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Titan's Atmospheric Aerosols

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Aerosols pervade Titan's atmosphere. At the Huygens probe entry site, the Descent Imager/Spectral Radiometer instrument determined the properties of these aerosols using several types of optical observations, which measured scattered sunlight and attenuation of the direct solar beam. All observations are fit simultaneously by the same radiative transfer model, which specifies the phase function, optical depth, and single scattering of the aerosols as functions of wavelength (0.4 – 1.6 μm) and altitude (0 – 140 km).

The aerosols are very forward scattering and highly polarizing, consistent with aerosols structured as binary-cluster-cluster aggregates of 0.05 μm monomers. Images near the sun show the number of monomers/aerosol particle is in excess of 1000. The wavelength dependence of measured optical depths is also consistent with such aerosols, which have characteristic dimensions larger than one μm.

Spectral measurements of scattered sunlight show the nature of aerosols varies with altitude. Above 80 km they are consistent with aerosols comprised of tholin materials measured in laboratories. Below 80 km the aerosols are less absorbing, probably due to the adsorption of a condensate. Near the surface the aerosols grow darker again, suggesting the condensate may evaporate. The number of monomers/particle remains roughly constant over the altitude range of measurements.

The aerosols are present at all altitudes sampled. The number densities are approximately 5 particles/cm^3 from 30 – 80 km, slightly less below 30 km, and fall off with a scale height of 65 km above 80 km.