A Cold Hole at the Pole of Jupiter

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The temperature field of Jupiter's arctic region reveals a prominent cold airmass in both the stratosphere (~30 mbar) and the troposphere (100–400 mbar), as seen in thermal images taken at the NASA Infrared Telescope Facility between July and October, 1999. This discrete airmass is some 3–5 Kelvins colder than the lower-latitude regions in both the troposphere and stratosphere. At both vertical levels, the latitude boundaries of this cold polar airmass oscillate in longitude with principal wavenumber 5–6, with stratospheric oscillations often ostensibly larger than those in the troposhere. This longitudinal oscillation is similar to the oscillation of the boundary of the thick (inner) "polar hood" that is detectable in reflected sunlight that is sensitive to particles around Jupiter's tropopause (~100 mbar pressure), using IRTF 2.3-μm and HST WFPC2 890-nm images. The sinusoidal boundaries slowly rotate prograde with a speed of 5°/day with respect to System III. The proximity and similarity of the thermal and particle boundaries suggests that the phenomenon is a classical polar vortex of the same type as seen in the polar regions of the Earth, Venus, Mars and possibly Titan. Analysis of ground-based thermal images from a telescope larger then the 3-m IRTF would improve the positional uncertainties arising from the diffraction-limited angular resolution. Further, the testing of possible gaseous entrainment within the "polar vortex" area would verify or refute similarities with other polar vortices. Such studies would be relevant to studies of terrestrial meteorology by showing the extent to which stratospheric phenomena can drive tropospheric properties. Detailed studies of Jupiter's polar regions might be most easily accomplished from appropriate remote sensing instrumentation on a polar orbiter mission as a result of optimized spatial resolution.

The work reported here was supported by funds from NASA to the Jet Propulsion Laboratory, California Institute of Technology. Ori Fox was supported by the Undergraduate Student Researcher Program (USRP).