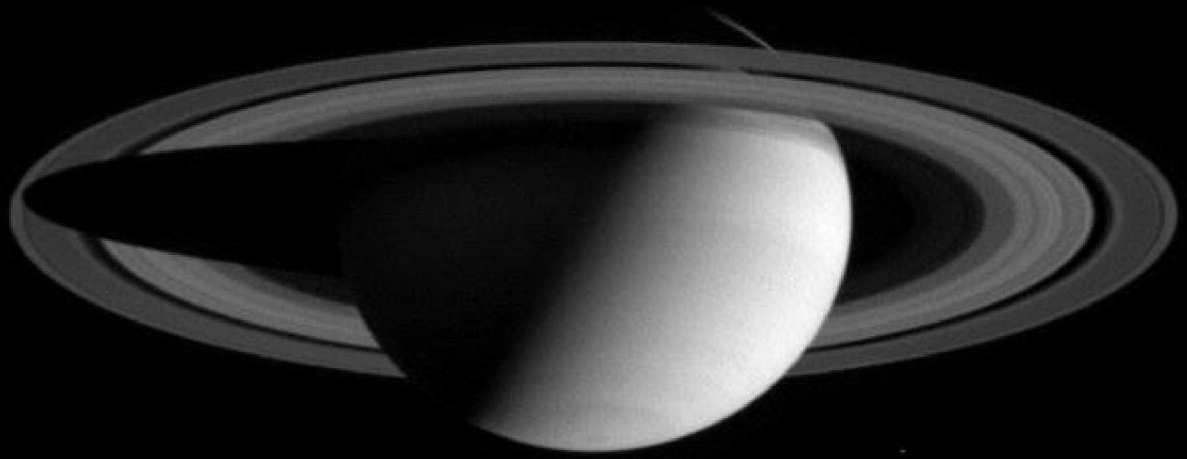
The CIRS Investigation on Cassini After Six Years at Saturn

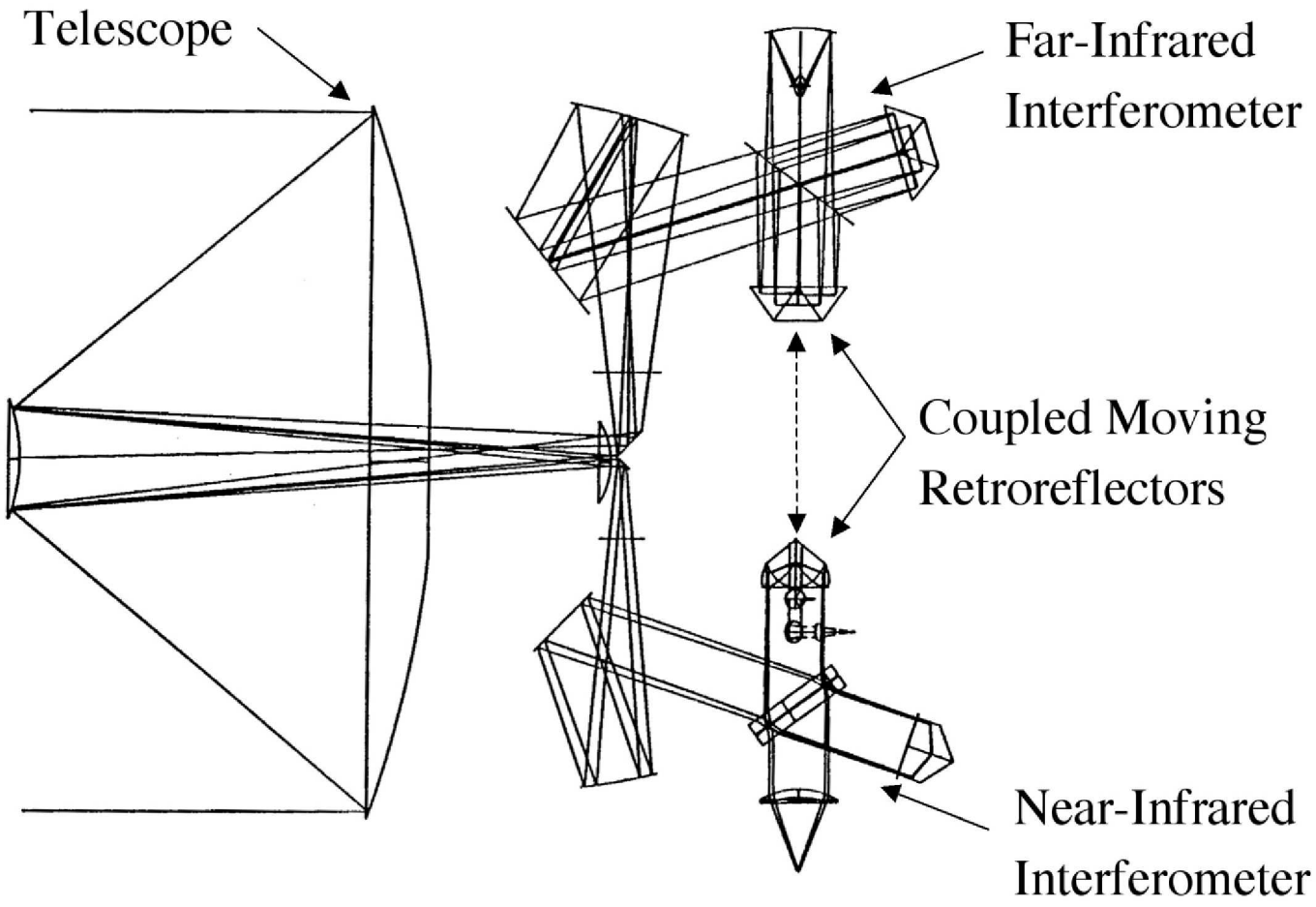


Don Jennings
presented at
University of Oxford
Atmospheric, Oceanic & Planetary Physics
13 May 2010

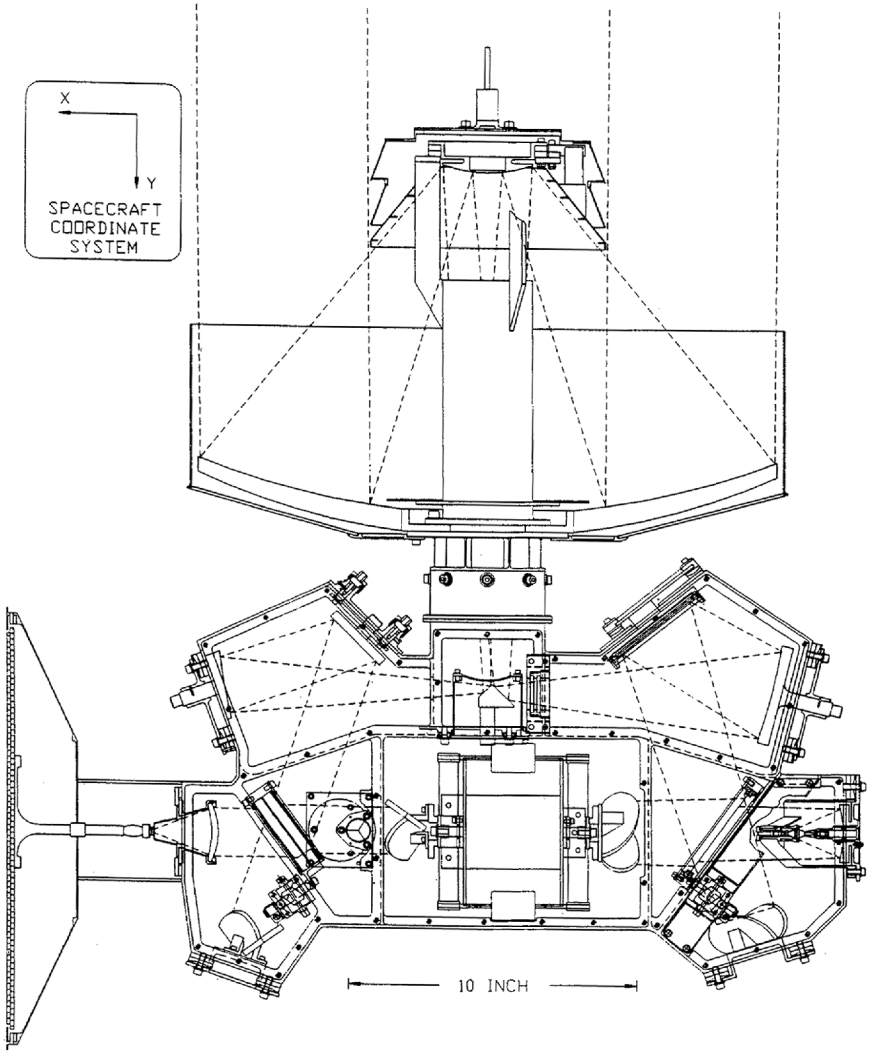
Description of CIRS Investigation

- Infrared spectroscopy of thermal emission from atmospheres, rings, and surfaces in 10±1450 cm^{-1} (1000±7 micron) region.
- Global mapping in atmospheres of the three dimensional and temporal variation of:
  - Gas composition.
  - Temperatures.
  - Dynamics.
  - Aerosols, clouds.
- Mapping of rings and icy satellite surfaces for:
  - Composition.
  - Thermal properties.

