The authors studied the effects of flooding on carbon emissions and sinks in the riparian zone. They measured field CO2 flux and developed a model to simulate the riparian carbon emissions. Although multiple methods applied, I am not convinced by the data yet. The introduction is not comprehensive, methods lack some important information, the results and discussions are not convincible. At the current stage, I think it is not suitable for publishing. There are also some comments need to be considered:

We appreciate these comments. In the revised manuscript, we have substantially revised the introduction, methods, and result and discussion sections.

In the introduction, we added contents related to the anoxic production of methane (see response to the comment on line 39-44 below) and particularly the impacts of riparian soil property and vegetation on riparian carbon fluxes and related modeling works (see response to the comments on introduction below), and therefore offered a more thorough overview of the recent progresses on flooding and riparian carbon fluxes.

In methods, we added necessary information (e.g.: sediment and soil) of our study region in section 2.1, added details about the setting up of the static chambers in section 2.2.1, and offered details about the gas chromatography used in this study in the new section 2.2.2. We removed section 2.3 (model scenario prediction method) in response to the restructure of results and discussion (see response to the comments on section 2.3.2 and section 3.5 for the restructure). We then added a new section 2.2.4 to explain how we get the accumulated CO_2 flux and calculate the annual CO_2 emission of riparian area and fluvial area as a whole (see response to the comments on equation 2, line 189-194 below).

In results and discussion, considering the estimation at global scale and the comparison with global forest CO_2 flux are only loosely connected to the main arguments of the manuscript and that we were not able to give a comprehensive evaluation of the carbon uptake potential for global riparian areas, we removed related sections in result (section 3.5, 3.6) and discussion (section 4.4) in the revised manuscript. Following this change, the discussion section has been substantially restructured to focus on two main results of our study: 1) increased carbon emission from riparian area due to flooding and 2) the role of post-disturbance survived vegetation in riparian carbon sequestration after the flooding period (see response to the comments on section 2.3.2 and section 3.5 below).

The abstract and conclusion part were revised correspondingly.

We believe these changes have greatly improved the quality of present manuscript, and made our manuscript more compact, organized and coherently presented.

Note: The line numbers shown in the bracket in our response below are referring to the line numbers in the revised manuscript.

Please correct the reference "Xunhua et al., 1998". The first name and last name were switched.

Thanks for pointing this out. We have corrected the reference in the revised manuscript. See below,

"The increasing atmospheric CO_2 originating from fossil fuel combustion and industrial activities can be regulated by plant metabolism (photosynthesis and respiration) and soil microbial activities **(Zheng et al., 1998)**." (Line 37)

Lines 39-44, flooding submergence could cause anoxic conditions, which favors the reduction reactions. Thus, methane should be released more than carbon dioxide and are more important?

We agree with the reviewer that flooding submergence causes anoxic conditions which could stimulate methane production and emission. In revised version of the manuscript, we have modified the second paragraph and added the following parts related to methane production in riparian zones to the introduction. See below for details.

"Riparian zones are of great importance in carbon cycling, which is associated with the production and consumption of CO_2 and methane (CH_4) (Zhang et al., 2016; Allen et al., 2007; Liu et al., 2021). " (Line 43-45)

"Also, the short-term anaerobic conditions caused by flooding may increase the production of methane because of the strengthened methanogenesis in riparian soils (Hassanzadeh et al., 2019; Hondula et al., 2021; Morse et al., 2012; Le Mer and Roger, 2001; Thorp et al., 2006)." (Line 55-57)

"This raises the possibility of elevated carbon (including methane and carbon dioxide) emissions and reduced carbon sequestration from riparian zones…" (Line 70-71)

"Considering an overall small contribution of CH_4 to the carbon balance of riparian zones (Liu et al., 2021; Vidon et al., 2019), only CO_2 fluxes were measured in analysis." (Line 126-128)

Line 58, a space was missed in the unit $mg \cdot m^{-2}\ h^{-1}$.

Corrected accordingly.

"Liu et al. (2021) demonstrated that high plant and soil respiration in riparian wetlands lead to large amounts of CO_2 emission in wet season (0.335-2.790 $\mathbf{g \cdot m^{-2}\ h^{-1}}$) than in dry season (0.072 - 0.387 $\mathbf{g \cdot m^{-2}\ h^{-1}}$) (Liu et al., 2021)." (Line 53-55)

Introduction is too short to summarize the recent research progress in riparian carbon cycle. More information is needed about riparian soil properties, CO_2 and CH_4 emissions, vegetation, and some modelling work.

