Titan Haze

Robert West, Panayotis Lavvas, Carrie Anderson

Abstract

The Titan haze exerts a dominating influence on surface visibility and atmospheric radiative heating at optical and near-infrared wavelengths and our desire to understand surface composition and atmospheric dynamics provides a strong motivation to study the properties of the haze. Prior to the Cassini/Huygens missions the haze was known to be global in extent, with a hemispheric contrast asymmetry, with a complicated structure in the polar vortex region poleward of about 55° latitude, and with a distinct layer near 370 km altitude outside of the polar vortex at the time of the Voyager 2 flyby. The haze particles measured by the Pioneer and Voyager spacecraft were both highly polarizing and strongly forward scattering, a combination that seems to require an aggregation of small (several tens of nm radius) primary particles. These same properties were seen in the Cassini orbiter and Huygens Probe data. The most extensive set of optical measurements were made inside the atmosphere by the DISR instrument on the Huygens Probe. At the probe location as determined by the DISR measurements the average haze particle contained about 3000 primary particles whose radius is about 40 nm. Three distinct vertical regions were seen in the DISR data with differing particle properties. Refractive indices of the particles in the main haze layer resemble those reported by Khare et al. (*Icarus* **60**, 127–137, 1984) between 0.35 and about 0.7 μm but are more absorbing than the Khare et al. results between 0.7 μm and the long-wavelength limit of the DISR spectra at 1.6 μm. These and other results are described by Tomasko et al., Planetary and Space Science 56 (2008) 669–707 and a broader summary of results was given by Tomasko and West, Chapter 12 in Titan from Cassini Huygens, Brown, Lebreton and Waite, Eds., Springer, 2009. New data continue to stream in from the Cassini spacecraft. New data analyses and new laboratory and model results continue to move the field forward. Titan's 'detached' haze layer suffered a dramatic drop in altitude near equinox in 2009 (West et al. *Geophys. Res. Lett.*, **38**, L06204, doi:10.1029/2011GL046843, 2011) with implications for the circulation and seasonal change in the stratosphere. The book chapter associated with this talk will also present new material on thermal-infrared data analysis and on new developments in laboratory work and haze microphysical modeling.