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Atmospheric Measurement Techniques Discussions

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Interactive comment on "Stratospheric Extinction Profiles from SCIAMACHY Solar Occultation" *by* Stefan Noël et al.

Anonymous Referee #1

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The importance of monitoring stratospheric aerosols for climatic impacts has long been recognized and various ground-based and space based instruments have been employed for several decades. These have led to an overall understanding of background aerosols and their variability due to stratospheric dynamical processes with sporadic contributions from volcanic injections. More recently, it has been realized that, strong stratospheric aerosol loadings rivalling volcanic injections can occur from large fires in the so-called PyroCb events, thus making it even more important to continue characterizing and monitoring stratospheric aerosols. The paper by Noël et al. presents an algorithm to retrieve stratospheric extinction profiles from the solar occultation measurements by the SCIAMACHY instrument between 2002 and 2012. They have also presented initial validation of these retrievals by intercomparison with coincident oc-

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cultation retrievals from SAGE II and limb scatter retrievals from SCIAMACHY. This algorithm has been used by the authors to retrieve profiles of various gas species like CO2, methane and water vapor in the past. The addition of the aerosol product should be useful for stratospheric aerosol database even though it would be of somewhat limited value because of the narrow latitude range of 50oN-70oN only. The content of the paper is well within the scope of AMT and is clearly structured. I recommend publication with some revisions. I have a few suggestions for improving the quality of the paper:

General comments:

1. As pointed out by the authors themselves, the ONPD retrieval algorithm leads to oscillations in the retrieved extinction profiles. This had been noted earlier in the retrieved profiles of gas species as well by the same authors and yet no effort has been made to ameliorate this issue. From the comparison of an individual profile with SAGE II (Fig. 8) it would appear that the oscillations are largely at altitudes over 30 km where the aerosol extinctions are very low anyway. However, later the oscillations showed up in the statistical comparison (Fig 9) at pretty much all altitudes. These oscillatory profiles make the data product of limited value. I think the paper would improve significantly by addressing this issue.

2. It will be useful to include intercomparison with some other concurrently available data products. The authors could explore using SAGE III on Meteor-3M or POAM III. In particular, the limb scatter data from OSIRIS provides good coverage spatially and temporally. The newly released level 3 stratospheric aerosol product from CALIPSO lidar also covers from ∼80oS-80oN and has good overlap in time with SCIAMACHY between 2006 and 2012. Inclusion of some of these intercomparisons will a add value to the paper.

Specific comments:

1. Page 2 line 25: The indirect effect of aerosols on the clouds may be more relevant

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in the troposphere or do you mean the overshooting clouds or the cirrus clouds near the tropopause?

2. One solar occultation instrument missing in the introduction as well as in Table 1 is MAESTRO on board the Canadian SCISAT mission, e.g. see McElroy et al. 2007, Sioris et al., 2010. Also, in Table 1, please add the latitude range covered by each instrument.

3. Page 2, line 48: It is probably fair to mention clearly that CALIOP is different from the other instruments listed in Table 1 because it is an active remote sensing instrument. It is primarily intended for tropospheric aerosol extinction measurements although stratospheric aerosol extinction retrievals have been recently produced. More relevant references for these stratospheric measurements by CALIOP are Thomason et al. (2007) and Kar et al. (2019).

4. Page 3, line 73: What do you mean by "actual" pressure and temperature profiles? In fact I am wondering why the authors used ERA-Interim rather than the newer ERA5 reanalyses. Are the pressure and temperature at mid-high latitudes in ERA-Interim better than ERA5?

5. Page 5, line 122: Please delete "exemplary" and rephrase this sentence.

6. Page 6, line 148: Please first refer to Figure 4 before this sentence.

7. Page 7, line 205: Why is 4.3 km used as the width for box car averaging? What is the impact of using a different choice on the vertical oscillation problem? Some discussion of this issue is needed here.

8. Page 9, line 240: Please mention the coincidence information between the two measurements for this case, including the latitude and longitude.

9. In Fig. 8, there is a large difference between the SCIAMACHY occultation and SAGE II profiles at the lowest altitudes (10-12 km)—could this be due to cloud related effects?

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10. Page 10, line 295: For completeness, please mention how the differences with SAGE II extinction profiles were calculated in the text, although it is given in the legend to the Fig. 9. Also please mention if any filtering criteria were used.

11. Page 10, line 301: Do the results change by tightening the coincidence criteria?

12. Page 11, line 304: By “mean error”, do you mean the standard error of the mean?

13. In Fig. 10, there seems to be a bias in the background case, the agreement is good mostly between 20 and 25 km with significantly larger biases above and below this altitude range.

14. Page 11 and line 320: Why do the size distribution issues affect only low altitudesâĂŤplease discuss.

15. What are the black vertical lines in all the panels in Fig. 11?

16. Page 12, line 339: Note that the volcano Nabro occurred at low latitude (13oN) and the aerosol plumes spread later to higher latitudes.

17. Page 13, lines 374-376: I think the interpretation of the anomalies at altitudes above 25 km in terms of QBO is an interesting result that needs to be discussed further, rather than simply assuming it to be the case. Please add a plot of a QBO index on top of the panels in Fig. 12 so the correlation between the aerosol anomaly and the QBO can be seen more clearly and then discuss the observed anomalies at middle/high latitudes for the easterly and westerly phases of QBO and in terms of aerosol transport from the tropics. Also please discuss the effect in terms of altitude.

18. Do the linear trends shown in Fig. 15 conform to trends from other studies, if any?

19. Page 14, line 413-414: Is the QBO effect expected to be similar for gas species and aerosols?

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