Atmospheric Measurement Techniques Discussions

Atmos. Meas. Tech. Discuss., referee comment RC3
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Comment on amt-2020-412

Anonymous Referee #2

Referee comment on "New correction method for the scattering coefficient measurements of a three-wavelength nephelometer" by Jie Qiu et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2020-412-RC3, 2021

General comments:

The authors introduce a new correction method to correct for the truncation error of the Aurora3000 nephelometer. This method uses the Angstrom exponent and also the hemispheric backscattering coefficient and is based on training a random forest machine learning model. To the reviewer's knowledge, the method is new and could be a step forward.

However, the reviewer has major concerns about the description of the model and the presentation and interpretation of results.

The role of the field measurements in this manuscript is not clear. In the absence of a complete, albeit simple, classification of the field data using SAE and SSA, it is questionable whether the data provide a sufficient basis for initialising the model. For example, it is not clear how strong the light absorption of the simulated aerosols are. Any information on single scattering albedo or the imaginary part of the refractive index are missing.

Furthermore, the reviewer finds it difficult to distinguish between measurement (PNSD) and speculative assumptions (refractive indices or kappa) in both models (dry and different RH conditions). For simplicity, the simulation study could also have been carried out with synthetic data for clearly defined aerosol types. The description of the model calculations are often imprecise, as important parameters such as refractive indices used from etc. are not specified.

Chapter 3 points out the performance of the new model. Why are results of the new model

only shown for data from the Gucheng measurement campaign? Why were experimental data not used to show the performance of the new algorithm for dry conditions by a closure experiment of the light scattering coefficient? And more important, why haven't the authors shown how their approach compares to the simple linear parameterization shown in Mueller et al., (2011)?

Specific comments:

Line 36: What parameter is mentioned?

Line 39: What methods have been proposed in Mueller et al (2011)?

Line 56: Figure 5 in Mueller et al (2011) suggests that a simple linear function is not sufficient. Unfortunately, this was not discussed further in Mueller et al. (2011).

Chapter 1: In general, the description of the state of the knowledge is little vague. How large are uncertainties when using the simple parameterizations of Anderson (1998) and Mueller (2011)?

Line 70 and Figure 1: Just taking a large set of total number concentrations as an argument that a large number of possible aerosol types have been covered is not sufficient. Furthermore, no evidence of a coarse mode particle can be seen in the particle size distributions. The large range of scattering Angström exponents (see Figure 2) suggest that could be are cases with a significant coarse mode volume fraction.

Line 89: A core radius of 35 nm might be too small to represent internally mixed aged particles. Furthermore, a constant core size also means that the volume fraction of absorbing material and the single scattering albedo decreases with increasing particle size. What does this mean for the interpretation of Figure 3? What range of single scattering albedos is covered with this model?

Line 88: What refractive indices are used for absorbing and scattering materials?

Line 91 and throughout the manuscript: Replace "band" by „wavelengths".

Line 92: Mie model: The description of the optical model should include how large the truncation angles were and how the imperfect Lambertian light source was taken into account. Are calculated values shown in Figures 3 and 4 for in ideal nephelometer or simulating the output of Aurora3000?

Figures 3 and 4: The reviewer believes that all measured size distributions (referred to as 'bulk' in Figure 3) served as the basis for the calculations. This should be mentioned in the text. Furthermore, it is not clear how the ratio of size resolved to total scattering is calculated. Was the size resolved scattering calculated for a constant size interval on linear scale or constant on logarithmic scale?

Line 123: Can the authors explain why R_{ext} is sensitive to HBF?

Figure captions 3 and 4 : "absorbing particles (b)"

Line 141: Please specify "Conditions of nephelometer light source"

Line 149: "RF predictor" not defined.

Line 150: Why are the model results just checked for data from Gucheng and not for the other stations?

Line 170: Specify "assumed size distributions of kappa"

Figure 6: y-axis, "CRH" should be C(RH)?

Figure 6: Do not split legend to subplot (a) and (b)

Figure 6: How can f(RH) and Fb(RH) be negative for low RH?

Lines 230: The reviewer can not follow the conclusion on the strength of the absorption. The authors missed to give any information on the strength of absorption like single

scattering albedo or complex refractive index.

Line 310: The reviewer thinks it would be better to reword the paragraph, since the study could also be done with synthetic datasets. With synthetic data, also simulations of e.g. desert and marine aerosol types could be done.