We thank the editor and the anonymous reviewer 1 for their valuable comments which will substantially improve our revised manuscript entitled: "Technical note: A low cost, automatic soil-plant-atmosphere enclosure system to investigate CO_2 and ET flux dynamics.". We have carefully addressed all comments of both reviewers. Please note the color code in our point-by-point answer below: (I.) reviewer comments are presented in black; (II.) our replies are in green; (III.) manuscript passages including suggested changes are presented in italic and gray

General comments:

The abstract is simply (e.g. accessibly, well) written, which for a gas exchange paper is a real breath of fresh air! Sometimes they are obtusely complicated which makes them hard to access, well done.

I think I have a few points on the 'broader implications' statements at the start; I'd add some specificity or remove them altogether. They feel somewhat unnecessarily broad.

1.) In general, I'd suggest working to change the passive voice (e.g. line 150-153) to active voice throughout (e.g. line 150 = "We measured the change in CO2 concentration after injection by connecting an infrared CO2 gas analyzer to the inlet and outlet of the sealed Greenhouse Coffins." Another example, line 159: "We conducted a greenhouse experiment to test the accuracy and precision of the low-cost sensors, as well as the overall capability of the greenhouse Coffins system in independent mode." Etc.

We will change the passive to active voice as suggested throughout the entire MS.

2.) I made some specific notes below, but I think the paper would be stronger if it had a more focused introductory narrative. The current

organization sets up an unnecessary contrast between the greenhouse Coffins and existing DIY chamber systems, rather than showing that this system builds upon recent developments in DIY chamber systems as a complement (not a direct comparison, especially given the difference in application and the same sensor used in many DIY chambers these days). I have given suggestions on reorganized narrative that the authors might consider.

We agree with your suggestions and the revised manuscript will introduce our method as complementary to existing developments and presenting recent developments in a balanced way. Please see the joined reply to comment 9.

3.) I think that a last pass for sentence fragments and overly-long sentences that could be made more efficient and readable by splitting in half is in order, as the authors write very well but in some spots in a verbose way!

We will thoroughly rework the entire MS with focus on readability by (i) shorted/split sentences where possible, (ii) using active voice and (iii) eliminating redundant/unnecessary wording.

4.) This is a really cool study that fits beautifully into the growing body of literature on DIY gas sensing devices, and I love that the authors show how it will work in the greenhouse space specifically for manipulative experiments that can be applied to real-world scenarios. The authors should pump up that part of their narrative as it is quite cool!

Thank you for the positive feedback which we greatly appreciate. We will try to boost this narrative.

List of technical corrections, specific comments by location:

5.) Would suggest making the first sentence more efficient and more germane to the actual paper's take-home by combining with the second: "Agricultural systems are particularly vulnerable to the more frequent, less predictable extreme weather events (e.g. droughts, heat waves) wrought by climate change (refs)." This kind of phrasing eliminates the superwide "funnel" at the start of the paper which is perhaps too wide for this paper's scope; yes, it's true that climate change is threatening ecosystem function, but for the purposes of this study, we all already know that are want to know why ag systems in particular are the focus. (section 40).

Done as suggested. Please see the joined reply to comment 4.

6.) **Section 45**: I think the authors would behoove themselves to reorganize a little here. I think the 'threat' in the paper is climate change, though what it really should be is 'agricultural systems being both a source and a sink for greenhouse gases in a climate changed world'. I suggest the authors do some (very slight, truly!) massaging of the narrative arc in this first paragraph to refocus (see above, for example). E.g., proposed rearranged 'flow' of narrative in this paragraph:

- Agricultural systems are threatened by the changing weather patterns associated with rampant climate change.
- What is more, ag systems have the potential to both contribute to (refs) and mitigate (refs) greenhouse gas emissions depending on the practices in place and the environmental contexts of the systems.
- To best mitigate the harms of extreme weather (esp. drought, heat waves) and to characterize the potential for agricultural fields to

decrease or even reverse GHG emissions, it is essential to better monitor (and thus understand) gas and water fluxes between those systems and the atmosphere.

