



Titan's methane meteorology

H.G. Roe (1), A.H. Bouchez (2), E.L. Schaller (1), C.A. Trujillo (3), M.E. Brown (1)
(1) Caltech, (2) W.M. Keck Observatory, (3) Gemini Observatory (hroe@gps.caltech.edu)

We report results from our ongoing observations of Titan's tropospheric clouds using resolved imaging and spectroscopy from large telescopes (Keck 10-m; Gemini North 8-m) and continuous photometry from a 14" telescope based in Cloudcroft, NM, USA. The former show cloud locations and altitudes, while the latter gives a nightly record of whole disk cloud coverage. In the 2003-2004 apparition we acquired Keck/Gemini data on 36 nights and 14" telescope photometry every night during November 2003-April 2004, weather permitting. In the 2004-2005 apparition we have observed Titan with Keck/Gemini on more than 30 nights, while 14" photometry has been recorded every night since October 2004, weather permitting.

In these data we see three classes of cloud activity:

Near the south pole we regularly see small regions of cloud covering $< 1\%$ of Titan's disk. These are the same type of clouds as we originally discovered in 2001 and are thought to most likely be caused by solar heating of the surface in southern summer leading to moist convection. The enlarged dataset now reveals frequency, size, location, and lifetime distributions of these clouds.

Several times we have now observed very large methane storms near the south pole that can account for up to 15% of Titan's $2 \mu\text{m}$ flux for several days. The overall lifetime of these large events is usually several weeks. The cause of these very large storms remains unknown, as does their relationship to the smaller scale polar clouds that are present much of the time.

In late 2003 we discovered clouds at temperate southern latitudes ($\sim 40^\circ\text{S}$) that were not observed prior to late 2003. We suggest several plausible formation scenarios for these clouds, including the possibility that they are related to geologic or cryovolcanic activity.

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