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: The study introduction explains more about savanna systems but the paper is on grassland, does this mean it focus on open savanna compared to close savanna?

Response: We sincerely appreciate the valuable comments. Due to the unique hydrothermal conditions, the vegetation in the valley-type savanna of the dry-hot valley in China is primarily composed of herbaceous plants, with trees and shrubs being sparse. Grasslands are an important component of this ecosystem. Therefore, the main focus of our manuscript is on the open savanna. At the suggestion of the reviewer, we have made this clear in the manuscript (Line: 85−87).

Question 2: No clear aim or at least objectives.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. In order to state the purpose of the study more clearly, we have revised and improved the ABSTRACT (Line: 20−28).

Question 3: I read this but i do not get the "so what" answer. There seems to be no conclusion in this abstract.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. According to the reviewer's suggestion, we have rewritten the ABSTRACT of the manuscript (Line: 28−45).

Question 4: This sentence seems too long, this can me made a second sentence.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have modified the sentence of the manuscript according to the reviewer's suggestion (Line: 51−54).

Question 5: Again this is too long, combining many ideas.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have modified the sentence of the manuscript according to the reviewer's suggestion (Line: 54−59).

Question 6: Same comment applies here.

Response: Thanks for your suggestion. We have revised the manuscript according to the suggestion of the reviewer. We have modified the sentence of the manuscript according to the reviewer's suggestion (Line: 59−63).

Question 7: Maybe moving references to the end of the sentence or each idea to have its own sentence will help.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have revised the manuscript according to the suggestion of the reviewer (Line: 68−72).

Question 8: Related researchers? I am not to what this related.

Response: We sincerely appreciate the valuable comments. We have pointed out specific researchers in the manuscript according to the reviewer's suggestion (Line: 72).

Question 9: What does this mean?

Response: We sincerely appreciate the valuable comments. As savannas contain C_4 grasses, the plant is called efficient photosynthesis plant, and they may be expected to be highly productive but the data suggest they are only moderately productive. We have added specific data to the manuscript (Line: 73).

Question 10: You mean mostly seasonal?

Response: We sincerely appreciate the valuable comments. The view expressed in the manuscript is that the carbon flux of the savanna ecosystem has significantly different characteristics in the dry season and the rainy season. We have modified the relevant content in the manuscript (Line: 74−75).

Question 11: Reference please, 2/3? Does this include the dry savanna systems with rainfall less than 400 mm per year?

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. The '2/3' mentioned in our manuscript mainly comes from the research results of 'Productivity and carbon fluxes of tropical savannas' by Grace et al. (2006). The ecosystem mentioned in the manuscript includes the dry savanna systems with rainfall less than 400 mm per year. We have supplemented the corresponding References according to the opinions of the reviewers (Line: 75−77).

Question 12: I think you must use “C” and “SOC” for Carbon and Soil organic Crabon respectively. But you will need to indicate this when you first mention these words in your manuscript.

Response: We sincerely appreciate the valuable comments. We have revised the manuscript according to the suggestion of the reviewer. In the revised version, changes to our manuscript were all highlighted within the document by marked in yellow.

Question 13: since?

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 82).

Question 14: I do not think this is the right word to use, maybe say “some researchers”

Response: We sincerely appreciate the valuable comments, and have revised the manuscript according to the suggestion of the reviewer (Line: 83).

Question 15: rephrase or delete one of these words

Response: Thanks for your kind suggestions. We have revised the manuscript according to the suggestion of the reviewer (Line: 89).

Question 16: does this mean lack of rivers? What does lack of water sources mean?

Response: We sincerely appreciate the valuable comments. The original intention of the manuscript is to refer to the drought and less rain in the study area. In order to avoid ambiguity, we revised the content of the manuscript (Line: 90−91).

Question 17: replace with ‘showed’ or ‘reported’ or ‘found’

Response: We sincerely appreciate the valuable comments. We have revised the manuscript according to the suggestion of the reviewer (Line: 97).

Question 18: This is an important statement but the first part must be rephrased to something like, “with expected increase in temperatures and unpredictable rainfall events driven by climate change, this ecosystem’s C sink ability could potentially decrease”

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have revised the manuscript according to the suggestion of the reviewer (Line: 101−102).

Question 19: I don’t think these words are fit for a scientific manuscript, rather. Please rephrase. For me, these words work well in popular news letters not scientific writing.

Response: We sincerely appreciate the valuable comments. We have revised the manuscript according to the suggestion of the reviewer (Line: 101−102).

Question 20: Monitoring

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have revised the manuscript according to the suggestion of the reviewer (Line: 104).

Question 21: Your introduction is on the savanna ecosystem but now you focus on the grassland? I am confused.

Response: We sincerely appreciate the valuable comments. Due to the specific hydrological and thermal conditions, the vegetation in the savanna ecosystem is primarily composed of grasses, with sparse distribution of trees and shrubs. Therefore, grasslands are a key component of this ecosystem. The same is true for the valley-type savanna ecosystem in the dry-hot valleys of China, where grasslands play a crucial role. The dynamic changes in grassland carbon flux will significantly impact the carbon balance of the entire river valley-type savanna ecosystem. Therefore, studying the carbon flux characteristics of grassland ecosystems in this region is of great practical significance and scientific value for clarifying the carbon source-sink patterns of the river valley-type savanna ecosystem. To further emphasize and clarify the significance and objectives of the research, we have added relevant content in the introduction section (Line: 106−117).

