Review of "The uncertainties in the laboratory-measured short-wave refractive indices of mineral dust aerosols and the derived optical properties: A theoretical assessment" by Senyi Kong et al.

This study investigates differences in the retrieval refractive complex refractive indices using different optical models. In their baseline case, optical properties were calculated assuming inhomogeneous super-spheroid model, and were then compared with homogeneous super-spheroid models and the homogeneous sphere models. Optical properties were calculated for wavelengths 355, 532, 633, 865, 1064 nm. Three particle size distributions (S, M, and L) or combinations of them were used in the simulations.

Overall, the work is interesting, and the evaluation of different aerosol optical models is relevant to the scientific community. However, certain sections of the text are not clear or are confusing. For instance, the authors refer to a numerical simulation as a “measurement” and, at times, as “experiments”. Additionally, the baseline simulation is referred to as a “dust sample”. These nomenclature makes some parts of the text unclear. Also, the authors evaluate the retrieval refractive indices in what they called “ideal” and “realistic” scenarios. However, the “ideal case” corresponds to a simulation where size and scattering truncation are not corrected, and it is unclear why they would evaluate and label such a case as “ideal”.

In the “realistic case”, which appears to be the appropriate scenario for evaluation, they found that using either the homogeneous super-spheroid model or the homogeneous sphere model was unable to match the optical properties for the large particle sizes. The reason for this is attributed to “differences in size distribution between the dust samples and the models.” However, it is not clear why there are differences in the size distribution between the baseline and the model simulations.

Specific Comments:

Title: The title mentions short-wave refractive indices only, but the manuscript evaluates five wavelengths 355, 532, 633, 865, and 1065nm, ranging from near ultraviolet (NUV) to near infrared (NIR).

Page 2, Line 36: It would be useful to include a brief description of what a homogeneous super-spheroid model actually is.

Page 4, Line 99: “*Dust samples of different sizes and optical databases for homogeneous models were prepared. Inhomogeneous super-spheroid dust models were regarded as the “dust samples.*””. It is not clear what the authors mean by “prepared”. Do you mean selected? From where? Which datasets were used to define the “dust samples”? It would be more clear if you define “dust samples” as the “baseline case”.

Page 4, Line 99-108: For clarity, I would suggest the authors to rewrite the steps of the numerical experiment in a more directly, avoiding stating that quantities were measured, and refrain from calling an optical model/simulation a “dust sample”.

Page 4, Line 113: "*Two correction processes were considered for the measurements of "dust samples" to mimic actual laboratory experiments*." This sentence is not clear. Were these processes used in the numerical simulation? If so, please make sure to clarify that in the sentence.

Page 4, Line 123: For clarity, I suggest replacing: "experiments…" by "numerical simulations", here and throughout the entire manuscript.

Page 4, Line 124: "*Note that E1 represents an ideal situation in which no instrument defects need to be corrected for the measurements, …*" It is not clear what the authors are calling "instrument defects" here. The corrections the authors mentioned previously (scattering truncation and size) corrections should not be refer to as instrument defects. The corrections are needed because instruments are limited in their measurement capacity and not because of a defect (broken or failure).

Table 1, Caption: Does the instrument bias the authors are referring to correspond to the same two corrections mentioned previously?

Page 11, Line 275: It is not clear why the authors decided not to include uncertainties in the absorption coefficient measurements in their simulations. The authors mentioned "*corrections were validated using measurements*". Why does the validation of corrections by measurements change the necessity of including them in the simulations?

Page 12, Line 285: "*Due to the sparce nature of the measurements, it was almost impossible for them to fall on the grid points of the look-up tables… These average refractive indices were referred to as the exact values*." This sentence requires clarification. What measurements are you referring to? Are the authors saying that the calculated scattering and absorption coefficients could not be obtained with the optical parameters represented in the authors' look-up tables?

Page 17, Line 384: "*Note the significant discrepancy emerged between the "dust samples" and the homogeneous super-spheroid models as the size increased, which was inconsistent with the findings in Figure 5*." Can the authors explain why the discrepancy is larger in this case (E3/E4) compared to E1/E2? Specifically, in the E4 case where the model has both scattering and size correction, why would the discrepancy be larger in this case?

Page 21, Line 428: "*The E4 scenario represented measurements closer to those obtained in the laboratory, while E1 was considered an ideal scenario*." According to Table 1, E4 corresponds to the cases where both size and scattering truncation corrections were applied, while E1 corresponds to a case "without correction". It is not clear why the authors would call the case without correction "ideal".

Page 22, Line 441: Instead of using the term "measurement", please clarify what exactly you are referring to. The same applies to lines 446, 447, and 450.

Figure 11: It is difficult to distinguish between each line in the plots. Using different colors and/or line styles may improve clarity.

Page 25, Line 518: "*However, when measuring their refractive indices in the laboratory, it is …*". Refractive indices of aerosol particles are not usually directly measured in the laboratory, but are derived from absorption or extinction measurements assuming an optical model.

Page 25, Line 530: "*Under and ideal scenario, where no instrumental defects needed to be corrected, the look-up tables for the homogeneous super-spheroid models were able to fit the measurements at any size.*". There are a few issues here:

First, the size and scattering truncation corrections are not "defects". A nephelometer measuring scattering in an angular range from 7 to 170 degrees is not a defect. Extrapolation (or correction) is the procedure used to obtain the total integrated scattering. Second, I would not refer to an "ideal scenario" as a case where beta_scat(0 to180) is approximated by beta_scat(7 to 170). Was a solution found using the super-spheroid model fitted with an approximation beta_scat(7 to 170)? What does that say about the consistency of the model?

Page 26, Line 552: "*The retrieved refractive indices were found to be size-dependent. As the size increased, the imaginary part decreased.".* Where is this shown in the authors analysis? How do you explain this result if you have assumed the same composition in each simulation? Was that observed for both the homogeneous and inhomogeneous models?

Page 26, Line 556: Please define "true values". Are the authors referring to the complex refractive indices obtained with the inhomogeneous super-sphere model? Why are they not shown?