Thanks for the comments. In the revised version of the manuscript, we have substantially changed the introduction section of the manuscript. We added more discussion related to riparian CO_2 and CH_4 emissions, how flooding disturbance would be affected by the flooding characteristics and the properties of riparian zone (e.g., soil properties, vegetation), and some modeling works on flooding and riparian carbon fluxes (in paragraph 2-5, Line 43-78, 114-122). At the same time, we removed contents that are only loosely related to the main content of the paper (e.g., line 45-51 or 3rd paragraph of the original manuscript, which discussed the impact of disturbances in systems other than the riparian system). We believe these changes offered a better overview of the recent progresses in the field and improved quality of the introduction substantially. See below for details:

Added discussion on how flooding characteristics affect riparian carbon cycling:

"Flooding disturbance strongly influences the biotic characteristics of riparian assemblages (Anderson et al., 2020) as well as the carbon cycle. Flooding could increase soil respiration and enzymatic degradation rate (Wilson et al., 2011). It was found that the rate of CO_2 emission in riparian wetlands is higher than that in neighbouring hillslope grasslands (Anderson et al., 2020). Liu et al. (2021) demonstrated that high plant and soil respiration in riparian wetlands lead to large amounts of CO_2 emission in wet season ($0.335\text{-}2.790\ g\cdot m^{-2}\ h^{-1}$) than in dry season ($0.072 - 0.387\ g\cdot m^{-2}\ h^{-1}$) (Liu et al., 2021). Also, the short-term anaerobic conditions caused by flooding may increase the production of methane because of the strengthened methanogenesis in riparian soils (Hassanzadeh et al., 2019; Hondula et al., 2021; Morse et al., 2012; Le Mer and Roger, 2001; Thorp et al., 2006).

The influence of flooding disturbance would also depend on the flooding characteristics and the properties of riparian soils. 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 (Hirota et al., 2007). The duration of flooding was also considered an important factor for riparian carbon dynamics and microbial community structure (Wilson et al., 2011). The spatial heterogeneity of soil properties would also affect the composition and diversity of bacterial communities in riparian zones and thus may influence the riparian carbon cycle under flooding disturbance (Wang et al., 2019b; Wilson et al., 2011)." (Line 50-64)

Added discussion on how vegetation affects riparian carbon fluxes:

"Strong seasonality for different greenhouse gas emissions has been detected in previous studies (Gaughan and Waylen, 2012; Allen et al., 2007). With flooding disturbance, riparian vegetation plays an indispensable role in sequestering carbon (Maraseni and Mitchell, 2016) and the variations in riparian vegetation communities are expected to define the ecological role of riparian zones in carbon cycle. During flooding season, flooding submergence may impede gas diffusion and decrease light intensity, leading to high mortality and limited growth of plant species (Colmer et al., 2009). This raises the possibility of elevated carbon (including methane and carbon dioxide) emissions and reduced carbon sequestration from riparian zones, shifting the role of riparian zones from a carbon sink to a carbon source. Conversely, as riparian species adapt to flooding submergence and recover from flooding, riparian zones may gradually return to the initial status or even promote CO_2 capture. Previous studies found that riparian vegetation may increase their leaf gas exchange in response to submergence stress so as to cope with oxygen limitation (Huang et al., 2017; Mommer et al., 2006; Liu et al., 2020). Besides, inundation depth increased reed density, height, leaf area index and biomass, and thus decreased the global warming potential during the growing season (Zhao et al., 2020). Therefore, riparian zone may oscillate between carbon source and sink depending on flooding. It raises the open question of whether riparian zones quantitatively promote or hinder carbon capture overall." (Line 66-78)

Added discussion on riparian carbon modeling works:

"However, the current research on the riparian carbon sequestration under flooding disturbance remains poorly constrained. There has been some modelling work about the riparian carbon stock, but fewer on the carbon flux. For instance, Dybala et al., 2019 modelled the change in carbon stock as a function of vegetation age, considering effects of climate and whether or not the riparian forest had been actively planted (Dybala et al., 2019). One limitation for models like Riparian Ecosystem Management Model (REMM) or other riparian models is that they require a large amount of site specific parameters, many of which are often modeled using other models as inputs (Vidon et al., 2019). In addition to climatic factors, factors such as floodplain width, flow regime, frequency of inundation, and the presence of dams, diversions, and levees also need to be considered when modelling the riparian carbon flux with the disturbance of flooding (Sutfin et al., 2016)." (Line 114-122)

Line 86, province?

Corrected accordingly.

"Our study site is in the downstream of the 164 kilometres lo ng Lijiang River in the Pearl River Basin in northwestern Guangxi Zhuang Autonomous Province, Southwest China (25° 06′ N, 110° 25′; Fig. A1)." (Line 140)

The information of sediment or soil should be added, including soil pH, total organic carbon/nitrogen content, etc.

