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Atmospheric Chemistry and Physics Discussions

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Interactive Comment

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 referee (reviewer #2) for careful reading of the manuscript. Below we discuss the specific comments of the reviewer. The page and line numbers given by the reviewer to address the comments refer to the original version of the manuscript and not to the version published online. In order to make clear the discussion to all readers we indicate in parenthesis also the page and line numbers relating to the published online version.

Response to specific comments:

P.2 l. 19 (p. 13309 l. 11): we agree with the reviewer. More precisely, ORM is able to retrieve the pressure at the tangent points and the profiles of temperature and VMR of H_2O, O_3, HNO_3, CH_4, N_2O and NO_2. The sentence will be changed accordingly in the final version of the paper.

P. 6 second paragraph (p. 13312 paragraph starting at line 21): The choice of the strategy to apply sequentially a full Levenberg-Marquardt retrieval and then the regularization process was made on the basis of some preliminary tests in which the performances of the a-posteriori regularization were compared with those of the regularization at each iteration step. These tests showed that comparable performances in terms of vertical resolution and retrieval errors are provided by the two approaches of regularization. These results are not unexpected because, when the Levenberg-Marquardt parameter is small and the matrix defined by Eq. (4) exists (as in our case), for each iteration the regularization performed together with Levenberg-Marquardt provides the same results as the regularization performed subsequently to Levenberg- Marquardt. So the only difference between the two methods consists in the initial guess of the last iteration. Furthermore, since at the last iteration the problem is well represented by a linear approximation, the result of the iteration depends very little on the the initial guess and hence on which of the two methods is used. Accordingly to the fact that the two regularization methods have comparable performances the choice of the strategy to adopt was determined by practical reasons. As mentioned by the reviewer, the a-posteriori regularization needs lighter calculation and it is preferable for an operational retrieval. A clarification will be made in the final version of the paper.

P. 6 Eq. (12) (p. 13313 Eq. (12)): The AKM of the final product is calculated as the derivative of x (provided by Eq. (2)) with respect to the atmospheric true state, taking

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into account that the derivative of $\widehat{x}$ with respect to the atmospheric true state is given by the AKM of $\widehat{x}$. This calculation provides Eq. (12). The calculation explained of Eq. (12) will be in the final version of the paper.

P. 7 discussion starting at l. 4 (p. 13313 discussion starting at l. 19): In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

Response to technical corrections

P.1 Introduction l.1 (p. 13308 l. 15) According to the wording used in inversion techniques with "conditioning" we do not intend an operation but a property. The sentence will not be changed.

P.2 l.2 (p. 13308 l. 20) The constraint matrix and the parameter driving the strength of the regularization are firstly introduced in the expression of the cost function and therefore they appear in the solution formula. We think that it is not important to specify in the introduction how the regularization matrix and the regularization parameter are used, because in the subsequent section this is described in detail.

P. 2 l. 10 (p. 13309 l. 2) In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

P. 2 l. 19 (p. 13309 l. 11) In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

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P. 3 Sect. 2, l. 10 (p. 13310 l. 12-13) In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

P. 3 Sect. 2, l. 14 (p. 13310 l. 16) L_1 is a matrix that operates on a vector. Therefore the function of which we calculate the first derivative is defined by the vector to which the matrix is applied. The variable wrt which the first derivative is calculated is that to which the elements of the vector are associated with. So the function and the variable requested by the reviewer depend on the vector to which L_1 is applied and cannot be defined in general. The issue can be clarified by replacing "matrix" with "operator".

P. 6 l. 1 (p. 13312 l. 15) The statement is referred to MIPAS and will be specified in the final version of the paper.

P. 6 l. 9 (p. 13312 l. 24) We believe that "two operations" is more pertinent.

P. 6 last line (p. 13313 l. 14) "species" will be replaced with "targets".

P. 7 l. 3 (p. 13313 l. 17-18) "VMR" will be replaced with "target".

P. 8 l. 12-13 (p. 13314 l. 29-30) we do not see the need to change the order.

P. 8 l. 17 and below (p. 13315 l. 4-5 and below) Also the fact that the chi-square

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is smaller when regularization is used is a sign indicating that the retrieval finds more easily the minimum. We prefer to leave the sentence as in the original version of the manuscript.

P. 9 l. 20 (p. 13316 l. 5) The use of "that" would make possible a few different interpretations of the sentence. We prefer not to change the sentence.

P.10 conclusions l. 2 (p. 13316 l. 12) In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

P. 10 period starting at l. 12 (p. 13316 l. 23) In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

Table 1 caption (p. 13319) In the final version of the paper the sentence will be changed according to the suggestion of the reviewer.

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

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