Question 22: The study must state clearly the aims, the objectives and/or hypotheses. Currently it is not clearly stated.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. In order to state the purpose of the study more clearly, we have revised and improved the Introduction (Line: 106−117).

Question 23: The current study showed that....

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have revised the manuscript according to the suggestion of the reviewer (Line: 378).

Question 24: This is the discussion, try to avoid referencing the tables. I see that this table is important but it should have been stated in the result section, here you need to include key references

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. According to the reviewer's suggestion, we re-summarized and discussed the data in the table, and retained some key references (Line: 385−395).

Question 25: I think the conclusion is currently too long and is a re stating of the results without stating what these finding mean for the brother picture. I like the first part stating the limitations of the study but the conclusion is not well written in this current state.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. On the advice of the reviewers, we have rewritten the second part of the conclusions of the manuscript (Line: 550−567).

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.

Serial Number	Line	Revised Contents
1	85−87	The savanna ecosystem in China is mainly manifested as the ecological landscape of the valley-type sparsely shrub-grass vegetation distributed in the special geographical unit of the dry-hot valley, which is similar to the tropical savannas, it belongs to the open savanna ecosystem.
2	20−28	The savanna ecosystem in the dry-hot valley of the Jinsha River is a unique non-zonal heat island habitat in the global temperate region. As a key component of this ecosystem, even minor changes in the CO_2 flux of grasslands can significantly impact the carbon budget of the area. However, there is currently a lack of field monitoring data and related research reports. To reveal the dynamic characteristics of grassland CO_2 flux in the Jinsha River dry-hot valley and to quantitatively assess the annual CO_2 flux, this study conducted long-term fixed-point observations of CO_2 flux changes in grasslands using the static chamber method. Additionally, the effects of various environmental factors on CO_2 flux were examined, and the variations in grassland CO_2 flux under future drought and rainless climate scenarios were also analyzed.
3	28−45	The results showed that during the dry season, the grassland in the Jinsha River dry-hot valley exhibited a carbon emission state, with an average daily CO_2 flux of 0.1632 $\mu mol \cdot m^{-2}$ s^{-1} and a cumulative CO_2 emission of 1.3215 t ha^{-1}. In contrast, during the rainy season, the grassland demonstrated significant carbon absorption characteristics, with an average daily CO2 flux of −0.1062 $\mu mol \cdot m^{-2}$ s^{-1} and a cumulative CO_2 absorption of 0.6137 t ha^{-1}. From a yearly perspective, the grassland ecosystem acted as a weak carbon source, with an annual cumulative CO_2 emission of 0.7078 t ha^{-1} a^{-1}, exhibiting carbon-neutral characteristics. In terms of environmental factors, the influence of temperature factors on the variation of CO_2 flux in the grassland was generally weak, which was related to the small temperature differences at different time scales in the study area. Precipitation primarily controlled the variation of CO_2 flux in the grassland indirectly by affecting soil moisture content and relative humidity. When soil water content was at the dry and intermediate periods, the net ecosystem carbon exchange of the grassland significantly decreased with increasing soil water content. However, when soil water content exceeded a certain threshold, further increases in soil moisture lead to an increase in net ecosystem carbon exchange. Additionally, reductions in relative humidity and increases in vapor pressure deficit also suppressed the carbon absorption capacity of the grassland. Overall, under future scenarios of sustained drought and low precipitation, the CO_2 emissions from the grassland ecosystem in the Jinsha River dry-hot valley may continue to rise.

4	51−54	Since the industrial revolution, human economic and social progress heavily relied on fossil energy consumption. The excessive emissions of greenhouse gases such as CO_2 have been considered to be the main cause of increased atmospheric CO_2 concentration and global warming (Sha et al., 2022; Wang et al., 2023).
5	54−59	The terrestrial ecosystem can absorb about 15.0%–30.0% of anthropogenic CO_2 emissions per year, and the carbon (C) neutrality capacity index reaches 27.14% (Green et al., 2019; Bai et al., 2023; Liu et al., 2023; Zeng et al., 2023). This makes it a significant C sink (Piao et al., 2018; Yang et al., 2022). Studying the dynamic changes in the C budget of global terrestrial ecosystems, along with their environmental driving factors, has become an important topic in the field of global change (Houghton, 2001; Bai et al., 2023).
6	59−63	Grasslands cover about 40.5% of the global land surface and are a crucial component of terrestrial ecosystems (Bai et al., 2022). Their carbon storage (CS) accounts for approximately 1/3 of the total terrestrial CS worldwide, which is equivalent to that of forest ecosystems and significantly influences the global C balance (White et al., 2000; Wang et al., 2021).
7	68−72	Being a significant component of the worldwide grassland ecosystem, its net primary productivity (NPP) accounts for about 30.0% of the total NPP of terrestrial ecosystems, which has significant impacts on global material cycling, energy flow, and climate change (Grace et al., 2006; Peel et al., 2007; Dobson et al., 2022).
8	72	Grace et al. (2006) indicated that the herbaceous plants in the savanna ecosystem are mainly C_4 grasses, but only moderate productivity, the average NPP was 7.2 ± 2.0 t C ha^{-1} a^{-1}, and the CO_2 flux (F*c*) of the savanna ecosystem has significantly different characteristics in the dry season and the rainy season.
9	73	
10	74−75	
11	75−77	The rainy season is mainly dominated by C absorption, and the maximum net rate of C fixation can reach 2/3 of the maximum value of the tropical rainforest (Grace et al., 2006).
12	full-text	In the revised version, changes to our manuscript were all highlighted within the document by marked in yellow.
13	82	Simultaneously, since the savanna ecosystem mainly stores C in the soil rather than the biomass of trees, some researchers have suggested that it may emerge as a more significant C sink resource than forests in the future (Dobson et al., 2022).
14	83	