Optical Layout



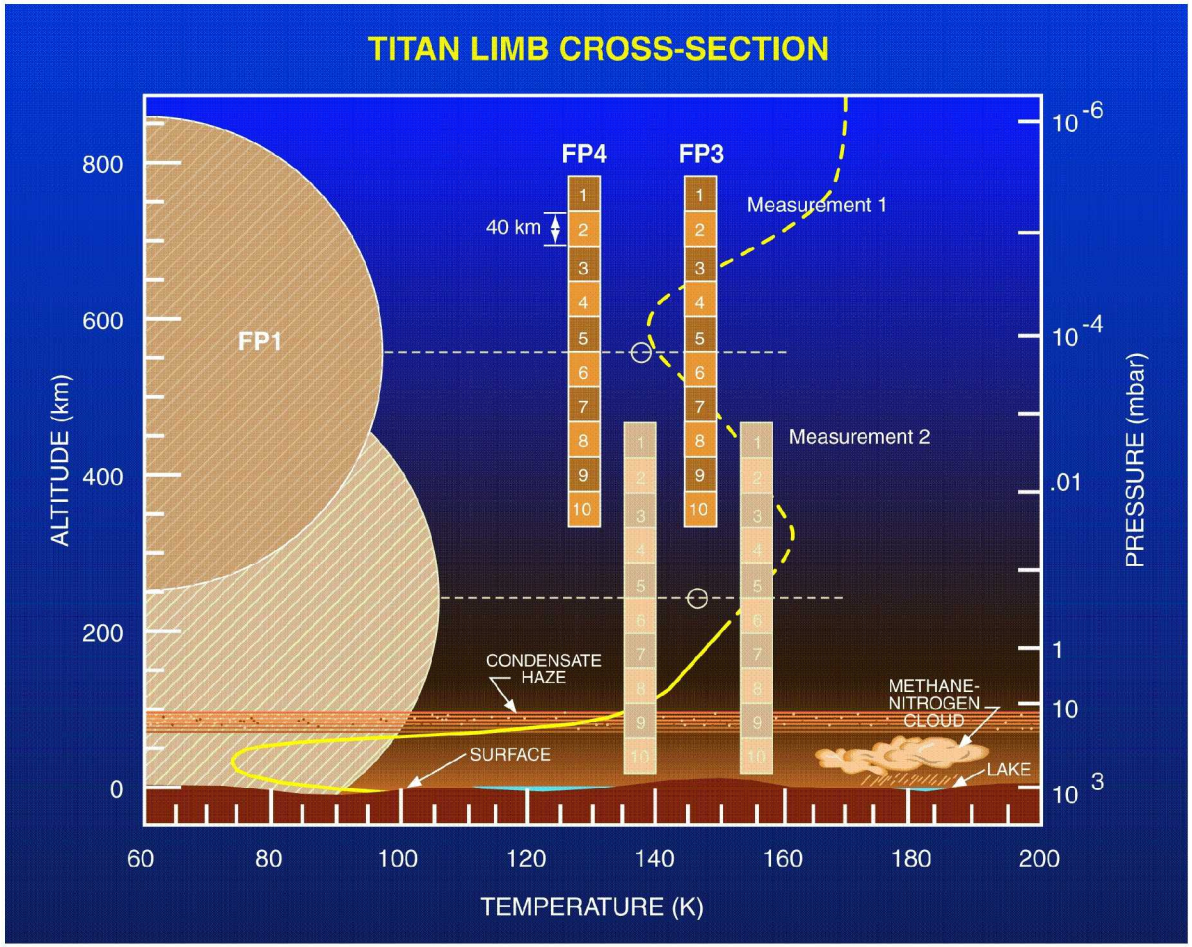
CIRS Mechanical Layout with Raytrace



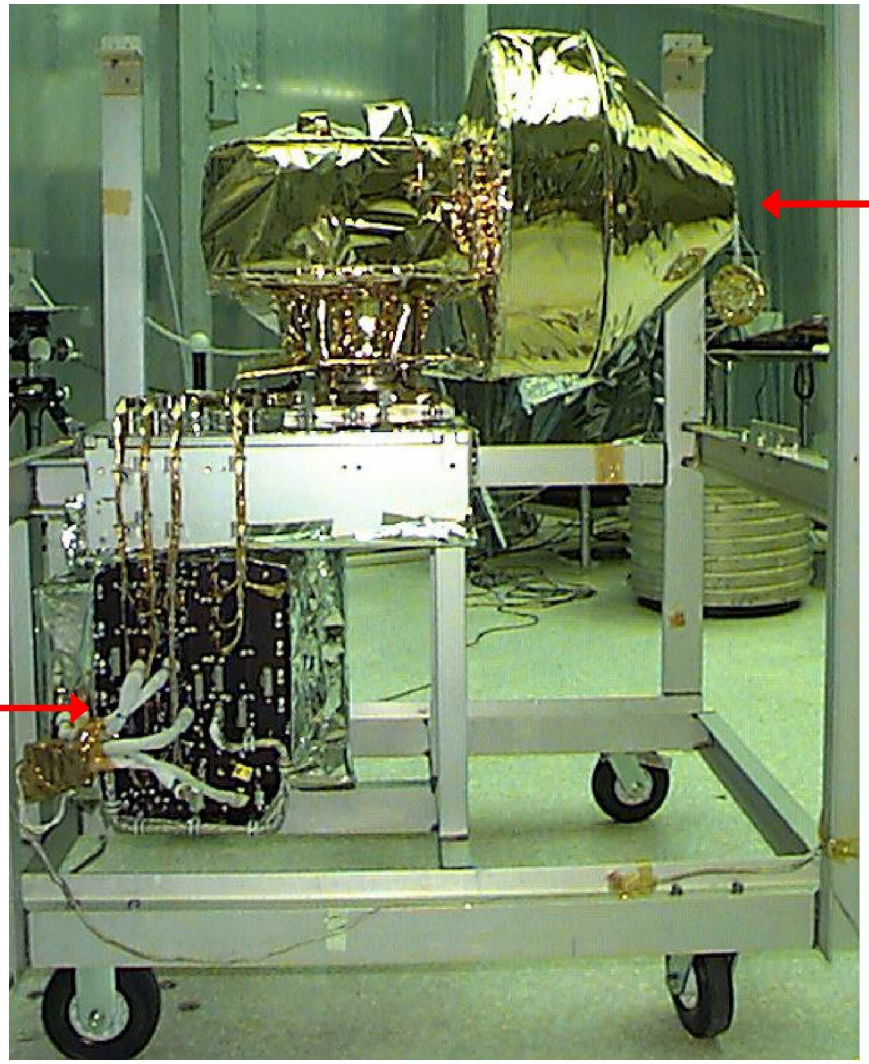
Instrument Description

Telescope Diameter (cm):	50.8		
Interferometers:	FAR-IR	MID-IR	
Type:	Polarizing	Michelson	
Spectral range (cm^{-1}):	10 - 650	600 -1450	
Spectral range (microns):	15.4 - 1000	6.9 -16.6	
Spectral resolution (cm^{-1}):	0.5 to 20	0.5 to 20	
Integration time (sec):	2 to 50	2 to 50	
FOCAL PLANES:	FP1	FP3	FP4
Spectral range (cm^{-1})	10 - 650	600 - 1125	1100 - 1450
Detectors	Thermopile	PC HgCdTe	PV HgCdTe
Pixels	2	1 x 10	1 X 10
Pixel FOV (mrad)	3.9	0.273	0.273
Peak D*(cm $hz^{1/2}$ W^{-1})	4 x 10^{9}	2 x 10^{10}	5 x 10^{11}
Data Telemetry Rate (kbs)	2, 4		
Instrument Temperature (K)	170		
Focal Planes 3 & 4 Temperature (K)	75 - 90		

