We appreciate the time and effort of the reviewers and the editor in providing constructive feedback to improve the manuscript.

To be consistent with the first revision, we would like to address the comments of three reviewers in the order: Reviewer 1, Reviewer 2 (numbered the same as in the first revision), and the new Reviewer 3.

Reviewer 1 asked that you

(i) Provide a more detailed evaluation against LI-COR, especially on systematic bias, sensor drift, and temporal mismatches,
(ii) Discuss use in low-cost settings, including accuracy without calibration and total time/cost,
(iii) Clarify geographic/climatic limitations,
(iv) Improve figure captions, definitions, and visual clarity
(v) Provide additional evaluation metrics and offer clearer guidance on limitations and recommendations.

Your responses seem to address most of the major comments, but there is room for improvement in the quantification of costs at least in the discussion.

We added the quantification of costs, specifically the time cost. Changes were made in the abstract, materials and methods, and limitations and modifications sections:

Abstract section: "The LC-SS, built from affordable, open-source hardware and software, offers a cost-effective and time-manageable solution (~USD700 and ~50 hours for assembling and troubleshooting), accessible to low-budget users, and opens the scope for research with a large number of sensor system replications."

Materials and methods section: "The total time required to build and calibrate the LC-SS is ~50 hours, depending on the user's familiarity with electronics and sensor integration. The detailed do-it-yourself guide of the LC-SS assembly with time estimation for each major step and sensor waterproof designs can be found on our GitHub page (https://github.com/OpenDigiEnvLab/soil-CO_2-sensor-system)."

Limitations and modifications section: "The LC-SS system can be built for approximately USD700, taking ~50 hours depending on the user's familiarity with electronics and sensor integration. This relatively low cost and manageable time commitment make the LC-SS a practical and scalable option for long-term, distributed CO_2 monitoring, especially in remote or underfunded research settings.

Reviewer 2 asked for additional information on

(i) The diffusion coefficients

(ii) The relationship between flux, CO_2 gradient, and modeled diffusion, which I believe you partially addressed

(iii) The generalizability of dCO2-dominance, which you have not addressed. Please do.

We carefully read again comments from reviewer 2, particularly the part: "*A more detailed discussion comparing the assumptions and empirical bases of each model in relation to the site's soil texture, structure, and water content would strengthen the interpretation. Specifically, elaborating on why models like Campbell and Sadeghi underestimate fluxes at this site, likely due to their development in structured or clay-rich soils and their strong attenuation of diffusion when air-filled porosity is low. Or why other models, like Millington or Marshall, tend to overestimate flux in coarse, dry soils by overemphasizing the role of air-filled porosity. These insights could assist researchers in choosing suitable diffusion coefficient models for various environments. This is particularly relevant in situations where users do not have access to flux chambers for validation. In such cases, selecting diffusion models based on soil texture and structure could improve results.*". In addition, the editor also specified "*The generalizability of dCO2-dominance, which you have not addressed. Please do.*" Besides adding more discussion on diffusion models as did in the first revision, we added a general guideline for selecting the most suitable empirical diffusion model for estimating soil gas transport:

"When selecting the most suitable empirical diffusion model for estimating soil gas transport—particularly for CO_2 flux—the general guideline is to prioritize models developed and validated under similar soil conditions. Additionally, testing multiple models that utilize the same input variables (for example, total porosity and air-filled porosity) but differ in formulation can help assess their sensitivity and applicability to a specific site."

We admit we are not sure that this was the full meaning of item #3 in the comment above; however, this is what we understood, and therefore added the section above to the manuscript.

Reviewer 3 asks that you

(i) Provide a deeper discussion of why the Buckingham model works well in arid, sandy soils,

(ii) Compare empirical assumptions of other diffusion models in the context of soil texture and moisture,

(iii) Evaluate and discuss the performance of other models during wetter periods, not just Buckingham

(iv) Discuss application in the absence of chamber validation (model selection based on soil properties).

I see you have responded to most of these, but there is a clear lack of a wet-conditioned model comparison across multiple models. This must be thoroughly addressed.

We understand reviewers 2 and 3 shared similar comments as both mentioned “a clear lack of wet-conditioned model comparison across multiple models” and that this is “a missed opportunity.”

This comment stems from the mismatch observed during wetter conditions following precipitation events. While sporadic precipitation events occurred during the study period, these did not result in sustained moderate to high soil water content. As such, the conditions were insufficient to support a comprehensive evaluation of the performance of multiple empirical diffusion models under wetter soil regimes. We added an explanation for the observed mismatch between modeled and measured fluxes following precipitation events in our first revision (L381-393) and acknowledged the limitation that our system was tested under dry, arid soil conditions (L433-436). However, to make it clearer, we also emphasized this issue in the abstract:

“Gradient method F_s was in good agreement with flux chamber F_s (RMSE = 0.15 µmol m^{-2} s^{-1}), highlighting the potential for alternative or concurrent use of the LC-SS with current methods for F_s estimation—particularly in environments characterized by consistently low soil water content, such as drylands.”