

## ***Interactive comment on “Retrieval of atmospheric CO<sub>2</sub> vertical profiles from ground-based near-infrared spectra” by Sébastien Roche et al.***

**Anonymous Referee #2**

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Generally,

The authors evaluate the CO<sub>2</sub> vertical profile retrieval from the NIR spectra recorded at TCCON sites using the GFITT2 algorithm. The retrieval uncertainty is discussed in terms of temperature, a priori profiles, instrument alignment, and spectroscopic parameters. Although the reliable CO<sub>2</sub> profile retrieval remains difficult, this study does the pilot study and shows some interesting results. Overall, I recommend the publication of this manuscript after addressing the following comments.

Specific comments

Line 26-28: please add ‘at Lamont’ at the end of the sentence.

Line 61: “non-linearleast-squares spectral fitting algorithm ” is GFIT also based on the

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OEM? If yes, please mention it in the text. If not, please add some discussion about the retrieval method in the paper.

Line 62: “A forward model . . . a priori knowledge of atmospheric conditions”, please also add instrumental conditions and the observation geometry.

Line 66: “Scaling retrievals do not require inter-level constraints on a priori concentration uncertainties. ”. A scaling retrieval is actually equal to a very strong inter-level constraint. Please re-write this sentence.

Line 67. “an uncertainty of 10<sup>-6</sup> ”. Please check why the uncertainty is so large?

Line 101. Does the wavenumber scales not included in GGG2014? If not, please mention it in the text.

Line 107: change “original TCCON spectral windows ” to “original TCCON retrieval windows”

Line 148:” We see no advantage to fitting non- contiguous windows in parallel, rather than in series, and then averaging the results. ”. How do you average the results? Do you apply the weighting function based on the SNR of each window?

Line 312-314:As the GFIT2 does not allow retrieve 2 profiles simultaneously, have you ever tried to retrieve the H<sub>2</sub>O profile first, and use the retrieved H<sub>2</sub>O profile as the a priori profile to do the CO<sub>2</sub> retrieval?

Line 444: What is the physical reason for the ‘zero-level offset’ error?

Line 445: What do you mean by “higher altitudes ”? please note the vertical range specifically.

Line 545. Section 3.2.4, I expect the authors to present a table here summarizing all the uncertainties for the CO<sub>2</sub> profile at Lamont, together with the typical vertical variation of CO<sub>2</sub>.

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