A model for analysis of fractal aggregate aerosols

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Our knowledge in aerosols in planetary atmospheres comes mostly from remote sensing and radiative transfer modeling. Accurately constraining physical properties of aerosols requires accurate radiative transfer modeling which requires accurately obtaining scattering properties of aerosols. There are many different methods to calculate the scattering properties. However, for non-spherical aerosols, such as the Titan's haze, this is a challenging problem [1]. Some methods provide high accuracy, at the expense of high computational cost; others usually lack high precision while providing fast calculations. Previously a fast, physically based semi-empirical model for fractal shape aerosols was used to calculate Titan's aerosols particle [2]. Although this model is promising in terms of both accuracy and computational cost, it has not been tested for particles with monomer numbers (N) larger than a few hundred. Still, it has been used to estimate scattering properties of particles with several thousand monomers [2,3].

In this project, we tested this model for fractal aerosols with N up to 1024 for a number of choices of refractive indices, size parameters (α), and aggregate shapes. For the validation, we created a database of scattering properties with 25 realizations for each choice using multi sphere T-matrix model (MSTM) [4]. With the available testing so far, we concluded that the parameterization requires some modifications. For example, in most cases as one of the variable increases errors also increase especially when matching with larger α. Phase functions usually fit well with small error except for small phase angles coinciding with the occurrence of coherent backscattering effect which is not modeled in the initial version of this model. Absorption modeled well, but parameterization quickly fails to calculate valid scattering efficiencies for larger parameters.

In this talk, we will discuss this model and its validation with our T-matrix database. We will also discuss our future plans in the extension of the validation, modification in the parameterization and the possible applications of this model and our extensive T-matrix database for planetary aerosols studies.

References

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[4] D.W. Mackowski and M. I. Mishchenko, 1996: Calculation of the T matrix and the scattering matrix for ensembles of spheres. *J. Opt. Soc. Am. A* **13**, 2266 – 2278.

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