<table>
<tr><td>15</td><td>89</td><td rowspan="2">It is mainly distributed in the Yuanjiang (YJ), Nu River, and Jinsha River (JS), and their tributaries in southwest China. The ecosystem is characterized by low annual rainfall, high average annual temperature, and high evaporation.</td></tr>
<tr><td>16</td><td>90−91</td></tr>
<tr><td>17</td><td>97</td><td>Yang et al. (2020) found that the ………</td></tr>
<tr><td>18</td><td>101−102</td><td rowspan="2">With expected increase in temperatures and unpredictable rainfall events driven by climate change, this ecosystem’s C sink ability could potentially decrease.</td></tr>
<tr><td>19</td><td>101−102</td></tr>
<tr><td>20</td><td>104</td><td>However, monitoring and research on the Fc features in this region is still lacking.</td></tr>
<tr><td>21</td><td>106−117</td><td rowspan="2">Similar to the tropical savanna ecosystem, grassland ecosystems play an important role in the dry-hot valley savanna ecosystem in JS and are a key component of the plant community in this region. Even small dynamic changes in grassland Fc will significantly affect the C balance of the entire valley-type savanna ecosystem and the surrounding area. This study focuses on the grassland ecosystem in the dry-hot valley of JS, using the static chamber method to observe the Fc of the grassland. The aim is to clarify the dynamic characteristics of grassland Fc and its correlation with environmental factors, quantitatively assess the annual Fc of the grassland, and attempt to address the trends of Fc changes in the dry-hot valley grasslands under future drought and low precipitation climate scenarios. This is done to offer a scientific reference for in-depth comprehension of the key processes of carbon cycle in the valley-type savanna in China, and to study and predict the ecological function changes of vegetation carbon sequestration under continuous drought and high temperature stress in the future.</td></tr>
<tr><td>22</td><td>106−117</td></tr>
<tr><td>23</td><td>378</td><td>The current study showed that ………</td></tr>
<tr><td>24</td><td>385−395</td><td>Fei et al. (2017b) found that most savanna ecosystems globally demonstrate C sequestration features, with only a few exhibiting characteristics of C emissions, with the NEE varying from around –3.87 to 1.28 t C ha^{-1} a^{-1}. Among them, the savanna ecosystem with C source characteristics is mainly grassland savanna and semi-arid savanna, especially the grassland savanna has the largest annual C emissions (Archibald et al., 2009; Hutley et al., 2005; Quansah et al., 2015), which is similar to the results of this study. In the arid/semi-arid regions of China, the NEE of different grassland ecosystems varies between –3.08 to 0.96 t C ha^{-1} a^{-1} (Du et al., 2012; Niu et al., 2018; Chen et al., 2019; Zhang et al., 2020; Bai et al., 2022). We found that most grasslands act as C sinks, with only a few, such as the Horqin sandy grassland (Niu et al., 2018; Chen et al., 2019), exhibiting C source characteristics, and the C emissions (0.91 to 0.96 t C ha^{-1} a^{-1}) is higher than those of the grasslands in the JS dry-hot valley.</td></tr>
</table>

25	550−567	(1) As a result of environmental factors, the F*c* of the grassland ecosystem in the JS dry-hot valley exhibited significant temporal variations. During the dry season, the grassland functioned as a C source, with the daily variation of F*c* showing a ‘W’-shaped bimodal curve. In contrast, during the rainy season, the grassland functioned as a C sinks, with the daily variation of F*c* displaying a ‘U’-shaped unimodal curve. (2) The F*c* of grasslands during the dry season was primarily influenced by RH. During the rainy season, F*c* was significantly affected not only by PAR but also by SWC, RH, and VPD. Overall, SWC, RH, and VPD were the primary environmental factors influencing grassland F*c*. Particularly when SWC was within an optimal range, an increase in SWC can effectively enhance the C absorption capacity of the grassland. However, when SWC was in a wet period, an increase in SWC will lead to a rise in the ecosystem’s NEE. (3) The grassland in the JS dry-hot valley was a weak C source, which was closely related to the continuous reduction in precipitation in recent years. As precipitation continues to decline, the C sequestration capacity of herbaceous plants will significantly decrease, resulting in increased CO_2 emissions from the grasslands in the study area. Under a future climate scenario of continuous high temperatures and drought, the plant community structure in some temperate regions may shift to savanna, and the grasslands in these regions may shift from being C sinks to C sources, thereby impacting the global C balance.