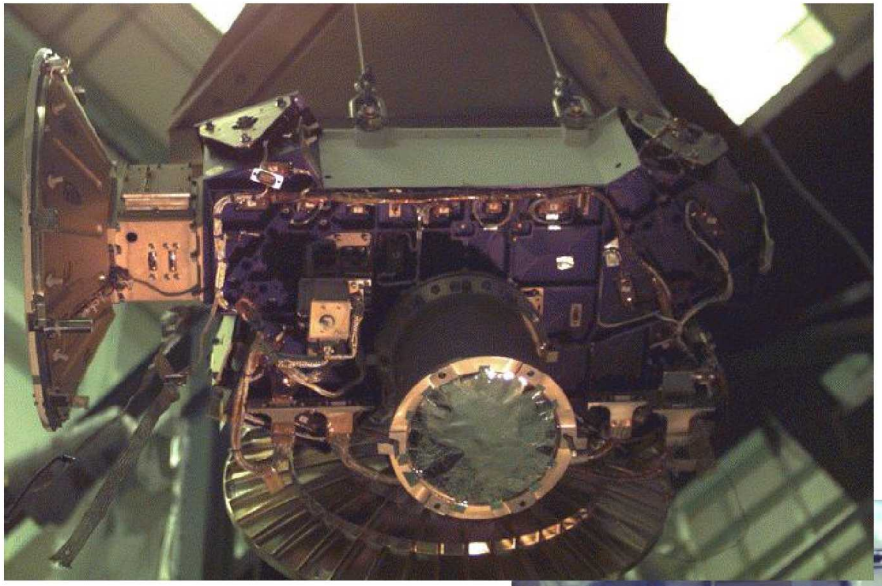
CIRS FOV's Projected on Titan's Limb

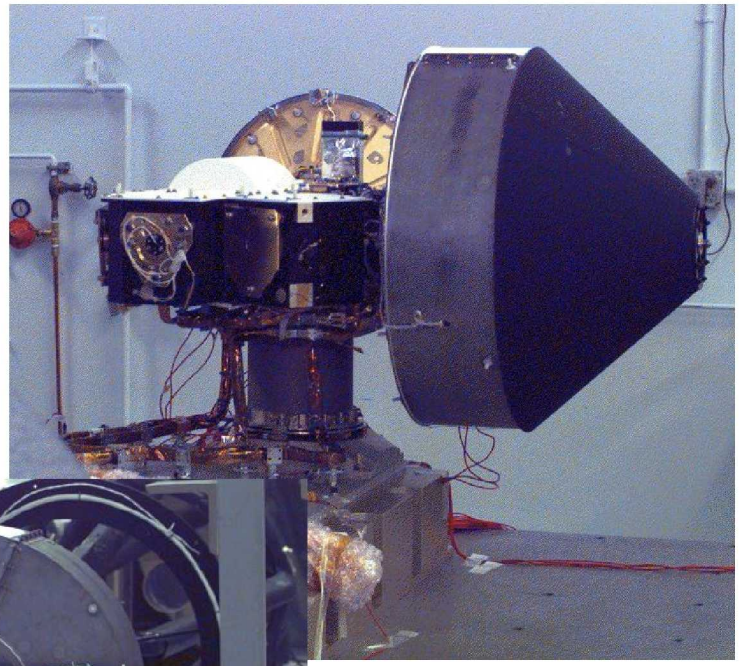


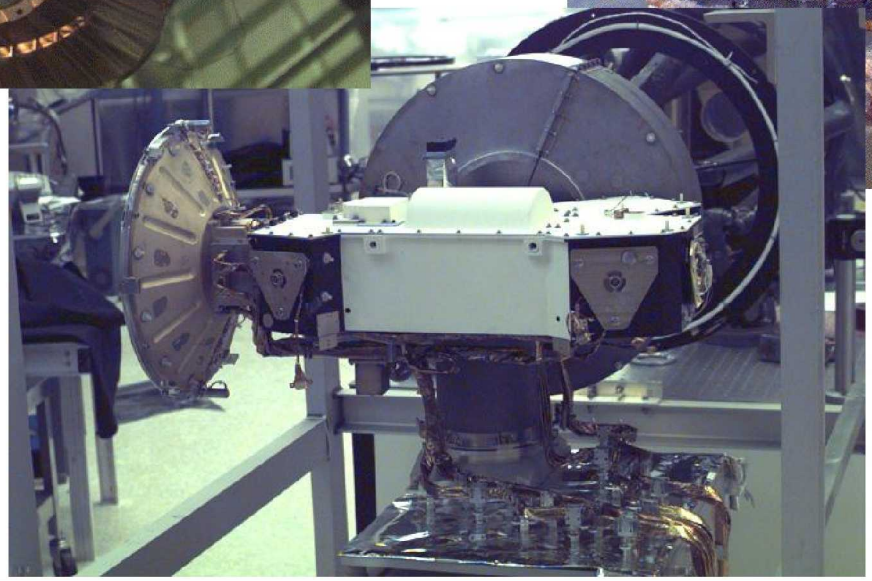
CIRS Ready for Thermal-Vacuum Testing



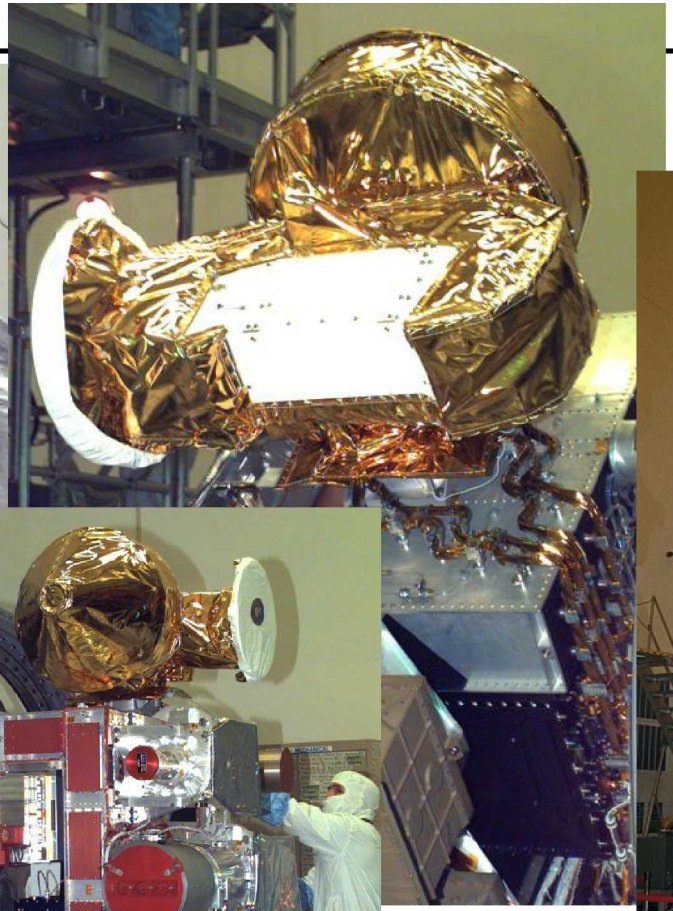
