

Response to
<https://doi.org/10.5194/egusphere-2026-144>
from Referee #2

This manuscript describes the development and evaluation of a low-cost CO₂/H₂O sensor for eddy covariance applications, which is particularly relevant given the growing demand for scalable carbon flux measurements. The results of this sensor are in agreement with the chosen reference system. Before publication, some clarification should be required as follows:

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

1. Impact of software updates on results: The paper describes some updates during the field campaign, particularly a major change on July 21. More clarification should be given to the software update and autocalibration and how that affected performance. Would this be a reliable method for a more long term use or how does drift affect over long periods of time?

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.

It is also important to note that in EC application the CO₂ analyzer does not need to measure absolute concentrations correctly but rather concentration changes (fluctuations) up to a few tens of minutes (the averaging time of the flux).

2. Differences in the prototype and reference system: As stated in the paper, the prototype and reference systems are installed at different heights and separated horizontally. Additionally, the prototype operates at 5 Hz, compared to 10 Hz for the reference system. Clarification should be given in the manuscript of how these changes impact the data between the prototype and the reference. For example, how does the separation affect flux differences?

The effect of sampling rate was discussed in the response to RC1.

In general, the observation height has impact in terms of turbulence properties and also on the field of view (the footprint) of the measurements. Turbulence spectra scale with measurement height and wind speed; in general, the lower observation level implies shift of spectra to higher frequencies. While reviewing the questions and the manuscript, we discovered a mistaken statement that the systems were installed at different heights. Both systems were installed at the same height of about 2.9 m. The prototype analyzer was located at a horizontal boom at 2.15 m. We will correct this information in the revised MS. The results will not be affected.

Thus, both systems measured the fluxes from similar footprints covered with same surface vegetation. The horizontal separation has an effect that the systems do not sample exactly the same turbulence realization (turbulence records at some horizontal distance are not fully correlated) and therefore the results can differ due to statistical uncertainty. We will discuss these aspects in more detail in the revised MS.

3. Line 16 says, "The results at the end of the paper are very promising..." and then proceeds to give the results. This sentence is not needed. The results should prove the promise, it does not need to be stated.

Thank you for the comment, we will remove the sentence.

4. Line 151: "indicated the presence of noise at high frequencies", consider specifying the frequency range

The noise in CO₂ signal can be observed as the upward sloping power spectral densities (multiplied with frequency) starting from normalised frequency around 0.5. Will be added to the MS.

5. The figures are in a blue/green color palette. Consider switching to a blue/red palette instead for readability.

We will change to blue/red palette while doing revision.

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