Galileo PPR Observations of Jupiter's Atmosphere

G. S. Orton, T. Z. Martin, L. Tamppari, L. Barnard (Jet Propulsion Laboratory, California Institute of Technology), L. D. Travis (NASA Goddard Space Flight Center, Institute for Space Studies), C. J. Braak, J. F. de Haan, and J. W. Hovenier (Free University Amsterdam)

Observations of Jupiter's atmosphere by the PPR have included a combination of photopolarimetry and radiometry. Problems with the filter wheel motion during the first orbit forced the team to adopt a limited use for the wheel, with only 1 - 2 filters being used per orbit. Photopolarimetric observations of Jupiter show a high degree of polarization toward the south pole and constrain the microphysical scattering properties of high-altitude particulates. With the limited filter use, thermal radiometric observations of Jupiter provided a means to determine the temperature at a single level near 200 - 300 mbars total pressure - but at high spatial resolution (except during the first orbit when all filters were working). Because of Galileo's low telemetry rates, only limited spatial coverage was available. This was supplemented by an aggressive program of earth-based observational support from the NASA Infrared Telescope Facility that extended vertical as well as spatial coverage of the atmosphere. Our observations showed that the Great Red Spot (GRS) and smaller anticyclones are cold and cloudy, consistent with an interpretation that they consist of material that is being forced upward. The GRS, in fact, is the coldest low-latitude region on the planet. The temperature gradient on its periphery peaks at a location that is coincident with the boundary of a high-altitude cloud, except on the southern edge. There appears to be a ubiquitous warm region immediately south of the GRS that represents weak cyclonic circulation. Alternatively, there are warm and clear regions that probably indicate forced downwelling. These include cyclonic features between neighboring anticyclonic white ovals; another is a visibly dark region that is not associated with any other area. Strangely enough, while they are considered regions of dry downwelling, detailed examination of 5-micron hot spots demonstrates that they are thermally neutral with respect to their surroundings, although parts of the nearby North Equatorial Belt have warm and cold regions that appear to be somewhat correlated with visible color or albedo. On a global scale, zonal thermal waves do not appear to have substantial structure on scales below 3000-5000 km. Meridional variations appear to correlate best with the zonal wind profile, i.e. they are invariant with time despite large-scale changes of cloud color or albedo that are documented in some of Jupiter's belts and zones.