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Interactive comment on "CO_2 partial pressure and CO_2 emissions from the lower Red River (Vietnam)" *by* Thi Phuong Quynh Le et al.

Thi Phuong Quynh Le et al.

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Dear anonymous reviewer,

Thank you very much for your kind suggestions and comments for ameliorating our manuscript.

We revised the ms in taking into account all comments and suggestions

Best regards,

On behalf of all co-authors

Thi Phuong Quynh LE

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Discussion paper

Anonymous Referee 2 Received and published: 9 February 2018 General comments: The authors reported new data on CO2 partial pressure and CO2 evasion from the lower Red River in Vietnam. This paper also provides useful water chemistry data of the river system. Considering that river systems in the Southeast Asia are underrepresented in the global budget of riverine carbon fluxes despite their large river discharge and carbon loads, this study could provide valuable datasets. However, the paper can be improved further by (1) strengthening the estimates of CO2 evasions, (2) providing detailed discussion on the observed patterns, and (3) reorganizing the paragraphs (e.g. some paragraphs in results fit to discussion, and vice versa). I would also suggest that the paper receive a thorough editing for grammar and clarity by the authors. Specific comments are below, which the authors can consider when revising the manuscript. Thank you very much for the comments. We revised the manuscript and checked the grammar as suggested.

Specific comments: Lines 43–47: These are confusing because the first one (2.7 Pg C yr-1) includes riverine carbon transport, mineralization, and deposition, while the second one ("a lower value" is for CO2 evasion only. I don't think the estimate of CO2 evasion (2.1 Pg C yr-1) from inland waters by Raymond et al. (2013) is a lower value than the previous estimate. Lauerwald et al. (2015) provided a lower estimate, though. The paragraph was revised "Natural hydrological processes and biogeochemistry of many rivers in the world have suffered from the influences of climate change and human activities in their drainage basins. Riverine carbon fluxes and outgassing are important parts of the carbon exchange among terrestrial, oceanic and atmospheric environment. Rivers and streams not only transfer various forms of carbon (dissolved and particulate) to oceans, but also evade a significant amount of carbon to the atmosphere (Battin et al., 2009; Richey et al., 2002). Due to CO2 evasion, the flux of carbon that leaves the terrestrial biosphere through global fluvial network was suggested to be twice larger than the amount that ultimately reaches the coastal ocean (Bauer et al., 2013; Regnier et al., 2013). Raymond et al. (2013) estimated a global evasion rate of 2.1 Pg C yr-1 from inland waters, and that global hot spots in stream and rivers which

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occupy only 20

Lines 125–126: Alkalinity measurement is critical for the calculation of pCO2 and CO2 evasion. Please provide more detailed information on how the alkalinity was measured and double checked. Was there a difference in alkalinity between filtered and unfiltered samples? It seems the turbidity can go up sometimes and I wonder how this could influence the alkalinity of filtered water. The method for alkalinity determination was added in the revised manuscript in page 4. " Total alkalinity of the hourly samples was immediately determined on non-filtered water samples (30 ml water sample) in situ by titration method with 0.01M HCl (APHA, 1995). For each sample, triplicates were titrated and the analytical error was below 3

We also tried to test the difference in alkalinity between filtered and unfiltered samples at the Hanoi site in March 2018 and found that the alkalinity values were not so different in dry season when suspended solids was not so high .

Lines 138–: Have you measured CO2 flux directly from the surface of the water and compared that with the calculated values? (e.g. Duc et al., 2013, Environmental Science Technology, 47, 968-975) Yes, we measured CO2 flux directly from the surface of the water using a floating chamber method. We obtained an average CO2 flux of 189 mmol.m-2.d-1 (with values ranging from 37.8 – 492.1 mmol.m-2.day-1). These values were lower than the values calculated from pCO2 measured using equilibrator method and the equation provided by Frankignoulle et al. (2001) and Raymond and Cole (2011). This result was surprising since it is considered that when the water flow is higher than 0.2 m s-1, the presence of the chamber induces artificial turbulence that results in elevated CO2 fluxes.

Lines 143–: I agree with the other reviewers that using wind speed as a component in the equation may not appropriate. Detailed explanation is needed on why the equation was chosen. As suggested by reviewers, we calculated k600 by other method proposed by Raymond et al (2012), basing on different variables such as river discharge,

water velocity, depth and slope. The values of k600 now are ameliorated and then CO2 flux evasion was recalculated. K600 was calculated as presented in the section “2.5 CO2 fluxes determination” , page 5-6: “In this study, k600 was calculated using the equation from Raymond et al. (2012) based on stream velocity (V, in m s -1), slope (S, unitless), depth (D, in meters) and discharge (Q, in m3 s-1), as follow: k600 = 4725 $\pm$ 445 x (V x S) 0.86 $\pm$ 0.016 x Q-0.14 $\pm$ 0.012 x D 0.66 $\pm$ 0.029 Eq. (2)

Lines 256–269: Detailed explanation is needed in “discussion” on why there is such a large difference in the measured and calculated pCO2. We apologize for the errors of pCO2 calculation. Values were corrected in the revised manuscript (see table 2). However, a difference between pCO2 calculated and measured was found. An explanation concerning this difference was added in the manuscript revised in page 7 -8. “3.3. Comparisons of the pCO2 results obtained by the two methods pCO2 along the lower Red River (Vietnam) in the dry and the wet seasons were determined by two methods: i) direct measurements using an equilibrator connected to an IRGA, ii) calculated from pH and alkalinity using the CO2-SYS® software. The direct pCO2 measurements gave slightly higher values than the calculated ones (Table 2), but the values of two methods were similar and presented the same trend of spatial and seasonal variations (R2 = 0.77, Fig. 2; Table 2). Lower values of the calculated pCO2 in this study may be caused by the analytical errors in pH or under-estimation of total alkalinity. Similarly, the CO2 outgassing rates which were calculated from measured pCO2 from equilibrator were higher than the ones derived from the calculated pCO2 from CO2-SYS, however they are in the same orders and have similar variation trends (Table 3, Fig 2)”

Lines 299–312: This paragraph would belong to discussion rather than results. Discussion: The results and discussion are mixed. We revised the paragraph

Lines 400: Are the differences statistically significant? Yes. The results from t-test showed that: - Seasonal (dry –wet) variation : difference appeared for all variables ($p< 0.05$) - Day-night variation: difference for pH ($p< 0.05$) but no clear difference for other variables

The results from t-test and ANOVA test showed that Spatial variation (5 sites) : temperature was not different within 5 sites. Other variables were significant different ($p < 0.05$). We added the difference statistics significant through the revised ms.

Lines 411–422: This sentence is too long. Extracting only essential information would be better than this long sentence. This sentence is now revised and moved to the section " 4.2 Spatial variations of pCO2 and fCO2 outgassing Âż in page 10 - 11

Tables: Is the "+/-" standard error or standard deviation? Please clarify it. It's standard deviation. We added the information in the table captions

Figures: Is the error bar standard error or standard deviation? Please clarify it. It is the standard deviation. We added the information in the figure captions

Figure captions needs to more detailed description of the figures including explanations on legends. Figure captions were revised as suggested, and thus more detailed.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-505/bg-2017-505-AC3-supplement.pdf

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Supplementary Material

CO_2 partial pressure and CO_2 emission along the lower Red River (Vietnam)

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Figure SM1: Daily variation of river discharge at the outlet of the Thao (Yen Bai), Da (Hoa Binh), Lo