Seeing Double at Neptune's South Pole

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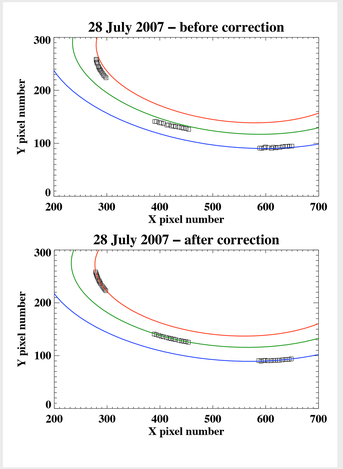
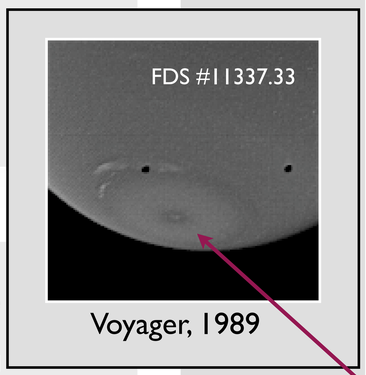
Image Navigation- Cloud Locations

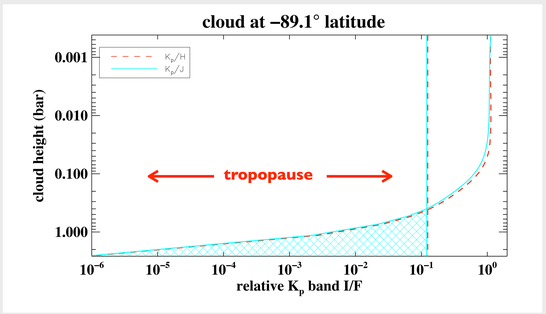
Neptune's activity limits the accuracy of centering when using the limb as a reference. To perform centering more precisely, we found the positions of three of Neptune's moons in each of our 15 H-band images (black squares) and shifted the images so that the positions of the moons were best-fit to lie on their orbits as derived from the Planetary Ring Node ephemeris data (red, green and blue curves). This allowed us to improve the alignment of the images as well as determination of disk center. We find the clouds are *near*, rather than *at*, the pole.



