

Assessing the Time Variability of Jupiter's Tropospheric Properties from 1996 to 2011

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We acquired and analyzed mid-infrared images of Jupiter's disk at selected wavelengths from NASA's Infrared Telescope Facility (IRTF) from 1996 to 2011, including a period of large-scale changes of cloud color and albedo. We derived the 100-300 mbar temperature structure, together with tracers of vertical motion: the thickness of a 600-mbar cloud layer, the 300-mbar abundance of the condensable gas NH_3 , and the 400-mbar *para*- vs. *ortho*- H_2 ratio. The biggest visual change was detected in the normally dark South Equatorial Belt (SEB) that 'faded' to a light color in 2010, during which both cloud thickness and NH_3 abundance rose; both returned to their pre-fade levels in 2011, as the SEB regained its normal dark color. The cloud thickness in Jupiter's North Temperate Belt (NTB) increased in 2002, coincident with its visible brightening, and its NH_3 abundance spiked in 2002-2003. Jupiter's Equatorial Zone (EZ), a region marked by more subtle but widespread color and albedo change, showed high cloud thickness variability between 2007 and 2009. In Jupiter's North Equatorial Belt (NEB), the cloud thickened in 2005, then slowly decreased to a minimum value in 2010-2011. No temperature variations were associated with any of these changes, but we discovered temperature oscillations of ~2-4 K in all regions, with 4- or 8-year periods and phasing that was dissimilar in the different regions. There was also no detectable change in the *para*- vs. *ortho*- H_2 ratio over time, leading to the possibility that it is driven from much deeper atmospheric levels and may be time-invariant. Our future work will continue to survey the variability of these properties through the Juno mission, which arrives at Jupiter in 2016, and to connect these observations with those made using raster-scanned images from 1980 to 1993 (Orton et al. 1996 *Science* 265, 625).