We would like to thank the anonymous reviewer for the useful comments and suggestions. We have taken advantage of the advices for improving the manuscript. For an easier comprehension, the reviewer's comments are included in our rebuttal in black typeface. Our replies appear in blue typeface. Line numbers appeared in the rebuttal are from the revised version, with changes highlighted with red color in the revised document.

Reviewer 1

This manuscript presents a valuable and comprehensive dataset on turbulent water, heat, and CO_2 fluxes across the Tibetan Plateau, based on measurements from 16 eddy covariance stations. The authors highlight notable spatial heterogeneity in meteorological conditions and land-atmosphere exchange processes. Given the scarcity of long-term, ground-based observations in this region, the dataset is relevant and will be useful for model validation and understanding flux dynamics on the Plateau.

That said, there are several areas that could be improved to strengthen the manuscript:

Responses:

We sincerely thank the reviewer for the positive evaluation of our dataset and for recognizing its scientific value and relevance to the study of land–atmosphere exchanges over the Tibetan Plateau. We appreciate the reviewer's thoughtful comments and constructive suggestions for improving the manuscript and we have revised the manuscript following the valuable comments and suggestions.

While the REddyProc is referenced for flux partitioning, key methodological details are missing — particularly the u* threshold filtering, gap-filling strategy, and quality control protocols. These are essential for transparency and reproducibility.

Responses:

We thank the reviewer for the valuable comments. In the revised manuscript, we have expanded the description of the flux partitioning procedure conducted with REddyProc to include details on the u* threshold determination, gap-filling approach, and quality control procedures.

The u* threshold was estimated using the bootstrapping approach implemented in REddyProc, following the standard procedure described by Wutzler et al. (2018). Thresholds were determined separately for each year, and the mean value was applied to exclude nighttime periods with insufficient turbulence. Flux gap-filling was conducted using the marginal distribution sampling method within REddyProc, based on relationships with radiation, air temperature, and vapor pressure deficit, using a 7–14 day moving window. Quality control involved removing data points with known

sensor malfunctions, spikes, or physically implausible fluxes, and applying the flagging scheme. Low-quality or filtered data were excluded prior to gap-filling and partitioning.

These details have been added to the revised section 2.2 “Methods for data processing and analyzing” (Lines 293–300) to improve clarity, reproducibility, and alignment with community standards.

Phrases like “significantly correlated” are used frequently, but without supporting statistical values (e.g., p-values, confidence intervals, or correlation coefficients). This weakens the interpretation of the results.

Responses:

We appreciate the reviewer's valuable comments, and we agree that including the statistical metrics strengthens the interpretation of our results. In the revised manuscript, we have added the corresponding correlation coefficients (r, the Pearson correlation coefficient) and p-values ($p<0.05$ or $p<0.01$) for all reported relationships previously described as “significant.” Where relevant, the correlation is statistically significant at the 95% or 99% confidence level. For some words like “significant” or significantly, they have been revised as “remarkable”, “pronounced”, “considerable”, “substantially ”, “markedly”, and others.

These additions now ensure that each statement of statistical significance is quantitatively supported. The revised results and figure captions have been updated accordingly, i.e. Lines 326, 332-334, 337, 363, 364, 391, 398, 432, 472, 481, 513, 517, 527, 535, 566, 603, 618, Figure 5, Figure S1, Figure S2, Table S7.

The manuscript classifies stations into "wet" and "dry," but it's unclear how this was defined. Some objective metric like aridity index, annual precipitation thresholds, or soil moisture levels would help readers understand the basis of this classification.

Responses:

We thank the reviewer for pointing out the need for greater clarity regarding the classification of sites as “wet” and “dry.” Generaly, the classification of climatic zones can be determined by using the aridity index (AI), defined as the ratio of total precipitation to total potential evapotranspiration over a given period; the formula for AI is given as: $AI = Prec/ET$, where Prec denotes the annual mean precipitation, and ET denotes the annual mean potential evapotranspiration. $AI > 0.65$ indicates humid regions, 0.5–0.65 semi-humid regions, 0.2–0.5 semi-arid regions, 0.03–0.2 arid regions, and < 0.03 hyper-arid regions (Programme, 1997; Zomer et al., 2022). Some in-depth analysis has been conducted following this concept.

In this manuscript, the wet and dry stations are roughly categoried following the status of precipitation and soil moisture, i.e. wet stations have a higher precipitation (> 400 mm) and larger soil moisture contents (SM10>10%). In contrast, the dry stations have lower precipitation or lower soil moisture contents. We have clarified these information in Line 475-479 of the revised manuscript.

References:

Programme, U.N.E., 1997. World Atlas of Desertification: Second Edition.

Zomer, R.J., Xu, J., Trabucco, A., 2022. Version 3 of the Global Aridity Index and Potential Evapotranspiration Database. Sci Data 9, 409. https://doi.org/10.1038/s41597-022-01493-1

The discussion occasionally loses focus, with hydrology, meteorology, and carbon cycle topics mixed together without strong connections. Consider restructuring or summarizing the key takeaways more clearly.

Responses:

We thank the reviewer for this thoughtful comment. We agree that strengthening the connections among meteorological, hydrological, and carbon fluxes components can improve readability and focus. In this manuscript, the Results and Discussion are presented as a combined section, where each subsection (3.1 – 3.4) focuses on a distinct aspect of the land – atmosphere exchange process—meteorological variables, precipitation and soil moisture, energy fluxes, and carbon fluxes (NEE, GPP, and Re).

