Titan’s Methane Weather

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Titan’s Methane Weather

Thanks to:
Gemini Observatory staff
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NSF
Mean daily insolation on Titan

30-year Seasonal Cycle
Atmospheric structure:
- **~80% N₂**
- **~90% N₂**
Methane

~90% N₂

Titan

~80% N₂

Earth

Water
Earth

Solid Atmosphere

Titan
Titan’s Surface Mapped by Cassini
Some Questions

- Methane weather? Where? When? How?
- Source of methane?
- Seasonal climate change; Massive monsoon?
Methane transmission

Karkschka (1998)

KPNO/NSO McMath FTS (1980)
Results
Last night
(9-June 2009 UT)

Surface  Troposphere  Stratosphere
5+ years of Gemini observations
South polar clouds
A. Typical Titan south polar cloud activity

11-Oct 03  18-Nov 03  29-Nov 03  10-Dec 03  24-Dec 03  26-Dec 03  11-Jan 04

B. October 2004 large cloud event

28-Sep 04  02-Oct 04  03-Oct 04  07-Oct 04  08-Oct 04  23-Oct 04  28-Oct 04

C. Pole projected view of large cloud event

28-Sep 04  02-Oct 04  03-Oct 04  07-Oct 04  08-Oct 04  23-Oct 04  28-Oct 04

Cassini Ta flyby 26-Oct

Schaller et al. 2006a Icarus
Dissipation of south polar clouds

Schaller et al. 2006b Icarus
Titan

North Pole

South Pole

Southern Summer

North Pole

South Pole

Southern Fall

?
Discovery of mid-latitude clouds at 40°S

Roe et al. 2005 ApJL
Geographic Control of mid-Latitude Clouds

Roe et al. 2005 Science
Lake-effect clouds in the north polar region

M. Brown et al. 2009 GRL
Tropical storms & atmospheric waves

2008-Mar-25  2008-Mar-31
F-ring & Pandora
Summary

- Titan has active methane meteorology
- Ground-based observing provides necessary temporal coverage. Adaptive optics crucial for spatial resolution.
- Discoveries in past 5 years include:
  - South polar cloud field in late southern spring
  - Seasonal shutdown of south polar cloud field (monsoonal shift of winds)
  - Mid-southern latitude clouds that are geographically controlled likely indicate region of geologic activity and methane resupply
  - Northern lake-effect clouds
  - Waves can communicate globally and generate clouds at latitudes/seasons not predicted by global circulation models
- Have only observed a fraction of Titan’s 30-year seasonal cycle ➡️ Need to continue observing!