

Interactive comment on “The impact of spectral resolution on satellite retrieval accuracy of CO₂ and CH₄” by A. Galli et al.

Anonymous Referee #1

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The paper “The impact of spectral resolution on satellite retrieval accuracy of CO₂ and CH₄” of Galli et al., submitted for publication in AMT, is addressing an important scientific aspect most notably relevant for future greenhouse gas observing satellites. It investigates to what extent greenhouse gas retrieval accuracy depends on the spectral resolution of the measured radiances. High spectral resolution typically means high costs. Therefore, it is important to know to what extent high spectral resolution is needed. However, spectral resolution is not the only parameter, which determines the accuracy, and potential accuracy loss by lowering spectral resolution may be compensated by optimizing other parameters such parameters which increase the signal-to-noise performance of the instrument. These related aspects are also discussed in this paper at least to some extent. Overall, the manuscript addresses an important

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scientific aspect not yet discussed in detail in the scientific literature so far and it is well written. I therefore recommend publication after the mostly minor comments listed below have been considered by the authors.

Abstract, page 10401, line 12: Sentence with “turn out to be consistent for the first two approaches”: It is not clear from reading only the abstract, which two approaches are meant here.

Abstract, page 10401, last sentence: The statement “For both GOSAT and synthetic measurements, retrieval accuracy decreases with lower spectral resolution, suggesting increasing interference errors” may be misleading. To avoid misunderstandings I suggest to add “for a given signal-to-noise performance” or equivalent to clarify that not only spectral resolution is relevant in this context. This remark is also valid for the Conclusions section (e.g., page 10420, line 21 following).

Introduction, page 10402, line 4 following: High signal-to-noise performance is also a competing requirement and I suggest to add this information here.

Introduction, page 10402, line 13 following: OCO-2 and TanSat will not measure CH₄. Earth Explorer 8 will very likely be launched a few years after 2018 and Sentinel-5 will not be optimized for CO₂. I recommend to modify the corresponding statements to consider this.

Section 2.1, page 10406, line 11 following: Sentence “We therefore verified that the retrieval accuracy did not notably change when the same retrievals were selected for every resolution at a given TCCON station.” Unclear. Please explain what exactly has been verified? Please provide more details on the results obtained.

Section 2.2, page 10408, around line 13: Sentence “The systematic errors of the retrieval always exceed this precision”. Is this really true (always?)? It seems to be a too simple summary of the detailed results shown later. I recommend to replace this sentence by “In this manuscript we focus on systematic errors as this error source is known

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to be the most relevant for the targeted application areas (e.g., Basu et al., 2013, and references given therein)” or equivalent.

Section 3.1, page 10411, line 28: “weighted by the scatter at each station”. Are the weights the scatter or the inverse of the scatter (or something else)?

Section 3.1, page 10413, line 16: Please replace “;” by “,” after Guerlet et al., (2013).

Section 3.4, page 10417, line 26 following: It is a bit strange that COT is reduced by a factor of 10 because this means that first realistic scenarios have been selected and then these scenarios are artificially modified, which means that the finally used scenarios are not realistic anymore!?

Conclusion, page 10421, line 12: “The two spectral degradation approaches”: Please make this section “stand alone” and explain which two approaches are meant here.

Conclusion, page 10422, last sentence: “to collect more spectra in a given . . . pixel”. Unclear.

Table 6, page 10432: Please add one column and list the parameter range mentioned in the caption.

Figure 7, page 10439: The color bar numbers are hard to read. Please enlarge.

Figure 8, page 10440: I recommend to add vertical lines (or equivalent) as otherwise it is difficult to figure out when one year ends and the following one begins.

Figure 9: This figure indicates that for “high enough SNR”, spectral resolution doesn’t matter. Notable accuracy differences only occur for “lower” SNRs. This highlights the importance of the SNR and that spectral resolution is not the only aspect that matters in the context of this study. This needs to be clearly stated in this manuscript to avoid misunderstandings (therefore my corresponding SNR related comments given above).

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 10399, 2013.