We would like to thank the editor, Mr. Zihao Bian, and the anonymous reviewers for their positive feedback and constructive comments, which have helped improve the quality of this manuscript. The manuscript has been thoroughly revised in response to the reviewers' comments. Please find our point-by-point responses below.

COMMENTS TO THE AUTHOR:
Reviewer #1:
This manuscript presents the Soil Methane Uptake Database (SMUD), a large and valuable compilation of in situ soil CH_4 uptake measurements spanning nearly four decades. The effort to harmonize data from 920 publications into a standardized, open-access database is commendable and highly relevant to the biogeochemistry and Earth system science communities. The inclusion of multi-temporal resolution data (daily to annual) together with associated environmental variables (e.g., soil temperature and moisture) represents a significant advancement over previous datasets.
Overall, the manuscript fits well within the scope of the journal and has strong potential to become a widely used community resource. However, several methodological clarifications, structural improvements, and interpretational constraints should be addressed prior to publication.

Response: We thank the reviewer for the positive assessment of our work and for recognizing the value of the Soil Methane Uptake Database (SMUD) for the biogeochemistry and Earth system science communities. We also appreciate the constructive suggestions regarding methodological clarification, structural improvement, and interpretational constraints.

The manuscript primarily aims to introduce a database but also includes elements of ecological interpretation (e.g., biome-specific controls and classification into temperature- or moisture-dominated systems). While soil temperature and moisture are indeed key drivers, other factors—such as soil organic matter, pH, and inorganic nitrogen—can be equally or more important depending on spatial scale, biome type, and season. Although incorporating these variables into the database may be beyond the scope of this work, their roles should be more explicitly acknowledged in the Discussion or in a dedicated limitations section.

Response: We agree that factors such as soil organic matter, soil pH, and inorganic nitrogen can significantly influence soil CH_4 uptake depending on spatial scale, biome type, and season. While the current version of SMUD focuses on harmonizing CH_4 fluxes together with key hydrothermal variables, such as soil temperature and soil moisture, we have now explicitly acknowledged the potential roles of these additional environmental and edaphic factors in *Section 4.1 (Lines 1340–1351)*.

"In addition, although soil temperature and soil moisture are key drivers of SMU and are included in the current version of SMUD, other factors, such as soil pH, C/N ratio, clay content, soil organic matter, and inorganic nitrogen and other soil texture- or nutrient-related properties, are also known to influence CH_4 oxidation. These factors may regulate methanotrophic activity, gas diffusion, and substrate availability, and their effects on SMU may vary with spatial scale, biome type, and seasonal conditions. Therefore, the current version of SMUD is better suited for analyses of SMU patterns and their relationships with climate, seasonality, and soil hydrothermal conditions, but is less suitable for independently resolving the effects of intrinsic soil physicochemical controls. Future applications could address this limitation by linking SMUD with external soil datasets, thereby supporting more comprehensive assessments of climatic, hydrothermal, and edaphic controls on soil CH_4 uptake."

Line 181: The manuscript states that all fluxes were converted to μg CH_4–C m^{-2} yr^{-1}, yet subsequent analyses (e.g., in the Results) appear to use μg CH_4–C m^{-2} yr^{-1}. This inconsistency needs clarification.

Response: We thank the reviewer for pointing out this inconsistency. We clarify that all raw flux measurements from the collected datasets were standardized and converted to μg $CH_4 - C$ m^{-2} h^{-1} throughout the Methods, Results, tables, and figures. This unit is commonly used in soil CH_4 flux studies and facilitates comparisons across different temporal resolutions.

In addition, the authors indicate that only uptake (positive values) was retained, excluding emission fluxes. Given that soils can alternate between CH_4 sink and source depending on environmental conditions, this filtering may bias estimates of mean fluxes, seasonal variability, and biome-level comparisons.

Response: We acknowledge that soils may alternate between CH_4 sink and source behavior depending on environmental conditions, and that excluding emission fluxes may affect estimates of mean fluxes and temporal variability when considering the full net soil–atmosphere CH_4 exchange.

However, the primary objective of SMUD is to characterize and synthesize soil CH_4 uptake processes and terrestrial methane sink dynamics. Therefore, only positive uptake observations were retained to maintain a consistent process focus across studies.

