Answer reviewer 2:

This paper presents a new Steady-State-Through-Flow (SS-TF) system based on low-cost Air Enquirer kits, including CO_2 and environmental parameter sensors. The CO_2 sensor is calibrated in a chamber where environmental parameters can be controlled. Multivariate regression models are derived from comparison with reference CO_2 measurements and applied to the CO_2 soil flux measurements. Conceptually, this work on application of low-cost sensors for a high temporal and spatial monitoring of CO_2 soil flux is useful, but requires more evidence on the performance evaluation of a new SS-TF system to be published in AMT.

2. *Only 5 comparison during 2 days of experiment are provided for the evaluation. This size of dataset is extremely limited. 2 days are not enough to catch all possible range of variations in environmental parameters that might affect the correction of the low-cost CO_2 measurements and calculation of the soil flux measurements. Moreover, it would be necessary to have an explanation and a correction for the mismatch observed when NSS-NTF shows negative flux.*
3. *For the evaluation of this new SS-TF system, I would prefer to see comparison with a commercial soil flux measurement system instead of comparison to NSS-STF measurement system using the low-cost sensor.*

First of all, we want to thank the reviewer for his/her comments. We think his/her experience can help us to improve the quality of the work.

We agree with the reviewer that a full validation of a new SS-TTF system will need a long-term comparison with commercial and/or research products chambers. However, we think it is really important here to underline that the main aim of this paper was not validating a new system but:

i) presenting a low cost sensors kit (Air Enquirer);
ii) offering a robust metrology for the calibration and the following application of low cost CO_2 sensors for environmental studies;
iii) showing for the first time a methodology of using low cost sensors kit in CO_2 fluxes networks, reducing price and improving data quality.

We noted the lack of a robust metrology chain in these type of measurements and we think it is important to describe and propose it.

We also believe that it will be really important to test our CO_2 dynamic flux system with other available systems being them commercial as well as from other research groups. Actually, we are going to submit a new project to, among others goals, buying a new Licor CO_2 flux system (https://www.licor.com/env/products/soil_flux/) and making an intercomparison campaign between different systems. However, the short comparison exercise carried out and presented in this paper shows that the new SS-TTF systems allows CO_2 flux values of the same order of magnitude that the ones observed with a simple static accumulation chamber and in the literature. This is a first important step. All this has been now better clarified in the conclusion of this manuscript as further actions, and in order to avoid misunderstands we have now modified the title of the manuscript for better fitting with its content.

The new version of the manuscript clarifies better the goal of the study and the results presented.

Specific comments

Line 97-100. Detailed description on the calibration chamber system is needed. How is the calibration experiment designed? For example, at what temperatures is the experiment held and for how long?

Thanks the reviewer for this comment. In order to answer to this comment, we think it is important to clarify what implies the calibration of CO_2 low cost sensors and the calibration of CO_2 flux chambers. In the first case, as explained within the manuscript, it is need a metrology to calibrate low cost CO_2 sensors and to understand the influence of environmental parameters on their response. This has been extensively done within this study and better presented in the revised version of this manuscript. In lines 117-122, the range of temperature, RH and pressure is detailed*:" Both experiments were performed in a temperature range between 20 ºC and 42 ºC and a relative humidity with diurnal cycles between 10% and 50%. Temperature in the calibration box was set to be in increased in slopes of 10ºC, although at low temperatures it fluctuated with room temperature. The pressure ranged between 1004 hPa and 1012 hPa in the calibration at IC3 and between 838 hPa and 850 hPa in the calibration at CRAM. The two calibration experiments at the CRAM and at IC3 stations were carried out with one month difference."*

We have added a new figure (new Figure 4) where the difference between calibrated sensor and the CRDS CO_2 value are plotted together with temperature and humidity values.

In regard to the calibration of flux chambers, this should be done creating a complete metrology chain where a primary reference standard: a CO_2 respiration soil is used to calibrate the response of the fluxes systems. An example of it is the metrology chain created by the project traceRadon for radon flux measurement (Roettger et al., 2021).

Fluxes system, as well as other monitors and systems, can be compared between them to carry out proficiency studies and to validate systems results. In this case you do not have any reference but you estimated the participants using a mean value of the participant's response and you can estimate the dispersion between them.

As explained in the introduction of this document the main aim of this study was not validated a new system but design, built a calibrate a new low cost sensors kit and apply it for new application showing it feasibility, low maintenance, low cost and further possible application for the scientific community.

Line 138. How well would the measurements at the top of the flux chamber represent the gas exiting the chamber? How much bias or uncertainty would be introduced with this assumption?

Answer: In order to minimize the concentration gradient within each chamber a fan was used to homogenize the air inside. Moreover, two instruments were located in two different point within the chamber to smooth possible bias. Finally, the total uncertainty budget of the CO_2 flux measurements has been presented with k=2 to have a bigger coverage factor.

Line 195-196. Is concentration first averaged and then used to calculate the flux? Or is the flux calculated using the original temporal resolution of the CO_2 measurements and then averaged?

Answer: The flux has been calculated using the original minute CO_2 measurement and then its average value has been calculated over 10 minutes. The revised version of the manuscript has been modified (lines 239-243) to clarify this procedure:

*"Each value of flux has been calculated using Eq. (7) and averaging the calibrated CO_2 values of AE #1 and #2 for the mixing chamber and taken the data from AE #3 for the flux chamber. 10 min. averages were calculated from every minute calculated flux data. The variability of the flux within the 10 minutes averages is represented in Fig. 6 as an associated uncertainty of 2σ. The associated expanded uncertainty for each value has been calculated propagating the 2*RMSE$_{multi}$ of the flux chamber CO_2 sensor."*

Line 197. What is the temporal resolution of the CO2 measurements? Is the RSE also calculated with 10 minutes averaged dataset? If not, the RSE would be different for the 10 minutes averaged flux.

Answer: The flux is calculated using equations 7 and 8 for dynamic and static chambers respectively. The RMSE is not the uncertainty of the flux but the Root Mean Square Error of the calibration fit of each kit with temporal resolution of 1 minute. The uncertainty of the flux has been calculated propagating the uncertainties of the variable and parameters participating in the Equation 7 and 8, respectively. Then in the case of the dynamic system, the uncertainty of the mean was also propagated for the 10 used values.

The new revised version of the manuscript explains this better now.

Figure 5. What's the difference between the 2 sigma error and the extended error?

Answer: The 2-sigma is twice the standard deviation of the flux within the 10 minutes average. The extended error adds the uncertainty associated with the sensors measurement (with k=2) to this variability. Although it was commented in the text, we have clarified (lines 239:243) and we have also added the explanation in the figure caption (now Figure 6):

"Figure 6. Time series of 10-min average CO_2 concentrations (upper panel) measured within the SS-TF chamber at the CRAM soil between 1st and 2nd of June 2016, and calculated f_{CO_2} (lower panel). The 2σ range for 10 minutes average variability and the extended error (adding 2 times the RSE of the multiparametric fit) are also plot."