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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Technical Note: Regularization performances with the error consistency method in the case of retrieved atmospheric profiles" *by* S. Ceccherini et al.

S. Ceccherini et al.

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We thank the reviewer for careful reading of the manuscript. Below we discuss his specific comments.

Responses to general comments

1) In order to follow the arguments described in the paper it is not necessary to know in detail the MIPAS retrieval algorithm. The needed information are the method used, which is the non-linear least square fit using the Gauss-Newton method modified by

the Levenberg-Marquardt method, the retrieval strategy, which is a global fit that determines the values of the target quantities at the tangent points of the lines of sight, and the fact that the problem is well-posed. These information will be added in the introduction. The reader interested in more specific details can refer to the following references quoted in the paper:

Raspollini P., Belotti C., Burgess A., Carli B., Carlotti M., Ceccherini S., Dinelli B. M., Dudhia A., Flaud J.-M, Funke B., Höpfner M., Lopez-Puertas M., Payne V., Piccolo C., Remedios J. J., Ridolfi M., and Spang R.: MIPAS level 2 operational analysis, accepted in Atmospheric Chemistry and Physics Discussion, 2006.

Ridolfi, M., B. Carli, M. Carlotti, T. von Clarmann, B. M. Dinelli, A. Dudhia, J.-M. Flaud, M. Höpfner, P. E. Morris, P. Raspollini, G. Stiller, and Wells, R. J.: Optimized forward model and retrieval scheme for MIPAS near-real-time data processing, Appl. Opt., 39, 1323-1340, 2000.

2) The statement at the end of the Results section says that the result showed in Fig. 2 "is in contrast with the expectation that Eq. (7) constrains the differences between the regularized and the non-regularized profiles to be on average equal to the errors of the regularized profile." The cause of this contrast between result and expectation is indicated in the fact that the expectation is legitimate only when $\mathbf{S_x}$ is diagonal. If $\mathbf{S_x}$ is not diagonal the expectation is not verified by the results. However, it is the expectation that is wrong, not the results. This point will be clarified in the final version of the paper.

3) The same issue was posed also by reviewers #1 and #2. We refer to the answers we provided to reviewers #1 and #2 (point 1 of general comments for reviewer #1 and specific comments on p. 13312 paragraph starting at line 21 for reviewer #2).

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4) The comparison of the results obtained with the error consistency method and with other commonly used methods is made in reference: Ceccherini, S.: Analytical determination of the regularization parameter in the retrieval of atmospheric vertical profiles, Opt. Lett., 30, 2554-2556, 2005.

We prefer not to repeat the comparison in this paper.

Responses to specific comments

1) We suppose that the reviewer is referring to page 13310. The regularization matrix is a general tool commonly used in retrieval of atmospheric vertical profiles. The discussion on the choice of the regularization matrix depends only on the a-priori information that is used to constrain the profile. Here, further details on MIPAS ORM do not help. The reader who is not interested in the details of the regularization process can skip the definition of R. The reader who wants to know more about regularization techniques is referred to two books at the beginning of the section.

2) A null vector is a vector which has all its elements equal to zero. This is a particular kind of constant vector. The choice of a constant vector (in our case the null vector) as a-priori vector when the regularization matrix is obtained using the L_1 matrix (discrete first derivative matrix) constrains the profile to reduce its derivative with respect to altitude.

3) It is not clear where the reviewer is referring to (lines 21 through 27 of which page?). However, how already specified in the response to the general comment n. 1, we will add a description of the basic features of ORM in the introduction.

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4) Fig. 1 shows a single profile as a representative example, however, it is combined with Fig. 2 which shows the results for an overall orbit showing the performances of the method on a significant number of retrievals. Furthermore, Fig. 1 shows not only the modifications introduced by regularization to the profile but also other important qualifiers such as the retrieval errors and the vertical resolution. The analysis of these quantities allows the reader to evaluate the advantages gained with regularization.

The reviewer poses the doubt that the structures observed in the non-regularized profiles and smoothed by the regularization could be real. Please note that the chi-square values are comparable for the regularized and the non-regularized profiles (see table 1), this means that also if these structures were real our retrieval cannot discriminate them outside the noise.

In the paper we show the performances of the error consistency method when applied to the ozone retrieval of measured MIPAS data. The results reported in the paper show that the method is applicable to MIPAS data. As already discussed in the answer to reviewer #1 (point 1 of the general comments) the error consistency method is applicable only to improve the conditioning of the inversion but cannot be used to solve ill-posed problems.

5) See answer to point 2 of general comments.

Interactive comment on Atmos. Chem. Phys. Discuss., 6, 13307, 2006.