average long-term accumulation rate, based on the Pb method and the Pu method (which does not give any resolution in time of accumulation rate)? Why don't you trust the Pb chronologies? Using an average long-term accumulation rate is contrary to the purpose of your study. Here's also a conceptual flaw: if you present changes over time in OC burial rate (Figs 6 and 7), which do not account for changes over time in sediment accumulation rate, then these graphs only reflect changes in OC content and dry bulk density.

L264-267. It is difficult to see this linkage between the buffer zones, time periods and OC burial rates. Can you think of a way to illustrate these links in a graph?

L276-278. This is an important conclusion.

L283-284. But only concerning long-term average sediment accumulation rates, while the purpose of this study was to investigate temporal changes of sediment accumulation rate, which can only be accomplished with the Pb data. This distinction should be made throughout the ms, and the Pb chronologies using both the CIC and CRS models should be shown.

Figs 6 and 7. The axis label should be "OC burial rate", not just "OC".

C3