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Atmospheric Chemistry and Physics Discussions



# *Interactive comment on* "Comparison of the inversion algorithms applied to the ozone vertical profile retrieval from SCIAMACHY limb measurements" *by* A. Rozanov et al.

**Anonymous Referee #1**

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## General comments

This paper compares three inversion algorithms applied to SCIAMACHY limb-scatter data for retrieving vertical profiles of stratospheric ozone.

It appears that a detailed study has already been carried out to validate two of the three retrieval methods presented in this paper by Brinksma et al. (Geophysical validation of SCIAMACHY Limb Ozone Profiles, Atmos. Chem. Phys., 6, 197-209, 2006). However, there is little mention of the results of the previous work. It is noted that newer versions of the Stratozone and ESA/DLR products have been used in this paper, but no information is given as to the changes from the versions considered by Brinksma et



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al. and whether these changes are expected to produce significantly different results. It appears that the main change for the ESA/DLR products was a switch in spectral region, but this change is not explicitly mentioned in the paper. The new work here is the inclusion of the SCIATRAN method. However, the analysis here is much less indepth than that of Brinksma et al., and thus the relevance of this paper is not clear.

If the main purpose of the paper is to study the results from the SCIATRAN method or of the newer versions of the other methods, significantly more focus should be placed on this. In particular much more data should be included. In the Brinksma et al. paper the Stratozone and ESA retrievals were compared to hundreds of lidar profiles (compared to only 3 in this paper) and data from satellite instruments, ozone sondes, and ground-based microwave instruments. What would a data user gain from this paper, other than the conclusion that the methods are "generally in good agreement"?

The methodology of the comparisons is also questionable. Except for the lidar comparisons, the results are only shown as comparisons of average profiles (and the associated standard deviations). This averaging will tend to minimize individual differences and is not the correct quantity to study. More appropriate would be to show the mean and standard deviation of the individual profiles (relative to the Stratozone method, for example). This would highlight the magnitude of the differences and would support values quoted in the text that are not obvious in the current figures (e.g. percent differences).

It is also not clear exactly what the conclusions of the paper are. It is stated that "The intercomparison shows that all retrieval methods are generally in good agreement." However, for ozone retrievals the 10-15% differences seen are surprisingly large and not what I would consider "good agreement" for comparisons of very similar measurements of the same quantity. I think that more work is required.

**Specific comments**

It surprises me that on such a long-running instrument, with tens of thousands of orbits,



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only 5 were selected for comparison. Perhaps this is due to limitations on one of the processors, but this is not mentioned.

In the introduction you state that "A detailed description of the retrieval processors will be presented in the next section.", but this is not the case. Only overviews of the three algorithms are given, with the details left largely to references. Though perhaps appropriate for the Stratozone and SCIATRAN methods, the information appears insufficient for the ESA/DLR method.

You state that "The retrieval problem in atmospheric remote sensing...". Of course there are many other retrieval problems that could be formulated, so please reword to state that you are referring to a particular retrieval problem.

In the General settings section you describe the initialization settings for the three methods. Of note are the assumptions of a constant surface albedo (0.3) and a pure Rayleigh atmosphere. Are these the settings that are generally used, or are they specific to this comparison exercise? What is the expected impact of these assumptions on the three methods?

In section 4 you spend a great deal of time discussing the sensitivity of the limb measurements (to the true state). This is interesting since, though you do not explicitly state it, you are presumably using the same a priori information for all three retrievals. As such you would expect that the methods would agree in regions where there is a lack of sensitity. It may not be as simple as this when the different methods of regularization are considered, but I think this would be the general expectation. In any case since you are comparing three retrieval processors (of the same data), I would think it would be appropriate to compare over all regions where the individual processors report results without any caveats as to the sensitivity (in their respective data products). You should consider the differences at, for example, 15 km, if these values are accessible to the data user, perhaps with some comments on the sensitivity, but these regions should not be ignored.



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As noted in the General comments, the presentation of the results is inadequate. Since the focus of the paper is on the differences between the methods, this is what the figures should illustrate. As well, the mean and standard deviation of the differences is what is important, not the difference of the means.

**Technical corrections**

None.

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