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Discussions

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.

quynhltp@gmail.com

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Anonymous Referee 3 Received and published: 13 February 2018 General Comments: The manuscript entitled "CO2 partial pressure and CO2 emissions from the lower Red River (Vietnam)" by Le et al provides new and important data on CO2 in the Lower Red River. The results are a good contribution for the understanding of the role of Asian rivers for the global carbon evasion from freshwater ecosystems. However, there are many technical problems that need to be address to increase the quality of the paper. I agree with the other reviewers that the estimate of the CO2 evasion is the main problem in the paper and must be reworked. The figures and tables are clear and well designed. However, I suggested some changes in the number of figures and tables. In summary, the authors should review the flux calculation (see specific comments

below); consider k600 calculations based on turbulence generated by water flow and; reorganize Results and Discussion sections. Specific comments and suggestions are below. We thank you very much for the helpful comments and suggestions.

Specific comments: 66 – This sentence suggests that there is a "limited knowledge" about carbon flux. Does it mean that there are published information about carbon flux in the Red River, or not? Yes, there are some published information about carbon fluxes for a peri-urban area in the Red River Delta (Trinh et al., 2012) and (Nguyen et al., 2018). We revised the sentence and add the references: "However, there is a lack of data concerning CO2 outgassing and carbon budget of the lower Red River (Trinh et al., 2012, Nguyen et al., 2018)."

79 – In the figure 1, the Ba Lat station does not seem to be located about 50 km from the sea. Please clarify. We apologize for the error. The Ba Lat site is 13 km from the sea. The information was corrected in the text page 3.

Some references in the introduction are missing (e.g. lines 48, 56) References were added in the revised manuscript

86 – I suggest removing the sentence "see below for the detail river discharge in 2014" and insert the correct reference - figure, table etc. The sentence was removed, the word "table 1" was replaced

109 – The sentence "All solutions used for. . ." is unnecessary. This sentence was deleted

151 – What is the "regulator"? You mean pump or a flux regulator? Please, clarify. It was changed into "a flow regulator".

162 – By convention k600 is the gas transfer velocity normalized to a Schmidt number of 600. And k is the gas transfer velocity. "Sc" should not be the "Schmidt number, normalized to Schmidt number of 600". "Sc" should be the Schmidt number of a given gas (CO2 in this case) at a given temperature. Please, clarify the calculation and check

if the calculation is correct. We revised the paper by recalculating the k600 proposed by (Raymond et al., 2012). Thus, Sc was removed from the new calculation. 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)

166 – I wonder why the authors did not considered the temperature variation measured by HOBO sensor to calculate “a”? Were temperature records not made at the same time? In addition, conductivity is much higher in Ba Lat station suggesting differences in salinity among stations. If “a” is a constant (line 167), the salinity variation seems not to be considered in the calculation. We calculated the fCO2 at 5 sited of the Red River with different α values : α = 3.941 10-2 mol.L-1.atm-1 at 24 oC for dry season and α = 3.138 10-2 mol.L-1.atm-1 at 27 oC for rainy season. The average flux of CO2 outgassing was 525.7 mmol.m-2.d-1. Then, this value was very closed with the one calculated from the constant α = 3.4 10-2 mol.L-1.atm-1 we used for both rainy and dry seasons of the Red River in this study, which resulted in the fCO2 average of the whole Red River 530 mmol.m-2.d-1. An explanation was added in page 6 “ïĄą is the solubility coefficient of CO2 for given temperature and salinity (Weiss, 1974) (mol L-1 atm-1). In this case, ïĄą = 0.034 mol L-1 atm-1. In this study, salinity variations were low, except for the Ba Lat station. Temperature did not change a lot. We checked the influence of different ïĄą values in the dry (α = 3.941 10-2 mol L-1 atm-1 at 24 oC) and the wet season (α = 3.138 10-2 mol L-1 atm-1 at 27 oC) at the 5 sites and compared with the constant ïĄą value of 0.034 mol L-1 atm-1. “