Thanks for the suggestion. Related information on soil and sediment characteristics of the study region has been added in section 2.1. See below for details.

"Lijiang River has a typical karst landscape, with widely exposed carbonate rocks (Wang et al., 2019b). The river from Guilin to Yangshuo is the most typical karst development area. The river channel is composed of sand and pebbles, and the soil type is red loam with high sand content (Wang et al., 2019b)." (Line 140-144)

“The soils of the Lijiang River riparian zone were sand-based, with sand contents ranging from 74.99% to 88.44%; silt and clay contents are lower, accounting for approximately 10% (Wang et al., 2019b; Lu and Wang, 2015). With the decrease of inundation frequency, the sand content is found to decrease while the clay and silt content increased gradually (Wang et al., 2019b). Soil pH is around 6.99 to 7.71, and soil total nitrogen is around 0.93 to 1.40 ($g \cdot kg^{-1}$) (Wang et al., 2019b). Different vegetation zones can further influence the chemical properties of soils (Lu and Wang, 2015).” (Line 148-152)

Section 2.2.1, the setup of static chamber and gas sampling are not clear for me. Do you have a base for the chamber? How to seal the chamber during the non-flood periods? The gas samples were taken every four hours, and the chamber were always closed during this time? If it is so, did the temperature inside of the chamber change a lot? How did you calibrate the flux data with temperature?

With respect to setting up of the static chamber and gas sampling, the following details have been added to section 2.2.1, in which we explained the design details of the floating and terrestrial chambers, sealing of the chambers, temperature controls and gas sampling procedures. We believe the information is able to provide a clearer view of the field methods we used for the study. See below for details.

“… On the river, floating static chambers were used (Sun et al., 2012) and were set up on shallow water and deep water. The floating static chamber was a cylindrical chamber (of radius 50cm and height 65cm) with a floating ring (about 20cm) around the bottom of the chamber to keep it floating on the water, and was thus sealed by the water. On the land during non-flooding seasons, the terrestrial static chambers (length 50 cm, width 50 cm, and height 50 cm) were used and were set up on riparian areas with vegetation and without vegetation. The terrestrial static chamber was put on a stainless-steel underside base (length 50 cm, width 50 cm and height 15 cm) instead of setting directly on the ground. The underside base increased the chamber’s size and prevented damage to the vegetation inside (Sun et al., 2013). There was a groove on the top of the underside base, and the upper portion of chamber was designed to be put into this groove. By adding water to the groove, the whole setting was sealed. (Sun et al., 2012, 2013). The floating static chamber and the terrestrial static chamber both were covered by foam and reflective aluminium, which can easily reflect the heat from sunlight and thus prevent rapid temperature changes or temperature becoming too high in the chamber (Søvik and Kløve, 2007). Also, the chambers contained two exhaust fans, a thermometer and a tube inside. A syringe was used to collect gas samples from the tube at intervals of 0, 10, 20 and 30 minutes. For 24-hour monitoring, samples were taken every 4 hours (a total 6 times per day starting at 10:00 and finishing at 06:00 the next day) in one day in April, August, and October (covering pre-flooding season, flooding season, and post-flooding season) in 2014 (both riparian area and river) and 2016 (river). In other words, diel data was taken at the 0, 10min 20min and 30min of 10:00, 14:00, 18:00, 22:00, 2:00 and 6:00.” (Line 160-175)

The detailed information of gas chromatography should be introduced.

As suggested, we added the following information about the gas chromatography method, followed by a reference to the operating guide. See below for details. Also, in response to changes in other places of the manuscript, we made the Section 2.2.3 "Measurement of gas concentration and hydro-environment condition" as Section 2.2.2, and the original Section 2.2.2 "Vegetation inventory and flooding tolerant experiment" as Section 2.2.3 in the revised manuscript, so that the methodology part is more coherent.

"Gas samples were collected by a syringe from the tube of chamber and were instantly transferred to airtight glass bottles (20ml, Agilent5190-2286). All samples were analysed within three days. The CO_2 concentration was measured using gas chromatography (Agilent7890A) equipped with an electron capture detector (ECD) and a flame ionization detector (FID) (Agilent Technologies, 2010). The measurements were conducted by Pony Testing International Group Co. Ltd (300887:CH)." (Line 177-181)

The statistical method of multiple comparisons should be given.

In this analysis, the two-way ANOVA method was used to examine the effects of vegetation and time on the riparian carbon fluxes. In section 2.2.5, we explained the usage, data requirement, null assumptions and software of the method. See below for details. The corresponding results were presented in Appendix Table A1-2, 4.

