



EGUsphere, referee comment RC1  
<https://doi.org/10.5194/egusphere-2022-1331-RC1>, 2022  
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## **Comment on egusphere-2022-1331**

Benedikt Herkommer (Referee)

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Referee comment on "Using portable low-resolution spectrometers to evaluate Total Carbon Column Observing Network (TCCON) biases in North America" by Nasrin Mostafavi Pak et al., EGU sphere, <https://doi.org/10.5194/egusphere-2022-1331-RC1>, 2022

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### **General Comments:**

Overall, this is a sound piece of work dealing with the important task of comparing different TCCON sites (in North America) and the study fits well within the scope of AMT. I recommend publication after minor revisions.

In Section 2.3, you are dealing with ILS measurements. In Figure 2 you show the ILS measurements of the TCCON stations but you are not classifying them (are they good/bad?). They are not used for a further data analysis, I do not see a strong need to show them here. Is there an acceptance level? The variation of 1% found for the fluctuations in EM27/SUN modulation efficiency (ascribed to variable humidity and room temperature) seems way too high, Alberti et al., 2022 demonstrated a significantly better reproducibility (see Fig. 15 in this work). It is important to take the variable partial pressure of H<sub>2</sub>O into account when doing the analysis (which can be calculated from total pressure, path length and H<sub>2</sub>O column) and to do the analysis repeatedly until a self-consistent solution (for ILS, column, and partial pressure) is found. If this has been taken into account, I would suspect that there was a problem in coupling the light source to the spectrometer in a reproducible manner.

You derive the airmass-dependent correction factors by comparing the measurements in the course of the day to the daily median, thereby assuming the variation is solely due to an airmass dependency. I am in doubt if this assumption is valid since it ignores intraday variability of GHGs, which, especially in a rural area like Toronto, seem reasonable for me to occur.

Next you are writing in line 281 you are using the same method as GGG2014 to apply the correction factors. However, there is missing an explanation or at least a specific citation on how this is done in GGG2014.

You are using the median for the comparison of the 10-minute bins of the different spectrometer but you are using the mean value to calculate the 10-minute bins. What are the reasons for choosing the mean or the median for the different situations?

In chapter 3.1.2 you are describing how the maximum biases are calculated. However, this procedure is not clear to me. I understand you are taking the 10-minutes bins of the different spectrometers and then calculate the difference of the minimal and maximal bin each, even though they are not temporal coincident. This however, would include the variation of the XGas value to the maximum bias. Please clarify what is done there.

Lastly, you are writing in the introduction that you were taking a pressure sensor to the road trip to compare with the pressure measurement done on site. However, no detailed comparison is included in the paper. It would be nice to at least say a few words to the pressure comparison or better to show some results (maybe in a table?).

### **Specific Comments:**

Line 48: I am not fully aware of TCCON doing calibration of surface pressure measurements. If they do, please provide a citation or an explanation how this is done.

Line 93: The abbreviations used for the EM27/SUNs and the TCCON station seem to be chosen randomly (e.g. it is unclear to me why the Armstrong Flight Research Center is abbreviated with "df"). Furthermore, for a reader it is quite confusing which abbreviation is a TCCON station and which is an EM27/SUN. Maybe add TCCON-xx to the TCCON sites or vice versa.

Table 1: It would help to reduce the reader's confusion with the abbreviations if you would add the abbreviations of the TCCON sites in the "Site" column.

Line 169 – 171: I am not sure if I understand correctly what you are doing. This is what I understood: You are using the Digiquartz data as a „standard“ measuring at height a. For AFRC and Lamont you are adding a factor to bring the pressure of the TCCON station to the level of the "standard" to correct for height. Have you ever compared the pressure measurements of the "standard" with the pressure of the TCCON station? Because otherwise, you cannot be sure if the correction is only due to height or also compensating sensor biases.

Line 290: In the list of citations Alberti et al. 2022 would be good do mention, too.

Caption Figure 6: I was confused by this plot first, since I thought you are comparing something with the TCCON data and not that you only recorded the measurements at

these sides. Maybe it is worth to write this explicitly.

Figure 8: Adding vertical lines separating the measurements of the different sites could help to make the plot clearer.

Line 365: Add explicitly which is the reference EM27/SUN (is it tb?). This could help the reader for making fast comparisons with the figures.

Line 408: This sentence is more appropriate to section 4, not 4.1. Because it sums up the results of all the other stations than eureka, it appears misplaced to me in a section treating the peculiarities of the Eureka station.

**Technical Corrections:**

In the caption of figure 1, Park Falls should be abbreviated by "pa" instead of "oc".