Dear Editors and Reviewers:

Thank you for your letter and for the reviewers' comments concerning our manuscript entitled "CO_2 flux characteristics of the grassland ecosystem and its response to environmental factors in the dry-hot valley of Jinsha River, China" (Manuscript No: egusphere-2024-1226). Those comments are all valuable and very helpful for revising and improving our paper, as well as the important guiding significance to our research. We have studied comments carefully and have made the correction which we hope meet with approval. The main corrections in the paper and the responses to the reviewer's comments are as flowing:

Reviewer #1:

Question 1: I still believe that this must just be called an open savanna. Because the start of this sentence because about "this ecosystems, which refers to savanna, then it just mentions CO_2 flues of grassland. Maybe this can be ignored but understanding that savanna and grasslands are two different biomes this grouping of a grassland and savanna causes confusion.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript.

The vegetation community in the study area is mainly composed of grasses, with sparse woody plants and the carbon source-sink pattern of the ecosystem is primarily controlled by the herbaceous layer, where even minor changes in the CO_2 flux of herbaceous plants can significantly affect the carbon balance of the entire region. Therefore, we focused our research on the dominant grassy layer within the area. However, as the reviewer pointed out, grasslands and savanna are two different biotic communities, and classifying them together can lead to confusion. The reviewer's suggestion to refer to them as "open savanna" is an excellent one. In line with the actual conditions of the study area, and to better highlight the research focus of the manuscript, we have decided to adopt the reviewer's recommendation and change the term "grassland" to "open savanna" in the manuscript. At the same time, we have also modified the relevant content of the manuscript.

Question 2: carbon (C)

Response: Thanks for your kind suggestions. We have revised the full text of the manuscript according to the suggestion of the reviewer.

Question 3: My confusion starts here. Above you introduce grasslands, that they cover 40% etc, and now from the above you jump to savanna. There is a disconnect

between these paragraphs. If you are focusing on the grassy layer within savanna system, maybe it is important to be clear and just discuss savannas dynamics and then mention that any changes in the dominant grassy layer (open savanna) will affect the CO_2 flux.... However, this may be ignored provided the editor things it is not confusing or does not affect the story of this paper. I just struggle to follow the flow and structure of this introduction.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. To more clearly express the narrative of this paper and enhance the coherence between different contexts, we have adjusted and revised the introduction section of the manuscript based on the reviewers' comments, particularly by further emphasizing the ecological significance of the research we conducted, providing a stronger background to support the findings (Line: 54−110).

Question 4: climate, herbivory, and fire are the key drivers of savanna dynamics globally (to my knowledge).

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. Previous studies have shown that hydrological conditions primarily control the internal structure and vegetation community composition of savanna ecosystems, while climate, fire, and anthropogenic disturbance determine and control the distribution of the savanna. In response to the reviewers' comments, we have supplemented the corresponding content in the manuscript (Line: 64−66).

Question 5: This is not true! the following statement is true "mainly composed of grass, with sparse distribution of trees and shrubs".

Response: We have revised the manuscript according to the suggestion of the reviewer (Line: 67−68).

Question 6: Are you referring to the savanna here that it is a huge component of the grassland?