"For riparian areas, two-way repeated-measurement ANOVA were employed to examine the effects of vegetation (bare soil vs. land with vegetation; between-subject factor) and time (measuring times in one day, within-subject factor) on the CO_2 flux in two sampling stages (April: pre-flooding and October: post-flooding). For aquatic habitats (fluvial area), two-way repeated-measures ANOVAs were used to examine the effects of sampling position (with vegetation vs. without vegetation or under water surface; between-subject factor) and time (measuring times in one day; within-subject factor) on CO_2 flux in sampling stages (April: pre-flooding, August: during flooding, and October: post-flooding). The *p*-values were calculated with the null hypothesis that the CO_2 flux of riparian areas or aquatic habits is not influenced by the factors mentioned. Before analyses, homogeneity of variance and normality are also examined. All data analyses were performed by the SPSS statistical software package (https://www.ibm.com/products/spss-statistics, version 22.0, Chicago, IL, USA). The effects were considered significant if p-value < 0.05." (Line 226-235)

Equation 2, the unit of each parameter should be clarified. How did you calculate the D and p value?

In the revised manuscript, we replaced this section with a new section (section 2.2.4 Annual riparian and river CO_2 emission calculation). In this new section, instead of presenting the carbon offset model, we explained how the measured carbon fluxes were accumulated to obtain carbon fluxes for different periods (pre-flooding, flooding and post-flooding) (see response to the comments on the daily CO_2 flux, lines 189-194 and line 357-361). Equation 2 was therefore removed from the revised manuscript.

Section 2.3.2, why did you compare with the CO_2 flux of global forests?

We appreciate the reviewer's comment on this. In revising the manuscript, we have carefully considered and re-evaluated the estimation of carbon uptake potential from global riparian zones and the comparison with global forest CO_2 flux. Considering this part was only loosely connected to the main arguments of the manuscript and that we were not able to give a comprehensive evaluation of the carbon uptake potential for global riparian areas (e.g., taking into account the systematic differences in global riparian vegetation, soil and hydrology), we removed this part and related sections in result (section 3.6) and discussion (section 4.4) in the revised manuscript. Following this change, we have substantially restructured the discussion section of the manuscript, focusing now on two main results of our study: 1) increased carbon emission from riparian area due to flooding and 2) the role of post-disturbance survived vegetation in riparian carbon sequestration after the flooding period. We feel these changes make main arguments of our manuscript more focused and the manuscript more consistent and evidence-based. See below for changes to the discussion,

"4.1 Increased carbon emission during flooding periods of the riparian zone

Hydrological flow has been found to be an essential factor within the carbon cycle of riparian ecosystems (Zarnetske et al., 2018). Our data suggest that flooding not only affects carbon emission from the fluvial channel but also the carbon fluxes of the riparian area. With regard to carbon emission from the fluvial channel, our data show that carbon emission of water-air interface significantly increased and showed a net emission of CO_2 in both the daytime and night-time (all-day CO_2 flux: 0.291 $g \cdot m^{-2} d^{-1}$ in April,2.560 $g \cdot m^{-2} d^{-1}$ in August). This is probably due to the increased lateral carbon flux from terrestrial areas to rivers due to flooding. Research found that when water flows through ecosystem, it would pick up dissolved organic carbon from vegetation and soils, transporting the carbon from riparian ecosystem to streams (Raymond and Saiers, 2010). A large amount of carbon could be transported to the river because of enhanced hydrological connectivity between the fluvial channel and its riparian areas during flooding periods (Zarnetske et al., 2018).

When comparing the CO_2 flux of shallow-water area (with aquatic vegetation) and deep-water area (without vegetation) (Fig. A2), 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 (pre-flooding: 0.090 $g \cdot m^{-2} d^{-1}$ in shallow water, 0.492 $g \cdot m^{-2} d^{-1}$ in deep water; post-flooding: -0.880 $g \cdot m^{-2} d^{-1}$ in shallow water, -0.545 $g \cdot m^{-2} d^{-1}$ in deep water). However, during the flooding season, both the shallow-water and deep-water areas had a carbon flux of about 2.55 $g \cdot m^{-2} d^{-1}$, probably because of an enhanced input of carbon from riparian vegetation and soils to the waters.