In addition, CH_4 emission events in upland soils are often episodic and may arise from distinct mechanisms, such as temporary water saturation, anaerobic microsites, or freeze–thaw processes. Including both uptake and emission fluxes within the same

framework could introduce substantial mechanistic heterogeneity and potentially obscure the environmental controls specifically associated with CH_4 uptake.

Nevertheless, we agree that this filtering limits the representation of the full spectrum of net soil–atmosphere CH_4 exchange. We have now explicitly acknowledged this limitation in the revised manuscript (*Lines 1335–1340*) and clarified that SMUD should primarily be interpreted as a database of soil CH_4 uptake observations rather than a comprehensive database of net CH_4 exchange.

"The original SMUD database retains both positive CH_4 fluxes, representing uptake, and negative CH_4 fluxes, representing emissions. For the analyses presented in this manuscript, emission fluxes were excluded to focus specifically on SMU patterns. We note that this filtering affects the representation of net soil–atmosphere CH_4 exchange; therefore, users should interpret the analyses presented here primarily as reflecting SMU capacity rather than comprehensive net CH_4 exchange, likely overestimating the total SMU."

The quality control (QC) system (Q01–Q07) is a useful feature; however, it is insufficiently quantified. The manuscript does not report the proportion of data flagged under each category or how exclusions affect the final dataset size. Providing these details would improve transparency and usability.

Response: We thank the reviewer for this helpful suggestion. We agree that providing quantitative information on the QC procedures improves the transparency and usability of the database. In the revised manuscript, we have added a detailed summary of the Q01–Q07 quality-control categories, including the number and proportion of records flagged under each category. We have also provided additional descriptions of the data screening results and clarified how the filtering procedures contributed to the construction of the final dataset.

These additions have been incorporated into the *Results and Discussion (Lines 786–801)*:

"Before the final data screening and filtering procedures, all 3,050 initially compiled records were evaluated using the Q01–Q07 QC system to identify potential issues and improve data transparency. The proportions of records flagged as Q01–Q07 were 0.56% (n = 17), 0.03% (n = 1), 17.44% (n = 532), 2.69% (n = 82), 4.13% (n = 126), 0.23% (n = 7), and 47.70% (n = 1,455), respectively. These QC flags were primarily used to annotate potential data limitations or specific data characteristics prior to subsequent filtering and harmonization procedures. Because individual records may contain multiple QC flags, the reported percentages are not mutually exclusive."

The dataset shows a strong geographical bias toward the Northern Hemisphere, particularly temperate regions, China, and other countries. While this limitation is acknowledged, its implications are not fully explored. It would be helpful to provide guidance for users, such as potential weighting strategies or cautions when extrapolating to underrepresented regions.

Response: We thank the reviewer for this important comment. We agree that the current version of the dataset exhibits substantial geographical imbalance, with observations concentrated mainly in the temperate regions of the Northern Hemisphere, particularly China and several other well-studied regions, while tropical regions, high-latitude ecosystems, and arid regions in the Southern Hemisphere remain underrepresented. In the revised manuscript, we have further expanded the *Results and Discussion section (Lines 830–832)* to clarify the potential implications of this spatial bias. Specifically, we now clarify that such uneven spatial coverage may introduce uncertainty when extrapolating patterns to poorly represented regions and may affect global-scale syntheses.

"This uneven geographical distribution reflects the current availability of field observations but may introduce additional uncertainty in global extrapolation and large-scale modeling applications, especially in regions with sparse observational coverage. "

The classification of observations into three categories (temperature-dominated, moisture-dominated, and jointly controlled systems) appears largely qualitative. This framework would benefit from quantitative support (e.g., regression analysis, partial correlation, or mixed-effects modeling). Alternatively, the authors should clearly frame these patterns as descriptive rather than mechanistic.

Response: We thank the reviewer for this valuable suggestion. We agree that the classification of observations into temperature-dominated, moisture-dominated, jointly controlled, and no-clear-dominant-control systems should be supported by quantitative evidence. In the revised manuscript, we have provided the standardized regression coefficient as the quantitative *(Table S1)* support for the classification of temperature-dominated, moisture-dominated, and jointly controlled systems and related description of the *Methods (Lines 684–773)* and adjusted the *Results and Discussion (Lines 1188–1210)*.

Table S1 Standardized multiple regression analysis used to classify the relative controls of soil temperature and soil moisture on soil methane uptake across ecosystems.

