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Atmospheric Measurement Techniques Discussions

Interactive comment on "Validation of first chemistry mode retrieval results from new limb-*imaging* FTS GLORIA with correlative MIPAS-STR observations" *by* W. Woiwode et al.

Anonymous Referee #2

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The manuscript compares retrieval results from the airborne limb-imaging infrared Fourier transform spectrometer (FTS) GLORIA characterised by increased sampling with the airborne limb-scanning infrared FTS MIPAS-STR and in-situ measurements. The results were obtained during the GLORIA's flight aboard the high-altitude research aircraft M55 Geophysica during the ESSenCe campaign (ESa Sounder Campaign 2011) on 16 December 2011. The manuscript analyses data obtained in one of the two measurement modes while data from the other mode is published elsewhere (Kaufmann et al., 2015). Retrieved profiles of temperature, HNO3, O3, H2O, CFC-11 and CFC-12 are compared. Despite of the very good structure of the manuscript (it was

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Discussion Paper

really easy to read), please consider several points of criticism before final publication:

The instrument to be validated with a better resolution (GLORIA) is compared with an instrument with poorer resolution. In principle, the comparison can be done on the resolution of the instrument with the poorest resolution. So the highlighted improvements in the resolution of the GLORIA actually cannot be validated in such a way.

It is even unclear if there are any improvements in the resolution of retrieved profiles in the context of information content. One can get such an impression looking on the large scatter of the GLORIA measurements. The results are not discussed with respect to retrieval errors of the involved instruments in necessary detail. Well, there is some mentioning of errors in Conclusions but without showing any number and discussing it previously. Averaging kernels and hence resolution values as in Fig. 3 depend, among other, on regularization constraints, so for a poor quality, oscillating profile, perfect averaging kernels and resolution are possible if weak regularization constraints are used. In other words the resolution plots are useless when plotted alone without additional information.

During the flight much more measurements in the chemistry mode were performed (according to Fig. 1, in Kaufmann et al., 2015). Why only measurements between 14:30 and 14:50 UTC are selected for the comparison? An analysis of more time intervals could help to explain better the discrepancies between the instruments and the role of spatial variability of atmosphere, couldn't it?

According to the objectives in the foregoing publications (e.g. Riese et al., 2014), 3D distributions by a tomographic retrieval with the new instrument are to be retrieved and analysed. Another paper (Kaufmann et al., 2015) by the same authorship as the current manuscript already implements a tomographic algorithm successfully for the dynamics mode. Is it not possible for the chemistry mode as well? I am therefore wondering why the comparison here is performed for 1D retrieval only; this 1D study possibly is with small use in the future because the other (tomographic) retrieval is the

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standard.

I think the depictions selected in the Comparison section seem to be too positive. What is criterion to write that e.g. 10% is a "good" agreement for ozone (P. 12703, L18) and the bias for ozone is "weak" (I could say instead it is not)? Perhaps some acceptable ranges of agreement in IR FTS for different target parameters could be provided/cited or the use of such depictions reduced.

Specific comments:

Title and elsewhere in the manuscript: “new” – the measurements and the instrument are not new: the measurements are 3 years old (almost 3 years at the time of submission) and the instrument has already considerable publication history.

P. 12697, L. 5: Quasi Newton method is a general term, i.e. what simplifications you introduce regarding ’quasi’?

P. 12703, L18: The mentioned local maximum is not really seen in the Figure and the increase for few profiles could be explained also by retrieval errors. Again, retrieval errors for each of the instruments/in-situ observations are very necessary to be provided and discussed.

P. 12703, L22: Writing that GLORIA profiles scatter around MIPAS-STR profiles is not correct: at 12.5, 14, 14.7 km I see only one GLORIA profile above MIPAS (and this one as an outlier) but far more profiles below.

References: perhaps you might add the available web links for proceeding papers: Hoepfner et al., 2001: http://www.imk-asf.kit.edu/downloads/ffb/IRS2000_proceedings_hoepfner_1.pdf; Kaufmann et al., 2013: https://earth.esa.int/documents/10174/134665/ESSenCe_Final_Report

Fig. 3. The many profiles overly so dense that it is hard to guess their distribution pattern. Please include mean of all profiles for both FT instruments and indicate their scatter range (standard deviation).

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