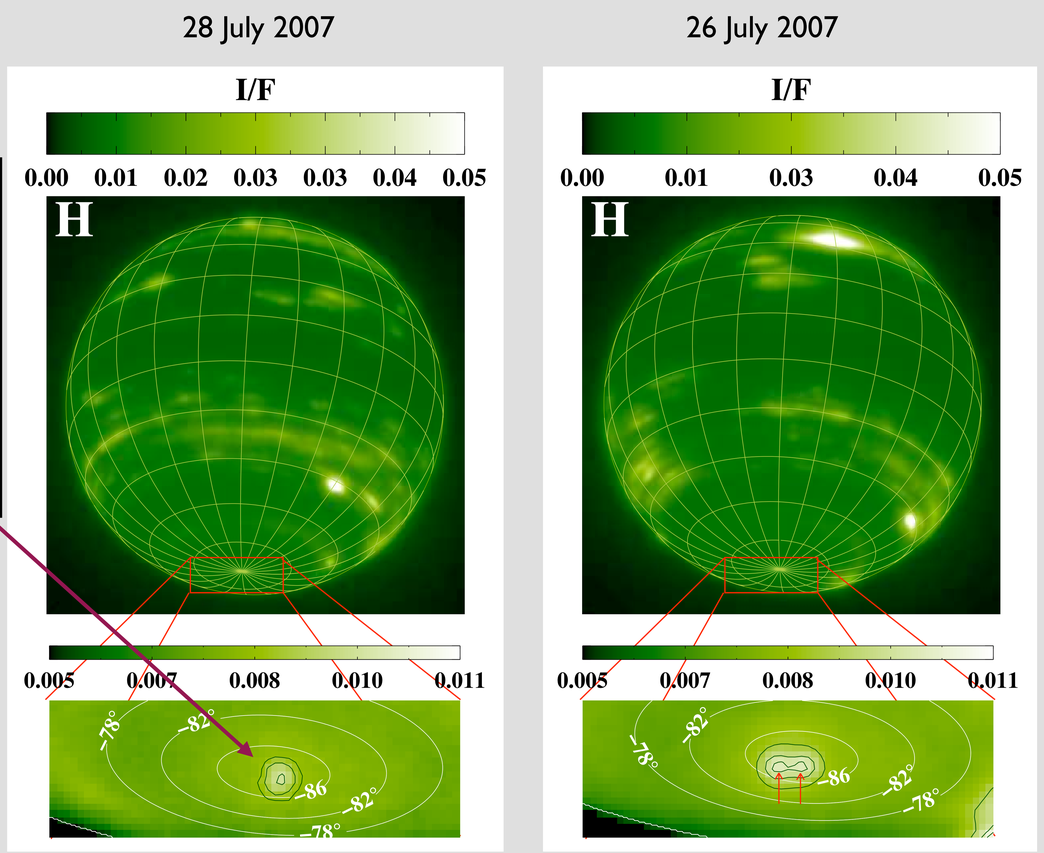


Cloud Altitudes

J, H and Kp filters probe various depths in the stratosphere; therefore we can use the observed cloud intensities in each filter to set limits on the cloud heights. The vertical lines in the plot below are the maximum Kp/H (red) and Kp/J (cyan) ratios allowed by the data; the curves are the expected ratios as a function of cloud height as determined from radiative transfer modeling. We find that the clouds are below the tropopause, consistent with cloud formation by methane condensation.



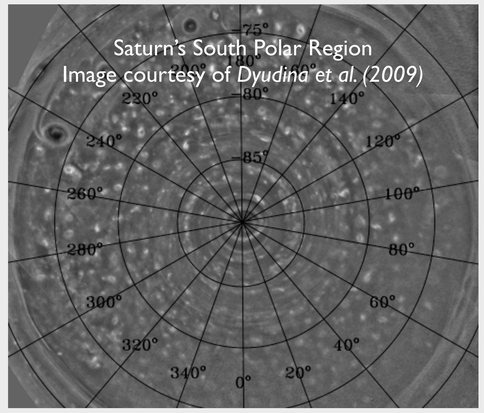
Keck near-infrared images of Neptune from UT 26 July 2007 show that **the cloud feature typically observed within a few degrees of Neptune's south pole had split into a pair of bright spots**. A careful determination of disk center places the cloud centers at -89.07 +/- 0 .06 and -87.84 +/- 0.06 degrees planetocentric latitude. If modeled as optically thick, perfectly reflecting layers, we find the pair of features to be constrained to the troposphere, at pressures greater than 0.4 bar. By UT 28 July 2007, images with comparable resolution reveal only a single feature near the south pole. **The changing morphology of these circumpolar clouds suggests they may form in a region of strong convection surrounding a Neptunian south polar vortex.**



These near-infrared (H band) images from the Keck telescope are sensitive to sunlight reflected off of clouds. Color bars are given in units of I/F, which is the intensity of the planet relative to the intensity we would observe from a perfectly reflecting disk. In the lower panels, we have zoomed in on the south pole, where the changing morphology of the circumpolar clouds is evident. Cloud activity within a few degrees of the pole has been observed since Voyager (e.g. Sromovsky et al. 2001).

South Polar Vortex?

The persistence of south polar cloud activity since the Voyager era suggests there is an organized circulation pattern at Neptune's south pole. Such a pattern has been inferred before, based on observations of a mid-infrared temperature enhancement at the pole (Hammel et al. 2007). On Saturn, a south polar circulation cell has been observed, in the form of subsidence in a polar vortex surrounded by a region of upwelling. Saturn's circumpolar region contains many discrete, bright clouds. Our finding that Neptune's south polar cloud feature(s) may be indicative of rigorous convection near, but not at, the pole, supports the analogy between Neptune's and Saturn's polar environments. The unexpected discovery of a vortex at Saturn's north (winter) pole as well (Fletcher et al. 2008) implies that polar vortices can exist despite considerable variations in seasonal insolation, and may general features of giant planet atmospheres.



Acknowledgments

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For more information, please see *Luszcz-Cook et al. (2010).*