

Reviewer 1

The carbon cycles in riparian zones play an indispensable role in global carbon offset and climate change. Because riparian zone is a dynamic zone connected terrestrial with aquatic systems, this zone is vulnerable and easy to suffer from environmental disturbances such as flooding events. However, the effect of these disturbances on carbon cycles in riparian zone is unclear. In this paper, the authors explore the effect of flooding events on CO₂ emissions in riparian zones based on two-year observations along Lijiang River and propose a global riparian carbon offset model and calculate the global carbon offset in riparian zones due to flooding events. Overall, I find the manuscript to be well written. The study has a heavy workload and the methods used are scientifically robust. The results are likely to be of interested to others working in this field and supported by useful, well-constructed figures and tables. It fits well in Biogeoscience and will be a useful step forward in our understanding of CO₂ emission in riparian zones under flooding events. I recommend the manuscript be accepted after my comments below are addressed.

We appreciate the positive comments on our manuscript. All suggestions have been considered carefully and addressed in the revised manuscript. Please see below for details.

Note: The line numbers shown in our response are referring to the line numbers in the revised manuscript with tracked changes.

Specific comments were listed as follows.

Abstract:

Line 19. Add “under flooding disturbance” to the sentence “This study examines...”.

The phrase has been added as suggested. See below,

“This study examines daily CO₂ perturbations **under flooding disturbance** in the river (fluvial area) and associated riparian areas with two-year in-situ observations along the Lijiang River.” (Line 20)

Introduction:

1. Line 32. I don’t really understand the sentence. Maybe it should be “Aquatic and terrestrial systems are highly dynamic systems linked by fluvial processes.” Or “Aquatic systems are interacted with terrestrial systems by fluvial processes.”

Thanks for the suggestion. The sentence has been modified accordingly. See below,

“Aquatic and associated riparian systems are highly dynamic systems linked by fluvial processes...” (Line 37)

2. Line 33. It should be “Riparian zones are generally defined as complex terrestrial Assemblages...”

Thanks. The grammar issue has been fixed.

“Riparian zones are generally defined as **complex terrestrial assemblages** of...” (Line 38)

3. Line 61. “find” should be “found”.

Changed accordingly. See below,

“Hirota et al. (2007) **found** that temporal variations of the greenhouse gases fluxes were strongly manipulated by water-level fluctuations in the sandy shore and by soil temperature in the salt marsh.” (Line 58)

Methods:

1. The title of section 2.2.3 should be “Determination of CO₂ flux and hydro-environment conditions”

The title of Section 2.2.3 has been modified as suggested. (Line 139)

Results and discussions

Line 333-335. “The global CO₂ fixed by river after flooding disturbance reaches 0.11 Gt per year.” “by river” or “by riparian zone”? After flooding disturbance, the water level will descend and the soil of the riparian zone will emerge, what “water surface of riparian zone” refers to?

Thanks for the question. Since the original description about different areas and seasons may lead to confusion, we have gone through the manuscript and decided to use “riparian area” and “fluvial area” to describe the two distinct areas, and use “pre-flooding season”,

“during flooding season”, and “post-flooding season” to describe different phrases consistently throughout the manuscript. In the revised manuscript, we have corrected all inaccurate descriptions related to the areas and seasons. Definitions of the two areas are also added to Section 2.2.4, in order to avoid ambiguity in our presentation of the results. See below and also our response to Review#2.

“Here, we define riparian area as the area that would be submerged during the flooding season but exposed during non-flooding seasons. Fluvial area refers to the river in non-flooding seasons and the river plus the flooded riparian area during the flooding season. Field investigation showed that the riparian area makes up 25% of the whole river width (riparian plus fluvial) and the vegetation coverage is about 60%.” (Line 173-176)

Reviewer 2

Dear authors,

I must stress that I decided to read the manuscript as currently constructed before looking at the responses to the reviewers since this is most likely how a typical reader will approach it. Afterwards, I also read the responses to the previous reviewers trying to assess the effort made by the authors to reply and change the manuscript according to their inputs.

I find this to be an adequate approach to both check the manuscript independently while not disregarding previous reviewing stages.

