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Light scattering by non-spherical and inhomogeneous particles: recent advancements and applications

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Non-spherical and inhomogeneous particles are ubiquitous in the atmosphere. One example is dust particles coated with water-soluble aerosols such as sulfate or nitrate. For these particles, the dust non-sphericity and the core-shell structure both fundamentally impact the optical properties. Even for clean dust particles, they are not only non-spherical but also inhomogeneous with a mixture of different mineral compositions. However, due to technical difficulties, it is challenging to obtain an accurate and comprehensive parameterization of the optical properties of non-spherical and inhomogeneous particles. In this talk, we will report our progress on computing the optical properties of non-spherical and inhomogeneous aerosols as well as their implications in remote sensing and atmospheric models. Specifically, we will highlight a GPU version of the invariant imbedding T-matrix program (GPU-IITM). In this new program, arbitrarily shaped and inhomogeneous particles can be friendly implemented. The GPU-IITM is 8–25 times more efficient than the conventional program, depending on the particle sizes. In addition, a machine-learning approach was developed to parameterize the optical properties of non-spherical and inhomogeneous particles. Aided with the aforementioned progress, we successfully developed a new aerosol optics scheme. Representative results of the optical properties of non-spherical and inhomogeneous aerosols will be given with applications in atmospheric radiative transfer, remote sensing and the weather research and forecasting model.

Keywords: aerosol, scattering, T-matrix

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