In addition to increased hydrologic connectivity between the riparian area and fluvial channel of the river, enhanced carbon emission also results from enhanced substrate availability during flooding

(Hirota et al., 2007). Previous work also reported that the extensive root system of riparian species with strong taproots and well-developed fibrous roots could force the species to demand more oxygen and accelerate root respiration and CO_2 emissions from the neighbouring rhizosphere (Elias et al., 2015). In submerged areas, the CO_2 may be transported to water and then released to the atmosphere as the carbon flux of water surface. Especially, the recovery of some C_4 riparian species after periodic flooding also contributed to the higher gas transportability and abundant substrate for CO_2 emission compared to the performance of C_3 species (Still et al., 2003). In addition to riparian vegetation, inundation could also increase the decomposition of stored organic matter (Denef *et al.*, 2001, Marín-Muñiz *et al.*, 2015) and soil respiration (Anderson *et al.*, 2020, Ou *et al.*, 2019). A previous study found that after 25 days of soil moisture enhancement, the anaerobiosis stimulates CO_2 loss by 1.5 times more than the normal soil moisture environment (Huang & Hall, 2017). Flooding leads to elevated soil moisture for weeks or even months, and thus an accelerated CO_2 supply to the inundated channel." (Line 436-465)

"**4.2 Post-disturbance survived vegetation as a critical factor for riparian systems to sequester carbon**

We observed that the carbon sequestration of riparian area and fluvial area as a whole was greatly enhanced after the flooding period, to the point that the overall carbon flux was negative. In consistence with our analysis, Kathilankal et al. (2008) proposed that tidal inundation caused a mean reduction of 49 % in the marsh-atmosphere carbon (CO_2) flux compared to non-flooded conditions (Kathilankal *et al.*, 2008). Our study offers proof that the hydrological flow is a determining factor on whether the riparian ecosystem is a net carbon source or sink.

One possible reason is that the vegetation's recovery after flooding enhances its ability to sequester more CO_2 for photosynthesis. The post-flooding succession of vegetation suggests that not all riparian plants can survive submergence and to become efficient carbon sinks. Indeed, species richness decreased after flooding, which indicates a decrease of the interspecific competition, giving a chance to species that can quickly recover from submergence. The dominant species changed from *C. dactylon* to *C. aciculatus* after flooding disturbance. Although the individual biomass and number of *C. aciculatus* did not increase, existing literature suggests that the leaf maximum net photosynthesis rate may increase significantly after severe submergence in the riparian zones of Lijiang (Huang *et al.*, 2017, Jie *et al.*, 2012). For the clonal plants, its physiological integration allowing them to survive submergence and spread rapidly after de-submergence. Luo et al. (2014), studying *Alternanthera philoxeroides* (alligator weed) after 30 days of submergence, found that connections between submerged and non-submerged ramets enhance the performance of the submerged ramets; and the de-submerged ramets had high soluble sugar concentrations, suggesting high metabolic activities (Luo et al., 2014). Wei et al. (2018) also found that after 30 days of submergence, stolon connection significantly increased growth, biomass allocation to roots and photosynthetic capacities of the submerged ramets, and increased growth and photosynthetic capacities of the unsubmerged ramets (Wei et al., 2018). Also, flooding could promote CO_2 use efficiency and the ability of the plant to use low light (Wang et al., 2019a). The enhanced photosynthetic capacity is believed to be one of the physiological strategies for species growing in critical zones with flooding disturbance. Moreover, human impacts can no longer be ignored on the riparian ecosystem (Ren et al., 2019), suggesting vegetation that can recover quickly and densely is essential to allow riparian zones to be efficient carbon sinks.

Our results suggest, on an annual scale, riparian area behaves either as a net source or sink of carbon depending on the relative importance between enhanced emission during flooding and the strength of post-disturbance carbon absorbance. Assuming the carbon flux rates of flooding season and non-flooding seasons were the same as we have measured on the selected days (Section 2.2.4, Fig.1-2), we estimated that the riparian area and the fluvial area as a whole can achieve carbon neutralization (C_{annual}=0) only when flooding days are fewer than 15 days. Therefore, the relative ratio of flooding to non-flooding days are essential factors to determine whether the riparian area is a net source or sink on an annual scale, and future long-term, high-frequency measurements are required to monitor the carbon dynamics of the riparian zone. Also, besides the contribution of recovered vegetation, our data shows that bare soil also contributes to the carbon neutralization, but the mechanism for bare soil to capture carbon still needs further analysis.

Nowadays, the risk and the number of global flooding events are expected to rise significantly with global warming (Hirabayashi et al., 2013). This means that the annual carbon cycle of riparian area and fluvial area as a whole is subject to a more variant and stronger impact from flooding. Previous research found that with a warmer climate, there would be a large increase in flood frequency in Southeast Asia, Peninsular India, eastern Africa and the northern half of the Andes (Hirabayashi et al., 2013). Our research highlights that flooding disturbance would not only cause large carbon emission during the flooding season, but can also promote carbon sequestration in the post-flooding season. It is therefore necessary to consider the dynamic effect of flooding on ecosystems' carbon cycle especially under global climate change." (Line 467-508)

Where is the daily CO_2 flux in different months?

