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Comment on amt-2021-369

Anonymous Referee #2

Referee comment on "Impact of particle size, refractive index, and shape on the determination of the particle scattering coefficient – an optical closure study evaluating different nephelometer angular truncation and illumination corrections" by Marilena Teri et al., Atmos. Meas. Tech. Discuss., <https://doi.org/10.5194/amt-2021-369-RC2>, 2022

Review of "Impact of particle size, refractive index, and shape on the determination of the particle scattering coefficient – an optical closure study evaluating different nephelometer angular truncation and illumination corrections" by Teri et al.

This manuscript presents a comprehensive evaluation of different angular corrections for the Aurora 4000 nephelometer. The study combines specifically designed laboratory experiments with model simulations, with special focus on irregularly shaped coarse particles. The manuscript is very well written and structured and reads very easily.

General comments

Although the authors performed a very comprehensive study evaluating different angular corrections and using different input data, I feel like there are still some points that should have been addressed in this manuscript. The first one is the evaluation of the angular corrections for moderately absorbing aerosols. The SAE-derived correction is the most widely used angular correction and the recommended one in this article (for unknown aerosol type, which is the general case), however, it is highly uncertain for absorbing particles. What is then the recommendation for absorbing particles? Secondly, the laboratory experiments focused on different aerosol types (PSL, AS, dust,...) but I wondered why ambient aerosols were not explored (in particular urban aerosol with low single scattering albedo).

Specific comments

Title: To what extent the results obtained in this study can be extrapolated to other nephelometers, like the TSI3563? I recommend the authors to include in the title that the study is limited to the Aurora 4000. Something like "Impact of particle size, refractive index, and shape on the determination of the particle scattering coefficient – an optical closure study evaluating different nephelometer angular truncation and illumination corrections for Aurora 4000 nephelometer"

Line 23: "... size distribution measured with optical particle spectrometers": not only optical spectrometers, some studies have been carried out using mobility and aerodynamic spectrometers. My suggestion is to remove "optical" to broaden the applicability.

Line 59: The work by Sorribas et al. (2015, *Q.J.R.Meteorol.Soc.*141: 2700 – 2707, <https://doi.org/10.1002/qj.2557>) already explored the effect of particles with irregular shape in the Anderson and Ogren (1998) correction. They found that for fine mode particles, the angular correction underestimates the observed scattering for both spherical and spheroidal approximations by less than $\approx 3\%$; while for particles within the coarse mode, the uncertainty for scattering was about 8%. I recommend the authors to read this manuscript carefully and take it into account both in the introduction (acknowledgement to previous work) and in the discussion of results.

Line 105: What is the uncertainty in the scattering angles?

Line 315: I have several concerns about the use of an optical spectrometer instead of using an aerodynamic spectrometer for this type of study. I am aware that there is no consensus on a standard instrument for measuring the coarse aerosol size distribution. However, since the focus of the study is to use the size distribution to retrieve aerosol optical properties I feel that it would be more appropriate to use an instrument that measures the size independently of the optical properties of the particles. Said that, and being aware of the amount of work behind these experiments, I recommend to include more information on the performance of the OPS:

- First of all, a discussion on the uncertainties in the size distribution obtained with the OPS for aerosol particles other than PSL. The instrument is calibrated with PSL, but how accurate is the size distribution for particles with different refractive index and shape (like dust)? How this would affect the results obtained? This is briefly discuss in lines 555-567, but this should be further elaborated. Using an APS instead of OPS would have been more optimal for this study.
- The loss correction applied to both OPS, is size-dependent? Different losses are expected for particles of different sizes...

Line 526: remove recently, it has been 10 years since its publication...

Fig8: I found this figure very informative and interesting for the scientific community. However, in general for atmospheric measurements, the aerosol type is not known (aerosols are a mixture of different components), so the recommendation is to use the SAE derived correction despite its large uncertainty (which is the most widely used correction scheme). Also, no recommendation are given for environments with high load of absorbing particles like urban sites. Extending the study to moderately absorbing mixtures will significantly enhance the scope of this manuscript.