Reviewer #2:

Question 1: No clear objectives or hypotheses presented in the introduction, and heavy on the savanna literature while the actual study focuses on a grassland system. I suggest the authors clearly indicate their objectives and/hypotheses for the study. The discussion already provides a split of themes that can be redefined as possible objectives for the study and clearly indicated in the introduction section.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. Due to the specific hydrological and thermal conditions, the vegetation in the savanna ecosystem is primarily composed of grasses, with sparse distribution of trees and shrubs. Therefore, grasslands are a key component of this ecosystem. The same is true for the valley-type savanna ecosystem in the dry-hot valleys of China, where grasslands play a crucial role. The dynamic changes in grassland carbon flux will significantly impact the carbon balance of the entire river valley-type savanna ecosystem. Therefore, studying the carbon flux characteristics of grassland ecosystems in this region is of great practical significance and scientific value for clarifying the carbon source-sink patterns of the river valley-type savanna ecosystem. To further emphasize and clarify the significance and objectives of the research, we have added relevant content in the introduction section (Line: 106−117).

Question 2: Mention a couple of these problems, preferably for your area of study.

Response: We sincerely appreciate the valuable comments. We have revised the manuscript according to the suggestion of the reviewer (Line: 51−54).

Question 3: Make this a new sentence

Response: We sincerely appreciate the valuable comments. We have rewritten the sentences in the manuscript (Line: 57−59).

Question 4: Relook this sentence

Response: Thanks for your kind suggestions. We have rewritten the sentences in the manuscript (Line: 68−72).

Question 5: since

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 82).

Question 6: monitoring

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 104).

Question 7: and to calculate

Response: Thanks for your kind suggestions. We have rewritten the sentences in the manuscript (Line: 111−114).

Question 8: This is done in order to offer a scientific reference for in-depth comprehension of the key processes of carbon cycle in the valley-type savanna in China, and to study and predict the ecological function changes of vegetation carbon sequestration under continuous drought and high temperature stress in the future.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have revised the manuscript according to the suggestion of the reviewer (Line: 114−117).

Question 9: hours

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 142−143).

Question 10: logger

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 142−143).

Question 11: I suggest you replace the picture insert with a picture of your actual study site where the chambers were placed, this will provide better context to your results.

Response: We sincerely appreciate the valuable comments, and have modified the content of Figure 1 (Line: 145).

Question 12: Please list the manufacturer's name as you list the name of the instruments.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. Based on the reviewer's suggestion, we have listed the manufacturer's name in Table 1 (Line: 167).

Question 13: Write sentence in past tense

Response: We sincerely appreciate the valuable comments, and have modified the sentences in the manuscript (Line: 152−153).

The specific modifications are as follows:

Question 14: Vaisala

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have modified this error in the manuscript (Line: 156−157).

Question 15: reference?

Response: Thanks for your kind suggestions. We have added references to the manuscript (Line: 159−160).

Question 16: participate?

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have corrected the sentences in the manuscript (Line: 173−175).

Question 17: define what abnormal data are

Response: Thanks for your kind suggestions. The abnormal data mentioned in the manuscript are mainly negative data in the dry season and negative data at night in the rainy season. We have defined it in the manuscript (Line: 198−201).

Question 18: Relook at this sentence

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have modified the sentences in the manuscript (Line: 202−204).

Question 19: report your results in the past tense

Response: Thanks for your kind suggestions. We have carefully examined and revised the full text of the manuscript. In the revised version, changes to our manuscript were all highlighted within the document by marked in yellow.

Question 20: see above comment

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 228).

Question 21: see above comment

Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 228).

Question 22: What can this be attributed to?

Response: Sincerely thank you for your valuable comments, we have added the following explanation in Section 3.2. During the dry season, the herbaceous plants in the study area were in a senescent state, and the grassland ecosystem was characterized solely by soil respiration. The study by Carey et al. (2016) found that in all non-desert biomes, soil respiration increases with rising soil temperature, however, beyond a certain threshold, the soil respiration rate decreases with further temperature increases. Therefore, we believe that the diurnal variation of Fc in the grassland of the JS dry hot valley during the dry season primarily relates to the diurnal variation of temperature. From night to morning, the temperature gradually decreased, leading to a reduction in soil respiration and a decrease in Fc. It was not until around 10:00 AM that the temperature began to rise, increasing in the intensity of soil respiration and a continuous rise in Fc, reaching its peak. Subsequently, the soil respiration rate decreased with further temperature increases, and after about 5:00 PM, as the temperature gradually declined, the limitation on soil respiration weakened, and carbon flux gradually increased again. During the rainy season, the soil moisture content in the grassland was relatively high, and the increase in soil water content had an inhibitory effect on the temperature sensitivity of soil respiration (Xiang et al., 2017). As a result, the CO_2 flux during the nighttime period remained relatively stable (Line: 258−271 and Line: 279−282).

Question 23: Suggestion for further assessing the controls of SWC on NEE: It would be valuable to create SWC classes for the whole dataset for dry, intermediate and wet periods and filter NEE estimates under these classes to start seeing how NEE responds to different SWC conditions. Archibald et al. 2009 performed a similar analysis and added FAPAR measurements to distinguish between leave and non-leave periods.

Since SWC is a considerable driver of semi-arid fluxes, this would provide an added value to indicate just how the ecosystem responds to SWC controls, apart from just understanding the correlation with NEE under different time scales.

How these classes are quantitatively defined will depend on the ranges of SWC, but literature in the semi-arid ecosystems alluding to what levels of SWC can trigger productivity in grassland will be a good start.

