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Atmospheric Measurement Techniques Discussions

Interactive comment on "Two-dimensional performance of MIPAS observation modes in the upper-troposphere/lower-stratosphere" *by* M. Carlotti et al.

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Answers to reviewer #2

General remarks

Before discussing the specific points we think it advisable to fix a few points about the "information load" analysis because most of the criticism of this reviewer descend from a misunderstanding about this quantifier:

A. The information load analysis has been previously introduced in *Carlotti and Magnani* (2009). In the discussion we quote four times this reference and in Sect. 3.3 we recall, just for the reader's convenience, the definition of information load and its rationale.

B. The "information load" (Ω) is, by definition, a quantifier. It is a scalar quantity that (according to Eq. 4) measures the amount of information carried by each clove (of the 2D atmospheric discretization) about the target quantity.

C. The Ω maps provide a picture of the "real" atmospheric sampling of the observations. They can be used to define optimal retrieval grids (where the information peaks) or to compare the atmospheric sampling relative to different targets or to different observation strategies (as in the case of this paper).

D. The information load analysis is neither a subset nor a complement of the 2D retrieval analysis. In the discussion paper, we show that the comparative analysis of Ω maps leads to conclusions that are afterwards validated by the simulated retrievals (see text from line 25 of page 2873 to the end of Sect. 5.1 and line 12 of page 2876). We then conclude that the information load analysis can be used to predict the relative performance of the corresponding retrievals. We claim this fact (In Sect. 5, in the abstract and in the conclusions section) as a result of our study.

E. The actual "performance" can be evaluated only after the retrieval analysis looking at precision, horizontal and vertical resolution of the retrieved profiles. In our simulated retrievals we use different retrieval grids to share the available information load among precision and spatial resolutions on the basis of their reciprocal trade-off (see the referenced paper: *Carlotti et. al.*, 2007).

We realize that the information load analysis is rather recent, the discussion paper reports its first application, and the reader can be barely familiar with the related

concepts. Therefore we have added at the end of Sect. 3.3 (line 10 of page 2869) of the discussion paper the following specifications about its use: “The Ω maps provide a picture of the “real" atmospheric sampling of the observations. They can be used to define optimal retrieval grids (where the information peaks) or to compare the atmospheric sampling relative to different targets or to different observation strategies. Therefore the information load analysis is useful to predict the relative performance of the corresponding retrievals".

Answers to major issues

1. See points A and B of the general remarks. As specified at point D the information load is not meant to add any quantitative benefit to the analysis.

2. The reviewer is partially correct when stating that “this work is not contained within the paper". For this reason we have changed “is then evaluated" with “has been evaluated" at line 8 of page 2862 of the discussion paper. Actually the work has been done but not extensively reported. We summarize the outcome of this work and (as stated at line 14 of page 2869, and at lines 16 and 25 of page 2870) we provide examples of the information load analyses. In this context we dedicate three figures (Fig.s 2, 3, and 4) to illustrate representative cases. A thorough report of the information load analyses covering the eight MIPAS main targets would be beyond the scope of our paper and would have required a lengthy discussion with an excessive number of figures.

3. See points D and E of the general remarks and the answer to major issue 2.

4. The information load is not meant to assess precision and spatial resolution (see points D and E of the general remarks). We evaluate the precision of the retrievals only in Sect. 5 where (precisely) simulated retrievals are discussed. The standard deviation of the difference between retrieved and input fields represents the

precision of the retrieval if only random errors (spectral noise) affect the retrieved quantities. Model errors (as those mentioned by the reviewer) are not applicable to simulated retrievals where the forward model used within the retrieval procedure is also used to generate the simulated observations (about smoothing errors see the answer to point 2 of “things to be done" section). However it is true that, in the comparison of different observation modes, different systematic errors can be expected depending on the choice of the observations to be analyzed. For this reason, at line 18 of page 2869 of the discussion paper we have included the information about the use of common MWs for the three observation modes. Furthermore, at line 8 of page 2872 we state that “common MWs and auxiliary data (those adopted for the NOM operational analyses) have been used in the simulated retrievals reported in this and in the next sub-section".

5. See point D of the general remarks.

Things to be done

1. Probably the reviewer refers to page 2871 instead of 2872. In this case the statements starting on line 5 are self evident only for the sample maps shown in Fig. 3. As stated at point 2 of the “answers to major issues" the full presentation of the information load analysis would exceed (alone) the size of the discussion paper.

2. At line 9 of page 2866 we state that the study reported in this paper refers to the GMTR retrieval code (Carlotti et al., 2006, Carlotti et al., 2001). In these references the forward model is discussed with details that answer points 1 and 2. In respect of this we have specified, at line 12 of page 2871 that we are using the GMTR forward model to generate the simulated observations. About points 3 and 4 the “two-dimensional structures" are a source of systematic error in the case of real atmospheres where the sign of the horizontal gradients change with

a frequency which is smaller than, or comparable to, the separation between the retrieval grid profiles. For our simulations the atmospheric fields are built using the climatological profiles taken from Remedios et al. (2007) that refer to six latitudinal bands (without day/night discrimination) whose amplitude ranges from 20 to 35 deg. The largest separation in our retrieval grids is less than 3.8 deg (see text) therefore the contribution of the systematic component (smoothing error) becomes negligible. We acknowledge that the above considerations are not straightforward in the discussion paper that, for the purpose, has been changed after line 20 of page 2871 by adding the above description.

3. See general remarks and answer to point number 1 above.

4. A “precision" analysis is necessary in order to assess the impact of random error sources on the products of any retrieval procedure. As stated in the discussion paper the quality of the retrieval products must be evaluated in terms of their precision and spatial resolution. In the case of real observations the precision is provided by the ESD of the retrieved values derived from the VCM of the state vector (defined by Eq. 2) as described at lines 11 to 14 of page 2867 of the discussion paper. Our precision analysis has been carried out on the results of simulated retrievals; in this case the precision is directly evaluated using the difference between retrieved and reference values. A thorough analysis of systematic errors is necessary to determine the “accuracy" of retrievals from real observations. As stated at point 2 of this section and at point 4 of the “major issues" section, in our comparative analyses the systematic components can be neglected.

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