

Dear Editor,

Thank you for your efforts and those of the reviewers in evaluating and handling our manuscript bg-2021-69, "Partitioning carbon sources between wetland and well-drained ecosystems to a tropical first-order stream – Implications to carbon cycling in the whole watershed", that now entitled "Partitioning carbon sources between wetland and well-drained ecosystems to a tropical first-order stream – Implications to carbon cycling at the watershed scale", based on the reviewer#2 suggestion. We have modified the manuscript in response to the second round of review, therefore based solely on second reviewer's comments, and a detailed point-by-point response and revisions to the manuscript follows. In the following document we refer to the tracked version of our manuscript.

Best regards,

Frédéric Guérin & Co-workers

Reviewer#2

Comment: The authors revised version of their study of C fluxes from the Nyong basin in Cameroon is greatly improved and addressed the concerns in the first submission. They have improved the narrative in the study and provided a clearer and data rich presentation of an important watershed type in the growing body of tropical carbon cycling. The paper is well cited and sets up follow up the next steps in studying this watershed well.

*Response: We very appreciate the positive comments of the reviewer#2 and we warmly thank her/him for her/his helpful and very constructive comments during these two rounds of revision which have significantly improved the overall quality of our manuscript.*

Comment: My comments are minor with one larger request. The units in the paper are still difficult to track and differ (slightly) from those in the literature. The authors present fluxes in t C yr<sup>-1</sup>, in contrast to Pg, Gg, or Tg C. For the sake of easier comparison to the wider literature, I recommend these be converted to a more commonly used unit. Similarly, for the estimates of degassing and respiration, they present in mmol or mol, in contrast to the rest of the paper in some form of g. I would again ask these to be converted to a more commonly used unit.

*Response: We agree with the reviewer#2 to change the units of our manuscript, which is a legitimate request. It was something asked in the first round of review that we missed. In the revised version of our manuscript, respiration and CO<sub>2</sub> degassing rates were converted to gC m<sup>-2</sup> yr<sup>-1</sup>. C fluxes in the first-order catchment were converted to MgC yr<sup>-1</sup> (MgC km<sup>-2</sup> yr<sup>-1</sup> or MgC-CO<sub>2</sub> km<sup>-2</sup> yr<sup>-1</sup> when weighed by catchment surface area) whereas C fluxes at the watershed scale were converted to GgC yr<sup>-1</sup> (MgC km<sup>-2</sup> yr<sup>-1</sup> or MgC-CO<sub>2</sub> km<sup>-2</sup> yr<sup>-1</sup> when weighed by watershed surface area).*

Comment: A final comment on the writing, which is inherently a personal preference. A fair number of sentences begin with 'This...', 'These...' etc., which asks the reader to do more work than should be. I

ask the authors to make the readers job as easy as possible and be specific about the 'this' they are referring to from the previous sentence. By no means are the authors alone in this writing style and perhaps this is my own personal preference getting the better of me, but a stylistic change I would prefer to see.

*Response: Beginning sentences with 'This...', 'These...' etc., is undoubtedly a French syntax and we thank the reviewer#2 for her/his comment. We made an extra effort to improve the writing style of our manuscript. Please, see the different revisions throughout the manuscript.*

Comment: Title- Suggest changing 'in the whole watershed' to 'at the watershed scale'

*Response: Modified as suggested.*

Comment: The abstract is well written and well organized, though a few typos or words missing (see specific comments).

*Response: We thank the reviewer#2 for her/his positive evaluation of our Abstract's section. We corrected the abstract for typos and add some extra sentences as suggested in the specific comments. Please see the revised Abstract L.20-52.*

Comment: The introduction is well written and cites recent literature. The only concern is the organization and structure of the 3rd paragraph, see specific comments for suggestions. Last, as the second objective focuses on temporal variation of C in rivers, maybe a sentence on this topic could be added to the 3rd paragraph, particularly as the seasonality of wetlands appears to play a large role.

*Response: We thank the reviewer#2 for her/his positive evaluation of our Introduction's section. We revised the third paragraph and add sentences of the seasonality of wetlands. Please see L.89-119.*

Comment: Methods No major concerns with the Methods section, only minor edits (see specific comments below). Results, Discussion, References No major issues.

