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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.

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Dear Dr Crawford, 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 ——

J. Crawford jtcrawford@usgs.gov Received and published: 8 January 2018

-This paper documents the chemical conditions and concentrations of dissolved carbon dioxide in the Red River system of Vietnam. The data contribute to the "database" of concentration values for the globe, with one goal of further constraining the CO2 source strength of inland waters. Therefore, the data are valuable on their own, especially

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given that they fill in geographic gaps for SE Asia. The main criticism of this paper is the use of a wind-driven gas exchange model. While criticism of gas exchange models are prevalent within the community of researchers, this example is especially problematic as it relies on unlikely drivers of turbulence (and thus gas exchange) in riverine systems. There is some evidence that gas exchange is enhanced by some wind patterns in very large rivers, however, gas exchange in rivers is not considered to be a major driver. Rather, it is turbulence generated by water flow that drives gas exchange rates in these systems. Therefore, the CO2 emission estimates are not only biased, as recognized by the authors, but are likely to be highly inaccurate due to the model selected. It is hard to believe the results without some other line of confirmation. In addition to the criticism of the estimates of gas exchange, I did not find the discussion points to be well supported by the data especially given the limited time and geographic scope of the measurements. There is simply not enough evidence to support any of the inferred drivers of CO2 variability in this river system. Thank you for the comments. We revised the manuscript in taking into account all comments from reviewers.

Specific Comments: -48: what references support plate tectonics as major drivers of carbon fluxes in this system? We added the information in page 3 “The Delta is located in a very flat and low land, with an elevation ranging from 0.4 to 12 m above sea level (Nguyen Ngoc Sinh et al., 1995). Previous studies showed the difference of lithology in the three upstream tributaries: Paleozoic sedimentary rocks (55.5

-53: are changes in sediments the hypothesized drivers of changing carbon fluxes in this study? Yes. The information concerning changing of suspended solids of the Red River was added in page 12, in the section “Influence of dams on pCO2 and CO2 emission ” Noted that the Hoa Binh site is situated downstream a series of reservoirs, which have been constructed in both Chinese and Vietnamese parts including two large dams Hoa Binh (in 1989) and Son La (in 2010). The Vu Quang site is located in the downstreamof a series of reservoirs, including two important Thac Ba (in 1970) and Tuyen Quang (in 2010). Previous studies emphasized that these dams have impacted

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water and sediment discharges downstream (Ha and Vu 2012; Ngo et al. 2014; Lu et al. 2015) with significant sediment deposition being observed in the reservoirs (Dang et al. 2010; Vinh et al. 2014; Lu et al. 2015).

-184: if exchange is less related to wind, then what is the justification for using this model in the present study? Thank you for the suggestion. But we now revise the ms by recalculating k600 proposed by Raymond et al 2012 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)

-214: such low temperature variability leads to skepticism of this environmental paramenter being a significant driver of CO2 variability. In addition, the broad conclusion here is that water chemistry seems to be quite stable over time. Thank you for the suggestion. The test by ANOVA and t-test results showed that no clear day-night variation but clear seasonal (dry-wet) variation of temperature was found at 5 sites. Other variables including pCO2, organic matters . . . showed seasonal variation. So, we revised the section of temporal variation of pCO2 and CO2 flux in page 9 -10

-273: a lack of CO2 diel variability, but a finding of diel exchange variability, is a direct function of the model. This diel variability in fluxes then, is simply due to changes in wind which I do not believe are likely drivers of gas exchange in most river systems. Again, we recalculated the k600 by Raymond et al (2012), that lead to the change in CO2 flux. We re-write the discussion.

-276: this section reads more like discussion than results We removed this section in the revised ms.

346: in contrast, this opening paragraph of the discussion most likely belongs in the results section of the manuscript Thank you for the suggestion. In the revised ms, this

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paragraph is in the section Results/ 3.4. Relations between pCO2 and water chemistry variables in page 8 -9.

-359: what part of the study design allows for a significant investigation on the role of dams and gas exchange? We added the paragraph for describing the 5 sites observed in page 3 “Five stations were studied along the lower Red River (Vietnam): Yen Bai station (at the outlet of the Thao River); Hoa Binh station (after Son La and Hoa Binh reservoirs, at the outlet of the Da River); Vu Quang (at the outlet of the Lo River); Hanoi and Ba Lat stations (in the main course of the Red River downstream). The three stations Yen Bai, Vu Quang and Hoa Binh are representative for water quality of the three main tributaries (Thao, Da and Lo) of the upstream Red River, whereas the Hanoi station is representative for the main course Red River after confluence of three main tributaries. Only the Ba Lat station, which is located at the Red River mouth (about 13 km from the sea) is influenced by seawater intrusion (Fig 1). A more detailed description of the river characteristics of the Thao, Da, Lo and the main branch of the Red River can be found in (Le et al., 2007)”

-401: paragraph is too speculative The paragraph was revised in page 13 (line 451)

-449: but the temperature variation was very small. How much could this have possibly contributed to the variation in CO2 exchange? Thank you for the suggestion. As we mention above, we recalculate the k600 and fCO2. So the results now were represented and synthetized. The discussion concerning day-night variations was rewritten. pCO2 differences between night and day were really low, most probably because of low temperature difference and low photosynthetic activity due to the turbidity of the Red River. The conclusion was also revised.

Please also note the supplement to this comment:
https://www.biogeosciences-discuss.net/bg-2017-505/bg-2017-505-AC6-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 (Vu Quang) rivers and in the main branch of the Red River at Hanoi and Ba Lat stations in 2014.

Fig. 1.