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Saturn's north polar region at depth: The North Polar Hexagon and North Polar Cyclone observed over two years by Cassini/VIMS

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For over two years beginning in October, 2006, Saturn's north polar region has been observed periodically from clear vantage points over high northern latitudes by the Visual Infrared Mapping Spectrometer onboard the Cassini/Huygens orbiter, The latest observations, acquired on June 15 and December 16, 2008, are especially clear, as they were obtained from sub-spacecraft latitudes poleward of 70 degrees N and at close range (< 450,000 altitude for June; < 510,000 for December). With much of the polar region under nighttime conditions, we used Saturn's thermal glow as a source of light to map clouds in silhouette, monitoring their movement with time to determine the polar wind structure. We find a cyclone at the north pole, with winds exceeding 135 m/s near 88.3 degrees N. latitude (planetocentric, pc). The center of the cyclone, at the exact pole, is covered by a small (< 500 km in diameter) cloud. Equatorward, winds fall off to ~10 m/s near the poleward edge of the hexagon near 78 degrees pc. Within the hexagon itself, clouds move at ~125 m/s. The hexagon itself stays nearly fixed in the rotational system of Saturn established by Voyager. However, while the hexagonal feature stayed fixed to high accuracy from late 2006 through early 2008 (<0.5 deg of movement over 16 months), we find that since February, 2008, the hexagon has rotated 8.9 degrees in longitude in the retrograde direction. Between the detailed June and December 2008 observations, the feature rotated 1.2 degrees, retrograde, corresponding to 0.0065 degree/day or 2 cm/s, retrograde. Beginning in June, 2008, sunlight is seen reaching cloud features within the hexagon as polar winter wanes. New results of cloudtop altitude are presented based on the reflected sunlight observed in various methane and hydrogen atmospheric absorption bands. These are compared to the cloud bottom pressures which we have determined to be near the 2-bar level based on analysis of 5-micron thermal spectra. Clouds observed in sunlight and at 5-micron are coherent, indicating little vertical shear in zonal winds in the north polar region.