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

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Here is a response to the short comment by Dr. Thomas von Clarmann (ACPD, 6, S6530-S6532, 2007). The authors thank him for the constructive contribution.

1. Eq.(7) is the equation resulting from the error consistency method described in the reference [Ceccherini S.: Analytical determination of the regularization parameter in the retrieval of atmospheric vertical profiles, Opt. Lett. 30, 2554-2556, 2005]. As reported in this reference, Eq. (7) is proposed on the basis of the criterion that "regularization has to be as strong as possible but must not introduce a smoothing in the profile that is larger than the retrieval error". Therefore, this criterion does not follow from chi-square statistics.

2. The sentence after Eq.(7) is intended to provide an intuitive idea of the rationale behind the error consistency method. In the final version of the paper we will specify that actually $\mathbf{S}_x$ is never diagonal in remote sensing of vertical profiles of atmospheric state variables. A discussion of the effects introduced by the off-diagonal elements of $\mathbf{S}_x$ regarding the EC method has been included in the response to reviewer #1, and it will be included also in the final version of the paper.

3. It is true that the EC method can be used to improve the conditioning, but cannot be used to handle ill-posed problems. The purpose of the method is, therefore, that of removing the anti-correlations (and the associated oscillations) that exist in the retrieved profile when the step of the limb-scanning sequence is smaller than the IFOV.

4. The authors do not see any difference between Eq.(9) of the paper and Eq.(1) of the short comment by Dr. von Clarmann but the notation. In the short comment x_i, x_{i+1} and K_i are used instead of $\widehat{x}_0$, $\widehat{x}$ and $\mathbf{K}$ respectively. Eq.(10) is directly derived from Eq.(9) by applying the definition of variance-covariance matrix of a vector and using the definition of $\mathbf{S}_y$. Eq.(11) is directly derived from Eq.(9) by deriving $\widehat{x}$ with respect to the true atmospheric state (that is the definition of averaging kernel matrix). The additive term for which Eq.(1) and Eq.(2) of the short comment differ is independent from y, so it can neither change the expression of the variance-covariance matrix nor that of the averaging kernel matrix (because it does not depend on the true atmospheric state).

   The authors think that the comment of Dr. von Clarmann arises from the fact that the Levenberg-Marquardt method is generally applied in a way that the last iteration is performed with $\alpha = 0$ (or very small). It is true that both the Levenberg-Marquardt method and the Gauss-Newton method search for the same exact solution, but Levenberg-Marquardt reaches it only if $\alpha = 0$ at the last iteration. The formulas reported in the paper are instead more general, taking into account also that the retrieval, due to optimized convergence criteria, might be stopped when α is still different from zero. In this case the value of α affects both the variance-covariance matrix and the averaging kernel matrix as described in the paper.

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