CIRS without MLI



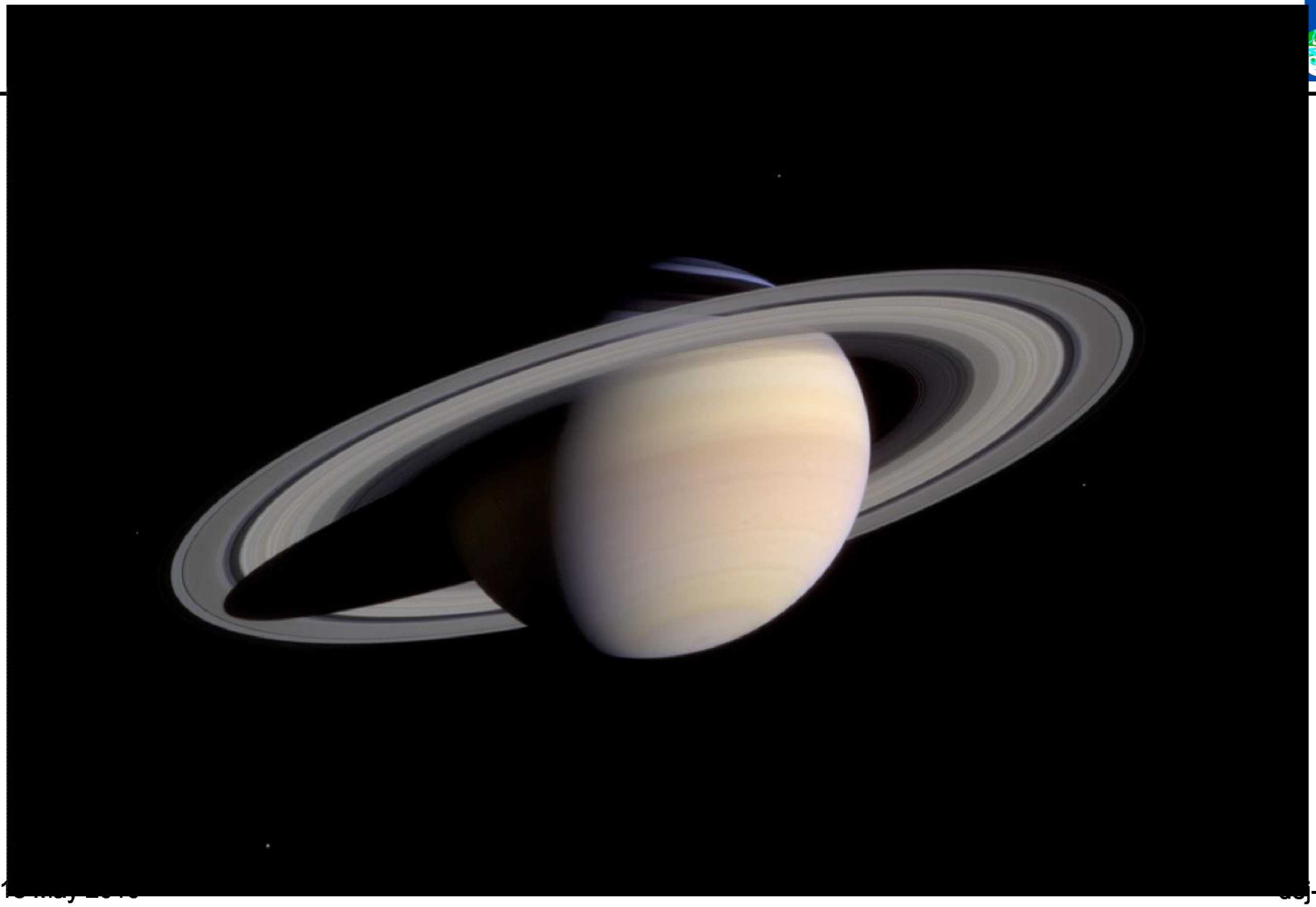




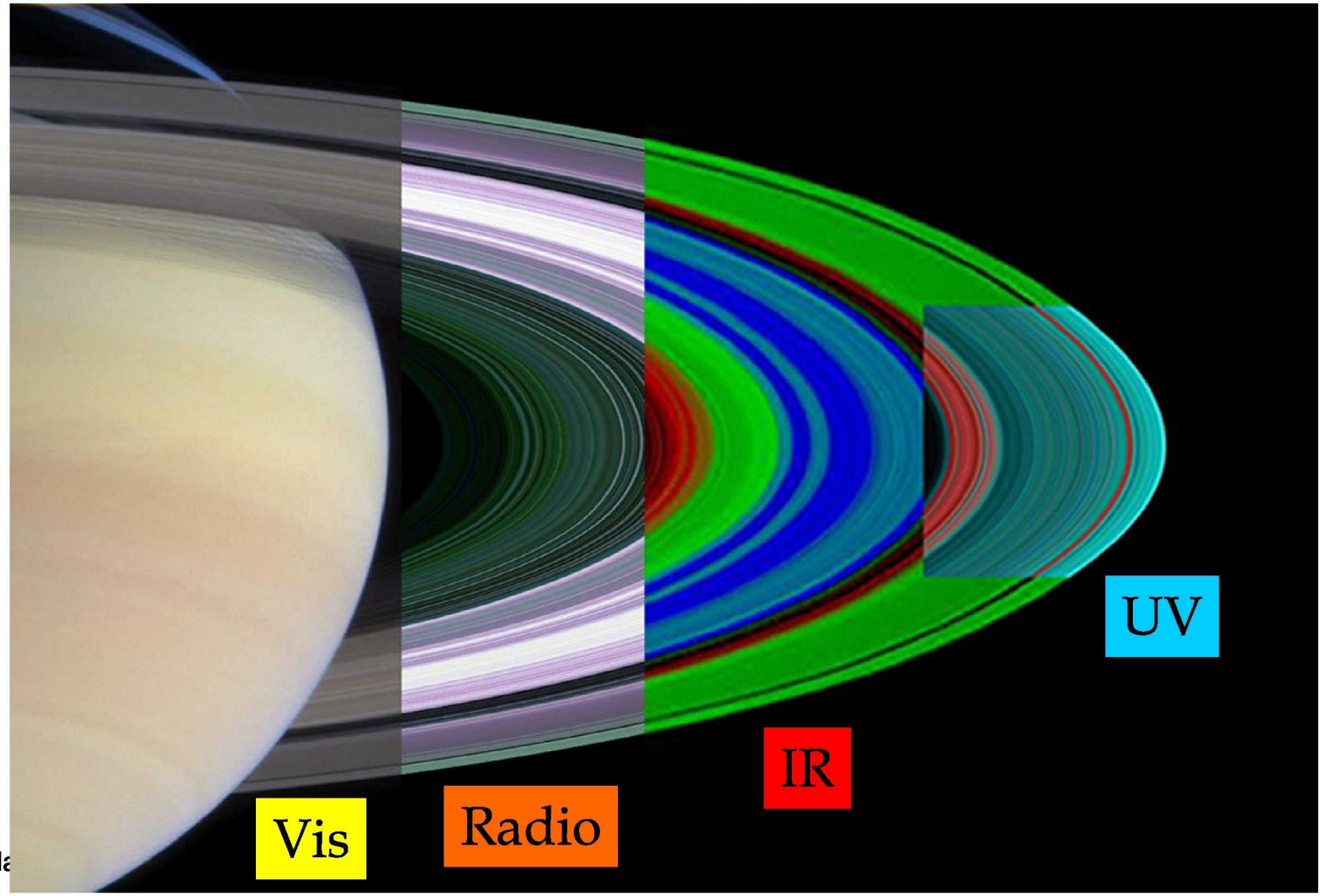
Installing CIRS on Cassini



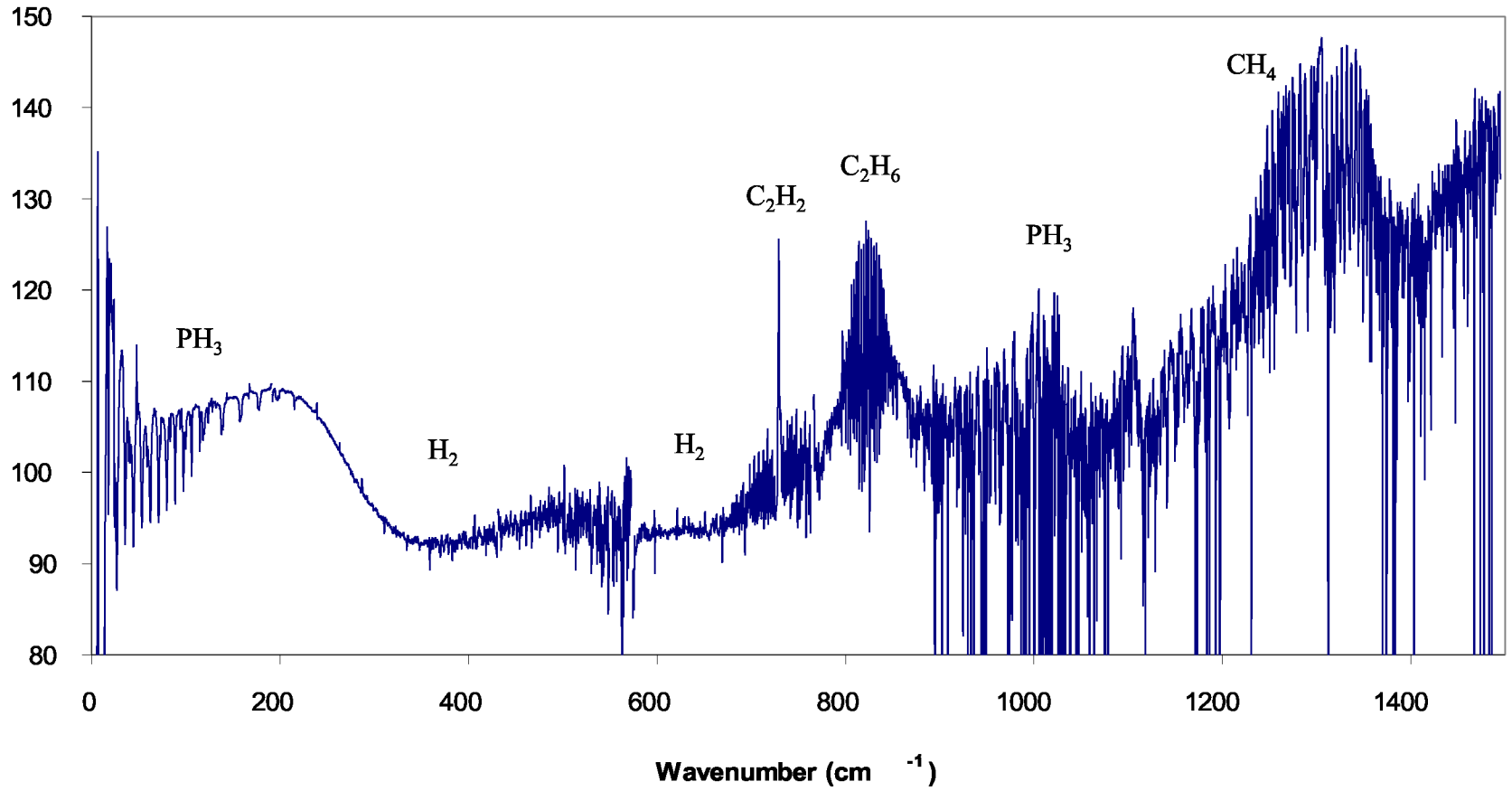
Saturn from Cassini



Saturn's Rings in Visible, Radio, Infrared, and Ultraviolet