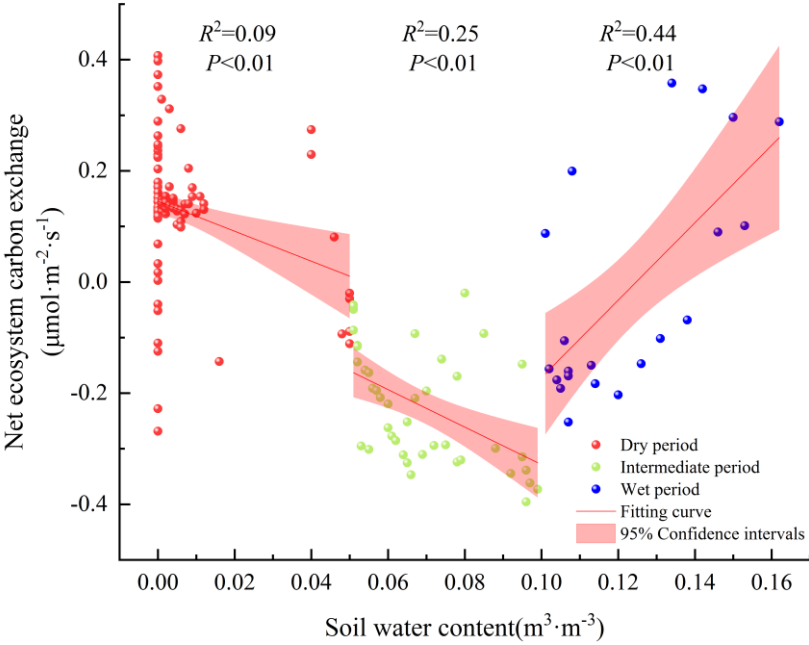
Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. To better highlight the research theme of the article, we have revised the content of the manuscript in conjunction with the findings of Grace et al (2006) (Line: 69−72).

We tried our best to improve the manuscript and made some changes marked in yellow in revised paper which will not influence the content and framework of the paper. We appreciate for Editors/Reviewers' warm work earnestly, and hope the correction

will meet with approval. Once again, thank you very much for your comments and suggestions.

Reviewer #2:

Question 1: Spelling error in Figure 8 (Dyr, instead of Dry)

Response: We sincerely appreciate the valuable comments. According to the reviewer's suggestion, we corrected the error content in the original Figure 8.

We tried our best to improve the manuscript and made some changes marked in yellow in revised paper which will not influence the content and framework of the paper. We appreciate for Editors/Reviewers' warm work earnestly, and hope the correction will meet with approval. Once again, thank you very much for your comments and suggestions. The following table is a list of specific changes to the article.

Editor #1:

Question 1: Lack of In-Depth Statistical Analysis: The manuscript does not sufficiently explore the environmental drivers.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. To delve deeper into the environmental drivers of carbon flux, we have employed a quadratic regression model, in addition to the original Pearson correlation analysis, to further quantitatively analyze and predict the response of NEE to Ta, Ts, RH, VPD, P, and SWC, as shown in Figures 8, 9, and 10. Simultaneously, we have supplemented and refined the relevant content in the discussion section of the manuscript based on the results of the quadratic regression model (Line: 384−534).

