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Atmospheric Measurement Techniques Discussions

Interactive comment on "A DOAS-like method for total column of CO_2 from ground-based FTS measurements of the direct solar beam" *by* Y. F. Huo et al.

Anonymous Referee #1

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Manuscript "A DOAS-like method for total column of CO2 from ground-based FTS measurements of the direct solar beam" of Huo et al. presents a new method for CO2 column retrieval from ground-based FTS measurements. In principle, the paper covers an interesting topic relevant for AMT. However, significant improvements are required before I can recommend publication in AMT.

General comments:

The authors developed a retrieval algorithm using radiance ratios (pairs) at a number of wavelengths. They claim that this method gives more accurate CO2 column retrievals

(page 2412, line 6). This statement is based on comparisons with results obtained via an "Optimal Estimation retrieval algorithm" (OE), which is not specified in detail. It is therefore not clear if new the algorithm is really better or if this is an artifact from the use of a non-optimal OE algorithm. For me it is not clear why the new algorithm should be better. I guess this is simply because of the use of a non-optimal OE algorithm. The authors have to provide more convincing analysis to support their claim. I recommend to use TCCON spectra and to apply the new algorithm to these spectra and to compare the results with the official TCCON CO2 data product.

Furthermore, the English needs to be significantly improved at various places.

Specific comments incl. typos etc.:

Abstract, line 13: "the results agree very well with that of GOSAT". This statement is based on Fig. 8, which is of very poor quality and does not support this statement. Please use a better y-scale, e.g., 380-400 ppm, and better symbols than tiny points. Only 7 GOSAT observations are shown. The correlation between the FTS and the GOSAT data seems to be close to zero. This sparse data set and its limited analysis does not support the statement given in the abstract.

Introduction, page 2406, lines 16-20: Which "many other reasons" ? Please provide examples and add references or remove this statement. "The disagreement about this issue": which issue? Please be more specific.

Introduction, page 2407, line 2: Please be more specific with respect to SCIAMACHY and GOSAT. For SCIAMACHY add the achieved precision and accuracy as reported in Reuter et al., 2011, and for GOSAT please add which algorithm and version you are referring to and cite the corresponding validation paper where the GOSAT data have been compared with TCCON. Later in the paper please mention which version of the GOSAT data have been used here and give a proper reference.

Introduction, page 2407, line 8: A major reason why the described ground-based ob-

servations typically have higher accuracy is because the light path is known due to direct sun observations, whereas for satellite retrievals a much more complicated problem has to be solved, because scattered light is used (and the light path depends on surface albedo, aerosols and cirrus, etc.).

Introduction, page 2407, line 24: What is “model parameter error” and what about non-model parameter errors?

Page 2408, line 17: Provide evidence (or cite an appropriate publication) why the scattering term is negligible. What about cirrus and (other) thin clouds?

Page 2409, line 5 an following. Please explain the symbols used more carefully. What exactly is NCO2. Definitely not “the number of CO2 in the atmosphere”. Is it the vertical column in number of CO2 molecules per surface area?

Page 2410, line 2. No evidence is given for the statement that the proposed method eliminates scattering effects. Provide evidence or remove this statement.

Page 2410, line 7 following. Same remark: No evidence is given where the statement that the listed parameters are the “main factors”, which determine accuracy, is coming from. Provide evidence or remove this statement.

Page 2410, line 12: Which noise is meant here? If you mean instrument noise than SNR is not “related to this” but a means to quantify the noise.

Page 2410, line 14 following: From Fig. 1 I cannot see the linear relation. Please provide more evidence for this statement.

Page 2410, line 16: “errors are acceptable”. Compared to what? What is the requirement here?

Page 2410, line 19: “shift is consistent in a limited spectral range”. Probably you mean that the shift is limited to a small spectral range.

Page 2411, line 2: The channels are not “demonstrated” but shown. What are the pairs

used? One cannot see this from Fig. 3.

Page 2411, line 15 following: Adding a random error to the temperature profile seems not to correspond to realistic relevant scenarios. Why not using more realistic temperature profile variations?

Page 2412, line 19 following: Concerning systematic errors caused by noise and adding a 0.9 ppm bias. This sounds strange. Apparently your retrievals are biased low by 0.9 ppm and you have added an offset to deal with this. If this is true please simply state this. Concerning the cause: This seems to be a speculation. How can noise generate a systematic bias?

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 2405, 2014.