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Interactive comment on "Assessment of errors and biases in retrievals of X_{CO2}, X_{CH4}, X_{CO}, and X_{N2O} from a 0.5 cm^{-1} resolution solar viewing spectrometer" *by* J. K. Hedelius et al.

Anonymous Referee #1

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This paper provides a valuable overview of the performance of EM27/SUN spectrometers when used for atmospheric column measurements of greenhouse gases (GHGs), compared with the standard set by TCCON measurements. The authors rightly identify the need for an expansion of the current ground based network of column GHG observations, which becomes more feasible with cheaper, more portable instrumentation such as the EM27/SUN. The primary value of this paper is in the detailed description of a methodology for comparing performance of the EM27/SUNs with TCCON, which will enable any users of EM27/SUNs (or similar ground based solar-viewing spectrometers) to assess the stability and precision of their instrument compared with a TCCON site in a manner consistent with that applied to other instruments, prior to deployment

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Discussion paper

in the field. The paper also identifies and thoroughly addresses the limitations of the EM27/SUN when used for long term monitoring, namely the non-linear response of the extended range InGaAs detector (necessitating the use of a standard spectral range InGaAs) and the impact of mirror degradation on long term stability when mirrors are exposed outside for long periods of time. I think that these results will prove to be very useful for the EM27/SUN user community in particular, and for those involved in ground based direct solar spectral measurements of the atmosphere in general.

I have a couple of specific suggestions which I think might improve the paper. Firstly, the paper alludes to quality control filters at the end of Section 2.2 which are applied to the measurements prior to the analysis. It would be useful to describe the filters used here, or at least refer to a previous publication, so that users of other EM27/SUN instruments can directly compare their performance using the analysis described here with that of the instruments studied in the paper. Similarly, I would be interested if possible to see a reference for the Bruker interpolated sampling routine mentioned briefly in Section 4.3 – I think this would be of use to those using non-Bruker spectrometers when processing their raw interferograms, prior to the retrieval stage. Overall, though, a very impressive level of detail is used to describe each part of the data-processing chain and the subsequent analysis, so in my opinion the paper is already of a high enough standard to be published.

Finally, I would like to suggest a few technical corrections:

Page 2 Line 5: Replace GHG with GHGs; Page 2 Line 8: Define acronym 'GOSAT'; Page 4 Line 17: ... spectral regions where individual gases...; Page 8 Line 24: 'cn' and 'ha' abbreviations for the instrument names are defined in the caption for Table 2, but not in the main text.