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Polar views of Saturn's deep atmosphere from Cassini/VIMS: New insights into waves, storms, and global circulation

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We present recently-acquired imagery of cloud and wave systems spanning the depths of Saturn down to the 3-bar level in the polar regions of Saturn, obtained by the Visual Infrared Mapping Spectrometer (VIMS) onboard the Cassini/Huygens orbiter. Images taken in both reflected sunlight and in Saturn's thermal glow at 5 microns wavelengths, will be presented. The 5-micron images reveal thick clouds at depth, seen silhouetted against the upwelling radiation. In the south polar region, a significant fraction of these deep discrete clouds appear surprisingly dark in reflected sunlight, indicating a nearly wavelength-independent dark absorber spanning the 0.5-3 micron region exists in or above these clouds. These compositionally-different cloud regions then may indicate that unusually strong vertical upwelling occurs at discrete locations near the south pole. In the north polar region, Saturn's Polar Hexagon, discovered in Voyager imagery by Godfrey (Icarus 76, 335-356, 1988), is a prominent feature at 5 microns, indicating that the feature is comprised of relatively large particles ($>$ 1 micron) and extends at least several bars of pressure down into the atmosphere. The re-acquisition of this feature near 77.5 degrees planetocentric latitude indicates that the hexagon is a multi-decade, long-lived feature which survives the Saturn seasons. A second hexagon, significantly darker at 5 micron than the brighter historical feature, is located near 74.2 degrees planetocentric latitude. The clouds in the 5-micron-bright

hexagon are relatively deep: 3.5 bars compared to the 2.5-3.0-bar level of clouds in the dark hexagon. Observed three times over a 12-day period between October 29 and November 10, 2006, both hexagonal features stay fixed in a rotational system defined by the Voyager-era radio rotation rate (Desch and Kaiser, Geophys. Res. Lett, 8, 253-256, 1981) to within an accuracy of 11 seconds per rotational period. This agrees with the stationary nature of the wave in this rotation system found by Godfrey (1988), but is inconsistent with more recent Saturn rotation rates found during the current Cassini era. Together with our new constraints on the depth of the feature, this result indicates that the feature is not linked to Saturn's radio emissions nor to auroral activity as speculated by Godfrey. (1988). New dynamical modeling indicates that the feature can be adequately explained as a stationary planetary Rossby wave, as proposed by Allison (Science 247, 1061-1063,1990). Images and movies of these and other discrete features – including the north polar aurarae - will be shown and discussed.