Biogeosciences Discuss., 11, C4942–C4948, 2014
www.biogeosciences-discuss.net/11/C4942/2014/

Biogeosciences
Discussions
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Interactive comment on "River inflow and retention time affecting spatial heterogeneity of chlorophyll and water–air CO_2 fluxes in a tropical hydropower reservoir" *by* F. S. Pacheco et al.

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Received and published: 5 September 2014

We thank the Referee 2 for the helpful review. Our detailed responses to each of the comments follow below.

Regarding the General Comments:

We agree with the Referee 2 that the sediment carbon fluxes are important for the carbon cycling and must be addressed. As suggested, we extended the discussion and added more information about sediment in the manuscript. We analyzed the data from Ometto et al. (2013) to show that sediment can be important to carbon emission

especially as source of methane.

We also believe that the physical effects of the underflow on the sediment may influence the carbon deposition and the carbon fluxes. We are conducting studies to answer a similar question made by Referee 2. This important question must be answered specially in river valley reservoir where the river inflows represent one of the major forcing. At this point, we added a discussion about this topic in the manuscript as suggested by Referee 2 and we proposed to focus on answer this question on future works.

We remade all statistical analysis and all comparison and differentiation made in the manuscript is statistically significant. We added more information about the statistical analysis in the manuscript. We think that the median values should not be used since median do not represents the net carbon fluxes over the considered time or space.

Regarding the specific comments:

All grammar issues were carefully fixed. Below, we pointed out answer (quoted as "AR") for all referred items.

8533: 11 – s on factors 14 – s on conclusion 21 – potentially 'a' more important source. . .

AR: Done.

8534: 24 – differences 'in'. . . 29 – large nutrient loads. . .

AR: The corrections have been made.

8535: 11- high density of spatial data 11 – our hypothesis is. . . 14 – the second hypothesis in not really a hypothesis, but more of a comment related to the investigation outlined in the first hypothesis. 20 – you can simply say elevation of 440m as this is a standard against mean sea level. 21 – what is the coppan system? Do you need to even reference wet-warm and dry cold?

AR: We changed the text as suggested and removed the reference. We also rewrote the first hypostasis and removed the second.

8536: 3 – I do not know what demographic density means.

AR: We changed 'demographic density' to the correct term 'population density'.

4 – restricted by rainfall?

AR: Changed to 'The river inflow is not related to the rainfall in the watershed...'.

Generally – do you need the description of how the PHYTO-ED works? This seems extraneous to the manuscript.

AR: We removed part of the description of how the PHYTO-ED works as suggested.

8537: 16-20, This section seems to have result more than methods presented. The RMSE of the spatial fit seems to be more appropriate for the results. 26 – state water temperature.

AR: We moved part or this section to the results as suggested.

8539: eq 2 appears to be incorrect. Please check the algebraic rearrangement from k600 – k. This should require all calculation for the (k) and hence the fluxes calculations be double checked.

AR: The error in Equation 2 is a typo; we used the correct equation to calculate the fluxes.

8541: 20 – you mention MODIS data but you need to be more specific. Was this 1km MODIS Aqua, Terra, what is the product and reference the dataset.

AR: We added additional detail about the data. The WST of Paraíba do Sul river inflow was retrieved using the M*D11A1 L3 product (Wan, 2008). The M*D11A1 is a standard products, generated using a split-window algorithm and seven spectral MODIS bands located in the regions of the shortwave infrared and thermal infrared. This algorithm is based on the differential absorption of adjacent bands in the infrared region (Wan and Dozier, 1996). The M*D11A1 products have been validated at Stage 2 by a series of field campaigns conducted between 2000-2007, and over more locations and time periods through radiance-based validation studies. Accuracy is better than 1 K (0.5 K in most cases), as expected pre-launch. This product is generated up to four times each day (i.e., 10:30 h, 13:30 h, 23:30 h and 2:30 h) and is delivered in a georeferenced grid with 1 km of spatial resolution in a sinusoidal projection.

