The capability of multi-angle and Multi-channel remote sensing observations to distinguish mineral dust CSS (composition-shape-size) types

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We present a systematic study of atmospheric wind-blown mineral dust radiative properties, aimed at exploiting the enhanced sensitivity multi-angle remote sensing measurements provide to particle shape, size and composition as compared to single-angle observations. Using data reported in the literature as a guide, we selected and characterized representative dust particle shapes and compositions, and performed extensive modeling of dust optical properties with Discrete Dipole Approximation (DDA) and T-matrix algorithms. Extinction coefficients, single scattering albedos, and scattering phase functions were computed at 550, 672, and 866 nm wavelength to investigate the effects of particle size distribution, composition, and degree of irregularity, on dust spectral optical characteristics important for remote sensing applications.

We use the range of optical models produced to test the Multi-angle Imaging SpectroRadiometer (MISR) instrument's ability to distinguish dust types. We simulate MISR reflectances with a multiple-scattering radiative transfer code for scenarios consisting of different dust types and amounts, to assess the instrument's theoretical sensitivity to dust properties. We also compare the simulated MISR reflectances with those measured by MISR for Sahara and Asian dust cases, to identify the main distinguishing features of each in actual MISR data.