EGU21-6603
https://doi.org/10.5194/egusphere-egu21-6603
EGU General Assembly 2021

A comprehensive database of the optical properties of mineral dust aerosol particles for spaceborne remote sensing applications

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Airborne atmospheric aerosol impacts the Earth's energy budget through their radiative effects and interactions with clouds. Among various aerosol species, mineral dust particles are the most dominant aerosols over desert areas.Continuous monitoring of the global distributions of the mineral dust aerosol is essential to the assessment of their local and climatic impacts. Satellite observations in conjunction with remote sensing techniques have been playing an essential role in the understanding of the global distribution of dust aerosol properties. However, the satellite-based retrievals of mineral dust aerosol properties may involve systematic biases and large uncertainty partly because their optical properties that are fundamentally determined by particle sizes, chemical compositions, and complex morphologies of aerosol particles are not adequately modeled. This presentation will introduce a recently developed comprehensive database for the single-scattering properties of irregular aerosol particles (so-called TAMUdust2020 database) for various remote sensing applications including both passive and active-sensor observations. The TAMUdust2020 database was developed based on an ensemble of various irregular particle shape models that mimic realistic mineral dust particle shapes and their diversity, and was developed with the state-of-the-art light scattering computational capabilities including the physical-geometric optics method (PGOM) and the invariant-imbedding T-matrix (II-TM) method. Comparisons of the scattering properties between laboratory measurements and the present simulations based on TAMUdust2020 database show reasonable consistency. Furthermore, we apply the dust aerosol scattering properties to simulate various spaceborne satellite observations, including multiangle polarimetric observations, thermal infrared observations, and lidar observations. In this presentation, we will demonstrate the capability of current satellite observations with the scattering property database to infer aerosol optical depth and particle effective radius.