

Interactive comment on “Retrieval of xCO₂ from ground-based mid-infrared (NDACC) solar absorption spectra and comparison to TCCON” by M. Buschmann et al.

Anonymous Referee #1

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The manuscript by Buschmann et al. describes an attempt to harmonize xCO₂ measurements from the NDACC and TCCON networks in the mid IR and near IR, respectively. If successful, this would provide a way of extending ground based xCO₂ measurements in space as well as in time. However, after carefully comparing the ability of NDACC to retrieve XCO₂ without the additional retrieval of total column O₂ (as TCCON does), the authors have to conclude that this does not work. The averaging kernels of the TCCON NIR and NDACC MIR retrieval turn out to be too different in the end. Besides, since the NDACC MIR averaging kernels peak in the stratosphere, the ability

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of NDACC to retrieve tropospheric CO₂ seasonal changes is limited and strongly depends on the a priori information that goes into the retrieval. Only the secular trend can be retrieved in a robust way. However, this adds no information beyond what has been known from in-situ measurements already.

After all, this is a negative result and I appreciate very much that the authors try to publish it. It confirms that the TCCON approach for retrieving xCO₂ by retrieving O₂ column simultaneously is not only useful but mandatory.

The manuscript itself has no major shortcomings but needs a number of style and language corrections as listed below.

General comments:

- It would help to show some statistics on how much NDACC and TCCON data was available for this comparison.
- why was the study done with the outdated GGG2012 dataset instead of the current GGG2014?
- p. 10526, l. 13: TCCON measurements from Ny-Alesund since 2004? Hard to believe since TCCON only started in 2004. The TCCON archive has data from Ny-Alesund from 2005-03-14.
- you should say more about how this compares to the results by Sussmann et al., 2013, for xCH₄.

Style:

- don't use brackets so extensively! They are ok for references and acronym definition but should be used with care otherwise.
- use of tense: many parts of the manuscript are written in present tense even though past tense would be more appropriate. Please check these guidelines for the correct use of tense in scientific writing:

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Minor comments:

p. 10524:

- l. 6: define IRWG
- l. 8: define TCCON
- l. 8: TCCON retrieves column-averaged dry-air mole fraction of CO₂ (aka XCO₂), not total column CO₂! Or are you really talking about CO₂ total column from TCCON instruments?
- l. 17: the argument is correct but not all remote sensing instruments measure the total column. Write something like "Remote sensing instruments that sample the total column ...".

p. 10525:

- l. 4: "ratioing"? "ratio" is a noun, not a verb!
- l. 5: "... to O₂ which is measured ..."
- l. 7: drop the brackets.
- l. 9: you haven't yet said what "xCO₂" is.
- l. 10: "have only been available" and drop the brackets around "TCCON" and "with ... recently".
- l. 12: drop the brackets around "NDACC".
- l. 16: again: "ratio" is not a verb!

p. 10526:

- l. 10: "at Ny-Alesund"

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- l. 12: you have defined the acronym "FTIR" before, so use it.
- l. 13: better "MIR spectra ... since 1992. Since 2004, NIR spectra have also been taken within TCCON". However:
- l. 15: "at Ny-Alesund"
- l. 18: drop the brackets
- l. 23: again: "ratio" is not a verb!
- l. 26: again: "ratio" is not a verb!

p. 10527:

- l. 3: again: "ratio" is not a verb!

p. 10528:

- l. 18: "certainty" or "uncertainty"?

p. 10529:

- l. 2: "as described above"? What are you referring to? Use equation numbers if possible.
- l. 2: better "... column abundance x^* (for the true quantity x) depends on ...". No brackets around x_a or A !
- l. 9: drop brackets!
- l. 12-17: break this sentence into 2-3 shorter ones! 6 lines is far too long!
- l. 23: brackets!

p. 10530:

- l. 6: the averaging kernel actually is a matrix, not a vector!

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- l. 22: too many "of"s!

p. 10531:

- l. 17: "40°"

- l. 24-26: this sentence is hard to understand.

p. 10532:

- l. 7: no comma after "given". Better: "We can use a common prior to quantify the differences ..."

- l. 12: no comma after "kernels"

- l. 15: do you want to say: "The common a priori x_a is the TCCON a priori which was used for both NDACC and TCCON retrievals."?

p. 10533:

- l. 15: no comma after "show".

Figures:

- Fig. 2: either the numbers or the description on the color bar are wrong!

- Fig. 6: different colors for the subplots might be better.

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