

Biogeosciences Discuss., referee comment RC2  
<https://doi.org/10.5194/bg-2020-477-RC2>, 2021  
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## **Comment on bg-2020-477**

Anonymous Referee #2

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Referee comment on "Spatial and temporal variability of  $p\text{CO}_2$  and  $\text{CO}_2$  emissions from the Dong River in south China" by Boyi Liu et al., Biogeosciences Discuss.,  
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### General comments:

This a generally thorough investigation into the magnitude and potential drivers of river  $\text{CO}_2$  emissions in a subtropical monsoon river basin. This is a useful study with important data to help fill in the gap on riverine  $\text{CO}_2$  emissions from an understudied region, and a brief look into the impact of flooding (from the monsoon season) on riverine  $\text{CO}_2$  emissions. Overall, the study is good and analyses appropriate, and I think this is a solid addition to the literature.

My one main concern is in relation to the way the dataset was collected. It appears that the data was not collected with replicates and in a kind of snapshot approach across a large river basin. It is therefore very challenging to standardise for hydrological conditions, time of day etc. when co-ordinating sampling from such a large basin. However, there should be some analyses and discussion around this point to explore how this might impact the results as presented. One of the aims of the study is to "investigate the spatial and temporal pattern of  $p\text{CO}_2$  and  $\text{CO}_2$  emission along stream size spectrum" – how would different sampling conditions affect this? Not enough context is provided to reassure the reader that artefacts of the sampling process are not driving at least some of the variability observed in this dataset.

### Specific comments:

L55. Please indicate which references refer to which so that the reader can use this as a pointer towards specific studies which observed one or the other pattern.

L96. What type of forest? Just to clarify, these "plains and hills" are predominantly covered by this forest? Please provide some more information on the extent of coverage.

L127. Please provide details of the flow meter, including accuracy etc.

L130. Can you provide an indication of how big this underestimation might be? An order of magnitude, or just a few percent?

L142-3. These volumes are larger than what are typically used for headspace extractions. Did you test this method for accuracy compared to smaller volume methods or can you provide a reference to back up this approach? Mostly to confirm that full equilibration between water and headspace is occurring within 1 min of shaking.

L162. Tink this is supposed to be eq 3.

L189. Does this include replicates at any sites? Or were single measurements only of FCO<sub>2</sub> and pCO<sub>2</sub> undertaken at each site? It seems strange to omit any kind of replication at each measurement site, so I would encourage the authors to explain why and discuss whether this lack of replication had any major impact on their findings. Further, were sites measured all in the same day or over multiple days? If so, how might time of day or hydrologic conditions varied across these measurements within each campaign? I know you can't go back and fix any of these potential issues after the fact, but some discussion of potential issues here would be useful to convince the reader that these decisions made when designing the sampling strategy have not substantially impacted the data that is presented here. This is most concerning when I look at Table 1. The values appear very consistent across all the sites, yet the standard deviation compared to the means are very large in some cases.

L197. Change Q to "discharge"

L225. What did this "strongest increase" actually relate to? Stream order is just a proxy for many things, including discharge, catchment characteristics etc. This is not fully discussed or addressed in the discussion.

L245. Clarify the sentence here: "indicating that the majority of the river network is a carbon source".

L259. Not sure what this means, between wet vs dry seasons?

L264. High compared to what?

L273. This too broad a statement to really be useful. This is dependent on the river and its setting etc. Perhaps rethink the purpose of this opening sentence and target it more directly to the immediate discussion.

L310. Which "should" lead to a decrease? Because you then observed pCO<sub>2</sub> to increase, rather than be diluted.

L322. Decomposition of organic carbon "within the water column" (internal DOC decomposition)?

L331. Plenty of studies have indicated that DOC can be readily decomposed in headwater streams, e.g. Vonk et al. 2013 (doi: 10.1002/grl.50348), Dean et al. 2019 (doi: 10.1029/2018JG004650).

L334. Should you not then see a correlation between DOC and pCO<sub>2</sub>?

L343. In line with previous studies, e.g. Long et al. 2015 (doi: 10.1002/2015JG002955).

Fig 8. I suggest repositioning the legend so that single blue dot is more obvious.

L393. For all rivers? Or large rivers? Because the earlier discussion suggested internal production of CO<sub>2</sub> was more important for the larger rivers.