Done as suggested and changed in the MS as follows: *"Agricultural systems are particularly vulnerable to the more frequent, less predictable extreme weather events (e.g. droughts, heat waves) wrought by climate change (Altieri et al. 2015; Ummenhofer and Meehl 2017). Moreover, agricultural systems have the potential to both contribute to (Tubiello et al. 2013; Chataut et al. 2023) and mitigate (Lal 2004; Powlson et al. 2016) greenhouse gas (GHG) emissions, influenced by the practices implemented and the specific environmental contexts in which they operate. Therefore, to best mitigate the harms of extreme weather (especially drought and heat waves) and to characterize the potential for agricultural fields to decrease or even reverse GHG emissions, it is essential to better monitor (and thus understand) gas and water fluxes between those systems and the atmosphere (Zhang et al. 2002; Joshua B. Fisher et al. 2017)."*

7.) **52-55**: "However, manual chambers require intensive labor to use at large scales and resolutions. In addition, commercial gas analyzers (not to mention the multiplexors and auto- or semi-automatic chambers associated with automatic systems) themselves are extremely expensive, presenting significant barriers to extensive chamber-based flux research, particularly in the relatively understudied global South." I think this needs rephrasing in light of the statements above. Perhaps:

- "Mesocosm-scale experiments, performed in greenhouses or climate chambers, allow researchers to mimic the in situ environmental conditions of many different settings, and provide the opportunity to variably

manipulate those conditions within a single study site. In this way, researchers can explore the impacts of precisely isolated environmental treatments, bridging the gap between lab-based studies of single plants and field-based studies and facilitating a more nuanced understanding of ecological dynamics.".

Done as suggested. Please see the joined reply to comment 8.

8.) I will also say that I think if this is the driving thrust of the argument, the introduction should be re-framed. Right now there is a lot of content on the difficulties of field-based gas flux work given the scope/scale of those studies, resulting in a lack of study on global South conditions. But then, we move to the utility of greenhouse/mesocosm experiments, which can bridge the gap between field and lab. Which is it? I think that the current setup should be adjusted to follow the structure I suggest above for P1, and be followed by, in P2:

- However, it is challenging to study the effects of climate change on agricultural GHG dynamics given the difficulties inherent to field-based (high variability, environmental noise, the labor and cost associated with large-scale, high-resolution data collection and equipment) and lab-based (lack of environmental context, lack of replicability, the high cost of equipment) research on plant-soil systems.
- Mesocosm-scale experiments located in greenhouses or climate controlled chambers therefore provide a middle ground, bridging the gap between lab and field studies by allowing for high replication, tightly controlled and isolated environmental

treatments, and the ability to monitor plants within a context similar to that of their in situ environment.

Done as suggested and changed in the MS as follows:

"Chamber-based systems (automatic or manual) in conjunction with high temporal resolution gas analyzers are one of the most common techniques for directly measuring CO_2 and evapotranspiration (ET), providing precise data on a leaf to plot scale and allowing to assess small scale heterogeneity (Smith et al. 2010; Dubbert et al. 2014; Riederer et al. 2014). However, it is challenging to study the effects of climate change on agricultural GHG dynamics given the difficulties inherent to both field-based and laboratory based research on soil-plant-atmosphere systems. Field based research comes at the expanse of high variability, environmental noise and the labor and cost associated with large-scale, high-resolution data collection and equipment, whereas lab-based is limited by a lack of environmental context and replicability beside the high cost of equipment (Savage and Davidson 2003, Sun, X. et al. 2013; Martin et al. 2017; Blackstock et al. 2019). Mesocosm-scale experiments on the other hand, performed in greenhouses or climate controlled chambers, allow researchers to mimic the in situ environmental conditions of many different settings, and provide the opportunity to variably manipulate those conditions within a single study site. In this way, researchers can explore the impacts of precisely isolated environmental treatments, bridging the gap between lab-based studies of single plants and field-based studies and facilitating a more nuanced understanding of ecological dynamics. (Riebesell et al. 2013; Stewart et al. 2013)."

9.) Then, the next paragraph (P3) can go into the recent advances in DIY devices for GHG exchange research (without needing to discuss gap filling, which creates an artificial divide between your innovation and the current existing ones, esp. given that most of the those could easily be adapted to mesocosm experiments so it's not useful to suggest they can't. Your innovation measures something specific, the net GHG flux of a whole patch of soil/plants! This is different and thus not directly comparable as currently suggested in line 72.

- E.g., "In recent years, researchers have been increasingly developing low cost devices for chamber-based gas-exchange systems using a do-it yourself (DIY) approach. These DIY systems reduce the generally high cost per device, allowing for higher replicability than has been previously possible using commercial systems. They leverage…such as the "Fluxbots". To expand the application space of such DIY devices to the mesocosm scale, we have developed and validated the "Greenhouse Coffin", a novel…"

Done as suggested and changed in the MS as follows:

"In recent years, researchers have been increasingly developing low cost devices for chamber-based gas-exchange systems using a do-it yourself (DIY) approach. These DIY systems reduce the generally high cost per device, allowing for higher replicability than has been previously possible using commercial systems (Fisher and Gould 2012; D'Ausilio 2012). They leverage affordable microcontrollers and sensors to build custom measurement tools designed for specific research needs. By integrating sensors for CO_2 and/or ET with microcontrollers, researchers were able to develop portable, precise, and cost-effective devices for monitoring CO_2 and ET fluxes, such as Macagga et al. (2024) and Bonilla-Cordova et al.