Saturn Brightness Temperature Spectrum



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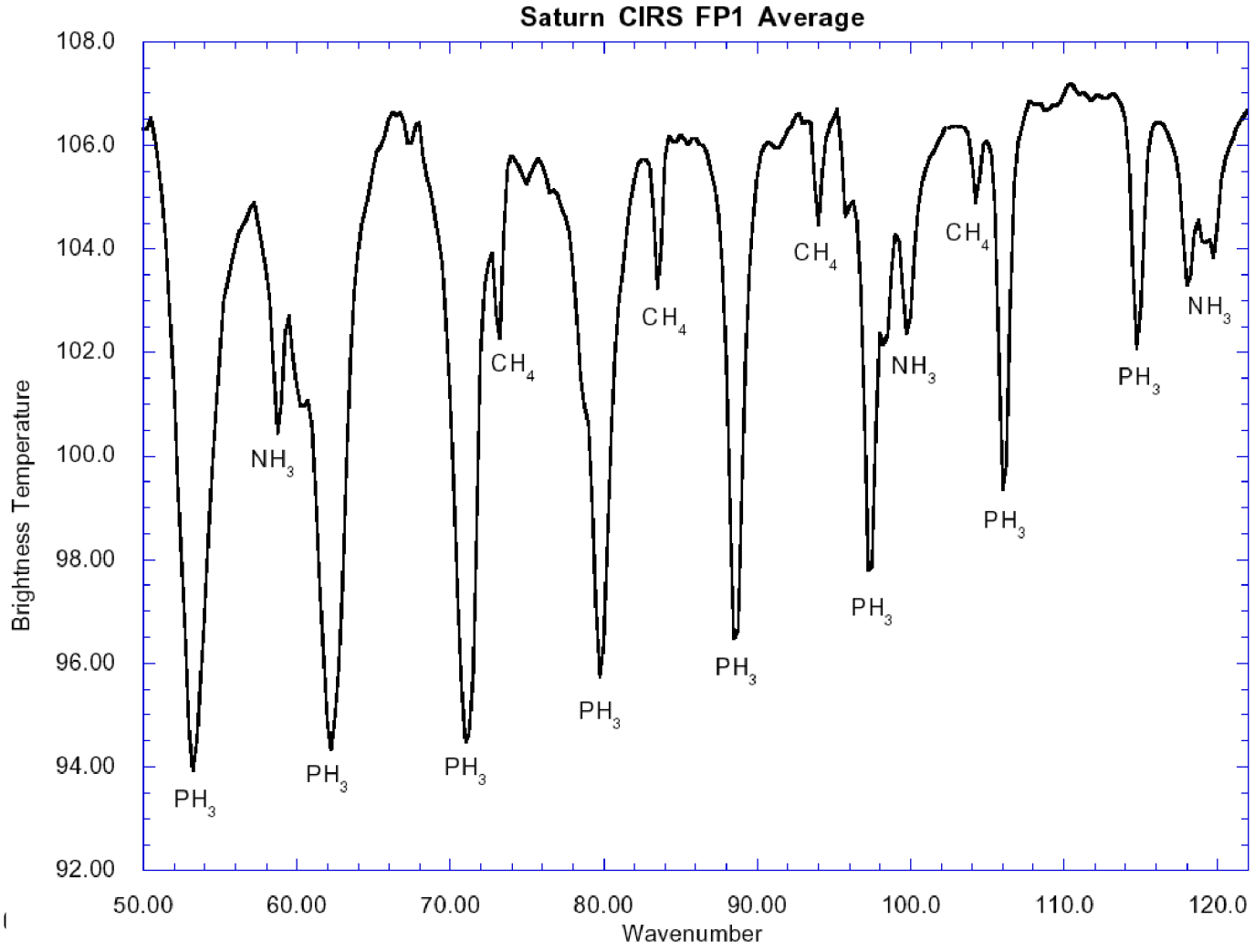
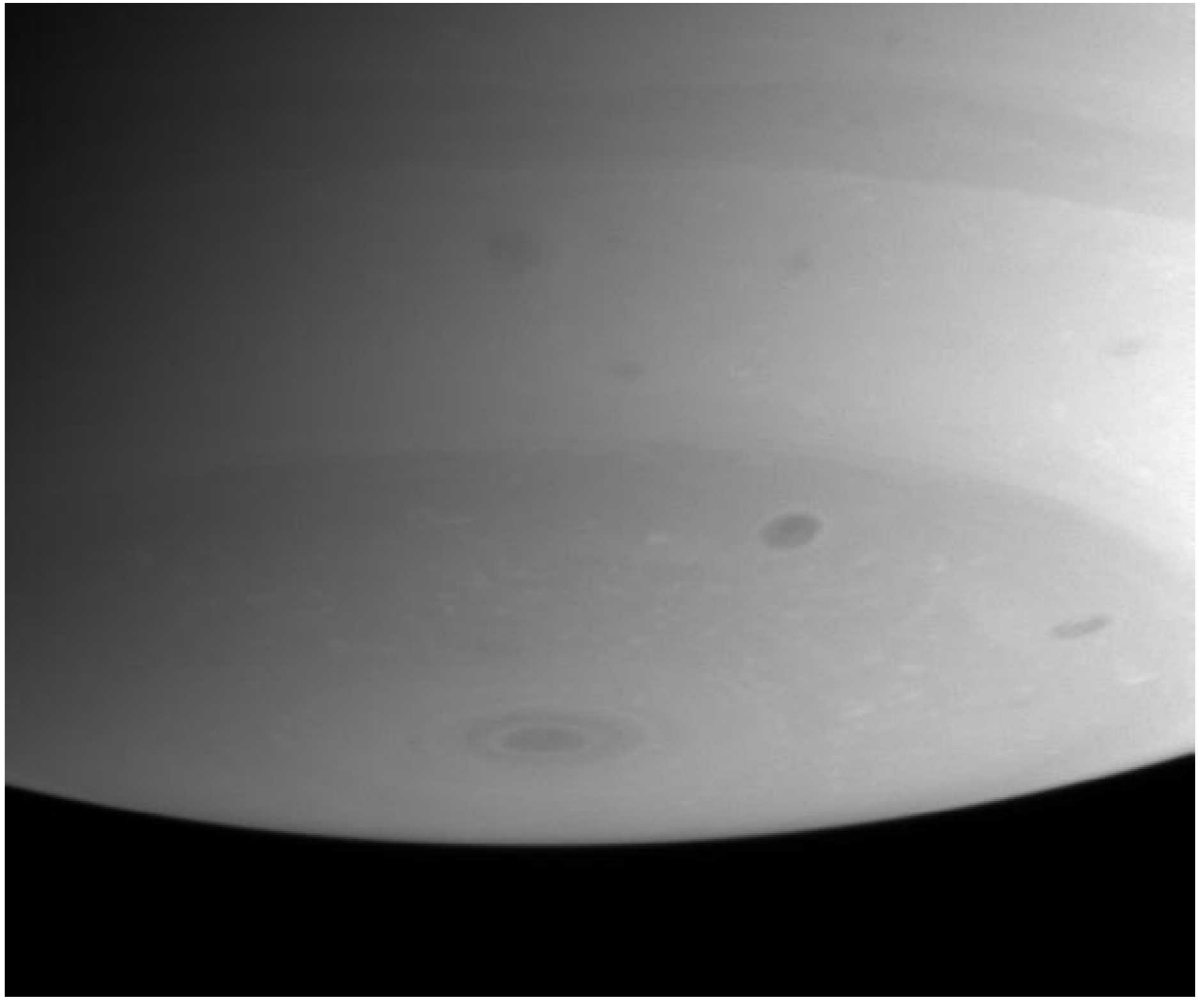
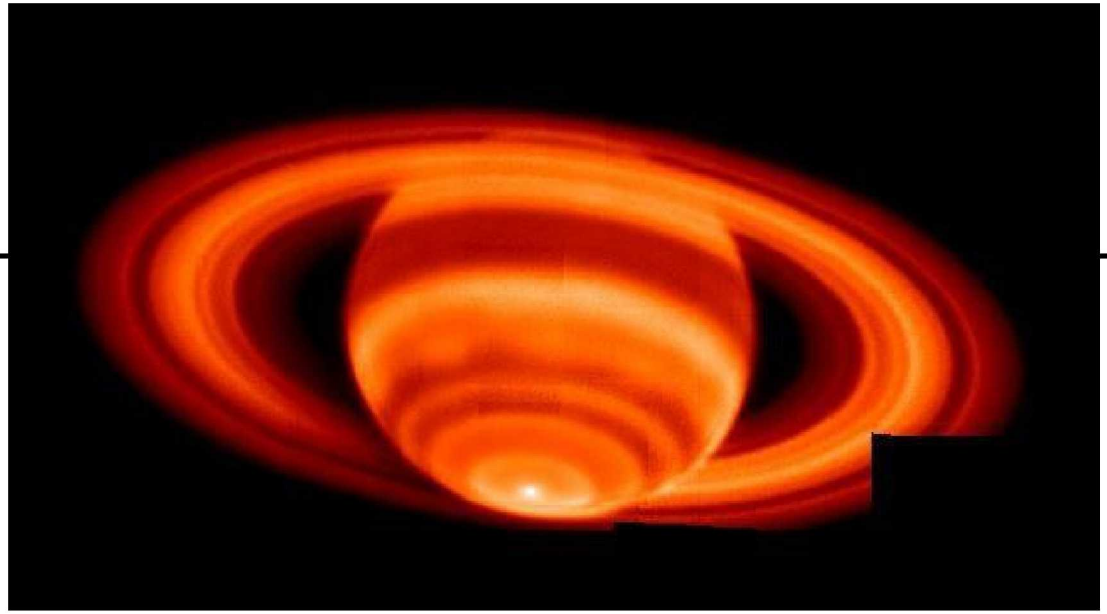
Saturn in the Far-Infrared



