

# ***Interactive comment on “Sensitivity of instrumental line shape with respect to different optical attenuators and resulting error propagation into atmospheric trace gas retrievals” by Y. W. Sun et al.***

## **Anonymous Referee #2**

Received and published: 27 May 2016

The manuscript “Sensitivity of instrumental line shape with respect to different optical attenuators and resulting error propagation into atmospheric trace gas retrievals” describes a series of systematic tests to find an optimal way of adjusting light intensity on the detectors of the Bruker IFS125HR high-resolution Fourier transform infrared (FTIR) spectrometer. This instrument type is widely used in the FTIR Network for the Detection of Atmospheric Composition Change (NDACC) as well as the Total Carbon Column Observing Network (TCCON). The results are certainly relevant for the NDACC and TCCON communities but also highly technical and instrument-specific. Like referee #1, I would prefer if the manuscript could be labelled as a technical note instead

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of a research article.

In general, the manuscript should be more concise and needs more structure. The individual sections are rather long and contain no subsections! That makes it very difficult to look up individual experiments and results. I also wonder if we really need a 3-page introduction and a whole section on optical background removal. The manuscript will also need extensive copy-editing at some point as it contains numerous language glitches and awkward formulations. This could as well be done before the next update – possibly with the help of some of the co-authors.

For the content, I agree with all the points raised by referee #1. In addition, I wonder why the authors did not test the effect of placing an attenuator or aperture into the parallel beam between the sun and the first plane mirror. This is a setup that is used for all the TCCON instruments built by Caltech (fixed-size aperture) as well as the instrument on Ascension Island (iris aperture). As far as I know, the instrument in Bremen is fully operational and such an additional experiment should only take a day or so. It can be done without even opening the instrument.

All in all, I would consider the necessary changes to the manuscript major. Below is a list of minor revisions that should also be fixed. Note that I did not report language glitches as there are too many:

- l. 72–73: the order of the references should correspond to the order of the retrieval algorithms.
- p. 3, footnote: in AMT, footnotes should be avoided (see authors' guidelines).
- l. 104–114: this summary of the different parts of the manuscript should already be covered by the abstract and is repetitive here.
- l. 123–161: the different experiment groups and attenuators are confusing. Rather put subsections here for each group and type of attenuator if necessary.

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- l. 162–172: this should definitely be a separate subsection.
- Fig. 1: I really like this schematic drawing of the instrument with all its mirrors (a). However, part (b) with the different attenuators should really be a separate figure.
- l. 205–206: the use of quotes here is awkward.
- l. 217: “... enforces the use of the interfering gases ...”? I do not understand.
- Figs. 2–6: the use of (1), (2), (a), and (b) is confusing. Rather write clearly what (1) and (2) are.
- Fig. 2: the dark blue (?) colour and black are hard to distinguish.
- Fig. 3: cryptic legends!
- Fig. 4: what is “calc” and “spec”?
- Fig. 5: cryptic legends!
- l. 256: what does “... kept at a level of less than 4%...” mean?
- l. 262: there is no Wunch et al., 2015, in your reference list. At least the year is missing from the entry in l. 606–608.
- l. 262: start a new paragraph before “NDACC ...”.
- l. 289–290: you need to explain a little more than just writing “The comparison ... in Fig. 7.”.
- Fig. 6: units for ME and phase error are missing.
- Fig. 8: better separate the two plots in (c) a little more and also add a vertical axis and label to the right one. Also: averaging kernels are square matrices. This looks weird in this aspect ratio.

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- Table 1: E+15 might be ok for computer code but please use  $10^{15}$  here for readability.
- l. 314–315: some of the lines in Fig. 9 and 10 clearly stand out from the rest. You should comment this here!
- l. 360–362: I do not understand this sentence.
- l. 369: “before” is mainly used with respect to time and sounds a little awkward here.
- Fig. 9 & 10: the colours are hard to distinguish. Try different symbols/line styles or make more subplots with fewer lines. Also: cryptic legends!
- Fig. 12: cryptic legends!
- Table 2: E+15 might be ok for computer code but please use  $10^{15}$  here for readability. Also not clear if the % in the relative bias refers to the actual value or is a percentage of the total random/systematic error.
- l. 411: “Uncertainty estimation . . .”
- l. 418–419: too many significant digits on these small percentages.
- l. 423–425: too many significant digits on these small percentages. Also: what is the 5/21?
- l. 432–435: too many significant digits on these small percentages.
- l. 444: the  $\cos(\dots)$  terms should be written in in-line math mode or as a proper equation.
- l. 446–449: please do not write exponential numbers as E+...!

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- references: you cite some inaccessible key references: Griffith 2010, Hase and Blumenstock 2001. Please check with the authors if they could be included in your manuscript's supplement or the new "Assets" section to make them available.

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