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Comparison of NLC particle sizes derived from SCIAMACHY/Envisat observations with ground-based LIDAR measurements at ALOMAR (69N)

by von Savigny *et al.*

Referee comment - SCIAMACHY PMC particle size manuscript by von Savigny *et al.*

General Comments:

This manuscript presents a comparison between NLC particle sizes derived from SCIAMACHY limb-scanning measurements and ground based lidar measurements obtained from the ALOMAR facility. This is a difficult comparison to make, primarily because the two data sets are obtained using very different measurement techniques, and have very different spatial and temporal sampling characteristics. Nevertheless the authors have done a thorough job of trying to account for these differences to compare the particle size retrievals in a meaningful way. When these differences are accounted for good agreement is found between the two data sets.

The paper is generally well written and clear in its presentation of the measurements and the analysis. The conclusions are straightforward and I have no significant objections to the analysis used. I recommend that the paper be published, but offer some comments below for the authors to consider.

Specific Comments & Questions:

Section 3

The single most important factor in obtaining a consistent agreement between the SCIAMACHY and ALOMAR data sets seems to be using the right width in the assumed size distribution for the SCIAMACHY retrievals. To this reviewer the argument presented to justify the rather large distribution width (24 nm) based on the sampling volume of the SCIAMACHY measurements at first did not make sense. But with more thought the reasoning seems sound. For completeness I think it would be good to show the sensitivity of the SCIAMACHY particle sizes to this parameter. For example, if you had just used the mean ALOMAR width parameter of 17 nm how much would the particle sizes change?

The size distribution width assumed in the SCIAMACHY analysis should be stated in the abstract for completeness.

It would be useful to have more information on the instrument degradation mentioned at the very end of this section. Although a reference is provided to Robert *et al.* [2009] the current paper should be clear whether this degradation contributes to errors in the SCIAMACHY particle sizes or not.

Section 4

Regarding the subset selection for the coincidences, the SCIAMACHY footprint at ALOMAR latitudes is at most 25 degrees wide in longitude. It seems to me that allowing a 16-degree offset between the ALOMAR location and the center of the footprint would sometimes put ALOMAR outside the satellite footprint. I am assuming that the orientation of the SCIAMACHY footprint is fairly reproducible from orbit to orbit – am I missing something?

The paper does not state what altitude is used is used from the SCIAMACHY profile for doing the Angstrom coefficient fit. Presumably the altitude of the peak in the scattering profile is used, but this should be stated. Because of the coarse vertical sampling of SCIAMACHY this altitude will generally not coincide with the peak altitude seen by the lidar? How does it compare in general? Since the sampling is 3.3 km, the peak SCIAMACHY altitude could easily be either below the lower lidar altitude or above the upper one. In these cases does the weighted mean defined in Eq (4) still make sense?

Section 5

Can you state explicitly how the lidar data are averaged for the yearly-averaged comparisons shown in figure 4 and table 1? It's not clear to me what constitutes a lidar "observation", since the instrument operates continuously. Are these daily averages?

Also, can you comment on why there are so few SCIAMACHY same-day coincidences with ALOMAR? I would think that if the lidar is operating continuously during the PMC season you would essentially get a temporal coincidence every time the SCIAMACHY footprint met the geolocation criteria. What am I missing?

I am assuming that all the results shown here assumed spherical particles and a Gaussian distribution of width 24 nm for the SCIAMACHY retrieval. However, this is not stated explicitly in the discussion of figures 3-6 and I think it should be.

When discussing the sensitivity of the retrieved particle size to the assumptions made about the underlying size distribution, I think it would be instructive to quote how the SCIAMACHY result would change if you just used the mean distribution width derived by the lidar (17 nm) rather than the smeared out distribution width of 24 nm. Presumably this would give much smaller particle sizes from SCIAMACHY.