In my view, this article is well-written and revolves around a relevant topic.

I have some comments and correction suggestions that I find relevant:

We appreciate your thorough and thoughtful review on our manuscript. We have carefully considered and addressed all the comments. Please see response to major comments and specific comments below.

Note: The line numbers shown in our response are referring to the line numbers in the revised manuscript with tracked changes.

- Authors sample in 2 distinct areas, "Fluvial" and "Riparian". Although "riparian zone" is more or less conceptually and spatially defined, "Fluvial area" is not defined properly, nor is it spatially detailed. There are some nuances and mentions of what it may conceal but not a specific and clear definition.

I would argue this is very important (more comments on this in the commented pdf file provided).

- related to this there are some tables and other parts that mention "terrestrial habitats". Again it must be very clear in which zone these habitats occur, and this must not be used as a sort of synonym for any of the aforementioned zones.

Previous reviewers have also pointed to this issue.

Thanks for pointing this out. In the revised manuscript, we have decided to use "riparian area" and "fluvial area" consistently to describe our results. Relevant terms in all figures and tables of the manuscript have also been modified accordingly. In addition, we have also added definitions of the two areas to Section 2.2.4, in order to give a clear idea of what these two areas refer to. Please see below for detailed changes related to this.

“Here, we define riparian area as the area that would be submerged during the flooding season but exposed during non-flooding seasons. Fluvial area refers to the river in non-flooding seasons and the river plus the flooded riparian area during the flooding season. Field investigation showed that the riparian area makes up 25% of the whole river width (riparian plus fluvial) and the vegetation coverage is about 60%.” (Line 173-176)

“Appendix Table A1. Repeated measurements ANOVA for effects of vegetation (**riparian areas** with vegetation vs. without vegetation; between-subject factor) and time (measuring times in one day; within-subject factor) on the CO₂ fluxes in two sampling stages (April and October) in **riparian areas**.” (Line 422-425)

- ANOVA results are not detailed or emphasized enough in the results, making it harder for the reader to understand where are the significant differences and results.

Specific description for the ANOVA results has been added in the manuscript, and reference to the ANOVA table has also been added along with relevant results. See below for some examples,

“Significant diel variations in CO₂ fluxes were also observed in fluvial area ($p<0.01$), but the CO₂ fluxes from shallow water and deep water did not have significant differences ($p>0.05$; **Table A2**).” (Line 248-250)

“TOC in fluvial area was substantially higher during the flooding period than that during the pre- and post-flooding seasons (Fig. 4a; $p<0.001$ **Table A4**)...” (Line 304)

This being said, I consider that you have replied and made most of the necessary changes to reply to other reviewers.

My recommendation is that minor changes are needed to get the manuscript fit for publication.

We appreciate the positive comment. Your suggestions have helped us to clarify our arguments.

Response to revisions/comments in the attached pdf file:

For other specific comments offered in the attached file, all of them have been fixed correspondingly. Please see below for details.

Line 31 “immensely” has been deleted.

“Climate change issues stemming from anthropogenic carbon emissions have strengthened dramatically, threatening ecosystem stability and biodiversity.”

Line 52 Turn “large” to “larger” as suggested.

“Liu et al. (2021) demonstrated that high plant and soil respiration in riparian wetlands lead to **larger** amounts of CO₂

Line 78 Grammar has been fixed.

“Riparian zones **are** believed to have considerable potential to contribute to biodiversity, carbon sequestration, and several other ecosystem services.”

Line 103 The extra space within the word “long” has been deleted.

“Our study site is in the downstream of the 164 kilometres **long** Lijiang River...”

Line 173-176 The definition of fluvial area is added. See also the response to the major comments.

“Here, we define riparian area as the area that would be submerged during the flooding season but exposed during non-flooding seasons. **Fluvial area refers to the river in non-flooding seasons and the river plus the flooded riparian area during the flooding season.** Field investigation showed that the riparian area makes up 25% of the whole river width (**riparian plus fluvial**) and the vegetation coverage is about 60%.”

