Public justification (visible to the public if the article is accepted and published):
Both reviewers recognize the value of this soil CH_4 dataset and its potential contribution to the broader research community.

Response: We sincerely thank the editor and reviewers for recognizing the value of our soil CH_4 uptake dataset and for providing constructive suggestions to improve the manuscript.

They have also provided several constructive suggestions to further strengthen the manuscript. The authors are encouraged to consider expanding the spatial coverage of observation sites and incorporating additional relevant variables, as recommended by the reviewers, to enhance the completeness, representativeness, and utility of the dataset.

Response 1: We sincerely thank the Editor and the reviewers for this constructive suggestion. In the revised manuscript *(Lines 345–350 and 530–534)*, we have further clarified the spatial distribution and representativeness of the current dataset, including the overrepresentation of mid-latitude regions and the relatively limited coverage of tropical, African, Oceanian, and polar ecosystems. We have also added a more explicit discussion of how these spatial biases should be considered when SMUD is used for global upscaling, model evaluation, or biome-level comparisons.

"These results indicate a strong sampling bias toward observations from the Northern Hemisphere. Records are primarily concentrated in eastern Asia, North America, and Europe. In contrast, large areas of Oceania, Africa, and the polar regions remain sparsely represented (Fig. 2). 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."

"Although SMUD provides broad global coverage, its current spatial distribution is not strictly area-weighted representative, with observations concentrated in mid-latitude regions and relatively sparse coverage in tropical, African, Oceanian, and polar ecosystems. Therefore, applications of SMUD for global upscaling and model benchmarking should account for these spatial imbalances."

Response 2: We thank the editor for this constructive suggestion. We have further clarified this issue in *Section 4.1 Limitations of the current SMUD (Lines 545–558)*.

Specifically, we now explain that although additional environmental variables such as

soil pH, C/N ratio, clay content, soil texture, and nutrient-related properties are important controls on CH_4 oxidation, these variables were not consistently reported across the original publications, which limits their direct inclusion as standardized fields in the current version of SMUD. We also added that future applications and updates of SMUD could address this limitation by linking the database with external gridded soil, vegetation, land-use, and atmospheric datasets, thereby allowing users to derive additional predictors and improving the utility of SMUD for synthesis, benchmarking, and upscaling studies.

" In addition, although soil temperature and soil moisture are key drivers of SMU and are included as core associated variables in the current version of SMUD where reported or derivable. 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. However, because these edaphic variables were reported less consistently across the original studies, they were not included as standardized core fields in the current version of SMUD. 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."