(2024). Others went a step further and developed fully automated measurement systems to determine CO_2 efflux, such as the "Fluxbots" (Forbes et al. 2023).

To expand the application space of such DIY devices to the mesocosm scale, we have developed and validated the "Greenhouse Coffins", a novel low cost automatic soil-plant enclosure system, designed to monitor CO_2 and ET fluxes within greenhouse experiments in a fully automatic manner. "

10.) **80**: highlighted words that can be deleted in green, here and throughout.

We did not receive a PDF copy that has been marked by you. However, the revised version will be carefully checked to avoid unnecessary sentence fragments and words.

11.) **80**: spell out "relative humidity (RH)" here and use RH for the remainder.

Done.

12.) **80**: not sure what 'based' means here in the context, apologies! Highlighted to flag it for the authors to confirm.

We deleted the incorrect wording "their based" from the sentence, which now reads as follows:

"Additionally, we evaluated the accuracy and precision of used low-cost NDIR CO_2 (K30 FR) and RH sensors (SHT31) by comparing their calculated CO_2 and ET fluxes with results obtained with a commercial infrared gas analyzer (LI-850, LI-COR Inc., Lincoln, USA)."

13.) **82-83**: suggest rephrasing to, “Furthermore, we tested a DIY, low-cost multiplexer’s ability to link multiple greenhouse Coffins to one commercial gas analyzer.” since you’re testing the multiplexor, not the system per se!
Done accordingly.

14.) **92**: What does “Arduino Uno-like” mean? Isn’t the ATmega a kind of mcu that can be associated with an Arduino board? I would clarify what you mean here otherwise I think it’ll cause confusion.
To avoid confusion, we changed “Arduino Uno-like” for “ATmega328 Microcontroller” throughout the entire MS (Arduino Uno-like refers to a cheap clone with similar properties, which is, however, not produced by the company Arduino). In addition, we added the description column to Tab.1, which now describes all components in more detail.

15.) **107**: “thus enabling researchers to chain each greenhouse coffin together to a single gas analyzer”.
Changed accordingly.

16.) **115**: see note above on line 92 re: microcontroller specs; this is a little bit confusing!
To avoid confusion, we changed “Arduino mega-like” for “ATmega2560 Microcontroller” throughout the entire MS (Arduino Uno-like refers to a cheap clone with similar properties), which is however not produced by the company Arduino). In addition, we added the description column to Tab.1, which now describes all components in more detail.

17.) 166: in what way does Bluetooth allow for easy data access? I'd love a few more details on how this works aka what format is the data in, how does it gets transmitted over Bluetooth, etc.! It seems cool.

Bluetooth facilitates easy data access by wirelessly transmitting data to another Bluetooth device in a text format, which can be easily read and processed by various software applications. This setup enables direct monitoring near the greenhouse coffin via a smartphone or tablet using a Serial application (e.g., Serial Bluetooth). Additionally, the microcontroller can be connected to a computer or Raspberry Pi keyboard, where the data is recorded as text, plotted, and can be monitored remotely using software like AnyDesk. We will include these details in the manuscript to provide a clearer explanation of how Bluetooth facilitates data access.

1. **Fig. 1**: I think the labels on the two modes are incorrect; I think the left needs to be independent mode and the right needs to be dependent, right? The legend is correct if so, just the labels are off.
We corrected it accordingly.

2. **142**: ha! This is awesome.
…and fun.

3. **180 section** : I suggest a table with the gas constants listed for easy access for readers looking to replicate your data processing method!
Please note the ideal gas constant is given in the MS as: "8.314 m^3 Pa K^{-1} mol^{-1}".

4. **242**: this wording is a little awkward and fumbly; I also think it's probable that you'll want to say "demonstrated" over "proved". Maybe,

“The validation experiment, performed continuously over five days using a single greenhouse coffin in independent mode, demonstrated that CO2 and ET fluxes can be measured reliably and accurately in a fully automated chamber using low-cost sensors.”.

- Remove highlighted sentence in 243-244.
- “…using low-cost sensors. Out of 223 automated measurements…”.

Done as suggested.

“The validation experiment, performed continuously over five days using a single greenhouse coffin in independent mode, demonstrated that CO_2 and ET fluxes can be measured reliably and accurately in a fully automated chamber using low-cost sensors. Thus, out of 223 conducted automatic measurements, more than 99% passed the flux calculation algorithm for CO_2 and ET, respectively. “