Line 271 The caption for Fig.2 has been changed accordingly.

“...and resumed low water-level in post-flooding season in 2014 (Blank) and 2016 (**Dashed**).”

Line 340-343 The concrete data has been removed as suggested as this is not Results section but Discussion section.

“...it is also found that shallow-water released less carbon in pre-flooding season and captured more carbon in post-flooding season than deep-water area. However, during the flooding season, **both the shallow-water and deep-water areas uptake carbon**, probably because of an enhanced input of carbon from riparian vegetation and soils to the fluvial channel.”

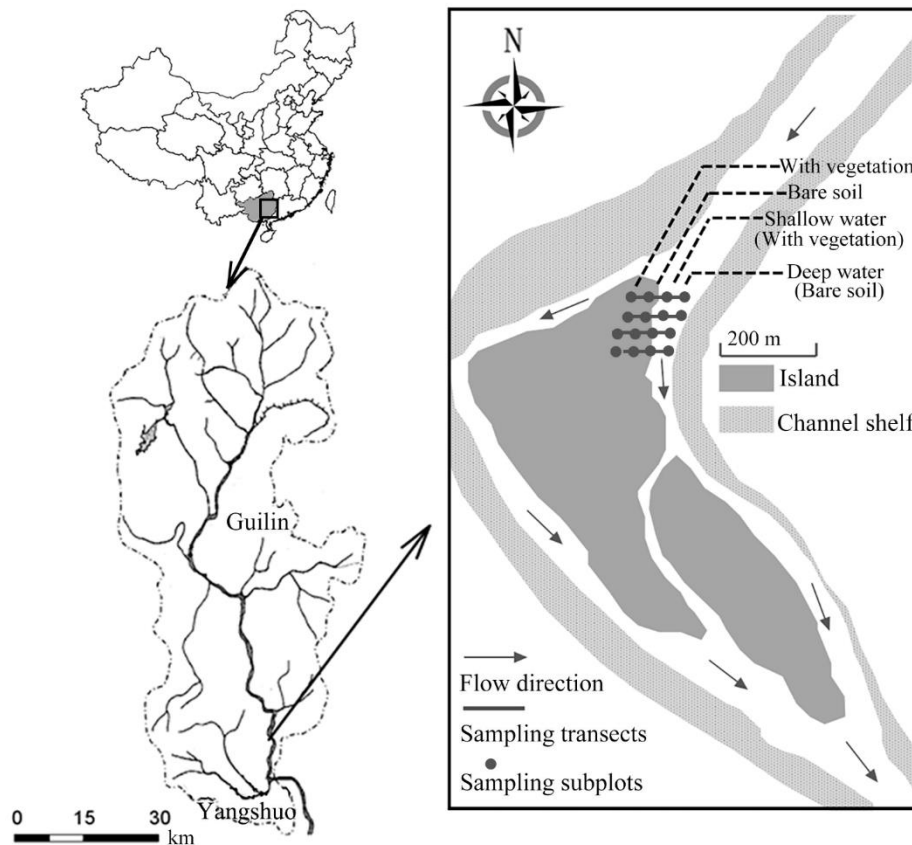
Line 393 & Line 402 “Global warming” has been modified into “climate change” accordingly.

“Nowadays, the risk and the number of global flooding events are expected to rise

significantly with **climate changes** (Hirabayashi et al., 2013).”

“Under **climate change**, both the risk and the number of flooding event are rising.”

Line 410 The Appendix Figure A1 has been improved to make the word “Yangshuo” easier to read.



Line 422 In all the Appendix tables, we used “riparian area” and “fluvial area” to describe the two concerned areas, in accordance with the Results section. See below for some examples,

“Repeated measurements ANOVA for effects of vegetation (**riparian areas** with vegetation vs. without vegetation; between-subject factor) and time (measuring times in one day; within-subject factor) on the CO₂ fluxes in two sampling stages (April and October) in **riparian areas**. Degree of freedom, *F*, and *P* (significance) values.”

“The *p*-values were calculated under the null hypothesis that CO₂ flux is not influenced by vegetation or measuring times in **fluvial areas**.”