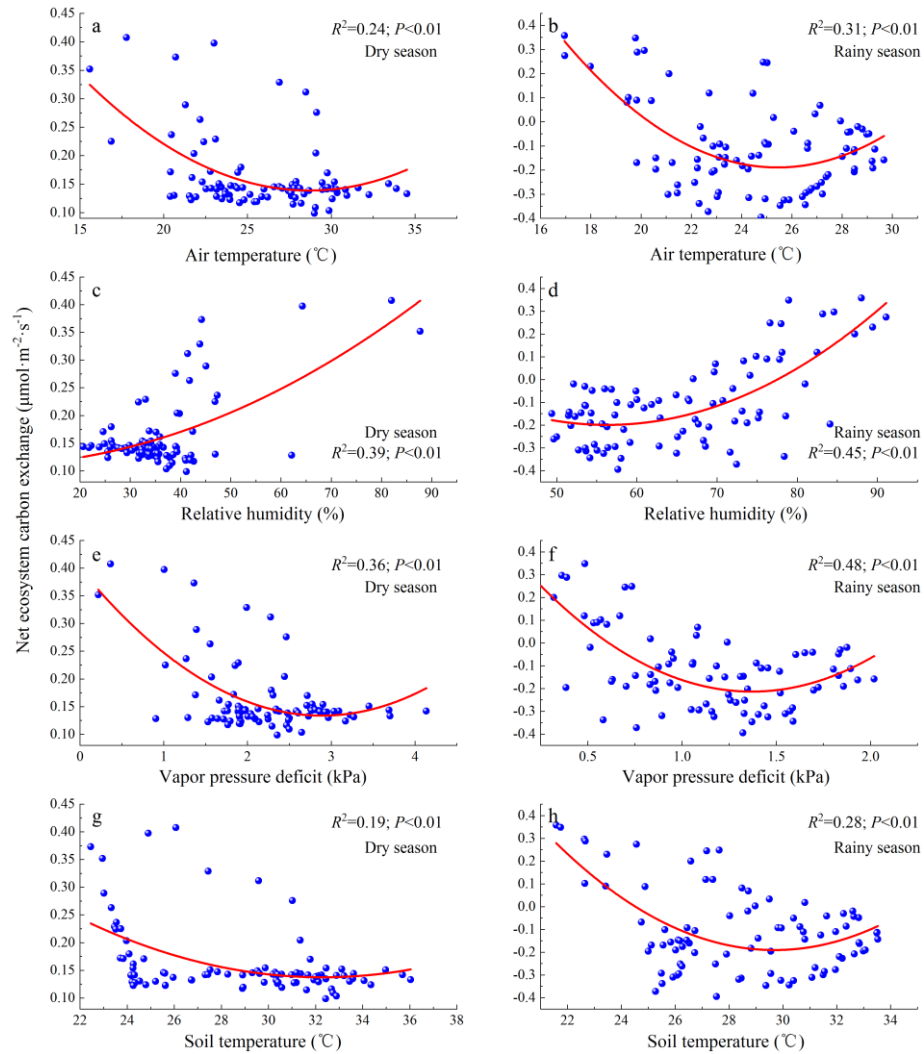



Figure 8 The response of Fc to environmental factors (a–the response of NEE to Ta in dry season; b–the response of NEE to Ta in rainy season; c–the response of NEE to RH in dry season; d–the response of NEE to RH in rainy season; e–the response of NEE to VPD in dry season; f–the response of NEE to VPD in rainy season; g–the response of NEE to Ts in dry season; h–the response of NEE to Ts in rainy season).

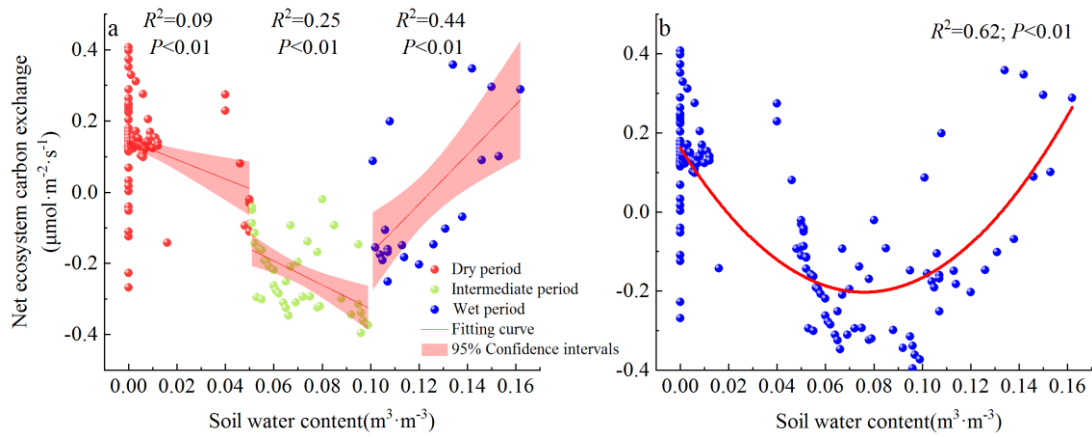



Figure 9 Effects of SWC on Fc (a–the relationship between NEE and SWC; b–the response of annual NEE to SWC).