Storms around Saturn's South Pole

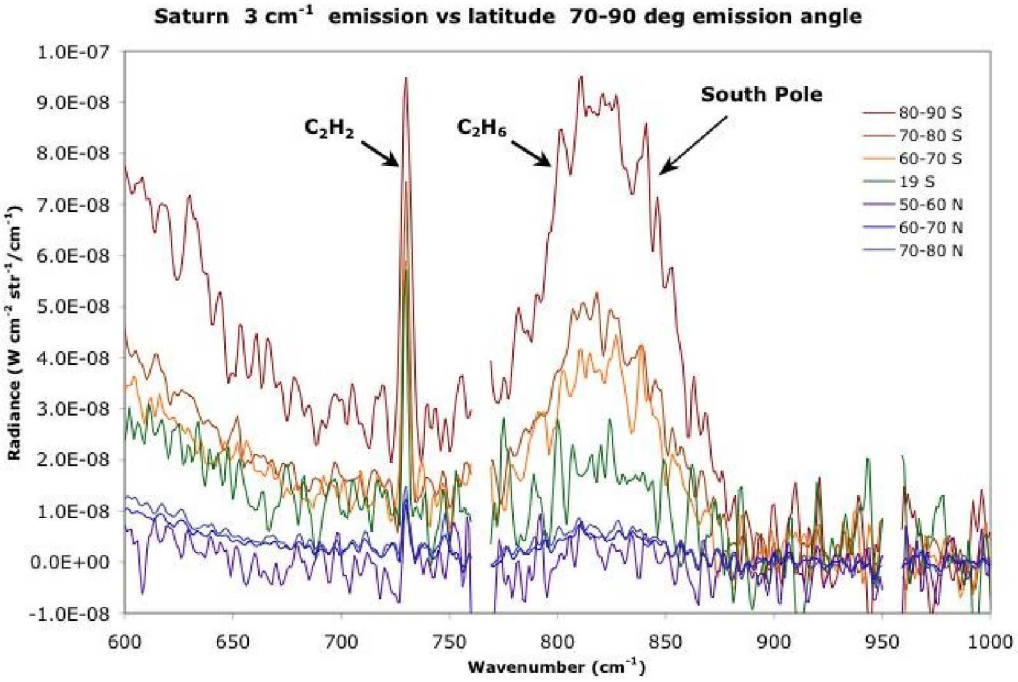


Saturn in the Infrared from Mauna Kea



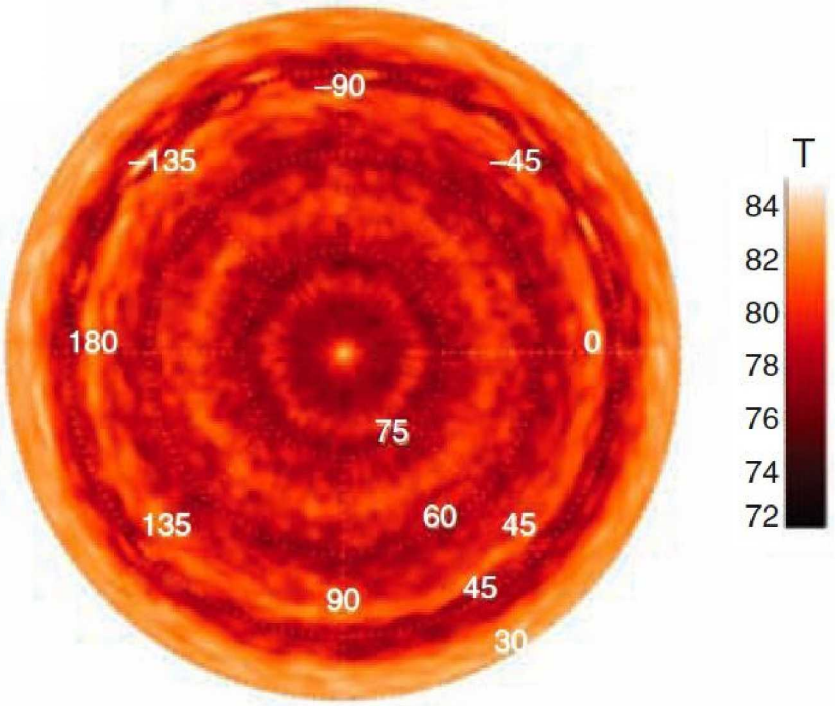
Orton and Yanamandra-Fisher Science 307, 696.

