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Title:
The Evolution and Fate of Saturn's Stratospheric Vortex: Infrared Spectroscopy from Cassini

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Abstract:

The planet-encircling springtime storm in Saturn's troposphere (December 2010-July 2011) produced dramatic perturbations to stratospheric temperatures, winds and composition at mbar pressures that persisted long after the tropospheric disturbance had abated. Observations from the Cassini Composite Infrared Spectrometer (CIRS), supported by ground-based imaging from the VISIR instrument on the Very Large Telescope, is used to track the evolution of a large, hot stratospheric anticyclone between January 2011 and the present day. The evolutionary sequence can be divided into three phases: (I) the formation and intensification of two distinct warm airmasses near 0.5 mbar between 25 and 35N (one residing directly above the convective storm head) between January-April 2011, moving westward with different zonal velocities; (II) the merging of the warm airmasses to form the large single `stratospheric beacon' near 40N between April and June 2011, dissociated from the storm head and at a higher pressure (2 mbar) than the original beacons; and (III) the mature phase characterised by slow cooling and longitudinal shrinkage of the anticyclone since July 2011, moving west with a near-constant velocity of 2.70±0.04 deg/day (-24.5±0.4 m/s at 40N). Peak temperatures of 220 K at 2 mbar were measured on May 5th 2011 immediately after the merger, some 80 K warmer than the quiescent surroundings. Thermal windshear calculations in August 2011 suggest clockwise peripheral velocities of 200-400 m/s at 2 mbar, defining a peripheral collar with a width of 65 degrees longitude (50,000 km in diameter) and 25 degrees latitude. Stratospheric acetylene (C2H2) was uniformly enhanced by a factor of three within the vortex, whereas ethane (C2H6) remained unaffected. We will discuss the thermal and chemical characteristics of Saturn's beacon in its mature phase, and implications for stratospheric vortices on other giant planets.