

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

### **Anonymous Referee #2**

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#### Overview of the paper

The authors present results from a study that compares the expected quality of trace gas retrievals using three similar MIPAS observing modes. The retrieval scheme is a two-dimensional method that should improve the horizontal resolution associated with the retrieval when compared to that of a one-dimensional retrieval. The authors discuss a quantifier they call the information load. They present results related to the "precision" and the horizontal and vertical spatial resolution as determined through simulations. They conclude that in the stratosphere the two MIPAS modes designed

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for the UTLS perform almost as well as the nominal mode. They also conclude that the UTLS-2 mode should provide the best horizontal resolution.

Major issues:

The abstract and the content of the paper do not agree. The main issues with the abstract are as follows where a direct quote from the abstract precedes the issue:

1) "For each observation mode we have calculated the 2-D distribution of the information load quantifier relative to the main MIPAS targets."

This is stated but detail is not given to back up the use of the word "quantifier". The word "quantifier" is misleading. The information load may have been used in a "qualitative" sense but it is not clear from the body of the work that it added any quantitative benefit to the analysis.

2) "The performance of the observation modes is then evaluated in terms of strength, spatial coverage and uniformity of the information-load distribution along the full orbit."

This work is not contained within the paper. The derivation of the information load is discussed and then an example is given but the work leading up to the "evaluation" is completely omitted from the body of work.

3) "The outcome of the information-load analysis has been validated with simulated retrievals based on the observational parameters of real orbits."

Based on the body of the paper this statement is confusing. I believe the authors made an attempt to link the missing information load analysis/evaluation with the simulated retrievals but in no way have they demonstrated the validity of the missing information load analysis. The most important point is the missing information load analysis.

4) "With this strategy we have assessed the precision and the spatial (both horizontal and vertical) resolution of the retrieval products."

This statement is also not consistent with the paper as written. The information load

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was never used to assess the precision and spatial resolution in any convincing fashion. Also throughout the work the authors continue to refer to the analysis they did pertaining to the precision of the retrieval. This analysis involved simulations and retrievals on these simulations followed by a comparison with the input fields. This analysis does not indicate how precise the retrieval is. It likely just demonstrates systematic errors associated with various small scale sizes that the discrete nature of the retrieval is unable to fully resolve.

5) "This paper reports the first application of the information-load analysis and highlights the validity of this approach."

Sorry but this paper does not highlight the validity of the information load analysis approach. It may end up doing so but the content of the paper will have to be modified significantly.

Four things need to be done in order for this work to be suitable for further review:

1) The quantitative results associated with the information load analysis have to be presented in a thorough manner such that the two main qualitative statements starting on line five on page 2872 become self evident. There is significant information that needs to appear between lines three and four on page 2872 so that the statements that follow are believable.

2) The standalone forward model used in the simulations needs to be discussed in sufficient detail so the reader is confident that: 1) the observations are modelled with a finite instrument field of view; 2) the observations are modelled such that spacecraft motion during an exposure is included; 3) the two-dimensional input grids are of significantly higher spatial resolution than the retrieved or output grids; and 4) the two-dimensional structures imposed on the input grids are well known so that the "precision" analysis is meaningful.

3) The quantitative aspect of the information load analysis has to be better related to

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the results of the simulations. This work will be aided by the work done in point number one above.

4) The authors have to justify their "precision" analysis as a useful diagnostic for two-dimensional retrievals. The work described in point number two above will be useful in doing this. This work requires a complete discussion of the systematic errors associated the choice of resolution for both the angular and vertical dimensions of the retrieval grid. The impact on the horizontal resolution was discussed but there was no discussion on the systematic differences between the inputs and retrieved values that are related to the choice of grid cell size.

#### Concluding Remarks

This paper may contain some interesting and useful results. However, too much information was excluded from the paper to judge whether or not the methodology that led to these results was sound and valid. The above four points are a good place to start. If the authors add the required information I would be more than happy to review the amended paper.

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