

Interactive comment on “The influence of instrumental line shape degradation on NDACC gas retrievals” by Youwen Sun et al.

Anonymous Referee #2

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This paper “The influence of instrumental line shape degradation on NDACC gas retrievals” by Sun et al presents sensitivity studies regarding the influence of ILS degradation in FTIR retrievals results. It is well known that the shape of the gas absorption lines can be impacted by the ILS, if instruments are not well-aligned. However, up to now there are not many published results regarding the quantitative impact. The lack of details in the impact of ILS makes this study important. The topic of the study is interesting and suitable for the journal. I suggest some revisions before its publication.

General Comments:

- The manuscript is short and lack important quantitative details regarding the finding with respect to the influence of ILS (results section). While the reader can check figures, and make sense of quantitative results authors do not explain in detail in the text

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their findings (see specific comments below).

- Authors use an ideal ILS of actual FTIR measurements to know the influence of different ILS degradation. This statement is important since all quantitative Figures shown are with respect to this reference. However, there is a lack of proof about the ILS of actual measurements. If the ILS of actual measurements deviate from ideal the results shown here might change significantly. I suggest to include the actual ILS of the FTIR and its temporal variability.

- My understanding based on the analysis and table 5 is that the effect of the ILS (given that degradation of ILS for most FTIRs-NDACC is low) can be regarded as negligible for most gases, except, N₂O, correct?. I do not find suggestions beside table 5 for including the ILS in the analysis of standard NDACC gases. Given that the ILS effect is negligible, would you suggest using ideal ILS?. I recommend to include a section with specific recommendations for FTIR/NDACC sites that will bring dialogue towards and harmonization in ILS.

- I recommend a thorough revision in format/style of the citations.

- I recommend a thorough English revision.

Specific Comments:

Abstract:

L27, I would change “current NDACC gases” with “current standard NDACC gases” since FTIR retrievals go beyond these mandatory gases.

L33-34, influence is written twice, remove one.

L38-40, “In order to suppress the influence on total column for ClONO₂ and other NDACC gases within 10% and 1%, respectively, the permitted maximum ILS degradation for each NDACC gas was deduced (summarized in Table 5)”. In my opinion, authors should summarize table 5 in the abstract rather than pointing the reader to

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table 5. I found this difficult to interpret if the reader aims to check the abstract only.

Introduction:

L61, "FTIR spectrometers are highly precise and stable measurement devices and the instrumental line shapes (ILSs) not far from the theoretical limit if carefully aligned". This sentence is not clear. Please change it accordingly. Consider something like this: "FTIR spectrometers are highly precise and stable devices and if carefully aligned the instrumental line shape (ILS) might not be far from the theoretical limit".

L72-74. It might be important to mention that TCCON only uses NIR, fewer gases, and only columns are aimed compared to NDACC.

3 Simulation of ILS degradation

I could not find a description of ALIGN60 in the references provided. I suggest to describe in more detail ALIGN60 in this paper.

NDACC gases retrieval

4.1 Retrieval strategy

- L151-152. Is there a reference for the retrieval setting of NDACC?, if so cite it here.
- The size of Table 2 can be significantly smaller. I suggest to remove all cells that are similar for the different gases and add a description in either the main text or caption of table, e.g., spectroscopy, P,T profiles, etc

4.2 Averaging kernels

- There are 26 Figures in the main text and I would consider removing some, e.g., Fig. 3 and 4 provide similar information. I would remove Fig 3 (or move it to supplemental information).
- Change to appropriate chemical formulas, e.g., HCL to HCl, etc.

4.3 Error Analysis

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I would expect a description of the ILS in the uncertainty budget here. However, it is not clear how the error in ILS influences the uncertainty budget in either table 2 and Figs 5 and 6.

- In order to catch attention to the influence of ILS in the retrieval of gases I would remove Figs. 5 and 6. Again, I think 26 Figs are overwhelming. Instead, in table 4, which also does not add information, add quantitative numbers of leading/dominant errors including the ILS uncertainty.

5. ILS influence

- It is mention that the ILS degradation of the FTIR at Hefei is less than 1.3% but authors do not show how they infer this. This is key in order to avoid convolution problems with the different types of degradation.

- L243-247. It is not clear whether a single spectrum is used (what time, sza, conditions?) or all spectra recorded on Feb 16, 2017. Clarify.

- L255-265. Expand a description of the different filter criteria used here. It is clear that retrievals need to converge, but what about the 3% rms limit, what does SIV mean and why 10% is used?

- The color code of ME amplitude, PE, etc in Figs. 7 and 8 are different. To be consistent, change to same color code scheme. Remove the ideal case in Fig. 8.

- Do results shown in Figs 7 and 8 correspond to a single spectrum? if so include date/time in the caption.

- It is quite strange that % difference in total columns (Fig. 7) is larger than % Difference of profiles in Fig. 8. Maybe Fig.8 is only the fraction?

- Use appropriate name for gases, e.g., change HCL to HCl, etc.

5.1 ME amplitude and PE influence

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- It is interesting to see in Fig. 7 that for some gases the % difference in RMS is negative, which would mean that the RMS of the reference is greater than using ILS degradation. Why would the rms be smaller using degraded ILS if the FTIR is characterized as ideal?

- In general, there is a lack of description in findings here. I recommend to have a more quantitative analysis and description of results in this section

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