Ecosystem	n	Dominance	beta_ST	p_ST	beta_SM	p_SM	abs_beta_ST/abs_beta_SM
Tundra	38	Moisture-dominated	0.095	0.535	-0.515	0.002	0.185
Boreal forest	224	Moisture-dominated	-0.047	0.465	-0.344	0.000	0.137
Temperate seasonal forest	1748	Moisture-dominated	0.041	0.076	-0.234	0.000	0.177
Temperate rainforest	54	Moisture-dominated	-0.117	0.266	-0.679	0.000	0.172
Temperate grassland	752	Temperature-dominated	0.282	0.000	-0.120	0.001	2.344
Shrubland	54	Moisture-dominated	0.244	0.059	-0.354	0.007	0.691
Woodland	26	Jointly controlled	0.485	0.028	0.604	0.008	0.803
Savanna	97	Temperature-dominated	-0.321	0.002	0.032	0.746	10.071
Tropical seasonal forest	660	Moisture-dominated	0.072	0.068	-0.203	0.000	0.354
Tropical rainforest	76	Jointly controlled	-0.567	0.000	-0.306	0.001	1.852
Subtropical desert	26	Moisture-dominated	-0.051	0.761	0.760	0.000	0.067
Desert	62	No clear dominant control	0.262	0.096	0.001	0.997	498.747
Alpine	233	Temperature-dominated	0.293	0.000	-0.113	0.083	2.597
Agriculture	1808	Temperature-dominated	0.189	0.000	-0.030	0.191	6.230
Urban	16	No clear dominant control	0.632	0.218	0.781	0.134	0.810
Bare	21	Moisture-dominated	0.301	0.142	-0.537	0.013	0.560

“To support the classification of temperature-dominated, moisture-dominated, jointly controlled, and no-clear-dominance systems, we conducted ecosystem-specific regression analyses of SMU as a function of soil temperature and soil moisture using standardized variables (Schielzeth, 2010). For each ecosystem group, we fitted multiple linear regression models with standardized variables, using SMU as the response variable and soil temperature and soil moisture as predictors. The relative importance of temperature and moisture was evaluated based on the significance and absolute magnitude of the standardized regression coefficients. Ecosystems were classified as temperature-dominated when the temperature coefficient was significant and larger than the moisture coefficient, moisture-dominated when the moisture coefficient was significant and larger than the temperature coefficient, jointly controlled when both predictors were significant and showed comparable standardized effects. Ecosystems that did not meet these criteria were classified as having no clear dominant control. These analyses were intended to support descriptive classification of empirical patterns rather than establish causal mechanisms.”

“Based on the covariation between SMU dynamics and soil hydrothermal variables, biomes were classified into four groups (Fig. 5). In temperature-dominated (e.g., Temperate Grassland; Fig. 5A), where SMU generally increased from winter to summer, broadly following the seasonal increase in soil temperature, whereas the seasonal pattern of soil moisture was less consistently aligned with SMU. In moisture-dominated (e.g., Boreal Forest; Fig. 5B), where seasonal variation in SMU corresponded more closely to changes in soil moisture, suggesting that moisture availability and associated diffusion constraints may be more important controls on SMU. In jointly controlled (e.g., Tropical Rainforest; Fig. 5C), characterized by both soil temperature and soil moisture showing significant associations with SMU, which indicates that seasonal SMU in tropical rainforest cannot be attributed primarily to a single driver; rather, temperature and moisture likely act together to shape observed SMU variability; In contrast, some ecosystems were classified as having no clear dominant control (e.g., Desert; Fig. 5D), because neither soil temperature nor soil moisture showed a clear dominant association with SMU. These results should be interpreted as a descriptive classification of empirical patterns rather than as evidence of direct causal mechanisms. The regression analyses identify whether SMU covaries more strongly with soil temperature, soil moisture, or both within each ecosystem, but they do not exclude the influence of other environmental and biogeochemical factors such as soil texture, pH, nitrogen availability, vegetation type, substrate limitation, or microbial community structure. In the Southern Hemisphere, no consistent SMU seasonality was evident across most biomes (Fig. S7), which likely reflects sparse observational coverage, uneven monthly sampling, and the smaller land area represented in the database.