Explanation about the assumption of calculation has been added at the beginning of Section 3.1. The rest of Section 3.1 is restructured and the sentences that may lead to misunderstanding have been removed. In accordance with this change and the removal of Section 2.3 (see response to Section 3.5), we have also added a new Section 2.2.4 "Annual riparian and river CO_2 emission calculation" to show how we use the measured CO_2 flux to evaluate the carbon balance of the whole region (see response to the comment on Lines 189-194), with assumption about different flooding seasons, flooding characteristics, riparian characteristics. See below for details.

"We assume that diel CO_2 flux follows similar patterns as measured on the selected days during the pre-flooding and post-flooding season. Based on this assumption, we compared the diel CO_2 flux of pre-flooding season and post-flooding season. In order to evaluate the effect of vegetation on riparian CO_2 flux, we directly measured the CO_2 fluxes in the riparian area with and without vegetation (bare soil) in different seasons." (Line 266-269)

Lines 180-183, is that due to the effects of climate? Without exclusion of the climate effects, I think you can’t reach the conclusion that “in post-flooding season, the terrestrial area with vegetation sequestrates carbon for a longer time”.

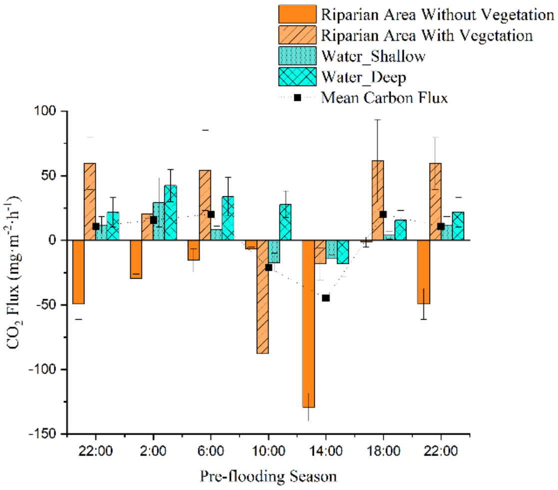
We have checked the climate factors of Lijiang River to see whether the change is due to the effects of climate. The climate factors in April (before flooding season) and October (after flooding season) are actually very similar. Based on the latitude and longitude of the studied area, it is easy to calculate that the sunrise time, sunset time and daylength of April are around 5:40, 18:14, and 12.5 hours; of October are 6:17, 17:43, and 11.42 hours. Thus, the sunrise time is later in October, and the daylength time is even shorter than October. Therefore, we do not think the longer carbon sequestration time occurred in this study is relevant to daytime change in Lijiang riparian area.

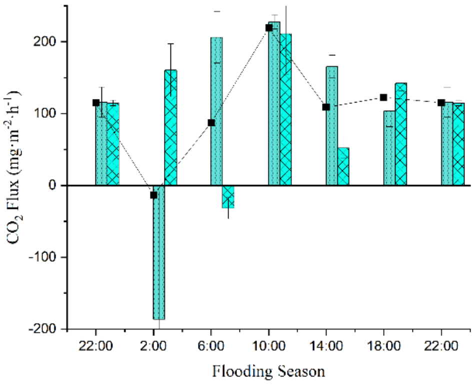
The temperature conditions are also similar (Minimum average temperature: April: 16℃, October: 17℃，Maximum average temperature: April: 23℃, October: 26 ℃). As for the precipitation, the rainfall in April (224mm) is even higher than October (85mm), which is not beneficial for plant growth and carbon sequestration. Thus, we do not think the enhanced carbon sequestration ability or the longer carbon sequestration time is caused by the season change itself in the studied area.

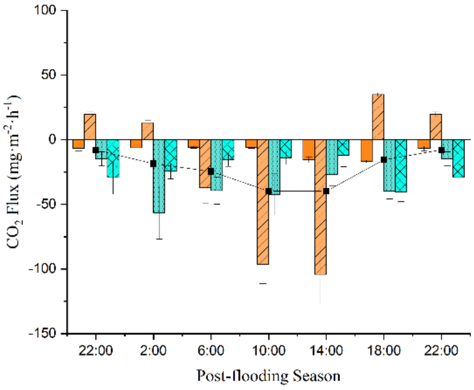
We suggest that vegetation is one of the most dynamic biotic factors affecting riparian carbon cycle and stronger and longer carbon accumulation during the post-flooding period could be due to a systematic change in riparian vegetation composition after flooding. As has been discussed in discussion (section 4.2), survived riparian vegetation had a higher tolerance to water submergence and high carbon uptake capacity. The carbon uptake of vegetation reflects the effects of a series of abiotic changes, which include not only the disturbance factor like flooding, but also the climatic factors.