Response: To further assess the impact of soil water content (SWC) in the dry-hot valley of the Jinsha River on net ecosystem carbon exchange (NEE), we divided the grassland soil water content into three levels based on the reviewers' suggestions: low soil water content (0 m^3 m^{-3}≤SWC≤0.05 m^3 m^{-3}), moderate soil water content (0.05 m^3 m^{-3}＜SWC≤0.10 m^3 m^{-3}), and high soil water content (0.10 m^3 m^{-3}＜SWC), corresponding to dry, intermediate, and wet periods, respectively. We then analyzed the relationship between SWC and NEE during these different periods (Fig. 8). During the dry period, SWC showed a weak negative correlation with NEE (R = −0.297, $P < 0.01$). In the intermediate period, there was a strong negative correlation between SWC and NEE (R = −0.500, $P < 0.01$). In the wet period, SWC exhibited a strong positive correlation with NEE (R = 0.661, $P < 0.01$). The results indicate that within an appropriate range of SWC, an increase in SWC can effectively enhance the C sink capacity of the grasslands in the dry-hot valley of the Jinsha River. However, when SWC exceeds a certain threshold, an increase in SWC may inhibit the C absorption capacity of the grasslands. As found by Davidson et al. (1998) and Taylor et al. (2017), net ecosystem productivity increases with rising SWC in dry environments, reaching a maximum under optimal conditions, and then decreases in waterlogged environments. Our research results support this ecological process well (Line: 462−477).

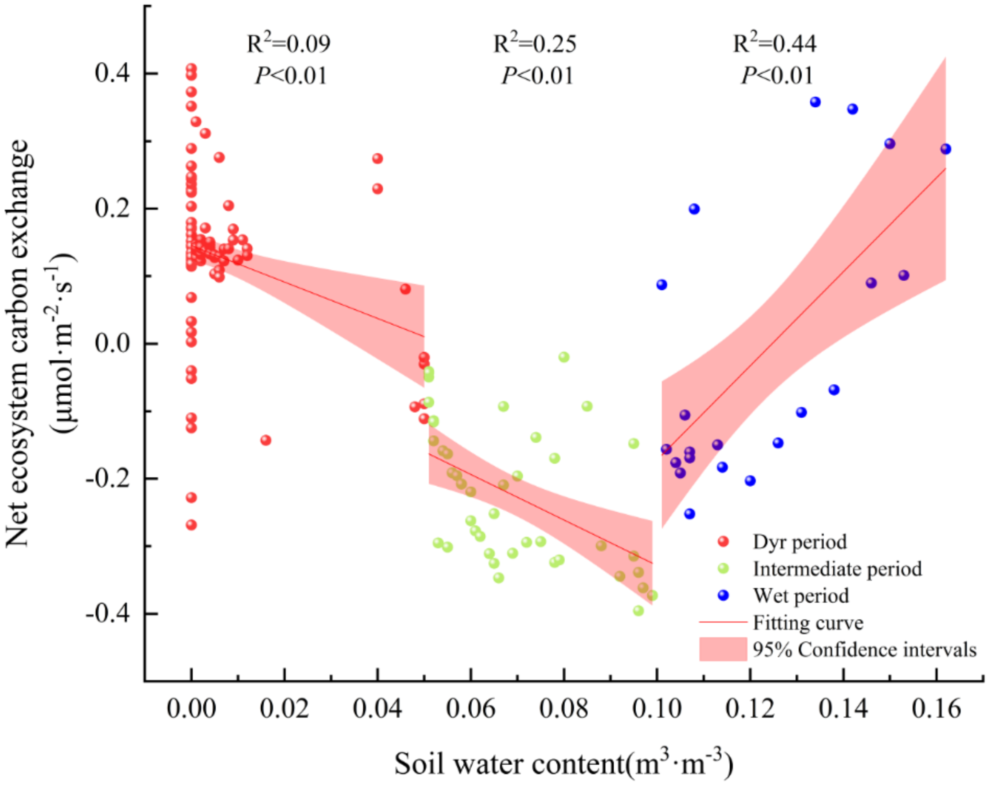


Figure 8 Relationship between NEE and SWC.

Question 24: reference

Response: Thanks for your kind suggestions. We have added references to the manuscript (Line: 413−415).

Question 25: I suggest this is moved to a supplementary section since it does not form part of the current dataset and the analysis performed. Similarly for Table 2. This just lengthens the discussion where it could be neatened up to present clear and concise ideas about the actual data. This figure (7) and the table can be referred to in the discussion but not presented within the manuscript.

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. According to the reviewer's suggestion, we re-summarized and discussed the data in the Table 2 and Figure 7, and retained some key references (Line: 378−395).

Question 26: See comment above

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. According to the reviewer's suggestion, we re-summarized and discussed the data in the Table 2 and Figure 7, and retained some key references (Line: 378−395).

Question 27: I suggest this figure is moved to section 3.1 to indicate how rainfall has been changing over the past decades and it would be necessary to also add the annual precipitation figure recorded for this study here in a different colour for better context.

Response: Thanks for your kind suggestions. We have moved the original Figure 8 to Section 3.1 and modified the content of the original Figure 8. The actual observed annual rainfall in this study was modified to other colors (Line: 247).

Question 28: which study area?

Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. We have modified the content of the manuscript (Line: 497−498).