Therefore, the biome-level classifications are most robust for ecosystems with adequate sample size and clear seasonal coverage, while patterns in data-limited regions should be interpreted with caution. ”

Minor comments:

Use consistent terminology throughout (e.g., SMU vs. CH_4 uptake vs. CH_4 sink).

Response: We thank the reviewer for this helpful suggestion. We have revised the manuscript to ensure consistent terminology throughout. Specifically, “soil methane uptake (SMU)” is now defined at its first occurrence and used consistently when referring to measured or analyzed soil CH_4 uptake rates. The term “CH_4 uptake” has been retained only where it improves readability or appears in broader descriptive contexts, while “CH_4 sink” is used only when emphasizing the functional role of ecosystems or soils as atmospheric methane sinks, rather than referring to specific uptake rates or flux measurements.

Figure 4: The combination of violin, box, and scatter plots reduces visual comparability; consider simplifying the presentation.

Response: We thank the reviewer for this helpful suggestion. We agree that visual comparability is important. In Figure 4, the plot type was selected according to sample size to avoid over-interpreting sparse data and to ensure that each group was represented using an appropriate level of statistical summary. For groups with fewer than 10 SMU observations, we used scatter plots because the sample size was too small to reliably summarize the distribution using box plots or violin plots; displaying individual points provides a more transparent representation of the available data. For groups with 10–20 observations, we used box plots to summarize the median, interquartile range, and overall dispersion, while avoiding violin plots because density estimation is unstable and potentially misleading with relatively small sample sizes. For groups with 20 or more observations, we used violin plots because the larger sample size provides sufficient support for visualizing the distributional shape. The number of SMU observations is indicated after each x-axis label. We have clarified this rationale in the figure caption.

Consider including a workflow diagram summarizing the data pipeline (literature search → screening/filtering → data extraction → QC → harmonization).

Response: We appreciate the reviewer’s constructive suggestion. To make the data

processing workflow more transparent, we have added a workflow diagram to the Supplementary Information *(Fig. S9)*, summarizing the major steps of the SMUD data pipeline, including literature search, study screening and filtering, data extraction, quality control, harmonization of units and variables, and final database assembly. We believe that this addition helps readers better understand the database construction process and improves the reproducibility and transparency of the study.

