Seasonal and Temporal Changes on Jupiter and Saturn: A Review of Ground-based Observations

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We report on the seasonal and temporal changes observed on Jupiter and Saturn, based on 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, that occur on various timescales. The North Temperate Belt disturbance (NTBs), at latitude of 22 degrees north, identified late March 2007, as a bright feature high in the atmosphere, quickly encircled the planet in about two months. The feature dissipated within days thereafter. An enhancement of ammonia ice was detected, similar to the spectra of ammonia clouds identified observed by *Galileo,* with the strength of the ammonia ice features varying from the localized "head" of the feature along the length of the plume (i.e., longitude). 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 and 2008 and the upcoming interaction in 2010 provide snapshots of the local meteorology. Is each of these interactions unique or generic? 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 2009 asteroidal impact with Jupiter, exactly 15 years after D/Shoemaker-Levy 9 collision, and the evolving atmospheric response indicates that the origin and statistics of such collisions need to be reassessed as being more frequent that realized.

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.