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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.

Anonymous Referee #1

Received and published: 24 September 2015

Specific criteria (as defined on the ATM website)

Does the paper address relevant scientific questions within the scope of AMT?

Answer: Yes.

Does the paper present novel concepts, ideas, tools, or data?

Answer: A new and valuable data set on stratospheric aerosol extinction is presented.

Are substantial conclusions reached?

Answer: yes

Are the scientific methods and assumptions valid and clearly outlined?

Answer: yes, although improvements could be obtained (see 'Specific comments' below)

Are the results sufficient to support the interpretations and conclusions?

Answer: yes.

Is the description of experiments and calculations sufficiently complete and precise to allow their reproduction by fellow scientists (traceability of results)?

Answer: yes. The retrieval code has been described in another paper, that is clearly cited in this paper. An adaption of this original code was used in this paper (the scattering phase function that was used, obtained from a Mie code instead of a Henyey-Greenstein phase function), but it is clearly explained.

Do the authors give proper credit to related work and clearly indicate their own new/original contribution?

Answer: yes.

Does the title clearly reflect the contents of the paper?

Answer: yes.

Does the abstract provide a concise and complete summary?

Answer: yes.

Is the overall presentation well-structured and clear?

Answer: yes.

Is the language fluent and precise?

Answer: yes. Some minor revisions are suggested . See below (Technical corrections)

Are mathematical formulae, symbols, abbreviations, and units correctly defined and used?

Answer: yes.

Should any parts of the paper (text, formulae, figures, tables) be clarified, reduced, combined, or eliminated?

Answer: some figures are too small to comfortably investigate, and/or the font of the labels is too small. See below (Technical corrections).

Are the number and quality of references appropriate?

Answer: yes.

Is the amount and quality of supplementary material appropriate?

Answer: not applicable

General comments

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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 instru-

ments, and continued by other limb and occultation instruments (GOMOS, OSIRIS, OMPS, . . .).

Specific comments

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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.

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.

Some further 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 (relative 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.

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.

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

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.

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?

Technical corrections

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The suggested corrections below improve readability in my opinion.

P 8354, line 5: . . . to co-located aerosol profile measurements from the SAGE II . . .

P 8356, line 21: . . . stratospheric aerosol extinction profile algorithm, that was developed at . . .

P 8357, line 9: Stratospheric aerosol extinction profile retrievals from SCIAMACHY . . .

P 8358, line 11: . . . at wavelengths of 470 and 750 nm.

P 8359, line 11: by Damadeo et al. (2013) yielding stratospheric aerosol extinction profiles that sometimes differ significantly from . . .

P 8359, line 15: We start by comparing globally . . .

P 8359, line 22: . . . were evaluated at this wavelength using . . .

P 8360, line 7: We find average agreement to within about 10% between . . .

P 8361, line 1: Figure 3 shows that there is no constant bias between SCIAMACHY and SAGE II aerosol extinction; the differences vary with latitude . . . (note: a bias is always systematic. This is where the confusion comes from)

P 8362, line 5: . . . Henyey-Greenstein parametrization used for SCIAMACHY . . .

P 8363, line 14: During approximately the first 2.5 years . . .

P 8364, line 1: The season during which eruptions occur . . .

P 8375, Table 1, caption: Relative difference [%] of the SCIAMACHY aerosol extinction with respect to co-located SAGE II . . .

P 8375, Table 1: please add 'SAGE II data version' in the second row, first column of the Table. Also, please specify why some numbers are given in brackets.

P 8377, Figure 2. Please enlarge the figure a bit. Especially the labels are difficult to read.

P 8378, Figure 3. Same comment as Figure 2.

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