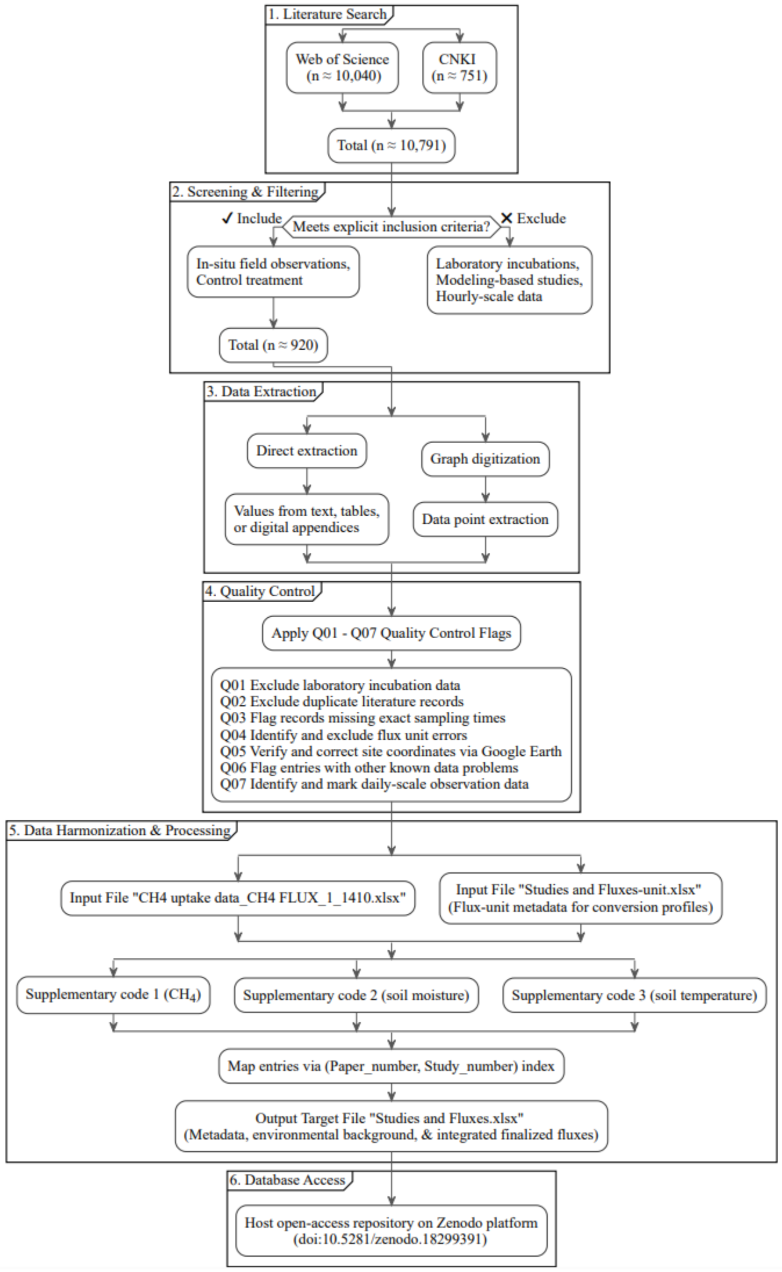

Figure S9. Workflow of the SMUD data compilation and processing pipeline.

Reviewer #2:

The manuscript presents the development of a global Soil Methane Uptake Database (SMUD), which systematically compiles and integrates 2,427 site-level in situ CH_4 uptake observations extracted from 920 peer-reviewed publications published between 1986 and 2025. The database encompasses multiple temporal resolutions, including daily, monthly, seasonal, and annual observations, and is accompanied by key environmental variables such as soil temperature and moisture. The primary contribution of this work lies in its first-time standardization of long-term, fragmented, and inconsistently reported soil methane uptake (SMU) observations into a unified, openly accessible database framework, thereby substantially improving data discoverability, reproducibility, and reusability. Compared with previous datasets, SMUD demonstrates clear advantages in temporal span, spatial coverage—particularly through the inclusion of additional observations from China and the Tibetan Plateau—and ecosystem representativeness. Consequently, the database has strong potential to become an important foundational resource for biogeochemical studies and Earth system modeling applications.

Response: We sincerely thank the reviewer for the positive evaluation and encouraging comments. We are pleased that the reviewer recognizes the value, novelty, and potential utility of SMUD as a standardized and openly accessible global database for soil methane uptake observations. We greatly appreciate this constructive assessment.

General Comments1. Retention of only positive values (uptake) while excluding negative values (emissions): In natural ecosystems, particularly in seasonally frozen regions, areas experiencing wet–dry alternation, and agricultural systems, soils may function as CH_4 sources during certain periods. Excluding emission records may therefore:(1) overestimate regional and global mean methane uptake rates; (2) underestimate seasonal variability; and (3) introduce systematic biases when comparing key ecosystems such as temperate croplands and permafrost regions. The authors are encouraged to explicitly report the number of excluded =emission records, and to discuss simply how this filtering procedure may influence the main findings, such as the relatively low uptake rates reported for agricultural land in Figure 4.**2.**

Response: We thank the reviewer for this important comment. We agree that soils may function as CH_4 sources during certain periods, especially in seasonally frozen regions, wet–dry transition environments, and managed agricultural systems. To address this concern, we have added explicit statistics on the excluded negative CH_4 flux records after applying the same quality-control and management filters used for Fig. 4 (*Lines 1052–1061*)

"To evaluate the potential influence of excluding CH_4 emission records, we quantified

the number and proportion of negative flux values. Negative values accounted for 10.72% of the annual records. Seasonally, the proportion of negative records ranged from 9.79% in autumn to 12.83% in winter and was also relatively high in summer (12.43%). The influence of this filtering varied among biomes. Agricultural soils had the largest absolute number of excluded annual emission records, which accounted for 17.84% of valid annual observations in this biome. These results indicate that CH_4 emissions occurred in a subset of observations. Therefore, excluding these records may influence estimates of mean CH_4 uptake and seasonal variability, particularly during periods when soils temporarily shift from CH_4 sinks to CH_4 sources. "

Knowledge gaps: The manuscript provides a generally comprehensive overview of the historical development of SMU observations, citing both foundational studies (e.g., Ojima 1993; Dutaur 2007) and recent syntheses (e.g., Saunois 2025; Jiang 2025). However, several important knowledge gaps deserve stronger emphasis.

