Review:
Parametric design for soil gas flux system: a low-cost solution for continuous monitoring
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General remarks:

The paper presents the development of a low-cost, parametric soil gas flux system for continuous monitoring of greenhouse gas (GHG) emissions. The design incorporates a chamber system, integrated sensors, a controller PCB, and software that allows for adaptability to various field conditions. The authors validated the system through laboratory experiments (static and transient CO2 tests) and field tests, highlighting its performance and flexibility. The paper also emphasizes the need for parametrized designs to enhance data quality and spatial coverage in soil gas flux studies.

The paper makes a valuable contribution to the field of environmental monitoring by providing an accessible and flexible solution for soil gas flux measurement. In my opinion, the following suggestions could help improve the paper before publication.

Abstract:

The abstract provides a concise overview of the study's objectives, methodology, and significance. It effectively highlights the challenges with current systems and introduces the proposed solution. Nevertheless, the abstract does not mention key results (e.g., sensor accuracy, field deployment outcomes) that would strengthen the impact of the findings.

line 5: prohibits -> prohibit

line 11: demonstrate -> demonstrates

Introduction:

The introduction provides a clear context for the challenge of monitoring soil gas flux, reviews existing approaches such as Eddy Covariance and chamber methods, and highlights limitations in current technologies. It effectively conveys the need for a low-cost, adaptable solution.

M&M:

The methods section outlines the system's components, the parametric chamber design, and the experimental procedures. However, including additional details would enhance clarity and support the reproducibility of the results:

line 66ff: Section 2.1.1 While the concept of parametric design is clear, the process described in Section 3.1 ("user has to define an initial expected soil gas flux...") is relatively brief in the methods section. More detail here on how the system translates user inputs into recommended dimensions or helps the user navigate the parameter space would enhance clarity.

line 77ff: Section 2.1.2 offers a general overview of the sensors used and the workflow executed on the microcontroller. Please add a bit more details on how the system is set up, powered and data transmission is achieved (if). To better support the manuscript's low-cost approach please also include information on system cost, also in comparison to the used reference device (see below).

line 100ff: p_s in formula (1) is not explained in the text. Additionally, the formula presented in the manuscript is different to the one shown in the python code: mdf = (Aa/(tc*(tc*freq)**(1/2)))*(V*P/(A*R*T)) (see code availability).

line 114ff: I assume the Licor LI-7810 is a reference measurement system, but that's not made clear. The type number appears here for the first time, without mentioning what it is.

line 126: Again Licor LI-7810 is mentioned – here again with another type number: 8200-01S without details given about it.

line 150ff: A map/image of the experimental setup would be a nice addition.

line 160ff: Could you clarify why the non-linear H-M model was chosen?

line 172: Where does the prior knowledge come from?

line 173: setup consistent → setup consists?

Results:

line 179: Link is wrong (see code availability)

line 181ff: While Figure 4 provides a useful visualization of the MDF landscape, the text refers to user inputs being used to generate a "list of options." It would be helpful if the Results section—or a referenced appendix—included a brief example of this list or offered more detail on how the system generates and ranks these options based on the input parameters. The reasoning behind the selected dimensions (20 cm height, 20 cm diameter) is well-explained, citing material availability and an acceptable area-to-perimeter ratio. However, this section could be strengthened by presenting the alternative configurations considered and explaining why they were rejected, beyond the limitation of material availability.

figure 4: Units for minimum Flux is missing

line 213ff: While the figure (Figure 6) show the higher lag for the low-cost system compared to the reference, quantifying the difference in response lag (in dimensionless time units) would provide a more concrete measure of this difference and strengthen the comparison. The discussion section later suggests potential modifications to mitigate such lags in the field (slowing chamber closure, turning off fan), which hints at the importance of this observed lag in the lab results.

figure 7: The method states the H-M model was used for flux calculation, but the results do not explicitly mention the variability or uncertainty associated with the calculated fluxes. Given

that the discussion later touches upon different flux calculation schema and their impact on uncertainty, providing some measure of confidence or variability for the calculated fluxes in this section would enhance the result presentation. For example, showing error bars or confidence intervals on the flux data in Figure 7b would be informative.

Discussion:

line 264ff: As noted above, quantifying the magnitude of the difference in response lag between the systems would strengthen the comparison here. While the discussion acknowledges the difference, elaborating slightly on its potential practical implications for flux calculation timing could be beneficial, though the later suggestions on mitigating field lags (slowing closure, fan control) do touch upon this implicitly.

line 270: The 2-day monitoring period is rather short to draw the conclusion of the robustness of the design, considering the use of low-cost sensors. Long-term stability of the used sensors and setup should be investigated.

line 287ff: the discussion could briefly elaborate on why selecting the optimal flux calculation schema is particularly important for low-cost systems (due to potentially higher sensor noise or different response characteristics compared to commercial systems) beyond the general statement about the link between design and schema. This would further strengthen the justification for this being a critical area for future work for this specific type of system.

Code availability:

DOI/Link is wrong –probably: doi.org/10.5281/zenodo.14748702

Grammar and spelling:

quite a few small typos – mainly singular/plural-s and usage of wrong prepositions