

Interactive comment on “Atmospheric CO₂ retrieval from ground based FTIR spectrometer over Shadnagar, India” by P. Mahesh et al.

Anonymous Referee #1

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This paper describes ground based solar Fourier transform spectroscopy remote sensing measurements of total column atmospheric CO₂ from Shadnagar, India. Similar measurements as part of the global TCCON network have become the de facto gold standard for validation of satellite-based measurements by GOSAT, OCO-2 and other instruments, and are used independently in model inversions to elucidate the global carbon cycle. It would be very desirable to complement the TCCON network in the region of the Indian sub-continent, as there is currently no coverage there.

Unfortunately, the work described in this paper falls far short of the accuracy and precision required and already demonstrated in the TCCON and NDACC networks, as published in several papers and the CDIAC data base by Wunch et al. and many others. Further, the authors make no acknowledgement of, or reference to, the large existing body of closely-related work in TCCON - this is inexcusable in such a publi-

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cation, there are over 100 publications listed on the public TCCON wiki. The authors appear to have done this work with little knowledge or recognition of the existing state of the science. The data presented are a small snapshot of demonstrably inferior accuracy, adding little or nothing to either the advancement of techniques or the body of geophysical data. I therefore recommend that the paper be rejected.

I provide an indication of the major inadequacies in the work which would have to be addressed before resubmission for publication.

1. The demonstrated precision and daily variation of XCO₂ is \sim 4ppm, 5-10 times worse than that achieved in TCCON. The total column amounts around 390 ppm appear to be biased 5-10 ppm low based on the calibrated TCCON network results. To be of value for current satellite validation and model applications, the accuracy and precision needs to be improved by an order of magnitude.

2. The poor accuracy and precision appear to be due to both the actual collected spectra and the retrieval method used. The spectra shown in Fig 1 show very bad saturation, especially in the MIR region. It is well known in TCCON that the InSb detector used here also saturates unless bandpass filters are used to restrict the photon flux. InSb is inferior to InGaAs detectors. Saturation will directly affect the accuracy of retrieved total column amounts. These aspects of the measurements are all described in the available published TCCON and NDACC literature but appear to have been ignored by the authors.

3. The retrieval method based on FASCODE3 is inadequately described - there is the perception that it is used as a "black box". The residuals displayed in Figure 2 show clearly that the forward model is not adequately fitting the measured spectra. The residuals are several times larger than those achieved with GFIT in the TCCON network or with other codes such as SFIT2/SFIT4 or PROFITT and indicate poor lineshape and position matching. However no details of the model are provided in the paper. No mention is made of how the solar spectrum is included in the forward model. Line

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119 implies that only an average solar zenith angle around 75 degrees is used for all spectra - if true this is a major source of potential error and inadequate for the accuracy required for these measurements to be useful. Finally, the method for profile retrieval is not explained at all.

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