Response: We thank the reviewer for this helpful suggestion. n the revised manuscript, we have strengthened the discussion of several key knowledge gaps related to global SMU observations and estimates *(Lines 242–246)*. Specifically, we now clarify that a major source of uncertainty arises from model parameterization and the limited observational basis available to constrain key model parameters. We further emphasize that addressing these gaps requires a more comprehensive, standardized, and robust global SMU database to support model development, parameter optimization, and large-scale SMU assessment.

"Together, these limitations indicate that a major source of uncertainty in current global SMU estimates arises from model parameterization and the limited observational basis used to constrain model parameters. Addressing this issue requires a more comprehensive, standardized, and robust global database to better support model development, parameter optimization, and large-scale SMU assessment."

The data scarcity in tropical regions: Although briefly acknowledged, the manuscript does not quantify how the lack of tropical observations contributes to uncertainty in the global SMU budget. The authors may strengthen this point by referring to the conclusion of Saunois et al. (2025), which identifies tropical regions as one of the largest current sources of uncertainty in global soil methane uptake estimates.

Response: We thank the reviewer for this valuable suggestion. In the revised manuscript, we have strengthened this discussion by explicitly reporting the number and proportion of SMU observations located in tropical regions and by comparing their representation with the global land area occupied by tropical regions. We have also

expanded the discussion to clarify how this data scarcity may influence global SMU estimates. The details are as follows (*Lines 882–886*):

"These findings further highlight the need to increase future SMU observations in tropical regions, which account for approximately 24% of the global land area yet contain only 15.7% of the records. This imbalance may weaken model calibration and evaluation in tropical regions, thereby contributing to uncertainty in global SMU budget estimates."

Absence of key edaphic variables (e.g., soil pH, C/N ratio, clay content): These variables are known to play critical roles in regulating CH_4 oxidation processes (e.g., Ni & Groffman 2018). Their absence implies that the current version of SMUD is primarily suited for analyses focused on climate and soil hydrothermal controls, whereas it is less capable of resolving the influence of intrinsic soil physicochemical properties. This limitation should be explicitly acknowledged in the Discussion section, and users should be encouraged to integrate SMUD with external soil datasets such as SoilGrids for more comprehensive analyses.

Response: We thank the reviewer for this helpful comment. Following the reviewer's suggestion, we have added the relevant limitations of SMUD to *Section 4.1, (Lines 1340–1351).*

"In addition, although soil temperature and soil moisture are key drivers of SMU and are included in the current version of SMUD, other environmental factors, such as soil pH, C/N ratio, clay content, and other soil texture- or nutrient-related properties, are also known to influence CH_4 oxidation. These factors may regulate methanotrophic activity, gas diffusion, and substrate availability, and their effects on SMU may vary with spatial scale, biome type, and seasonal conditions. Therefore, the current version of SMUD is better suited for analyses of SMU patterns and their relationships with climate, seasonality, and soil hydrothermal conditions, but is less suitable for independently resolving the effects of intrinsic soil physicochemical controls. Future applications could address this limitation by linking SMUD with external soil datasets, thereby supporting more comprehensive assessments of climatic, hydrothermal, and edaphic controls on soil CH_4 uptake."

Specific Comments

Line 30–35 (Abstract and Introduction): The manuscript states that the database contains "daily (n = 1425), monthly (n = 2001), seasonal (n = 1720), and annual (n = 1098)" observations. However, the sum of these values (6,244) substantially exceeds the reported "2,427 site-level records," indicating that some sites contributed observations at multiple temporal resolutions. While this is reasonable, the manuscript should clearly distinguish between "site-level records" and "observation data points" in the Methods section.

Response: We thank the reviewer for pointing this out. In our database, the 2,427 site-level records refer to unique site-level entries extracted from the literature, whereas the numbers reported for daily, monthly, seasonal, and annual data refer to observation data points available at each temporal resolution. These temporal-resolution-specific datasets are not mutually exclusive, because a single site-level record may provide observations at more than one temporal resolution. Therefore, the sum of daily, monthly, seasonal, and annual observations exceeds the total number of site-level records.

