

Dear Dr. Bouillon,

Thank you very much for the thoughtful review of our manuscript. Based on your comments, we have further improved the manuscript. Please find below our point-by-point response (in bright blue) to your comments. All changes have also been highlighted in yellow in the track-changes file. The line numbers refer to the lines in the revised version.

We hope that the revised manuscript is now acceptable for publication in Biogeosciences.

Thank you very much for your kind consideration.

With best regards

Lishan Ran, on behalf of all co-authors

L13: emission measurement : emission measurements

Reply: Revised.

L16-18: this new sentence is intended to address one of the key issues raised by Ref #1, i.e. that $p\text{CO}_2$ is governed not just by in situ metabolism. While this sentence captures that, it is not fully clear unless you specifically mention that ‘terrestrial carbon inputs’ also include inorganic C (i.e. CO_2). The same holds for other versions of this statement on L 292-293 and L464-465.

Reply: Thank you for your comments and suggestions. We agreed with your comments. Based on your suggestions, we have rephrased these statements in the revised version. For Line16–18, now it reads “Spatial and temporal patterns of $p\text{CO}_2$ were mainly affected by terrestrial carbon inputs (i.e., organic and inorganic carbon) and in-stream metabolism, both of which varied due to different land cover, catchment topography, and seasonality of precipitation and temperature.” Please also refer to Lines 16–18, Lines 292–293, and Lines 462–465 in the revised version of the manuscript for the changes.

L108: Field measurement and analysis: Field measurements and analyses

Reply: Revised.

L318: CO_2 in small rivers can emit into : CO_2 in small rivers can exchange with

Reply: Revised.

L323: “and thus the higher $p\text{CO}_2$ in downstream large rivers”: awkward, rephrase.

Reply: Thank you very much for your comments and suggestions. We have rephrased this sentence. Now it reads “Recent studies indicate that carbonate buffering could decrease the CO_2 emissions from small rivers by increasing the ionization of CO_2 (Stets et al., 2017), thereby increasing the transfer of DIC towards the rivers downstream, which resulted in the higher $p\text{CO}_2$ in downstream large rivers.” Please also refer to Lines 323–325 in the revised version of the manuscript for the changes.

L335-337: please remove this or reformulate. I do not see the logic of invoking the absence of anoxic environments to explain this.

Reply: Thank you for your comments and suggestions. We have removed the sentence from the manuscript.

L367: “This could either enhance directly riverine $p\text{CO}_2$ or fuel OC decomposition”:
This could either directly increase riverine $p\text{CO}_2$, or fuel OC decomposition.

Reply: Revised. Again, thank you very much for your constructive comments, which have greatly improved the manuscript.