Investigating the treatment of particle size distribution of densely packed particulate media in light scattering models

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Light scattering models play an important role in characterizations of various particulate media from remote sensing measurements. One challenging application of these models is the retrieval of properties of densely packed media. In this framework, we investigate the differences that arise due to different treatments of particle size distribution and dense packing to better understand the proper application of light scattering models to some particulate media. We evaluate emissivity spectra of a powdered mineral, a typical task in remote sensing data analysis, from two techniques: polydisperse Mie [1] versus polydisperse superposition *T*-matrix [2] approaches. The first approach treats particle size dispersion statistically where scattering parameters are computed using a known size distribution function (e.g., log-normal, gamma). This method is simple and fast, however, dense packing of particles is not explicitly incorporated. The second approach considers a physical assemblage of particles with individually specific sizes and captures the multiple scattering of light important in densely packed media. This method has a large computational burden and limitation on the number of particles that can be used, however. Both models use equivalent optical constants and particle size distribution of a specific powdered enstatite sample measured in a laboratory as inputs to compute the single scattering albedo and scattering matrix. Emissivity is then computed from those using a radiative transfer model (invariant-imbedding solution [3]). The resulting emissivity spectra is compared to spectra of the same enstatite powder measured in a laboratory. This ensures that the resulting differences are arising from the differences from the two modeling approaches, and thus, the importance of the treatments of particle size distribution and packing density in modeling spectra of densely packed media, such as mineral powders, can be fairly assessed.

References

[1] Mishchenko, M. I., L. D. Travis, and A. A. Lacis, 2002: *Scattering, Absorption, and Emission of Light by Small Particles*. Cambridge, UK: Cambridge University Press.

[2] Mackowski, D. W., and M. I. Mishchenko, 2011: A multiple sphere *T*-matrix Fortran code for use on parallel computer clusters. *J. Quant. Spectrosc. Radiat Transfer* **112**, 2182–2192.

[3] Mishchenko, M. I., J. M. Dlugach, D. G. Yanovitskij, and N. T. Zakharova, 1999: Bidirectional reflectance of flat, optically thick particulate layers: an efficient radiative transfer solution and applications to snow and soil surfaces. *J. Quant. Spectrosc. Radiat Transfer* **63**, 409–432.

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