Figure 1, the standard deviation/error of the data should be provided.

Thanks for the suggestion. Standard deviations of data were added. See right,







Lines 189-194, you should calculate accumulated CO_2 emissions rather use the average value. Otherwise, I think you can't get the conclusion that "the riparian zone acted overall as a carbon sink".

In the revised version of manuscript, we added a new Section 2.2.4 "Annual riparian and river CO_2 emission calculation" where we explained how we calculated carbon fluxes of riparian area and fluvial area as a whole using coverage as the weight. Following the suggestion, the annual riparian and fluvial CO_2 emission are now calculated as the sum of emission in pre-flooding season, flooding season and post-flooding season, instead of averaged values of the measured fluxes. See below,

In Results:

"The riparian area is composed of vegetation area and bare soil. During the field investigation, we found the vegetation coverage in Lijiang riparian area is about 60%. Using vegetation coverage as the weight, we can get the accumulated CO_2 flux of riparian area (Section 2.2.4, equation(3))." (Line 291-295, Results 3.1)

"In both April and October, the all-day carbon fluxes in the riparian area were negative, indicating that the riparian area acted as a carbon sink in non-flooding season (April: -0.156 $g \cdot m^{-2}\ d^{-1}$, October: -0.500 $g \cdot m^{-2}\ d^{-1}$). The carbon uptake in October, which represented the post-flooding season, was higher. Overall, we found that in the post-flooding season, the riparian vegetation can sequestrate CO_2 for a longer time and fix a higher amount of carbon." (Line 299-303, Results 3.1)

"Based on the vegetation coverage and the ratio of riparian area width to river width in flooding season, we can accumulate the CO_2 flux of riparian area and the river as a whole (Section 2.2.4). The CO_2 flux of the whole region was 1.833 $g \cdot m^{-2}\ d^{-1}$ in pre-flooding season, and -0.592 $g \cdot m^{-2}\ d^{-1}$ in post-flooding season, which indicated that the whole region turned from a carbon source to a carbon sink after flooding." (Line 329-332, Results 3.2)

In Methods:

"2.2.4 Annual riparian and river CO_2 emission calculation

We are interested in whether or under what conditions the riparian area and the fluvial area as a whole can achieve carbon neutralization (which means the net carbon emission is zero) at the annual level with flooding disturbance. We take flooding disturbance into account by dividing the whole year into pre-flooding season, flooding season, and post-flooding season. We assume that flooding events happen at an annual timescale and consider the time that flooding would happen as flooding season. The occurrence of extreme weather like rainstorms or frost is not considered here. The riparian area refers to area that would be submerged during flooding. The field investigation showed that the riparian area in the non-flooding seasons (pre-flooding season and post-flooding season) was about 25% of the river width in the flooding season, and the vegetation coverage is about 60%. Thus, the annual riparian CO_2 emission is calculated as the sum of emissions in pre-flooding season, flooding season and post-flooding season, by the following equation:

$$C_{annual} = \sum C_{i,j} = \sum W_{i,j} * D_j * a_{i,j} \tag{2}$$

Where C_{annual} is the annual expected carbon emission (C_{annual} =0 means the whole region reaches carbon neutralization at the annual level), $C_{i,j}$ is the annual CO_2 emission of river or riparian area in different seasons (i=1, 2 refer to river and riparian area respectively, j=1, 2, 3 refer to pre-flooding season, flooding season, and post-flooding season respectively), $W_{i,j}$ is the width of river or riparian area in different seasons, D_j is the days of corresponding season, and $a_{i,j}$ is the all-day CO_2 flux of river or riparian area in different seasons. Specially, during flooding season, the width of riparian area ($W_{1,2}$) is 0 meter because all the riparian area is submerged. The all-day CO_2 flux of riparian area in pre- ($a_{2,1}$) or post-flooding season ($a_{2,3}$) is calculated by the following equation:

$$a = a_{veg} * p + a_{soil} * (1 - p) \tag{3}$$

Where a_{veg} is the all-day CO_2 flux of vegetation area, a_{soil} is the CO_2 flux of bare soil area, and p is the vegetation coverage." (Line 205-224)

Table 3, the whole plant species can be shown in the supplementary data.

