

Response to
<https://doi.org/10.5194/egusphere-2026-144>
from Referee #1

This work designed a low-cost CO₂ sensor to measure CO₂ flux. The system has advantages in fast response and low noise. The good performance of the low-cost sensor was validated by simultaneous long-term field measurement of CO₂ flux using a scientific reference eddy covariance setup. This study fits well within the scope of AMT and have importance implications in greenhouse gas measurements and the evaluation of their climate effects. The following concerns should be addressed before it can be accepted for publication.

We are grateful for useful comments and recommendation. Our responses to your comments are found below, along with proposed changes to the manuscript.

Specific comments:

Lines 83-85: The fund information should go to the section “Acknowledgements”.

Thank you, will be moved to “Acknowledgements”.

Lines 111-115: The software updates have a significant impact on the performance of the sensor. The authors should elaborate on what the key update is.

We have explained the major software update and autocalibration topics in the response to the referee comments #1 and repeat it here.

The prototype development involved series of minor software updates trying to improve the instrument's performance and characteristics. However, the software update on 21 July 2022 improved the sensor performance significantly, eliminating the signal jumps after each autocalibration.

Prior to this software upgrade, the auto-calibration was performed according to the following algorithm. The signals were measured with 5 Hz until temperature of the cell changed certain threshold (around 0.2° C). Then autocalibration was applied by measurement a reference signal at 1 Hz for 1 sec; after such calibration the CO₂ reading was adjusted to the reference signal. Then measurements continued again with 5 Hz frequency.

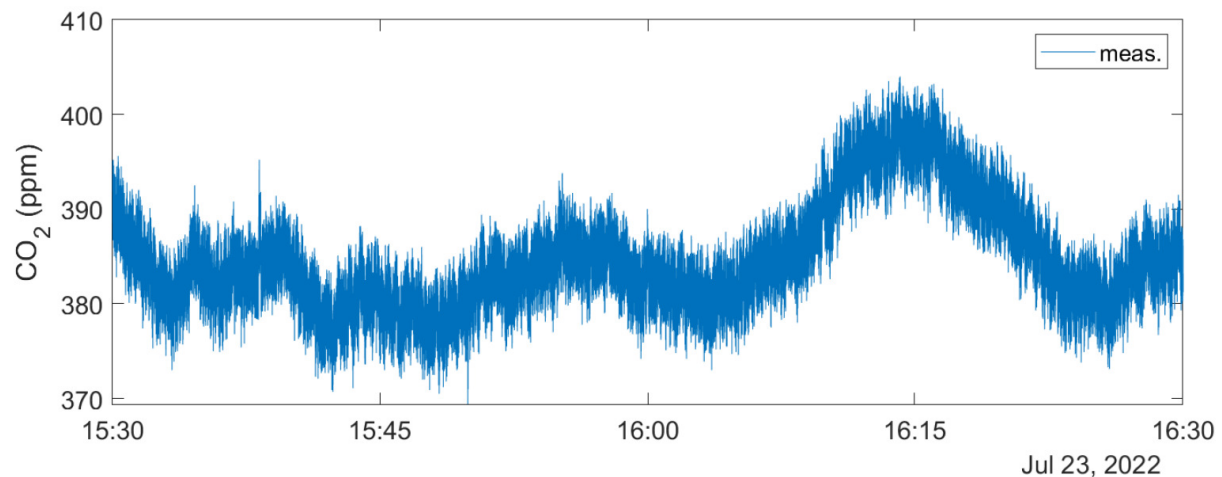
With the software update on 21 July 2022, the signal jumps occurring with reference autocalibrations disappeared. The autocalibration procedure was modified to perform step-wise predictions for the drift between the calibrations against the reference signal using internal signals from instruments components. Continuous corrections to the signal based on such drift predictions virtually removed discontinuities in signal after each autocalibration.

Due to built-in autocalibration against the reference signal the long-term signal drifts were avoided. At the end of the field experiments the prototype's calibration was tested in Vasiala's lab and no drifting was detected.

We will amend the revised MS with this additional explanation.

Lines 120-124: The CO₂ mixing ratios before and after 21 July should be given to have a better understanding of how the software update shapes the measurement of CO₂.

The "jumping behavior" of CO₂ signal was shown on Fig. 2 of the MS. Below we show two examples (on 23 July and 27 July 15:30 till 16:30) of the measured CO₂ mixing ratios after the software update on 21 July 2022. Discontinuous jumps of the signal have disappeared. We will add these plots to the SI of the revise MS.



