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Atmospheric Measurement Techniques Discussions

Interactive comment on "Improved stratospheric aerosol extinction profiles from SCIAMACHY: validation and sample results" *by* C. von Savigny et al.

C. von Savigny et al.

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Reviewer comments:

General comments

The paper by C. von Savigny et al. presents a new version (1.1) of the aerosol extinction data product, derived from SCIAMACHY Limb measurements. The data quality has been improved in a significant way with respect to the previous version (v1.0), as is demonstrated by comparisons with SAGE II results. The major volcanic eruptions

that affect the stratosphere leave clear traces in the data set, as well as a Pyrocumulonimbus event, and the evolution due to atmospheric dynamics (QBO, Brewer-Dobson circulation) is clearly visible. The data set represents a quasi-continuous, 10 year global stratospheric aerosol record and forms an important contribution to the effort of constructing a long-term view of global stratospheric aerosol evolution, as initiated by the SAM/SAGE instruments, and continued by other limb and occultation instruments (GOMOS, OSIRIS, OMPS, . . .).

Specific comments

A first comment on the calculation of relative differences and associated standard deviations. For all comparative calculations in the paper, the sample mean and deviation have been used. This is common in the atmospheric sciences. However, these estimators are prone to outliers and give misleading results when the data population is not normally distributed. The simple use of percentiles (for example the 50th percentile or median for the population centre, together with the 16th and 84th percentile for the data spread) more or less remedies these problems. This is just a general comment I wished to express; please do not change the paper.

Reply:
This is certainly a good point, and we will take it into account for further comparisons. We follow the reviewer's suggestion and do not change the current paper.

Reviewer comments:
The 'weak' point of the retrieval method for the new SCIAMACHY data version involves the assumption of a lognormal size distribution with fixed median radius and distribution width. The assumption does not reflect realistic aerosol distributions, for which these quantities vary in altitude and time. As an example, in the aftermath of strong volcanic eruptions, the median radius can increase by a factor (say 5) with

respect to the assumed value of 0.11 micron, due to coagulation processes. The variation of size and distribution width has a significant impact on the scattering phase function, on which limb scatter measurements are dependent. Nevertheless, the assumption is commonly used in the limb scatter community, especially when one is forced to retrieve extinction at one wavelength only. The obtained retrievals of course have the peculiar feature that extinction values at two different wavelengths differ by a constant factor, as can be seen in Figs. 7 and 8 (and as is mentioned in the text). This behaviour doesn't reflect reality; for example, the peaks, caused by volcanic eruptions, should exhibit a much flatter spectrum than for background conditions (due to the larger particles present). The solution would be to do aerosol retrievals at multiple wavelengths, and to consider median size and width as fit parameters; this is however out of the scope of this paper. I nevertheless think that it is a good idea to mention the problem, by adding a small paragraph. Section 2.2 would be the appropriate place for this.

Reply:
We fully agree with the reviewer that assuming a constant particle size distribution corresponds to a fairly strong assumption which will affect the retrieved aerosol extinction values. The reviewer is absolutely correct that an improved version of the retrieval should be based on extinction profile retrievals at individual wavelengths followed by a particle size retrieval. This kind of retrieval is currently implemented at IUP Bremen. We followed the reviewer's suggestion and added a paragraph on this issue to section 2.2.

Reviewer comments:
P 8359, line 7. It is mentioned that SAGE II aerosol data is considered as one of the data sets with highest accuracy. The word 'accuracy' refers to random uncertainty and is therefore related to the statistical 'spread' of comparisons (rel-

ative differences). The average relative difference between two data sets reflects more the precision. I think it is better to add the word 'precision' as well in the sentence.

Reply:
We don't fully agree with the reviewer's understanding of the terms "precision" and "accuracy" and think the reviewer confuses the terms. "Accuracy" corresponds to the (absolute or relative) mean difference between the retrievals and the true values, whereas "precision" is related to the spread of the differences about their mean value. Since we aimed at making a statement about the average difference between the measurements and the true values we believe "accuracy" is the correct term in this sentence.

Reviewer comments:
P 8359, line 19. Please specify (using just a short phrase) why data with SZA > 87 degrees were excluded. I know the problem with these data, but it is better to include an explanation for the inexperienced reader.

Reply:
Thanks, we added a brief statement explaining, why limb-scattering observations for SZA > 87 deg were not processed.

Reviewer comments:
P 8359, line 20. Why were the data from 2002 (nominal operation starting in August 2002) not used?

Reply:
Yes, we could have included data from August 2002, but in order to display complete

years only, we started in January 2003.

Reviewer comments:
P 8361, line 11. It is mentioned that the SAGE II version 7.0 aerosol extinction profiles are almost always larger than the v6.2 values. I think this is a mistake. Figures 1, 2 and 3 indicate exactly the opposite. That is, if the formula for the relative difference ((SCIA-SAGE)/SAGE) is correct. Please correct. This has no consequence for the rest of the paper.

Reply:
The reviewer is absolutely correct, the version 6.2 values are almost always larger than the v7 values. Many thanks for catching that and we apologize for this oversight.The statement was corrected.

Reviewer comments:
P 8364, line 7. It is stated that PSC signatures are visible in Fig. 6, top panel, especially in the Southern Hemisphere. However I do not see any clear signatures. Is it because the figure is too small? Or due to the colour scale?

Reply:
The PSC signatures are visible at 18 km in the southern hemisphere at latitudes below 55S in September/October. Essentially all years show enhanced aerosol extinction during the southern PSC season. We added more specific information where to find the PSC signatures.

Technical corrections:

Reply:
We included all the technical corrections listed by the reviewer, thank you!

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 8353, 2015.