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Biogeosciences Discussions

Interactive comment on "Rainfall leads to increased pCO_2 in Brazilian Coastal Lakes" *by* H. Marotta et al.

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Final Author Comments of the manuscript "Rainfall leads to increased pCO2 in Brazilian coastal lakes" authored by Marotta H., Duarte, C. M., Pinho, L. and Enrich-Prast A.

Dear editor,

We greatly appreciate the valuable comments and suggestions received from J. Downing and the anonymous reviewer #2. Our reactions to their recommendations and the actions that will be taken to address them if we are invited to resubmit a revised version are described in detail below.

Actions taken in response to the comments by the Referee John Downing

Referee J. Downing "My main concern is that I would like the authors to evaluate the likelihood that correlations such as those seen in Fig. 3 are the result of an overall temporal coincident trend"

Comment: We agree that the relationships could, without further information, reflect other changes associated with climate rather than an effect of rainfall. However, water temperature did not vary in parallel with rainfall, and the relationships shown in Fig. 3 are independent of changes in temperature, which are relatively small along the year. Increased depth is associated with high rainfall, but we cannot formulate a mechanism by which increased depth could lead by itself to high pCO2. We cannot think of any other parallel driver, possibly covarying with rainfall that could account for the relationships observed.

Action: In line with this, the revised text will read: "In contrast, another important driver of lake pCO2, water temperature, remained relatively uniform and was not significantly related to the large differences of CO2 saturation observed in the lakes studied (t-test, $p > 0.05$ comparing both sampling events for each lake)". "Rainy seasons have been related with major increases in depth (Suzuki et al., 1998) and acidity (Chagas and Suzuki, 2005) in coastal lakes of Rio de Janeiro State, which provide evidence for high inputs of land-derived materials to lakes in the study area following intense rainfall".

Referee J. Downing: "It would be useful if the authors could provide more direct measurements of pCO2 in the groundwater that show them to be high and a likely source of supply. It would also be interesting, from the perspective of anthropogenic influences on the global C cycle, to hear what the ultimate source of the CO2 (and DOC) in the groundwater might be"

Comment: We agree that data on pCO2 from groundwaters in the area would strengthen the manuscript. We also agree that discussion of the source of CO2 and DOC in the lakes is also relevant.

Action: We plan to strengthen the manuscript by including data on CO2 in groundwa-

ters in the studied area. We will also revise the text to indicate that: “The Restinga vegetation in the lake watershed provides abundant organic carbon to the soils, which can be entrained to groundwater along with the CO2 derived from respiration of the organic carbon during periods of intense rainfall to eventually reach the lake (Marotta et al., accepted). Stable carbon isotopic signature has revealed that DOC in the studied lake waters largely represent allochthonous carbon from terrestrial sources transported to the lake by groundwater (Marotta et al., accepted)”.

Referee J. Downing “Although understandable throughout, the language could benefit from some editorial attention as it is awkward in places.”

Comment: We agree.

Action: We will revise closely the text to improve clarity.

Actions taken in response to the comments by the Referee #2

Referee #2: “The main weakness of this good study is the lack of evidence of clear evidences for the proposed carbon routes. As mentioned by J Downing, the temperature dependence of the pCO2 has to be evaluated”.

Comment: We agree that the possible role of temperature need be evaluated and the proposed route of carbon inputs better substantiated.

Action: We will include more data on pCO2 in groundwaters and will test for the possible role of temperature changes in accounting for the variability observed in pCO2. We plan to include the text as follows: “In contrast, another important driver of lake pCO2, water temperature, remained relatively uniform and was not significantly related to the large differences of CO2 saturation observed in the lakes studied (t-test, $P > 0.05$ comparing both sampling events for each lake)”.”... “Rainy seasons have been related with major increases in depth (Suzuki et al., 1998) and acidity (Chagas and Suzuki, 2005) in coastal lakes of Rio de Janeiro State, which provide evidence for high inputs of land-derived materials to lakes in the study area following intense rainfall”..

and “The Restinga vegetation in the lake watershed provides abundant organic carbon to the soils, which can be entrained to groundwater along with the CO2 derived from respiration of the organic carbon during periods of intense rainfall to eventually reach the lake (Marotta et al., accepted). Stable carbon isotopic signature has revealed that DOC in the studied lake waters largely represent allochthonous carbon from terrestrial sources transported to the lake by groundwater (Marotta et al., accepted)”.

Referee #2: “(...) the statement that most of the additional CO2 found in lakes after strong rainfall events comes from groundwater is probably too strong. Is this hypothesis valuable for all the studied lakes?”

Comment: We agree.

Action: We now provide additional evidence on the pCO2 of groundwater and have also softened the statement to consider other possible sources. The revised text will read “In addition to groundwater inputs, the high pCO2 in lakes following periods of intense rainfall may be supported by enhanced respiration, fuelled by allochthonous inputs, of the lake communities”.

Referee #2: “In addition to the technical corrections mentioned by J Downing, details about replicates and analytic precision are required”.

Comment: We agree.

Action: The revised text will read: “pH was measured with a precision of 0.01 pH units using an Analion PM 608 pH meter and total alkalinity by Gran’s titration (APHA, 1992). Each lake was analyzed for pCO2 at least 4 times per sampling day”.

Interactive comment on Biogeosciences Discuss., 6, 11521, 2009.