

Interactive comment on “Impact of aerosol size distribution on extinction and spectral dependence of radiances measured by the OMPS Limb profiler instrument” by Zhong Chen et al.

Anonymous Referee #3

Received and published: 20 March 2018

The paper titled "Impact of aerosol size distribution on extinction and spectral dependence of radiances measured by the OMPS Limb profiler instrument" by "Zhong Chen¹, Pawan K. Bhartia², Robert Loughman³, and Peter Colarco²" examines the impact of aerosol size distribution from CARMA on OMPS extinction. While the paper is well written, I think there is still scope for improvement particularly the way the paper is emphasized on the impact of aerosol size distribution on deriving extinction. I also see that the topic is of great importance to the stratospheric aerosol community as improvement on OMPS aerosol retrieval will be a very good addition to other limb scatter measurements such as OSIRIS, and SCIAMACHY.

C1

Although, I understand it's a comparison between assumed aerosol size distribution in version 1 of OMPS aerosol retrieval and ASDs from CARMA, I think the comparison here is probably not correct as model has its own pros and cons when it comes to aerosol size distributions. While I have no issues in using modeled ASDs in this study, I would like see a comparison between modeled ASDs/extinction and available observations (e.g. balloon measurements). I also see an issue here as the ASD derived from CARMA used in this study is from a period 1990-1993 which is when the stratosphere is highly volcanically affected due to Mount Pinatubo. I believe that using these ASDs for the study here will have a clear impact on extinction as aerosol size distributions vary from these two periods.

From the paper, I understand that for version 1, the ASD is derived from aircraft measurements. I wonder why only this aircraft measurement was used while there were many other aircraft/in situ balloon measurements were available. For example, for OSIRIS/SCIAMACHY retrieval balloon in situ measurements during low volcanic/background period were used for ASDs. My concern is that ASDs from a large volcanically perturbed time period may not be a correct assumption as there were many moderate volcanic event post-SAGEII era (after 2005). This is what was done in version 1 of OMPS retrieval and similar volcanically influenced ASDs are used in the model simulated ASDs here if I understand it correctly.

The paper fits within the scope of the journal. Although, the paper is reasonably well written, I find that there is a lot of scope for improvement. So, I recommend some revisions below:

Major comments:

Page 3 L10: Why are ER-2 measurements in August 1991 was used while there were many other ER-2 measurements/balloon measurements during moderate/background periods were available which will be more realistic in terms of OMPS period of measurements?

C2

Page 4 L10: I am not an expert in running models but I am not sure how the simulations were done here? The sentence reads as "no explosive eruptions were used for the precursor emission but then in line 19 it reads as the simulation was done for the period 1990-1993 which includes Mount Pinatubo time period. I think it would be helpful for readers if you could explain this a little bit more in detail.

As from the model simulations, I believe the simulations were made using prescribed SSTs for the period 1990-1993. My concern here is that a highly volcanically influenced ASDs are used here as this may not be a correct way of representing ASDs for the stratosphere for the OMPS measurement time period which includes many moderate eruptions. May be, it is more realistic if the simulation was done with same prescribed SSTs for the post-Pinatubo period (post 2005) to represent more of moderate volcanic eruptions.

Page 5 L 4-10: How does OPC's compare to these distributions? I would like to see a comparison here. Although, gamma distribution in this case may be a better representation, I still believe that lognormal distribution is the best possible representation of stratospheric aerosols which I think would fit very well to the observations.

I would like to see a sensitive analysis to Gamma distribution and lognormal distribution and compare them with actual measurements available on an altitude basis. I would like to see how these distributions differ particularly near tropopause region and higher up. Probably showing a comparison at different altitudes may help understand the observations better.

The other possible way to compare your results is to compare CARMA ASDs with OPC measurements from Deshler et al., 2003 as balloon measurements have higher vertical resolution than aircraft measurements which will give us an idea how CARMA compares with the observed size distribution. I believe this is an important point to make as authors are testing a new ASD from a model in this study and this point should be addressed.

C3

Page 7 L10: I am not sure what this means? "We find that the key difference between the two ASDs is that the Pueschel distribution has larger $dN/d\log r$ values at 0.1 micron, which causes the derived aerosol scattering phase function $P(\theta)$, shown in Figure 4, to be more "Rayleigh-like" at large single scattering angle θ , i.e., closer to the Rayleigh $P(\theta)$ "

Page 10: It may help the reader if authors could explain as how the extinction is computed and at what wavelengths the extinctions are calculated.

Page 11 Figure 9: How does it look like in the lower stratosphere. This is where the main issue of all limb scatter measurements lies. I would like to see a similar plot for lower altitudes say 18, 16, or 13 km. If you could use a tropopause height climatology and use the above altitudes to do a similar plot, I expect to see some data showing up at 13 km for higher latitudes where I think limb scatter measurements have issues. What wavelength is extinction in Figure 9 calculated at?

Page 13 Figure 11: The figure says ASI's are computed at three different wavelengths. Are these wavelengths just used for ASI's or are these used for computing extinction as well (for example in Figure 9)?

Page 15 L15-20: The OSIRIS data are in reasonably good agreement with SAGEII (Rieger et al., 2015) except in the lower stratosphere at higher latitudes. I would like to see how CARMA ASD's derived extinction compare to OSIRIS. I understand it may be out of the scope of this paper but it would definitely help the stratospheric aerosol community as I believe OMPS measurements are valuable which may help fill the gap between SAGEII and SAGEIII-ISS in addition to OSIRIS/SCIAMACHY/CALIPSO.

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2018-4, 2018.

C4