To avoid confusion, we have revised the *Methods section* as follows:

"In this study, "site-level records" refer to unique database entries compiled from individual studies and sites, whereas "measurements" refer to CH_4 flux values available at specific temporal resolutions. A single site-level record may contribute measurements at daily, monthly, seasonal, and annual resolutions."

Line 181: The manuscript states that all fluxes were converted to μg CH_4–C m^{-2} yr^{-1}, whereas the Results section (Line 343–373) consistently reports values in μg CH_4–C m^{-2} h^{-1}, and Figures 4 and 5 also use hourly units. This inconsistency in units should be clarified and standardized throughout the manuscript.

Response: We thank the reviewer for pointing out this inconsistency. We have carefully checked the unit descriptions throughout the manuscript and have corrected the unit in *Line 181(now in Line 457)* accordingly.

Line 214–230 (MAT/MAP validation): The authors validated site-reported climate data against ERA5-Land products and obtained relatively strong correlations ($R^2 = 0.86$ for MAT and 0.79 for MAP). However, the manuscript does not discuss representativeness issues arising from elevation differences between site locations and the 0.1° ERA5-Land grid, particularly in regions with complex topography such as the Tibetan Plateau and the Andes. The Methods section should therefore include a statement noting that ERA5-Land estimates may exhibit systematic biases in mountainous regions with strong elevation gradients, and that users are encouraged to prioritize local observations when available.

Response: We thank the reviewer for this helpful comment. In the revised manuscript, we have added a statement in the *Methods section* to clarify this limitation *(Lines 652–653)*.

"Locally measured or site-reported MAT and MAP values were prioritized when available, particularly for sites located in mountainous areas with strong elevation gradients."

Table 1 and Table 2 (data structure): Table 1 includes fields such as "SMU Jan to Dec (µg CH_4–C m^{-2} h^{-1})," whereas the original fluxes listed in Table 2 remain in the units reported by the source publications and are not standardized. Consequently, users of the "Studies and Fluxes" file must refer back to Table 2 or the original literature to identify the original measurement units. The authors should explicitly clarify in the Table 1 footnote that all monthly, seasonal, and annual SMU values have been standardized to unified units, whereas the original units are preserved in Table 2 and the source publications.

Response: We thank the reviewer for this helpful suggestion. In the revised manuscript, we have added clarifying descriptions to the captions of Table 1 and Table 2.

"SMU values in this file have been standardized to unified units of µg CH_4–C m^{-2} h^{-1} for comparison across studies."

"Original flux values and units are preserved as reported in the corresponding literature records and have not been standardized in this table."

Figure 4 (annual and seasonal flux comparisons): The categories "Rainforest" and "Tropical Rainforest (TRRF)" appear to coexist in the figure and associated text, but the distinction between them is unclear. In Lines 363–373, the manuscript simultaneously refers to "tropical rainforests (46.5)" and "rainforests (46.5)," which may lead readers to interpret them as separate ecosystem categories. The terminology and classification scheme should therefore be clarified and consistently applied throughout the manuscript.

Response: We thank the reviewer for pointing out this ambiguity. In the revised manuscript, we have clarified the terminology and applied the classification scheme consistently throughout the text and Figure 4 *(Lines 966–968)*.

"Among forest biomes, the high median fluxes observed in tropical rainforests (46.5 µg CH_4–C m^{-2} h^{-1}) and temperate rainforests (42.3 µg CH_4–C m^{-2} h^{-1}), differ from some earlier estimates (Dutaur and Verchot, 2007)."

Data Availability and Code Accessibility: The statements regarding data and code availability are clear and appropriate. The Zenodo repository link is functional, the code is distributed under the MIT License, and the dataset is released under the CC BY 4.0 License, all of which are consistent with ESSD standards. To further improve reproducibility, the authors are encouraged to explicitly report the computational environment used for data processing and analysis, including MATLAB and R versions as well as the major dependent packages.

Response: We thank the reviewer for this constructive suggestion. In the revised

manuscript, we have added information on the computational environment used for data processing, analysis, and figure generation in the *Methods section* (*Lines 774–777*).

“Data processing and calculations were performed using MATLAB R2021a (MATLAB code files 1–3). Figures were generated using R version 4.5.0 (R Core Team, 2025; R code files 1–11). The major R packages used for plotting included ggplot2, dplyr, tidyr, readxl, and patchwork.”