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Seasonal and Temporal Variability of Jupiter and Saturn

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We report on the seasonal and temporal changes observed on Jupiter and Saturn, based on near- and mid-infrared data acquired from several observatories (NASA/InfraRed Telescope Facility, NAOJ/Subaru, ESO/Very Large Telescope) and provide compelling rationale for a coordinated network of large telescopes for continued ground-based observations. Jupiter has been experiencing an era of atmospheric global upheaval since 2005, the observed atmospheric changes being manifestations of changes in local meteorology and latent physical parameters of the system, and occur on various timescales and latitudes. The discrete storms in Jupiter's atmosphere have undergone significant changes over the past decade. The merger of the three white ovals into Oval BA and its subsequent color change in 2006 appear to be correlated to periodic interactions with the Great Red Spot (GRS). Subsequent episodes of GRS-Oval BA interactions in 2006, 2008 and 2010 provide snapshots of changes in the local meteorology. We identify relationships between latent physical variables of the spatially and temporally changing systems in terms of cloud opacities, aerosol distribution and thermal fields. The recent dramatic ongoing revival of the South Equatorial Belt (SEB) allows an unique insight into the dynamical processes that maintain belt/zone morphology. Ground-based near- and mid-infrared observations of Saturn from 1995 - 2009, covering half a Saturnian year, provide a rich data set to model seasonal changes in Saturn's atmosphere from autumnal equinox (1995) to vernal equinox (2009). Since 1995, as Saturn's south pole received increasing solar insolation, its albedo exhibits an increase in reflectivity at mid-latitudes in the southern hemisphere, decreasing towards the equator, anti-correlated with the thermal field. Similar to equatorial oscillations of temperatures on Earth and Jupiter, Saturn displays stratospheric temperature oscillations, with a period of half a Saturnian year, suggesting the influence of seasonal forcing. We anticipate development of similar phenomena in the next few years, as Saturn approaches northern solstice. Given the wealth of information from various spacecraft missions (Voyager, Galileo, Cassini) to both giant planets, many important questions remained unanswered, requiring continued exploration of these giant planets.

Keywords: Jupiter, Saturn, Atmospheres, Variability