Question 29: The main key finds can be provided as a summary in the conclusion, rather than their current format. The current conclusion only presents the limitations and the main findings. It will be necessary to refer to the statement made at the end of the introduction regarding predicting the ecological functioning changes of vegetation carbon sequestration under drought and temperature stress in the future and indicate how the current findings can be used to contribute to these predictions.

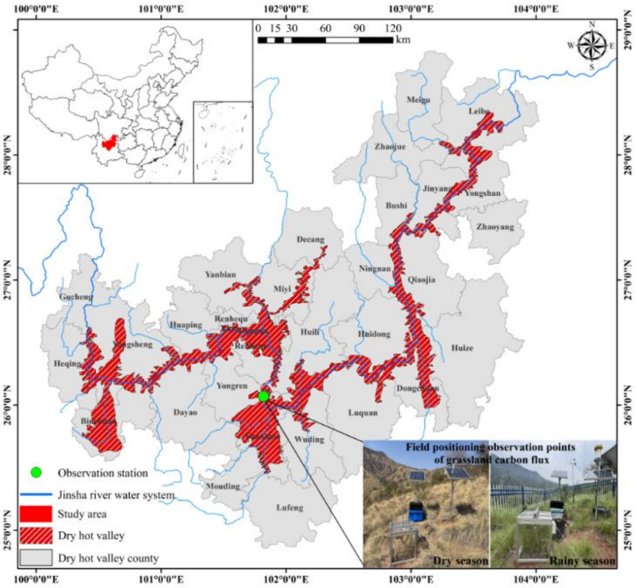
Response: Thanks for your kind suggestions, which is valuable for improving the accuracy of the manuscript. On the advice of the reviewers, we have rewritten the second part of the conclusions of the manuscript (Line: 550−567).

Question 30: covariance

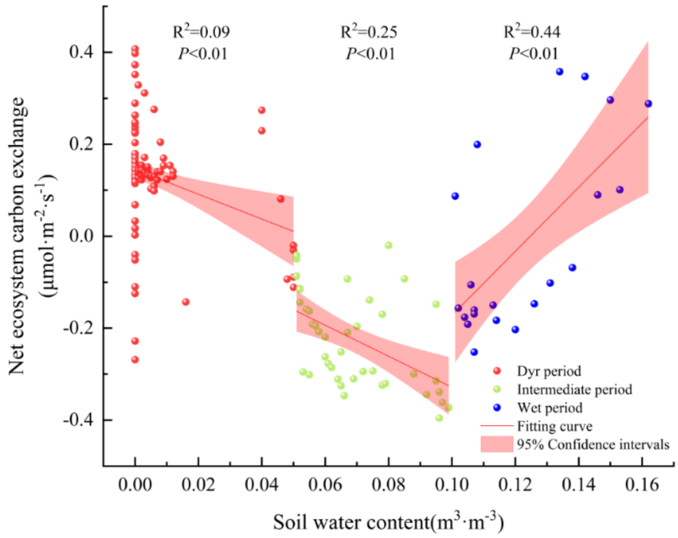
Response: We sincerely appreciate the valuable comments, and have modified this error in the manuscript (Line: 545−547).

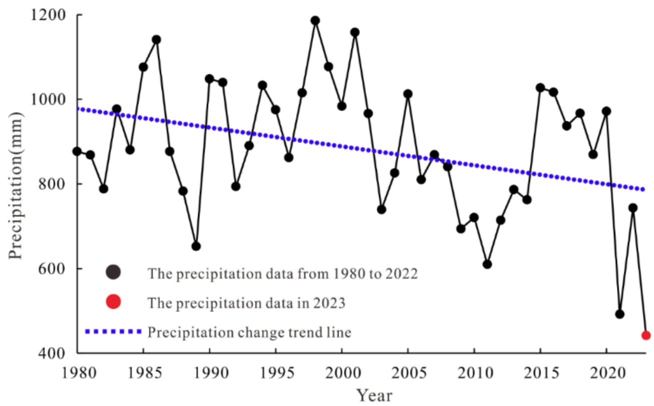
We tried our best to improve the manuscript and made some changes marked in yellow in revised paper which will not influence the content and framework of the paper. We appreciate for Editors/Reviewers' warm work earnestly, and hope the correction will meet with approval. Once again, thank you very much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

Serial Number	Line	Revised Contents
1	106−117	Similar to the tropical savanna ecosystem, grassland ecosystems play an important role in the dry-hot valley savanna ecosystem in JS and are a key component of the plant community in this region. Even small dynamic changes in grassland F*c* will significantly affect the C balance of the entire valley-type savanna ecosystem and the surrounding area. This study focuses on the grassland ecosystem in the dry-hot valley of JS, using the static chamber method to observe the F*c* of the grassland. The aim is to clarify the dynamic characteristics of grassland F*c* and its correlation with environmental factors, quantitatively assess the annual F*c* of the grassland, and attempt to address the trends of F*c* changes in the dry-hot valley grasslands under future drought and low precipitation climate scenarios. This is done to offer a scientific reference for in-depth comprehension of the key processes of carbon cycle in the valley-type savanna in China, and to study and predict the ecological function changes of vegetation carbon sequestration under continuous drought and high temperature stress in the future.
2	51−54	Since the industrial revolution, human economic and social progress heavily relied on fossil energy consumption. The excessive emissions of greenhouse gases such as CO_2 have been considered to be the main cause of increased atmospheric CO_2 concentration and global warming (Sha et al., 2022; Wang et al., 2023).
3	57−59	Studying the dynamic changes in the C budget of global terrestrial ecosystems, along with their environmental driving factors, has become an important topic in the field of global change (Houghton, 2001; Bai et al., 2023).
4	68−72	Being a significant component of the worldwide grassland ecosystem, its net primary productivity (NPP) accounts for about 30.0% of the total NPP of terrestrial ecosystems, which has significant impacts on global material cycling, energy flow, and climate change (Grace et al., 2006; Peel et al., 2007; Dobson et al., 2022).
5	82	Simultaneously, since the savanna ecosystem ··········
6	104	However, monitoring and research on the F*c* features in this region is still lacking.
7	111−114	The aim is to clarify the dynamic characteristics of grassland F*c* and its correlation with environmental factors, quantitatively assess the annual F*c* of the grassland, and attempt to address the trends of F*c* changes in the dry-hot valley grasslands under future drought and low precipitation climate scenarios.

