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Interactive comment on "Building the COllaborative Carbon Column Observing Network (COCCON): Long term stability and ensemble performance of the EM27/SUN Fourier transform spectrometer" by Matthias Frey et al.

Anonymous Referee #1

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The manuscript "Building the COllaborative Carbon Column Observing Network (COC-CON): Long term stability and ensemble performance of the EM27/SUN Fourier transform spectrometer" by Frey et al. assesses the stability of Bruker EM27/SUN spectrometers and evaluates their use for greenhouse gas (GHG) observations. EM27/SUN spectrometers are the spectrometers used in the recently founded COllaborative Carbon Column Observing Network (COCCON). The EM27/SUN spectrometers are portable and easy to operate. They have been used to quantify GHG emission sources (cities, exploration sites, ...) by column budgeting and are also used at permanent sites

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to complement the well-established Total Carbon Column Observing Network (TC-CON). Therefore, COCCON will increase the number of sites, which perform groundbased column observations of GHGs. This is of high importance for the validation of GHG satellite retrievals. Since a high stability and small bias are vital for a network of GHG observations, this paper is scientifically of very high interest. The manuscript is well written and in my opinion it should be published after minor revisions.

Below are several point that should be addressed prior acceptance.

Abstract: The abstract should be more quantitative and clearer. All the information I am requesting is contained somewhere in the manuscript but in my opinion it should be mentioned in the abstract, e.g. "the EM27/SUN is stable on timescales of several years" How stable, how many years? "average bias across the ensemble" Is the average a good measure? What about min/max? "the application of these empirical factors is expected to further improve" The abstract should contain a number for the bias after all corrections and one before. Future papers will cite this number and quite often this is only taken from the abstract and not from the text.

p.2, line 11: "Furthermore these measurements can be directly used to evaluate emissions reductions as demanded by international treaties..." I do not know a study, where such measurements have been used to evaluate emission reductions. Please give a reference or mention that this is a future plan.

p.6, 3.2 It is mentioned that the EM27/SUN spectrometers are operated at a significantly different temperatures. It would be interesting to have a separate assessment of the temperature on the EM27 retrievals.

p.8, line 32: Why do HR125 LR and EM27/SUN have a different bias compared to TCCON?

p.9, line 4: "The offset between EM27/SUN and TCCON shows a seasonal variability. Reasons for this are mainly the differences in airmass correction, averaging kernels

and retrieval algorithm." Maybe this is discussed in the papers mentioned. However, it is highly important for the network. Therefore the reasons should be (re-) discussed here.

p.11/12, 4.2: The instrument dependent calibration factors: It would be good to elaborate the discussion about them and have the numbers summarised in a table, e.g. overall biases a) with instrument dependent cal factor (including uncertainties on the cal factor) and b) w/o instrument dependent cal factor.

p.13 line 9: define how you quantify "scatter"

Figure 1: How much information is coming from the apriori in the ILS retrieval? If the constraints are high one can always get a stable ILS. Is it possible to add averaging kernels or similar for the ILS retrieval? At least some explanation should be included in section 3.1.

Figure 2: I am not sure if this figure is really needed.

Figure 4 and 6: The difference in the left figures is difficult to see and contains the same information than the ratio in the figures on the right. Therefore I would leave the difference out in the figures on the left.

Figure 10: I would delete this.

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