We have retained this integrated structure to maintain consistency with the Earth System Science Data format, in which the main purpose is to describe, evaluate, and provide access to the dataset rather than to conduct extensive process-based interpretation. To improve clarity, we have strengthened the transitions between subsections to better link meteorological, hydrological, and carbon processes. We have also added a brief summary paragraph at the end of each subsection. Check line 368-372, line 416-420, 520-524, 596-601 of the revised manuscript. These revisions help clarify the focus of each section and make the takeaway message more clearly.

There are a number of minor grammatical issues and typos throughout. I've flagged several below but recommend a full proofreading pass before submission.

Responses:

Thanks for the careful corrections and comments. The entire manuscript has undergone a comprehensive proofreading and language revision to correct minor

grammatical issues and typographical errors. These edits have improved readability and consistency throughout the whole manuscript.

Line-by-Line Comments

Title: The title suggests strong emphasis on temporal patterns, but the manuscript only presents seasonal analysis, there's little interannual variation discussed. You might consider rephrasing.

Responses:

We appreciate the reviewer's helpful comment. We agree that the original title implied a broader temporal scope than what is actually analyzed. As our observations cover approximately two years, the study primarily focuses on spatial, seasonal, and diurnal variations of land–atmosphere exchanges of water, heat, and CO_2, rather than long-term interannual changes.

To better reflect the dataset and analyses presented, we have revised the title to emphasize both the spatial distribution and the short-term temporal variations of the observed fluxes. The revised title reads: "Quantifying the spatial-seasonal patterns of land-atmosphere water, heat and CO2 flux exchange over the Tibetan Plateau from an observational perspective"

This version accurately captures the scope of the dataset and the analyses presented, highlighting the spatial coverage of the observation stations and the focus on short-term temporal variability derived from in-situ measurements.

Line 43: Probably should be "located" rather than "locating."

Responses:

Thanks for the correction. We have revised the abstract and the whole sentence to avoid the grammar error.

Line 52: Key worlds?

Responses:

Thanks for the correction. We have corrected "worlds" as "words" following the comment.

Line 56: Use "is pivotal" instead of "are pivotal," since "interaction" is singular.

Responses:

Thanks for the comments. We have revised the whole sentence following the comment. Check line 78-79 of the revised manuscript.

Lines 94–95: It's not clear what these names refer to, consider clarifying.

Responses:

Thanks for pointing out this ambiguity. We have revised the manuscript to clarify what each name refers to upon its first mention. Check line 115-119 of the revised manuscript.

Table 2 vs Line 408: Table 2 includes "EBC" — did you mean "EBR"? Also, line 408 references Table 1 for EBR, but the data appears in Table 2. Please check consistency.

Responses:

We thank the reviewer for catching this inconsistency carefully. "EBR" is correct — the term "EBC" in Table 2 was a typographical error and should indeed read "EBR", referring to the energy balance ratio. We have corrected this label in the table and ensured that all occurrences of EBC/EBR throughout the manuscript are now consistent. Check Table 2 of the revised manuscript.

Additionally, we have corrected the table reference in the text: the values for EBR are presented in Table 2, not Table 1 as previously indicated. Check line 460 of the revised manuscript.

Lines 123–125: Are these numbers from your own results? If so, clarify. If not, cite the sources.

Responses:

Thanks for the comments. The values are from the supplymental material of Table S1 of Wei, et al. 2021. We have clarified their origin in the revised manuscript. Check line 145 of the revised manuscript.

Line 131: "CO_2 flux exchange" is redundant, consider "CO_2 flux".

Responses:

Thanks for the correction. We have revised the sentence to void redundancy following the comment. Check line 151-152 of the revised manuscript.

Line 170: "Platrom"?

Responses:

Thanks for the correction. We have corrected the word to “platform”. Check line 195 of the revised manuscript.

Line 231: “to analyzing” should be “to analyze.”

Responses:

Thanks for the correction. We have revised the word following the comment. Check line 259 of the revised manuscript.

Line 254: When referencing “WPL correction,” please explain what WPL stands for (Webb-Pearman-Leuning)?.

Responses:

We thank the reviewer for the helpful comments. Yes, WPL stands for Webb–Pearman–Leuning, referring to the density correction proposed by Webb, Pearman, and Leuning (1980). We have revised the manuscript to explicitly define the term WPL correction upon its first mention.

Specifically, WPL correction accounts for the effects of air density fluctuations caused by heat and water vapor transfer on the measured CO_2 and H_2O fluxes, ensuring accurate computation of mass and energy exchange between the surface and atmosphere. Check line 283 of the revised manuscript.

Line 499 / Figure 6: Figure 6 only shows 12 stations, but the manuscript states 15 were used. Please clarify which stations were excluded and why.

Responses:

Thanks for the comments. We appreciate the reviewer’s careful observation. In the revised manuscript, we have clarified that three stations—QOMOS, NAMORS, and Baingoin—were excluded from the CO_2 fluxes analysis shown in Figure 6.

These sites were removed because the diurnal variations of net ecosystem exchange (NEE) were found to be physically unrealistic or inconsistent with expected flux patterns: At QOMOS and NAMORS, the diurnal cycles of NEE exhibited inverted daytime and nighttime patterns, suggesting potential sensor issues. At Baingoin, abnormal nighttime CO_2 release was observed, which is likely associated with local biomass (cow manure) burning for heating, as reported by field technicians during the observation period.

Given these anomalies, data from the three stations were not included in the regional synthesis and subsequent analysis to ensure data quality and physical consistency. The manuscript has been updated accordingly in line 305-310 of the revised manuscript.

Line 513: “carbon absorption primarily occur” → should be “occurs.”

Responses:

Thanks for the correction. We have revised the word following the comment. Check line 571 of the revised manuscript.