CIRS spectra latitude dependence



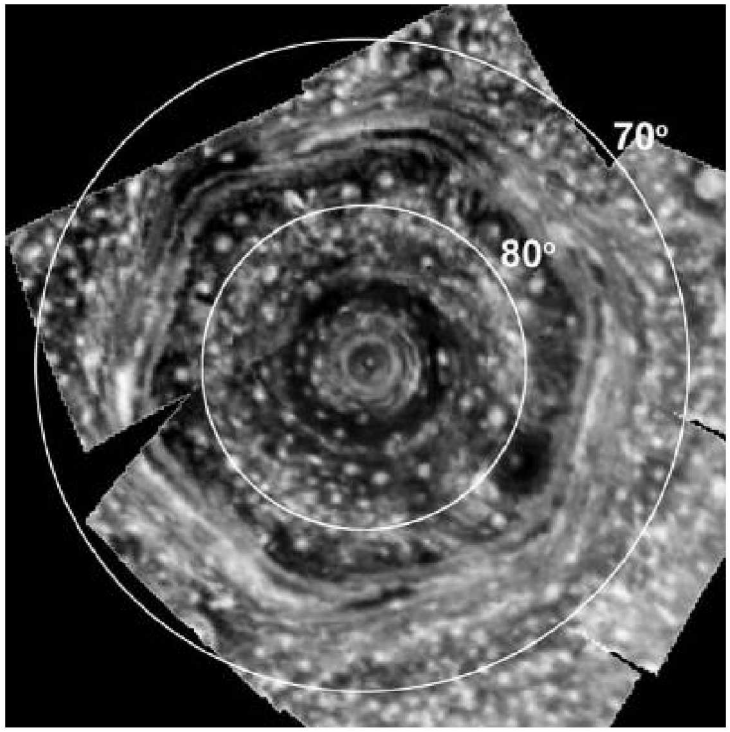
Hesman *et al.* Icarus 202, 249.

Saturn's North Polar Hexagon



CIRS thermal image

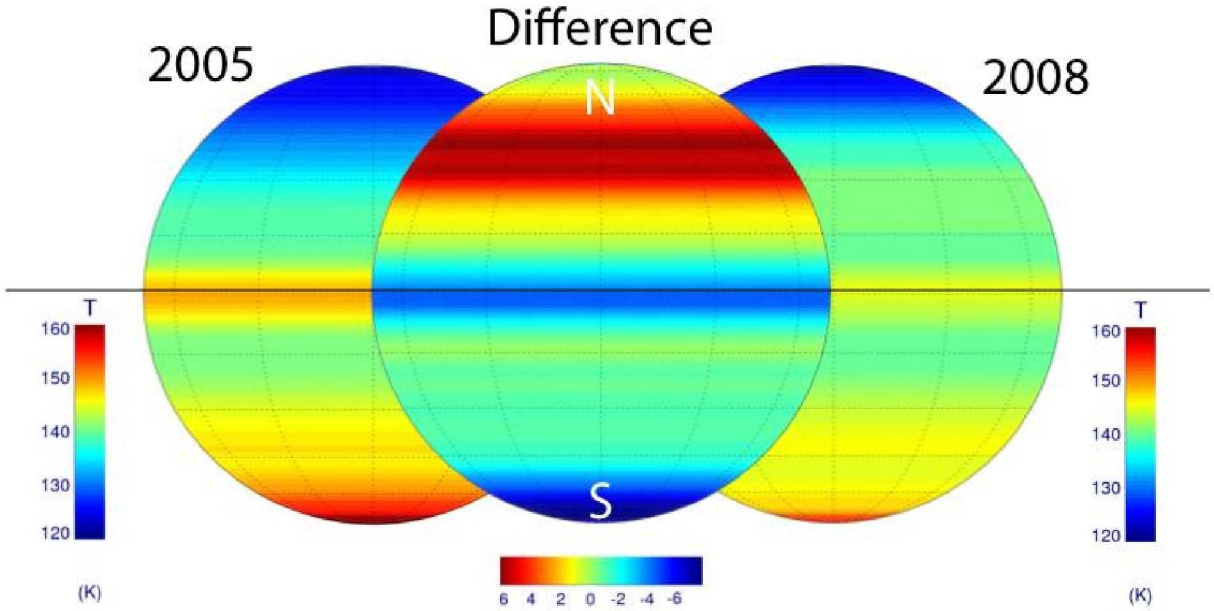
Fletcher *et al.*, Science 319, 79 (2008)



VIMS image

Baines *et al.*, Plan. Sp. Sci. 57, 1671 (2009)

