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The Distribution and Nature of Titan's Aerosols: A New Look

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Titan passed through southern summer solstice in late 2002, allowing an unprecedented view of summer seasonal effects. A set of images was acquired with the Hubble Space Telescope spanning the 0.25-2 μmspectral range. Among the effects seen were a rapidly changing hemispheric asymmetry and a polar hood that is visible at short wavelengths. The north-south asymmetry has reversed, returning Titans dominant visual feature to something like its Voyager-era state. The polar hood is spectrally different from the north-south asymmetry and is due to a mode of small particles. The amount of absorbing material in the polar hood cannot be uniquely constrained, but a lower limit can be derived by assuming that the absorber is the same as that found in the main haze (i.e., it is analogous to Titan tholin) and that the absorber is entirely above the main haze. The hood spectrum is consistent with about 4×10^{-6}g/cm^2 of tholin-like material above the main haze south of 65 S. A larger amount of material mixed lower in the atmosphere cannot be ruled out. An upper limit to the particle radius of about 0.02 μmcan be determined by the lack of a bright polar hood in near-infrared methane band images. Considering time scales for removing material from the stratosphere leads to an estimate of summer polar mass production that is within a factor of five of published estimates of annual, global aerosol mass production. More detailed modeling of the observations is proceeding. The model includes the prediction of disk-resolved polarization based on particle characteristics. Comparisons to HST polarimetric images will provide new constraints on the properties of the northern, southern, and polar aerosols. Preliminary analysis of the polarimetry images shows the polarization is radial at all wavelengths (0.25-2 μm) and the magnitude of polarization peaks near 0.75 μm. The polarization is consistent with small particles, but is less than predicted by models of Pioneer 11 and Voyager 2 polarimetry.