<table>
<tr><td>8</td><td>114–117</td><td>This is done to offer a scientific reference for in-depth comprehension of the key processes of carbon cycle in the valley-type savanna in China, and to study and predict the ecological function changes of vegetation carbon sequestration under continuous drought and high temperature stress in the future.</td></tr>
<tr><td>9</td><td>142–143</td><td rowspan="2">The average value of the environmental factors observation data for 5 minutes, 30 minutes, and 24 hours are automatically recorded through the CR1000X data logger.</td></tr>
<tr><td>10</td><td>142–143</td></tr>
<tr><td>11</td><td>145</td><td>
</td></tr>
<tr><td>12</td><td>167</td><td>Table 1 Information of micrometeorological observation system.
<table>
<tr><th>Name of instrument</th><th>Manufacturer</th><th>Observation parameter</th><th>Height (depth) of installation (m)</th></tr>
<tr><td>Temperature and humidity sensor</td><td>Campbell</td><td>Ta (°C) and RH (%)</td><td>1.5</td></tr>
<tr><td>Photosynthetic effective radiometer</td><td>Campbell</td><td>PAR ($\mu mol \cdot m^{-2} \cdot s^{-1}$)</td><td>1.5</td></tr>
<tr><td>Wind speed and direction sensor</td><td>Campbell</td><td>Ws (m/s) and WD (°)</td><td>1.5</td></tr>
<tr><td>Rainfall sensor</td><td>Campbell</td><td>P (mm)</td><td>1.5</td></tr>
<tr><td>Soil multi-parameter sensor</td><td>Campbell</td><td>Ts (°C), SWC ($m^3 \cdot m^{-3}$), and SC (dS/m)</td><td>Soil horizon 0.1</td></tr>
</table></td></tr>
<tr><td>13</td><td>152–153</td><td>The observation time began at 3:05 PM on March 3, 2023, and ended at 10:50 AM on November 1, 2023.</td></tr>
<tr><td>14</td><td>156–157</td><td>The net ecosystem carbon exchange (NEE) was mainly measured by the CARBOCAP ® C dioxide sensor GMP343 of Vaisala Company.</td></tr>
<tr><td>15</td><td>159–160</td><td>It has the characteristics of flexibility and high precision and is widely used in ecosystem CO_2 monitoring (Harmon et al., 2015).</td></tr>
<tr><td>16</td><td>173–175</td><td>When the *Fc* is measured, the whole monitoring system will collect the original data of GMP343 at a speed of 2 Hz through the CR1000X data logger, and average the data collected within 5 seconds for statistical analysis (main scan interval).</td></tr>
</table>

17	198−201	Quality control was conducted on the raw data to remove invalid NAN values and abnormal data (the abnormal data mainly consisted of negative values during the dry season and negative values at night during the rainy season).
18	202−204	For data with a missing duration of more than 3 hours, interpolation is mainly performed by distinguishing between daytime and nighttime periods.
19	full-text	In the revised version, changes to our manuscript were all highlighted within the document by marked in yellow.
20	228	The VPD fluctuated between 0.11–4.13 kPa, and its value decreased significantly after May, which was related to the increase of P and RH in the rainy season (Fig. 2a and 2c).
21	228	
22	258−271	The highest F*c* value appeared in the evening (19:20) in March, which was 0.2158 μmol m^{-2} s^{-1}. In April and May, it appeared in the evening (13:35). They were 0.1148 μmol m^{-2} s^{-1} and 0.1397 μmol m^{-2} s^{-1}, respectively. During the dry season, the herbaceous plants in the study area were in a senescent state, and the grassland ecosystem was characterized solely by soil respiration. The study by Carey et al. (2016) found that in all non-desert biomes, soil respiration increases with rising soil temperature, however, beyond a certain threshold, the soil respiration rate decreases with further temperature increases. Therefore, we believe that the diurnal variation of F*c* in the grassland of the JS dry hot valley during the dry season primarily relates to the diurnal variation of temperature. From night to morning, the temperature gradually decreased, leading to a reduction in soil respiration and a decrease in F*c*. It was not until around 10:00 AM that the temperature began to rise, increasing in the intensity of soil respiration and a continuous rise in F*c*, reaching its peak. Subsequently, the soil respiration rate decreased with further temperature increases, and after about 5:00 PM, as the temperature gradually declined, the limitation on soil respiration weakened, and carbon flux gradually increased again.
	279−282	During the rainy season, the SWC in the grassland was relatively high, and the increase in SWC had an inhibitory effect on the temperature sensitivity of soil respiration (Xiang et al., 2017). As a result, the F*c* during the nighttime period remained relatively stable.