Thanks for the suggestion. Appendix Table 3 has been added to show the whole plant species. See below,

Appendix Table A3. The whole plant species in pre-flooding season (surveyed in April) and post-flooding season (surveyed in October).

Pre-flooding season	Post-flooding season
Aster tataricus	*Alternanthera philoxeroides*
Astragalus sinicus	*Aster tataricus*
Athyrium sinense	*Astragalus sinicus*
Cardamine hirsuta	*Cardamine hirsuta*
Carex duriuscula subsp. *stenophylloides*	*Carex polycephala* var. simplex
Carex polycephala var. simplex	*Chrysopogon aciculatus*
Chrysopogon aciculatus	*Cynodon dactylon*
Cichorium endivia	*Oxalis corymbosa*
Conyza canadensis	*Polygonum hydropiper*
Cynodon dactylon	*Polygonum lapathifolium*
Digitaria ciliaris	*Stellaria media*
Hemarthria altissima	
Lindernia antipoda	
Oxalis corymbosa	
Poa annua	
Polygonum hydropiper	
Polygonum lapathifolium	
Polygonum muricatum	
Potentilla chinensis	
Salvia plebeia	
Stellaria media	
Urena lobata	
Viola philippica	
Vitex negundo	

Section 3.5, how did you verify the model data?

In the revised manuscript, in response to the main restructuring of the manuscript's discussion (see response to section 2.3.2 above), we have decided to present this as a subsection of section 4.2 (Post-disturbance survived vegetation as a critical factor for riparian systems to sequester carbon). Therefore, instead of presenting this as a separate section and a model that needs verification, this part intends to give a general idea of how flooding and post-disturbance vegetation recovery interplay to control net carbon balance of the riparian zone on an annual scale. We argue that this change makes the manuscript more coherent and evidence-based. See related changes in discussion below.

"Our results suggest, on an annual scale, riparian area behaves either as a net source or sink of carbon depending on the relative importance between enhanced emission during flooding and the strength of post-disturbance carbon absorbance. Assuming the carbon flux rates of flooding season and non-flooding seasons were the same as we have measured on the selected days (Section 2.2.4, Fig.1-2), we estimated that the riparian area and the fluvial area as a whole can achieve carbon neutralization(C_{annual}=0) only when flooding days are fewer than 15 days. Therefore, the relative ratio of flooding to non-flooding days are essential factors to determine whether the riparian area is a net source or sink on an annual scale, and future long-term, high-frequency measurements are required to monitor the carbon dynamics of the riparian zone. Also, besides the contribution of recovered vegetation, our data shows that bare soil also contributes to the carbon neutralization, but the mechanism for bare soil to capture carbon still needs further analysis." (Line 491-500)

The unit should be kept the same through the manuscript. For example, the CO_2 flux is expressed as $g·m^{-2}$ d^{-1}, $g·m^{-2}$ $year^{-1}$, and $mg·m^{-2}$ h^{-1}.

We have checked throughout the manuscript, and we ensure that all CO_2 fluxes were expressed in the unit of $mg·m^{-2}$ h^{-1} when describing the CO_2 flux of different measuring time within a diel cycle, and in the unit of $g·m^{-2}$ d^{-1} when describing the integrated all-day CO_2 flux.

Figure 5, the unit should be $Gg·m^{-2}$ $year^{-1}$?

In response to the main re-structuring of the manuscript's discussion (see response to comments on section 2.3.2), Figure 5 has been removed from the revised manuscript.

Section 3.6, how did you upscale the site CO_2 flux to a global/regional CO_2 flux? Did you consider the effects of temperature, vegetation, seasonal changes, variations of soils etc.? If not, it is hard to believe the data.

We appreciate this comment. We have carefully reevaluated this part. Considering this part was only loosely connected to main arguments of the manuscript and that we were not able to give a comprehensive evaluation of the carbon uptake potential for global riparian areas (e.g., taking into account the systematic differences in global riparian vegetation, soil and hydrology), this part and related sections in result (section 3.6) and discussion (section 4.4) were removed in the revised manuscript. See also response to section 2.3.2 above.

Lines 357-361, again, you couldn’t conclude a net emission by using the average flux data.

As suggested in the comment to Line 189-194, we used the accumulated rather than averaged carbon flux to evaluate the carbon balance of the whole area. We added a new section 2.2.4 in the revised manuscript to explain the calculation. See also response to Line 189-194.

Section 4.3, I didn’t find any data of microbiology. So please delete this part.

In response to the comment on section 2.3.2, we have substantially restructured the discussion and this part was removed from the main discussion sections in the revised manuscript. See also response to comment to section 2.3.2 above.

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