Comment: Tables/Figures/Supplemental Files Table captions generally go above the table (minor edit)

*Response: Modified as suggested.*

Comment: Table 4- can you provide 2 decimal points for these correlation coefficients? Non-significant p-values are also informative, one idea would be to put the significant correlations in bold text

*Response: Modified as suggested.*

Comment: Table 6- I thought several of these measurements weren't made in the 2nd order site but were interpolated. If that is the case, please add that to the caption. The units for the columns are inconsistent (m<sup>-2</sup> for F and km<sup>2</sup> for area). I would suggest picking one and sticking to it. Again the conversion issue of mmol to t C appears here too.

*Response: Referee is right when she/he mentioned that measurements in second order streams were interpolated and therefore we modified the table caption as suggested. Also, throughout the manuscript, units were converted to a more commonly used unit, as explained above in this document.*

Comment: Table 7- there is no Table 7! It goes from 6 to 8, please correct!

*Response: Corrected as suggested.*

Comment: Figure 3, d- soil profiles are a little small on a full page, I imagine they will be even smaller when published. Can you make this bigger or separate out as a Supplemental Figure?

*Response: We added figure 3d as Supplemental Figure (Fig. S1). Please see the supplement information.*

Comment: Figure 6- conductivity should be capitalized. I might add a note in the caption that the hashed boxplot is for GW and what the boxplots represent (median, quartiles, etc.).

*Response: Corrected as suggested.*

Comment: L20- change 'great' to 'large'. L22-23- clarify to 'measured groundwater in a well-drained'. I might also change the order of this sentence to list what was measured before listing the groundwater and streams. L25- replace 'occasionally' with 'supplemented C measurements with measures of heterotrophic'. L28- 'In larger streams (order > 1)'. L33- is higher metabolism the only reason low oxygen was observed? If you make this statement, can you include the respiration. L35- missing 'were' between exports and 1.6

*Response: Corrected as suggested. Yes, higher rates of heterotrophic respiration in the river are very likely the main reason of lower oxygen in high-order streams. We added respiration rates in stream orders 1 and 5. Please also see the revised Abstract L.20-52.*

Comment: L47- this first sentence contains a ton of information but is very long. I would suggest breaking into 2 sentences after 'cycle' on L48.

*Response: Corrected as suggested. L.54-59.*

Comment: L52- 'overlying' is redundant, delete

*Response: Corrected as suggested. L.61.*

Comment: L57- check the order of citations. They appear to be alphabetical but the years are not chronological. If this follows the journals format, ignore this comment.

*Response: Yes, it is the journal format as implemented in Mendeley Desktop.*

Comment: L75- seems like this paragraph needs a concluding sentence. Perhaps something about empirically measuring C in all forms rather than relying on pH and total alkalinity estimates that are error prone are key to improving estimates from inland waters.

*Response: We agree with the referee and so we added two sentences to conclude this paragraph. L.84-87*

Comment: L77- Remove the i.e. Make this into a new sentence or integrate into the first half of the sentence. 'In the aquatic system itself' is strange wording, consider changing to 'within the ecosystem'. You might consider widening the scope of this sentence to ecosystem respiration, as respiration by autotrophs is non-negligible and opens the discussion to a wider range of papers

*Response: We modified this paragraph. Please see L.89-119.*

Comment: L82- this paragraph starts by introducing respiration, but here shifts to degassing as a function of wetland area. Organization could be improved. Perhaps this paragraph could be about wetlands role in riverine processes, and include the various aspects of how they affect C export, evasion, and respiration.

*Response: We modified this paragraph. Please see L.89-119.*

Comment: L122- 'flows west to the Atlantic...'. Same comment on L123 and L141.

*Response: Corrected as suggested.*

Comment: L124- Is width an appropriate measure of wetlands? Is there an areal estimate that could supplement? Or does this refer to width laterally extending from the river?

*Response: Yes, refer to width laterally extending from the river. Please see L. 169.*

Comment: L127- not sure what to make of 'of unequal importance'. I would delete it

*Response: We agree and corrected as suggested. L.173.*

Comment: L208- 'bubbles'. I would suggest starting a new paragraph after bubbles and merging the paragraph that starts on L215 with this paragraph that all describes the sampling and instrumentation. Further I would cut/paste the mention of respiration here and move to L246 where you detail the respiration methods.