170 – Please, check the units of each element of the equation. The flux was calculated in μmol m-2 s-1 but the k, a and pCO2 air is cm h-1, mol L-1 atm-1 and ppm, respectively. Please reorganize the section 2.4.1 for clarification. Thank you for the comments. The flux is now calculated from different variables taking into account dif-

ferent units. We added the explanation for converting the final unit of flux calculation in mmol m-2 d-1 in the section 2.4 CO2 fluxes determination in page 5

183 – If k600 values are closely related to flow velocity and channel gradient, why author used k600 values calculated from wind speed? The authors should present a convincing explanation or review the calculation and values. Thank you for the comment. We now calculate the k600 by the formula proposed by Raymond et al (2012) which is based on river flow velocity, river discharge, depth, slope in pages 5 and 6: “k600, was gas transfer velocity of CO2 or piston velocity (cm h-1). Some studies indicate that k600 values are closely related to flow velocity and channel gradient for rivers (Alin et al., 2011). 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)”

220 – The same results are presented in Table 2 and Figure 2. Please, remove the table or the figure. Figure 2 was removed as suggested.

223 – I suggest add Alkalinity values in the table or figure 2. Alkalinity values are presented in the table 2, in the column named “TAlk”.

257 – Change “monsoon” to “wet”. It was changed

263-269 – Abril et al., 2015 discuss overestimation of pCO2 using total alkalinity in acidic, organic-rich freshwaters. However, if this water condition is not the case of Red River, the find of Abril is not an explanation for the opposite (lower calculate values when compared with the measured values). These values should be similar or, please, provide a clear and convincing explanation. Thank you for the suggestion. We removed the sentence from the revised manuscript.

276 – Discussion inside the Results section. Results and Discussion are mixed in several parts of these sections. I suggest re-write and reorganize these sections. Thank

you for the suggestion. We re-writed and reorganized the Results and Discussion sections

Table 1 – Please double check the station location. I plot the station locations and there are some inconsistences (e.g. Ba Lat is located in the ocean and not in the Red River). There was a mistake for the location of the Ba Lat site. This was corrected in table 1 and in the text. Other sites were also checked.

Table 2 and Figure 2 – Why the values after +/- in table 2 and the error bar in Figure 2 are different? What does they mean? We checked the table 2. The figure 2 was removed in the revised manuscript.

Figure 6 – What the gray and dark circles mean. Dry and wet season? Insert these information in the figure caption.

The figure 4 demonstrates the Relationship between environmental variables and pCO2 at the five sites of the lower Red River in the wet (Sept) and the dry season (Nov) 2014. The figure and caption were revised.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-505/bg-2017-505-AC4-supplement.pdf

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Supplementary Material

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

Thi Phuong Quynh Le[1*], Cyril Marchand[2,3], Cuong Tu Ho[4], Nhu Da Le[1], Thi Thuy Duong[4], Trung Kien Nguyen[4], XiXi Lu[5], Phuong Kieu Doan[1], Thi Mai Huong Nguyen[1] and Duy An Vu[1]

[1]: Institute of Natural Product Chemistry, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Cau Giay, Hanoi, Vietnam.
[2]: IMPMC, Institut de Recherche pour le Développement (IRD), UPMC, CNRS, MNHN, Noumea, New Caledonia, France.
[3]: Faculty of Chemistry, University of Science – VNUHCM, 225 Nguyen Van Cu, Ho Chi Minh City, Vietnam
[4]: Institute of Environmental Technology, Vietnam Academy of Science and Technology, 18 Hoang Quoc Viet Road, Cau Giay, Hanoi, Vietnam.
[5]: Department of Geography, National University of Singapore, Arts Link 1, Singapore 117570, Singapore.

Correspondence to: Thi Phuong Quynh Le (quynhltp@yahoo.com or quynhltp@gmail.com)

Figure SM1: Daily variation of river discharge at the outlet of the Thao (Yen Bai), Da (Hoa Binh), Lo (Vu Quang) rivers and in the main branch of the Red River at Hanoi and Ba Lat stations in 2014.

Fig. 1.