The cloud cover fraction over Funil reservoir was retrieved using MODIS Level 2 Cloud Mask product (named M*D35L2) (Ackerman et al., 1998).The algorithm used to generate this product employ a series of visible and infrared threshold and consistency tests to specify confidence that an unobstructed view of the Earth's surface is observed. This product is generated up to four times each day (i.e., 10:30 h, 13:30 h, 23:30 h and 2:30 h) and is delivered in a georeferenced grid with 1 km of spatial resolution in a sinusoidal projection.

The MODIS products were acquired online (http://reverb.echo.nasa.gov/reverb/) and preprocessed using the MODIS Reprojection Tool (available at https://lpdaac.usgs.gov). The data were first resampled to a 150 m spatial resolution (compatible with the bathymetric grid). They were then re-projected

to the Universal Transverse Mercator (UTM) coordinate system (zone 22 South) with the World Geodetic System (WGS-84) datum as reference; they were then converted to a raster image. Finally, a MATLAB® program was then used to retrieve the WST at the rivers inflows and to compute the cloud cover fraction over the reservoir.

8542: In general, if Chlorophyll is used to determine the transition zone locations, then presumably this zone changes in size throughout the year, as do all of the other zones. How do the authors handle this in the analysis specifically? Perhaps just additional detail on this in the methods since it is included in the discussion.

AR: We added additional information in the methods section as suggested. We also added the area of each zone in the results. We determined the size of each zone (riverine, transition, lacustrine) of the reservoir in the dry and rainy seasons using the results from the spatial interpolation of the Chl data. After the interpolation, we used a pixel classification method to determine the boundaries of each zone (class). We checked the boundaries location with the observed data. Finally, we determine the area multiplying the number of pixels of each class by the area of each pixel. The boundary of each zone is represented in the Figure 2 by the dashed lines.

8545: 24-25 high pCO2 from riverine sources may not only come from reduced phytoplankton due to turbidity. High CO2 is prevalent in almost all river water, and may come from many difference sources, including terrestrial respiration. This should be made more clear.

AR: We rewrote this sentence. 'The high pCO_2 observed in the riverine may be explained by the terrestrial ecosystem respiration entering the river as dissolved soil CO_2, the oxidation of allochthonous and emergent autochthonous organic carbon, the acidification of buffered waters, the precipitation of carbonate min-

erals, and the direct pumping of root respiration CO_2 from riparian vegetation (Butman Raymond, 2011).'

8546: 17-19 this discussion would benefit from more detail that might have been presented within the Ometto et al 2013 reference. It appears that additional carbon data is available and would be useful to the reader within this manuscript. Specifically, if there are complementary data on the outflow CO2 and CH4 concentrations.

AR: We added more details about the sediment and we extended this section in the manuscript as suggested. We used data from Ometto et al. 2013 to show that sediment can be important to carbon emission especially as source of methane.

20-22 - especially because there is no data – the authors should use terms like 'could' instead of seems to.

AR: We changed as suggested.

References

Ackerman, S. A., Strabala, K. I., Menzel, W. P., Frey, R. A., Moeller, C. C. and Gumley, L. E.: Discriminating clear-sky from clouds with MODIS, J. Geophys. Res., 103D24, 32141-4 32173, 1998.

Butman, D., and Raymond, P. A.: Significant efflux of carbon dioxide from streams and rivers in the United States, Nat Geosci, 4, 839-842, 10.1038/ngeo1294, 2011.

Ometto, J. P., Cimbleris, A. C. P., dos Santos, M. A., Rosa, L. P., Abe, D., Tundisi, J. G., Stech, J. L., Barros, N., and Roland, F.: Carbon emission as a function of energy generation in hydroelectric reservoirs in Brazilian dry tropical biome, Energ Policy, 58, 109-116, doi: 10.1016/j.enpol.2013.02.041, 2013.

Wan, Z. and Dozier, J.: A generalized split-window algorithm for retrieving land-surface temperature from space, IEEE Trans. Geosci. Remote Sens., 34, 892−905. 1996.

Wan, Z.: New refinements and validation of the MODIS land-surface temperature/emissivity products, Remote Sens. Environ., 12, 59-74, 2008.

Interactive comment on Biogeosciences Discuss., 11, 8531, 2014.