*Response: Corrected as suggested. See the revised section 2.2 at L.250-305.*

Comment: L210- what is a one-off sample?

*Response: We meant single samples. L.258.*

Comment: L211- delete 'of the water'.

*Response: Corrected as suggested. L.258.*

Comment: L255- 'will be' changed to 'was'. Is there another study you can cite that combines estimates of water column respiration with a supplemental estimate of benthic respiration to get ecosystem

respiration or total heterotrophic respiration? I might look in Reisinger et al. (2021) and references therein as a possible example.

*Response: Actually, Reisinger et al. (2021) estimated respiration rates in temperate rivers only. As heterotrophic respiration in the river is strongly dependent of water temperature we believed that respiration rates measured by Reisinger et al. (2021) did not fit with our study. We are not aware of other study in tropical streams and rivers that estimate benthic respiration from direct measurements except Cardoso et al. (2014). In addition, benthic respiration rates measured by Cardoso et al. (2014) were also used by Borges et al. (2015) and (2019) to estimate total respiration in African rivers as Borges et al. (2015) and (2019) measured pelagic respiration only as we did. Comparison between these different studies in African Rivers will be facilitated*

*Besides, while double check our results we realized that we badly reported the benthic respiration rate measured by Cardoso et al. (2014). In the previous version of the manuscript we used a benthic respiration rate of  $21 \text{ mmolC m}^{-2} \text{ d}^{-1}$  (which is  $92 \text{ gC m}^{-2} \text{ yr}^{-1}$ ), but the right value of benthic respiration rate by Cardoso et al. (2014) is actually  $50.8 \text{ mmolC m}^{-2} \text{ d}^{-1}$  (which is  $222 \text{ gC m}^{-2} \text{ yr}^{-1}$ ). In the revised version we used  $222 \text{ gC m}^{-2} \text{ yr}^{-1}$  as benthic respiration rate. With this revised benthic respiration rate, the total respiration in the river (benthic plus pelagic) represents now 10% of the  $\text{CO}_2$  degassing (instead of 8.5%).*

Comment: L257- 'catchment'. Singular.

*Response: Corrected as suggested. L.309.*

Comment: L258- are these sub-catchments in the Nyong basin? Please specify.

*Response: Yes, this was specified. L.309.*

Comment: L372- were groundwater table measurements mentioned in the Methods section?

*Response: No, because we did not measure groundwater table. Groundwater table level was retrieved from Nkoue-ndondo et al. (2020). We added this statement in the caption of figure 4*

Comment: L386- wow, those are really high  $\text{pCO}_2$ ! Well beyond the calibration ranges for the GC described in the methods. Were these values verified in another way?

*Response: According to SRI FID manual,*

*->The Flame Ionization Detector is the most commonly used GC detector, responding linearly from its minimum detectable quantity of about 100 picograms to almost 100%. » -the detection limit is 1 ppm.*

*We are therefore confident with the high value measured in the groundwater*

Comment: L443- 'goes to the wetland...'

*Response: Corrected as suggested*

Comment: L450- this doesn't needed to be added to the paper but you have a great dataset to explore how k600 scales with discharge in 5 different stream orders (based on scaling equations, but still).

Ecosystem metabolism estimates are greatly improved with a known  $k_{600} \sim Q$  relationship, I would think deploying O<sub>2</sub> sensors (and pairing with CO<sub>2</sub> sensors) in these streams could be a great next step to begin estimating in-stream C fluxes, following the best practices in the literature (Grace et al. 2015, Hall and Hotchkiss 2017, Appling et al. 2018). Also a good note or addition to the Discussion starting in L656.

*Response: We thank the reviewer#2 for these interesting comments: Indeed, it is something we have planned to do in a near future. For now, we believe this is beyond the scope of our manuscript and chose not to include this suggestion.*

Comment: L530- take a look at some papers from different soil types in Central America to expand the discussion on respiration and seasonal soil moisture (Veldkamp et al. 2003, Schwendenmann and Veldkamp 2006)

*Response: We expand the discussion on respiration and seasonal moisture. Please see L.615-625*