

## ***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 #3**

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General comments: The topic is very good in that it illustrates the similarities and differences between the flavors of SCIA limb ozone profiles, which should help users of the data sets better understand the different versions (two from the U. Bremen and the official version from the DLR) of the same product. In its present state, however, the article does not include enough information for the reader to understand what exactly are the quantitative differences and why/when they occur. Consumers of the data (ozone profiles) will want to know whether they have to be concerned with which particular flavor they choose or can they use whatever suits the coverage needs, knowing that anyone of the three flavors will be within X amount of the others. Breaking down the differences, i.e. the mean and standard deviation of differences, between the three

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processors for different cases, i.e. latitude, surface albedo (bright vs. dark), clouds, would also help the reader better understand which flavor to consume.

The description of the three different algorithms used should be more balanced. The SCIATRAN algorithm is explained in greater detail (maybe because the first author is more intimately familiar with it than the other two). Don't cut back on the SCIATRAN detail, instead give like detail about the other two, especially the DLR processor. It would be helpful to more clearly call-out the commonalities of the processors, eg. use of tangent height normalization, a priori, first guess, and the distinct differences. Maybe a short summary paragraph at the end of section 2.

Common: tangent height normalization, a priori, first guess, background atmospheric state, atmospheric aerosols, surface albedo, etc. Different: Forward model, minimization technique, spectral filtering (triplets vs. DOAS), different altitude for tangent height normalization.

Is the configuration used for each processor that which is used in producing each of the respective off-line products or has it been modified here for convenience?

The plotting of actual ozone profiles is refreshing in that it is the quantity retrieved, but it would be helpful to the reader if differences from a reference profile were also shown. For example, a companion to Fig. 4 with the mean and standard deviation of the difference between each retrieval and the a priori, that is if the a priori is the same in each of the three retrieval methods. If the a priori are not the same, then pick a common reference profile and also add lines showing the difference between the a priori and the reference profile.

Need to add a little more about the SCIA measurements, i.e. the SCIA spectra vertical sampling, vertical instantaneous field of view (IFOV), spectral resolution, typical SNR in this spectral range near the normalization tangent height and at 25 km.

Specific comments:

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Page 1973: Do all three use the same retrieval grid spacing and initial atmosphere state, including temperature and pressure?

Page 1974, line 8: What is the typical number of iterations?

Page 1974, line 27 to page 1976, line 2: Might be more clear if reworded similar to “ĒRoazanov et al., 2005a, describe the details of the retrieval method when applied to SCIAMACHY data for the retrieval of NO<sub>2</sub> and BrO vertical profiles.” Now, what about when the application is the retrieval of O<sub>3</sub> vertical profiles? Are the details the same, just the unknown is now O<sub>3</sub> and the spectral range is different?

Page 1975, lines 8-9: Does this mean that only measurements between 9 and 49 km are fed to the different processors? What determines the lowest tangent height actually used in each processor to construct a “y” vector? That is to say, are observations containing clouds used or is there any screening for clouds and those tangent height observations with clouds discarded and the tangent height lower limit is then greater than 9 km?

Page 1975, lines 14 thru 19: This discussion is confusing to me. How is “enough regularization” defined or determined?

Page 1975, line 21: How were the look-up table corrections created, i.e. what radiative transfer model was used?

Section 3: What NO<sub>2</sub> profile is used in Sciarays?

Page 1976, second paragraph: Is the spectrum from a single tangent height used for the normalization or several spectra averaged to increase the reference SNR, which should decrease with increasing altitude?

Page 1976, line 24: Using a SNR different by a factor of 10 seems like a disconnect in the description of the instrument. Is the SNR of the Stratozone algorithm accounting for more than instrument errors, i.e. also forward model errors and cross sections? Do any of the processors account for the correlation in altitude of the “y” vectors introduced

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by the tangent height normalization step? This should lower the estimated uncertainty of the retrieval.

Page 1977, end of main paragraph: Did the authors test the hypothesis of similarity between the three by using a perturbation analysis of a synthetic profile, i.e. what is the impulse response function of each processor.

Page 1978: Is the finite IFOV accounted for in calculating the averaging kernels or in the forward models?

Page 1978: Since only a SNR of 100 is used in the Stratozone processor, wouldn't processors 2 & 3 have less of a dependence upon the a priori?

Page 1980, line 3: This IFOV information should be moved to or repeated in a section describing the SCIA measurements.

Page 1981: Are the sample sizes the same? If not, then how do the results compare when the set is limited to those events that are common to all three?

Page 1981, lines 3-5: Yes, modeling of the scattering process maybe to blame, but aren't there other possibilities? This seems like a good place to look closer and try to discern the root of the difference.

Page 1982: Shifting the profiles based upon the TRUE algorithm: Did the authors test the similarity between shifting the retrieved ozone profile (level 2) and shifting the input tangent height scans (level 1)?

Page 1983, line 12: Under-regularization: Is this true of other cases and it is just hidden in orbital and zonal averages?

Page 1990: One small set of data consumers may be those folks that use the ozone profile to better estimate the tropospheric ozone amount from nadir total column ozone measurements. For their understanding, what is the comparison (amongst the three processors) of the ozone column integrated from the top of the atmosphere down to

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particular altitudes, most specifically down to the tropopause?

Minor comments:

Page 2, line 23: "...module, which..."

Page 1974, line 11: "...), which..."

Page 1974, line 12: "...approach, was..."

Page 1975, line 13: "...iterative..."

Page 1979, line 3, "Thus, based upon the ..."

Page 1980, line 12: "...makes..."

Page 1980, line 13: "...other methods, thus introducing larger..."

Page 1982, line 23: "For clarity, only..."

Page 1977, line 15 - 18: "...approach, as employed by the SCIATRAN retrieval processor, the ... by Rodgers (2000) is not valid and should ..."

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Interactive comment on Atmos. Chem. Phys. Discuss., 7, 1969, 2007.

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