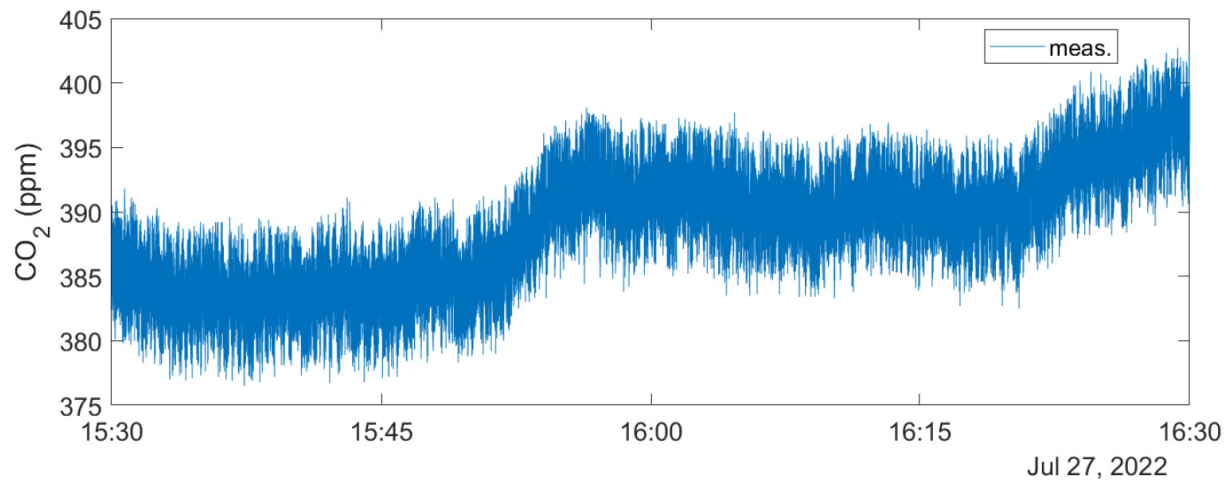


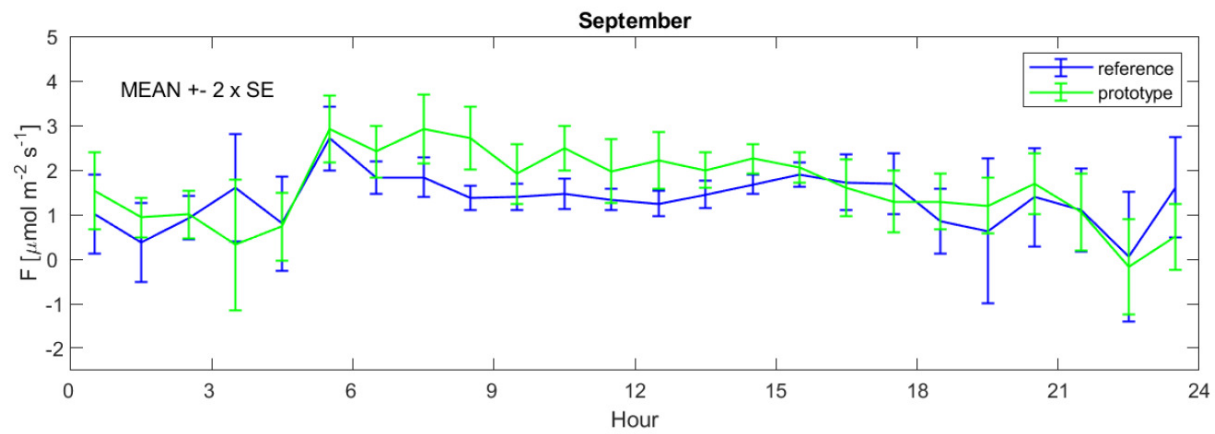
Figure 6: The current x-axis is difficult to read. I would suggest changing the x-axis to day 1 to 31.

We will modify the x-axis in Fig. 6 in the revised MS.

Figure 8: The difference in CO₂ flux in September is also relatively large. What is the reason?

In September the average flux magnitudes are relatively small. At 30 min averaging level, however, relatively large variation of fluxes occurs, which can be observed in the results of both systems (Fig S1).

Below we present closer look at the September comparison. Instead of SE (standard error) representing the error bars on Fig. 8, we use here 2 x SE (of the average for each hourly bin). Twice the standard error would present the confidence intervals at 95% probability. We observe that two curves differ more than the error bars only for a few hours in September, thus making it difficult to decide if they are different. However, within time interval from 7 am till about 3 pm the difference tends to be systematic. As a possible reason for this could be density fluctuations effects, if not properly accounted for. However, similar pattern is not observed in previous and following months (see August and October in Fig. 8). We have applied the same correction routines throughout the period. Thus, currently we cannot confirm if the difference in September between the two system results is real and significant. Also, we are not aware of system malfunctioning during this specific period.



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