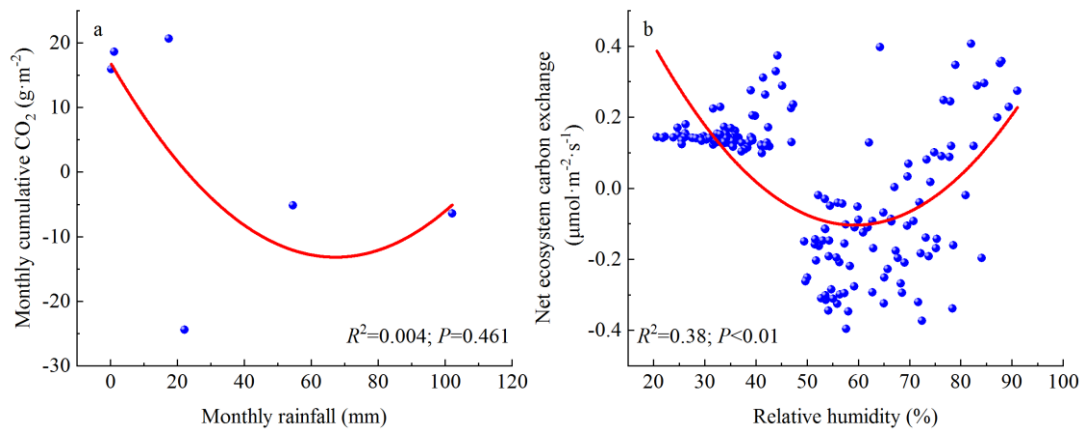



Figure 10 The response of Fc to monthly rainfall and annual RH (a–the response of monthly cumulative CO_2 to monthly rainfall; b–the response of annual NEE to RH).

Question 2: Missing Discussion of Ecological Significance: This aspect needs to be explicitly addressed to provide a stronger contextual basis for the findings.

Response: Thanks for your kind suggestions. To further clarify and elucidate the ecological significance of the research content we have conducted, and to provide stronger background support for the research findings, in accordance with the suggestions of the associate editor, we have made comprehensive revisions to the introduction and discussion sections (Line: 54−110, 375−383, and 510−534).

Overall, with the intensification of global climate change, predicting the future carbon sequestration potential of terrestrial ecosystems will be of great significance for formulating climate change adaptation strategies. However, due to the potential changes in precipitation patterns and rising temperatures associated with global climate change, the frequency and intensity of extreme climate events, particularly heatwaves and droughts, are expected to continue increasing over the next decade. This will have profound impacts on the carbon source/sink dynamics of terrestrial ecosystems,

especially complicating the carbon cycling processes and their response mechanisms. This significantly hinders researchers from further deepening their understanding and accurately predicting the carbon budget characteristics of terrestrial ecosystems under future climate change. The Jinsha River dry-hot valley ecosystem is a non-zonal special thermal island habitat in the global temperate zone. Revealing the carbon flux changes of this ecosystem and its response mechanisms to environmental factors will play a crucial role in accurately predicting the carbon sequestration capacity of global terrestrial ecosystems, particularly temperate ecosystems, under future extreme drought conditions.

Question 3: Uncertainty Analysis: While confidence intervals are presented in Figure 8, a comprehensive uncertainty analysis is absent and should be included.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have supplemented the manuscript with content related to deterministic analysis. On one hand, we have supplemented the research findings of previous studies, enhancing the certainty and credibility of the analysis results. On the other hand, we have analyzed the correlation coefficients between SWC and NEE under conditions where other environmental factors such as temperature, radiation, and humidity were controlled or not ($R = -0.546$, $P < 0.001$; $R = -0.535$, $P < 0.001$). The results indicate that there is no significant difference, suggesting that other environmental factors have no significant impact on the nonlinear relationship between NEE and SWC (Line: 446−461).

