

Interactive comment on “Synergy between middle infrared and millimetre-wave limb sounding of atmospheric temperature and minor constituents” by U. Cortesi et al.

Anonymous Referee #1

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General comments

In this paper an application is presented of data fusion obtained by using the MSS inversion technique. The considered observations were collected by a sub-mm wave (MARSCHALS) and an IR (MIPAS_STR) spectrometer that measure the same air masses on board of a stratospheric aircraft. The authors apply, for the first time, the MSS fusion in conjunction with Tikhonov-Phillips regularization and show results that demonstrate the better quality of level 2 products obtained by combining the fused MSS solutions with respect to the products derived from the separate MSS inversion of data from the individual instruments. Authors also compare the performance of the

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MSS-fused products with the results of an alternative fusion approach that consist in the inversion of MARSCHALS observations using the products of the MIPAS-STR inversion as a-priori information within the optimal estimation strategy. The subject of this investigation is relevant and the quality of the presentation is good. Overall, I consider this paper to meet the scope of AMT. However, before publication I recommend authors to address a couple of not negligible weak points that I raise in the following section.

Specific comments

The main objection I move to this paper is the lack of comparison (or at least of discussion) with the simultaneous inverse processing of the observed radiances. Authors mention the alternative strategy in the introduction, however this approach is no longer considered in the following discussions. Actually, I guess the simultaneous inversion to be the most efficient data-fusion method whenever level 1 data are available. I would have liked to see the comparison of simultaneous inversion with MSS data fusion in order to provide a strong indication to user community about the right direction to aim. I do not ask to include such a comparison in this paper but, at least, a sentence to point out the problem. The authors must admit that the products of MSS analyses (see also below) are not user friendly, hence the level 2 users must have solid motivations to prefer the MSS products. On the other hand, I would tend to consider the inversion of MARSCHALS observations using L2 products of the MIPAS-STR as a-priori information, a suitable choice for the optimal estimation rather than a data-fusion technique. An effective data fusion (as the MSS fusion is) is expected to be more effective than optimal estimation, so I consider of minor importance the comparison reported this paper.

The common criteria to judge the quality of retrieved profiles are total error and vertical resolution (whose importance is also recalled by the authors in section 2.2 for IR observations). I understand that the MSS approach does not provide the second property. Some hint about vertical resolution can be derived from DOF and RID quantifiers but this is less than what can be derived from the AK of a standard inversion. Authors

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should address this point when introducing the adopted quantifiers.

Technical corrections

Apart from the considerations in the “specific comments” section, I have found confusing for the reader to call “data fusion” both the sequential inversion of MIPAS and MARSCHALS level 1 data and the MSS data fusion. I suggest to always refer to the first as “L1+L2 method” (as done in the abstract and elsewhere) and to the second as “MSS data fusion”.

Page (P) 11674, line (L) 20. Change “O2” into “O3”.

P 11675, L 14. “(Ingmann et al.,2012) should be “Ingmann et al. (2012)”.

P 11676, L 17. “negative lapse rates”: specify “T lapse rates” if this is the case.

P 11677, L 4. “millimetre” should be “millimeters” or “millimeters”.

P 1677, L 9. “absorption lines” should be “emission lines” since this is our case.

P 11677, L 13-17: this paragraph is a single period which is difficult to understand. Please try to write it more clearly.

P 11679, L 6,7. “millimeter-wave and mm-wave”: please define mm-wave at the first occurrence and use it elsewhere.

P 11682, L 19. Delete “covariance” because it is redundant with “off-diagonal”.

P 11682, L 27. “either with” should be “with either” + delete “with” at L 29.

P 11684, L 8. Close the parenthesis before “were utilized”.

P 11684, L 12. “0.8 arcmin”: It would be useful to provide (also) an estimate of pointing accuracy in terms of kilometers at tangent point.

P 11685, L11. 5% error in CO2 VMR (about 20 ppm) seems too large. Is it correct?

P 11687, L 11. “by calculating”. L 19 “by selecting. L 20 “by performing”.

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P 11688, L 22. “Differently by” should be “Differently from”.

P 11690, L 9. Here and elsewhere. “performances” should be “performance”.

P 11696, L 5. “o3” with capital “O3”.

P 11696, L 8: SF has not been defined as acronym of Synergy Factor.

P 11696, L 16 and elsewhere. cross-sections: this term has a specific definition in spectroscopy. If authors intend to use this term in a different context they should specify their definition. On the other hand, in the figures I see VMR profiles instead of cross-sections. Cross-section is, instead, used properly at P 11676, L 28.

P 11696, L 21-22. This list of targets has been already defined in this page at L 5.

P 11702, L 27. “up to about 60%”: A reduction of this entity cannot be appreciated in the top-right panel of Fig. 10. A plot of the average error at each altitude could help to support the 60% statement.

P 11703, L 22. “to both” should be “both to” + delete “to” at L 23.

P 11703, L 25. “in context of” do you mean “in the context of”?

P 11704, L6. Delete “,” after “conclusion”.

P 11706, L 2. “when both combining” should be “when combining both”.

P 11718, Figure 1. The dots of band B and those of band D are not distinguishable in the figure. I suggest to use a different color (green?) for one of the two.

P 11718, Figure 1 caption. Please explain what you intend for “scan position”. I exclude it is the tangent altitude because I see dots well below 5 km while in sect. 4 it is stated that tangent altitudes are between ~5 km and flight altitude. Moreover some dots in Figure 1 seem to be at 0 km (refer to nadir observations?).

P 11722, Figure 5. I suppose the black line across all the maps represents the flight altitude. If this is the case it should be specified at least in the caption of the first figure

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where it appears.

P 11724, Figure 7 caption. "H3O" should be "H2O".

P 11726, Figure 9 caption. Add "(left panel)" after "products" and "(right panel)" after "SF".

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