23	462−477	To further assess the impact of SWC in the dry-hot valley of the JS on NEE, we divided the grassland SWC into three levels: low SWC (0 m^3 m^{-3} ≤ SWC ≤ 0.05 m^3 m^{-3}), moderate SWC (0.05 m^3 m^{-3} < SWC≤ 0.10 m^3 m^{-3}), and high SWC (0.10 m^3 m^{-3} < SWC), corresponding to dry, intermediate, and wet periods, respectively. We then analyzed the relationship between SWC and NEE during these different periods (Fig. 8). During the dry period, SWC showed a weak negative correlation with NEE (R = −0.297, P < 0.01). In the intermediate period, there was a strong negative correlation between SWC and NEE (R = −0.500, P < 0.01). In the wet period, SWC exhibited a strong positive correlation with NEE (R = 0.661, P < 0.01). The results indicate that within an appropriate range of SWC, an increase in SWC can effectively enhance the C sink capacity of the grasslands in the dry-hot valley of the JS. However, when SWC exceeds a certain threshold, an increase in SWC may inhibit the C absorption capacity of the grasslands. As found by Davidson et al. (1998) and Taylor et al. (2017), net ecosystem productivity increases with rising SWC in dry environments, reaching a maximum under optimal conditions, and then decreases in waterlogged environments. Our research results support this ecological process well.  Figure 8 Relationship between NEE and SWC.
24	413−415	Under the climate scenario of continuous warming and decreasing precipitation in the future, the vegetation community structure in some temperate regions will shift to the savanna vegetation community (Yang and Chang, 2007; Jing et al., 2024).

25	378−395	The current study showed that within the grassland ecosystem situated in the JS dry hot valley, the daily maximum CO_2 uptake rate was recorded at only 1.4286 μmol·m^{-2} s^{-1}, which stands notably lower in comparison to other grasslands found in arid and semi-arid regions (2.16 to 7.90 μmol·m^{-2} s^{-1}), such as meadow steppe and desert steppe on the northern slope of Tianshan Mountains (Hu et al., 2018; Guo et al., 2022), Horqin sandy grassland (Niu et al., 2018), Tongyu semi-arid degraded grassland (Du et al., 2012), and Loess Plateau semi-arid grassland (Zhang et al., 2020).
26	378−395	Fei et al. (2017b) found that most savanna ecosystems globally demonstrate C sequestration features, with only a few exhibiting characteristics of C emissions, with the NEE varying from around –3.87 to 1.28 t C ha^{-1} a^{-1}. Among them, the savanna ecosystem with C source characteristics is mainly grassland savanna and semi-arid savanna, especially the grassland savanna has the largest annual C emissions (Archibald et al., 2009; Hutley et al., 2005; Quansah et al., 2015), which is similar to the results of this study. In the arid/semi-arid regions of China, the NEE of different grassland ecosystems varies between –3.08 to 0.96 t C ha^{-1} a^{-1} (Du et al., 2012; Niu et al., 2018; Chen et al., 2019; Zhang et al., 2020; Bai et al., 2022). We found that most grasslands act as C sinks, with only a few, such as the Horqin sandy grassland (Niu et al., 2018; Chen et al., 2019), exhibiting C source characteristics, and the C emissions (0.91 to 0.96 t C ha^{-1} a^{-1}) is higher than those of the grasslands in the JS dry-hot valley.
27	247	
28	497−498	As far as the grassland ecosystem in the dry-hot valley of JS is concerned ·········
29	550−567	(1) As a result of environmental factors, the F*c* of the grassland ecosystem in the JS dry-hot valley exhibited significant temporal variations. During the dry season, the grassland functioned as a C source, with the daily variation of F*c* showing a ‘W’-shaped bimodal curve. In contrast, during the rainy season, the grassland functioned as a C sinks, with the daily variation of F*c* displaying a ‘U’-shaped unimodal curve. (2) The F*c* of grasslands during the dry season was primarily

		influenced by RH. During the rainy season, F*c* was significantly affected not only by PAR but also by SWC, RH, and VPD. Overall, SWC, RH, and VPD were the primary environmental factors influencing grassland F*c*. Particularly when SWC was within an optimal range, an increase in SWC can effectively enhance the C absorption capacity of the grassland. However, when SWC was in a wet period, an increase in SWC will lead to a rise in the ecosystem's NEE. (3) The grassland in the JS dry-hot valley was a weak C source, which was closely related to the continuous reduction in precipitation in recent years. As precipitation continues to decline, the C sequestration capacity of herbaceous plants will significantly decrease, resulting in increased CO_2 emissions from the grasslands in the study area. Under a future climate scenario of continuous high temperatures and drought, the plant community structure in some temperate regions may shift to savanna, and the grasslands in these regions may shift from being C sinks to C sources, thereby impacting the global C balance.
30	545−547	Therefore, our forthcoming research will emphasize the extended observation of the Fc changes in the savanna ecosystem with a complete vegetation community structure, especially the use of eddy covariance ………