Atmos. Chem. Phys. Discuss.,
https://doi.org/10.5194/acp-2019-812-RC1, 2019

Atmospheric Chemistry and Physics Discussions

Interactive comment on "Scattering matrices of mineral dust aerosols: a refinement of the refractive index impact" *by* Yifan Huang et al.

Anonymous Referee #1

Received and published: 11 November 2019

Aerosol optical properties are fundamental for our understanding of their radiative effects in the realm of remote sensing. This manuscript investigated the optical properties of dust aerosols, with a focus on the role of the refractive index and its influence on current model development. By evaluating models with laboratory study of scattering matrix, the authors found the refractive index is as important as the particle shape in determining dust models. The current results shown in this paper support the conclusion that refractive index should be considered more carefully in studies of aerosol radiative effects. Therefore, the subject and the contents of this paper are interesting, and it might contribute to our further understanding of the behavior of various aerosols not just limited to dust. The paper in current status is well organized and nicely written, but I still want to raise a few questions before it gets published:

1. Line 23, Page 3: Figure 1 shows the large variations on dust refractive indices. However, it is unclear why do the authors need to use both crosses and shaded areas for their illustration? Can the authors be more specific on their motivations based on those studies?

2. Line 9, Page 5: It seems that a couple of important parameters for these numerical simulations are not introduced in the method section. For example, what is the range of sizes on dust particles considered for the numerical simulations? How to take into account the particle orientation during simulations?

3. Line 20, Page 5: In Section 2, the authors use the summation of relative errors of the six non-zero scattering matrix elements to specify the "accuracy" of the numerical model. However, bear in mind that different elements might have different variations. Thus, the relative errors may have quite different magnitudes, which could make the evaluations might not be that fair. Meanwhile, some mentioned studies only considered the relative errors of the scattering phase function, which also makes the comparison not purely apple-to-apple. I am wondering how different the results will be if different variables were considered?

4. Line 19, Page 7: Figure 5 illustrates very informative scattering phase matrices for the five dust samples. As we all can see, the numerical results achieve quite a different accuracy and different refractive indices. I am not sure I am entirely clear of the causes of the differences, and I hope the author could provide more thorough discussions in revision.

5. Line 19, Page 7: Comparing to Figure 5, the P22 appears to be the worst (among all six elements) comparing the model simulation and the observations. Why is that? What can further be done to limit this discrepancy here?

6. Line 6, Page 9: The authors mentioned that Figure 7 is the optimal simulation results with RI of 1.8+10ˆ(-4)i, but the caption mentioned 1.6+10ˆ(-4)i.

7. Lines 17-22, Page 11: The last paragraph of Section 4 is quite confusing for me. Actually, the comparisons in Figures 9-11 as well as the corresponding discussions before this paragraph are quite clear.

8. The authors mainly considered the differences in particle shapes and RI. Inevitably, the aerosol particle size could be another key variable here. Did the author do any simulation on the effect of sizes? This could complicate the comparisons tremendously, but it is worth to show only the most apparent changes when size is taken into account.

9. “Scattering matrix” and “phase matrix” are both used in the manuscript, but indeed they represent different physical quantities.

10. Line 24, Page 2: It should be “spheroids, ellipsoids, and superellipsoids” instead of “a spheroid, an ellipsoid, and a superellipsoid”

11. Lien 24, Page 3: “referred to as well-accepted database values” is inconsistent with the label in the figure.

12. Line 5, Page 4: If I understand it correctly, the aspect ratio refers to the proportional relationship between particle height and its width. So a larger aspect ratio means the particle is larger in height but relatively smaller in width. Then, how to comprehend the irregular ratio of 0.3, for example? How is irregular ratio defined?

Interactive comment on Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2019-812, 2019.