Question 4: Causal Network Analysis (Figure 7): Many causal links appear to be missing, reducing the interpretative power of the analysis. As it stands, the figure is more akin to a correlation matrix than a robust causal network.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. To express the influence of environmental factors on NEE and the interrelationships among different environmental factors more clearly, and to further enhance the interpretability of the research findings in the manuscript, we have revised the content of Figure 7 in the manuscript. Additionally, in conjunction with the newly revised figures, we have improved and supplemented certain sections of the manuscript (Line: 324−351).

Question 5: Figure 1 may contain a territory that is disputed according to the United Nations. If and when the manuscript is accepted for final revised publication, you will be asked to choose one of the following options: (a) you could remove the

disputed territory from the map and submit new figure files, or (b) we could add a statement that some figures contain disputed territories.

Response: Thanks for your kind suggestions. According to the requirements of the deputy editor, we have modified Figure 1.

We tried our best to improve the manuscript and made some changes marked in yellow in revised paper which will not influence the content and framework of the paper. We appreciate for Editors/Reviewers' warm work earnestly, and hope the correction will meet with approval. Once again, thank you very much for your comments and suggestions.

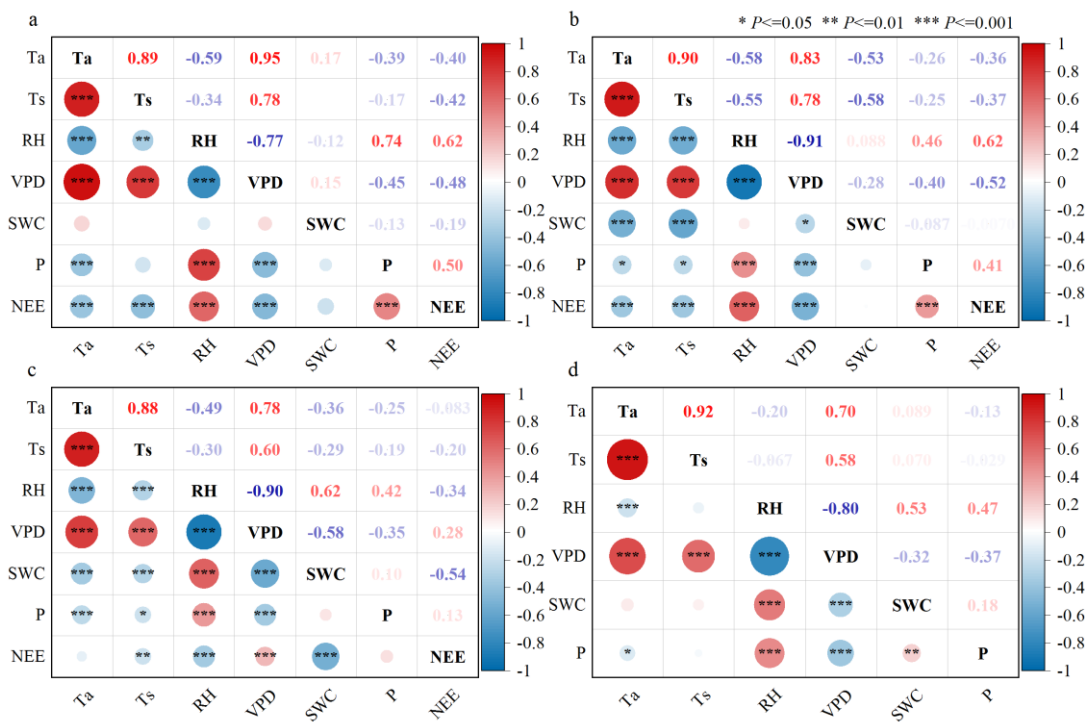



Figure 7 The Pearson correlation between Fc and environmental factors (a–daily scales of the dry season; b–daily scales of the rainy season; c–annual daily scales; d–the correlation between different environmental factors, the data is consistent with Fig. 2).

