

## ***Interactive comment on “Intercomparability of $X_{\text{CO}_2}$ and $X_{\text{CH}_4}$ from the United States TCCON sites” by Jacob K. Hedelius et al.***

**Anonymous Referee #2**

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General comments:

This manuscript presents a study of the intra-network bias of the  $X_{\text{CO}_2}$  and  $X_{\text{CH}_4}$  among the four currently operating TCCON sites in the United States using a pair of portable low resolution spectrometers of the type EM27/SUN designated as mFTSs in the manuscript. Both, the TCCON spectrometer with a spectral resolution of 0.2  $\text{cm}^{-1}$  and the mFTSs with a spectral resolution of 0.5  $\text{cm}^{-1}$  measure the direct solar radiation in the near infrared spectral region using standard InGaAs detectors. The inter-comparison campaign was performed within a short time period of 5 weeks to reduce the potential drift between the mFTSs. The authors consider different reasons for the residual differences in the  $X_{\text{gas}}$  products between the TCCON sites and the mFTSs. Some of these reasons, like the air-mass-dependent artifacts, surface pressure bias, a priori temperature profile error and the sensitivity of the averaging kernel difference,

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are discussed in detail. However, the manuscript mentions only the possible biases due to the non-ideal instrumental line shape (ILS) without going into further details. In my opinion, this is an important piece of information which would help in understanding the cause of the residual biases between the TCCON sites. The paper is very well written and has a good structure. I recommend its publication after incorporating the following changes.

Major comments:

I suggest to include a plot (or to give values) showing the ILS parameters of the 4 TCCON sites. The sensitivity of the TCCON retrieval results with respect to the ILS parameter has been studied in the past by several investigators. Therefore, the authors could use this information and check if their findings are in agreement with the expected bias due to an imperfect ILS of the TCCON spectrometer.

Furthermore, as correctly pointed out in the manuscript, there exist some problems due to the difference in the resolution of the two spectrometer types. As a result, I suggest performing an additional step of truncating the TCCON measurements to the resolution of the mFTSs and making the intercomparison study. This would create identical measurements performed by the two different types of spectrometers at the same spectral resolution. The inter-comparison of the  $X_{\text{gas}}$  retrieved from the two datasets would eliminate several differences which are present when comparing the mFTS retrieval results with the high resolution TCCON retrieval results, but will preserve other errors which are instrument and detector related. This study would therefore give a more exhaustive investigation of the residual bias and their possible causes.

Minor comments:

Page 7 line 4-5: What is the motivation of using a different scaling factor than that of the TCCON  $X_{\text{gas}}$  calculation scaling factor?

Technical comments:

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Page 6 line 10: Reference missing, e.g. Petri et al. 2012, Gisi et al. 2012

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Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-279, 2016.