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Jovian tropospheric aerosols inferred from the Cassini ISS limb-darkening data

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To obtain new observational constraints on the single scattering phase functions of aerosols in the Jovian upper troposphere, we have analyzed Cassini Imaging Science Subsystem (ISS) imaging data obtained at a wide range of solar phase angles (0-140 degrees) in two spectral channels (BL1: 455 nm, CB2: 750 nm) for a bright zone (STrZ) and a dark belt (SEBn). In this study, we applied the Mie theory for spherical particles to the tropospheric aerosols for simplicity. We found that the real refractive index (n_r) of aerosols is much higher (n_r = 1.85) than previous experimental values of nr for NH_3 ice particles. This would strongly suggest the idea that aerosols in the upper troposphere are not composed of pure NH_3 ice.

Jovian tropospheric aerosols have been expected to consist of nonspherical particles from the atmospheric temperature in the upper troposphere. Application of Mie scattering theory to the tropospheric aerosols in Jupiter is a controversial issue when deducing the scattering properties from remote sensing data. We investigate how much robustness there is in the results obtained from our latest study, by comparing the best-fit Mie scattering phase functions derived from the Cassini ISS limb-darkening data with those for various nonspherical particles. Assuming that shape of nonspherical particles in the upper troposphere is spheroidal, we calculate the scattering phase functions for a wide variety of real refractive index, effective radius, and ratio of long axis to short axis. T-matrix method is used for this calculation. The scattering phase functions for spheroidal particles which have a near value (n_r = 1.45) of real refractive index for NH_3-ice (n_r = 1.42) are found to have weaker backward scattering compared with our best-fit Mie scattering phase functions. It is obvious that these scattering phase functions cannot reproduce the observed limb-darkening data. Conversely, several scattering phase functions for spheroidal particles (n_r = 1.85) have similarity to our best-fit Mie scattering phase functions with respect to the strength and shape of scattering phase function. Based on this preliminary investigation, we can say that Jovian tropospheric aerosols are not composed of pure NH_3-ice particles even though we focus on the nonsphericity of these aerosols.

In this presentation, we will show the simulated limb-darkening curves calculated with the scattering phase functions for nonspherical particles, along with the observed limb-darkening curves.

Keywords: Jupiter, cloud structure, radiative transfer, Cassini