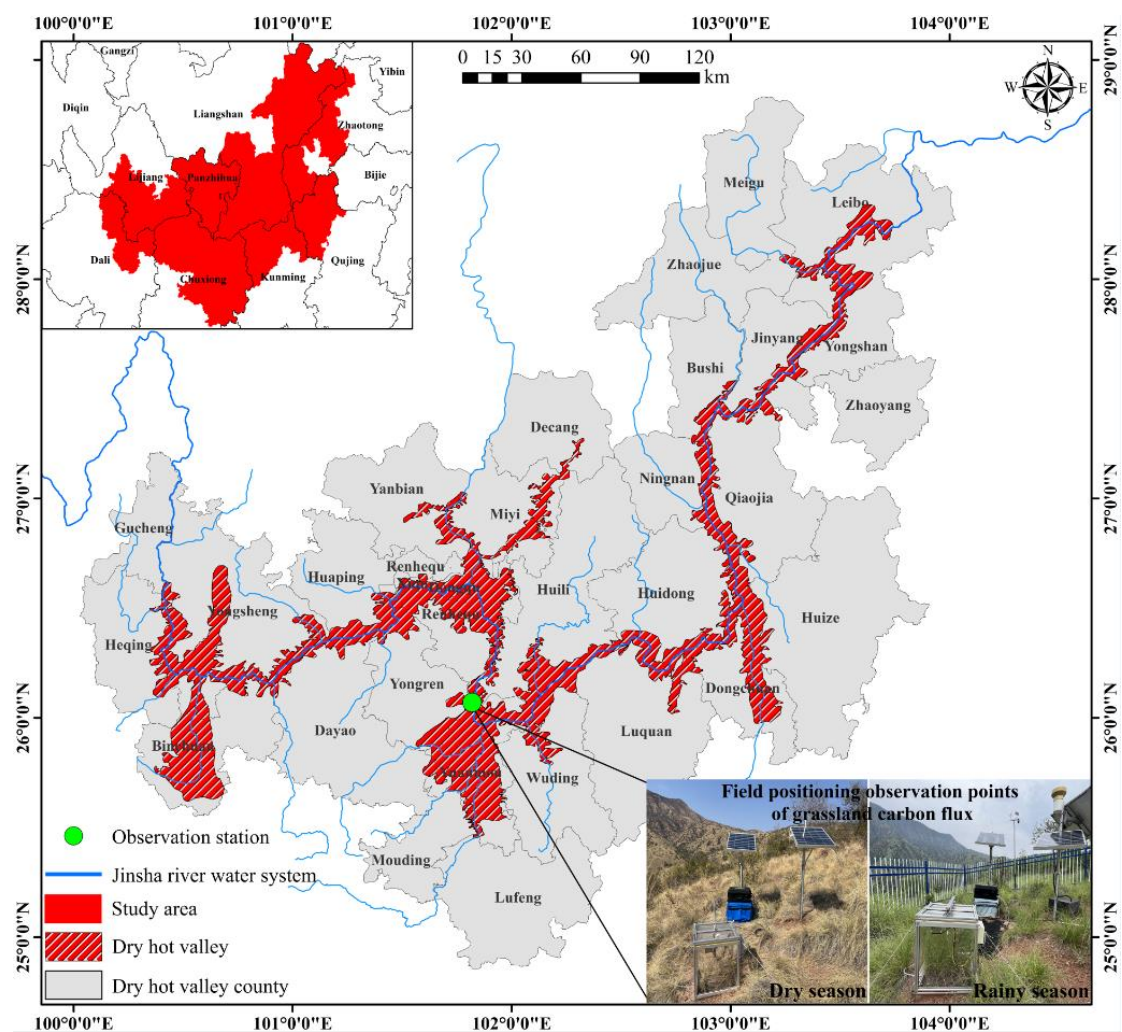



Figure 1 Range of dry-hot valley in JS and location of the Jinsha River Field Observation Station.