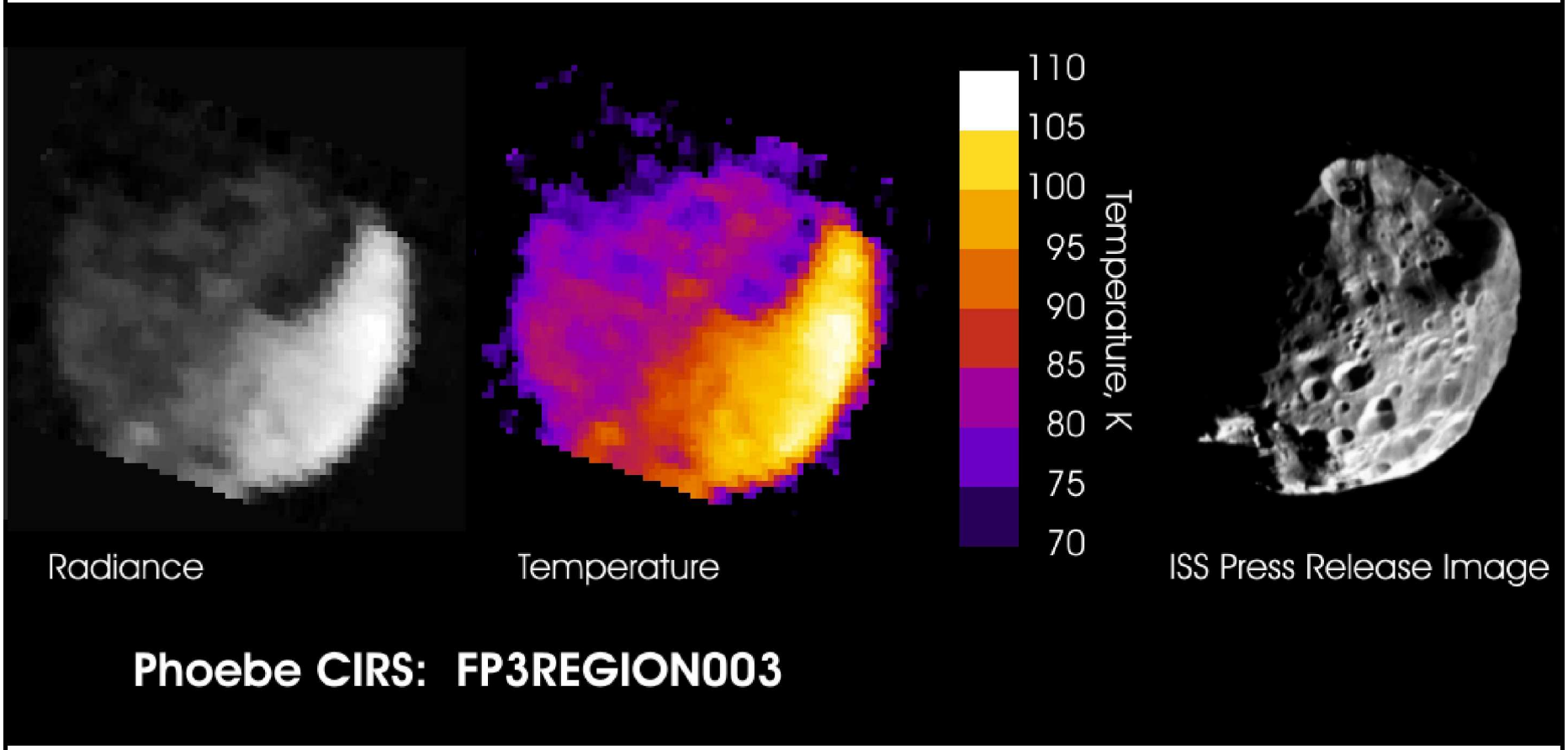
Saturn's Seasonal Temperature Changes



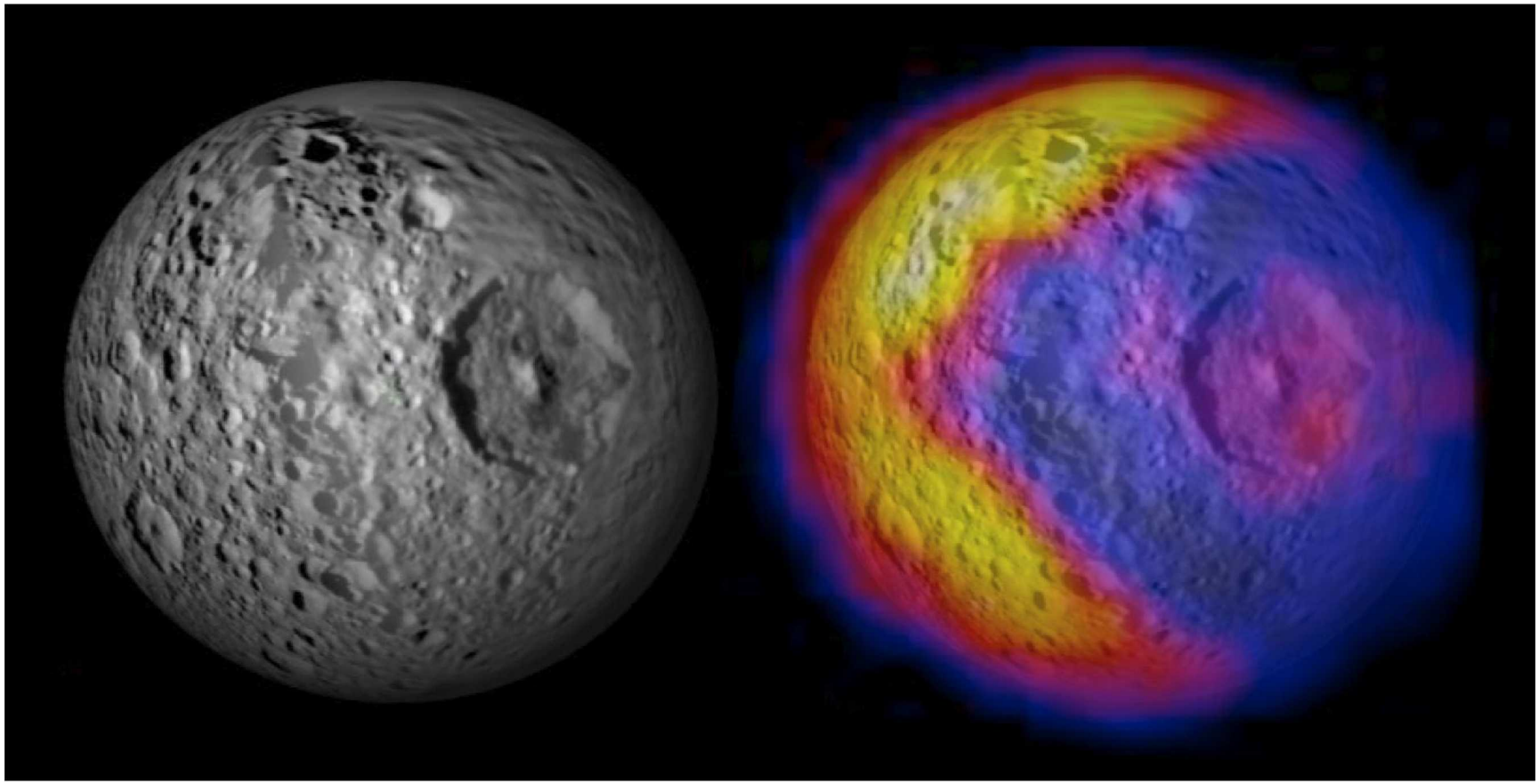
Saturn's Stratospheric Temperatures

Fletcher *et al.*, Icarus, in press

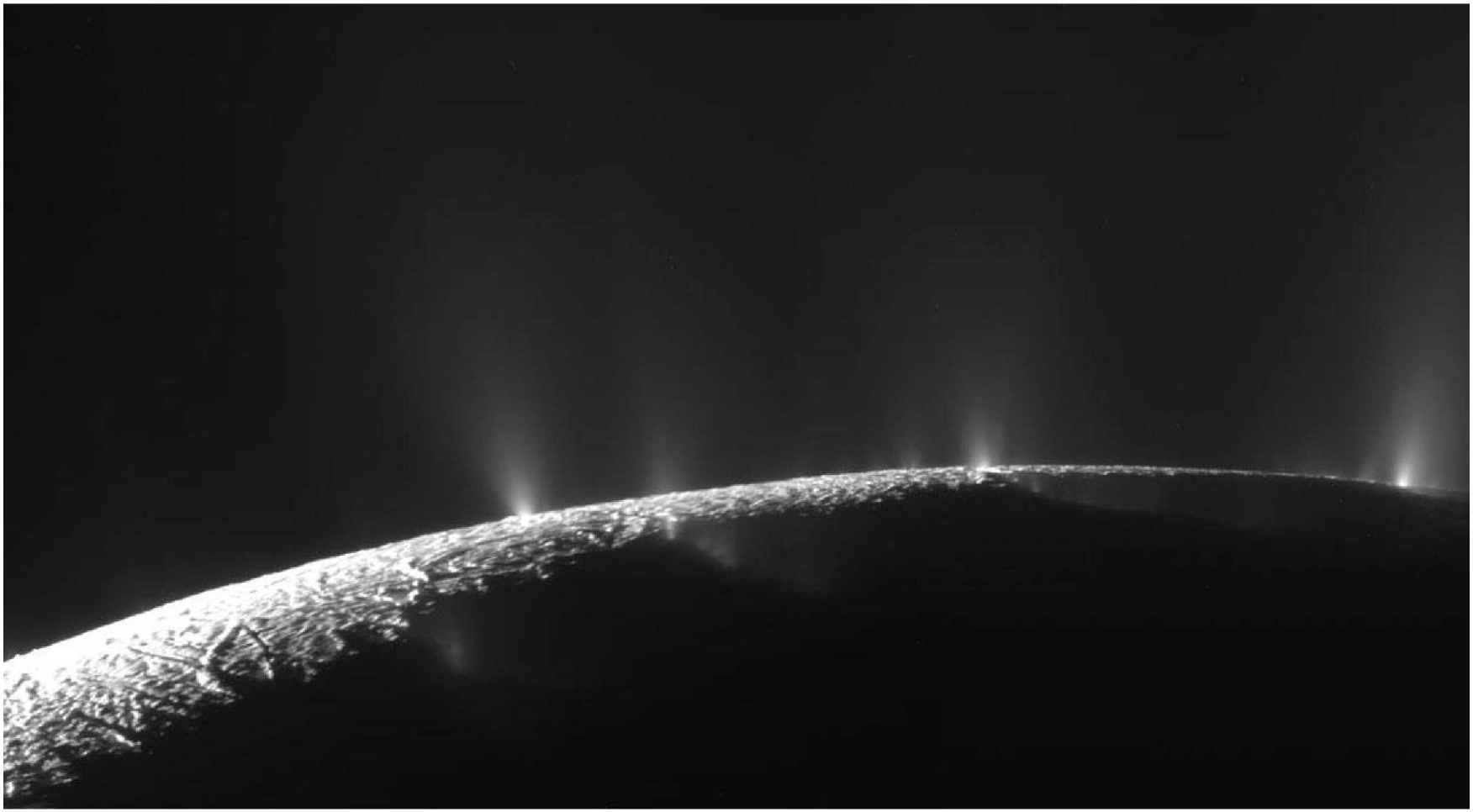
CIRS Thermal Images of Phoebe



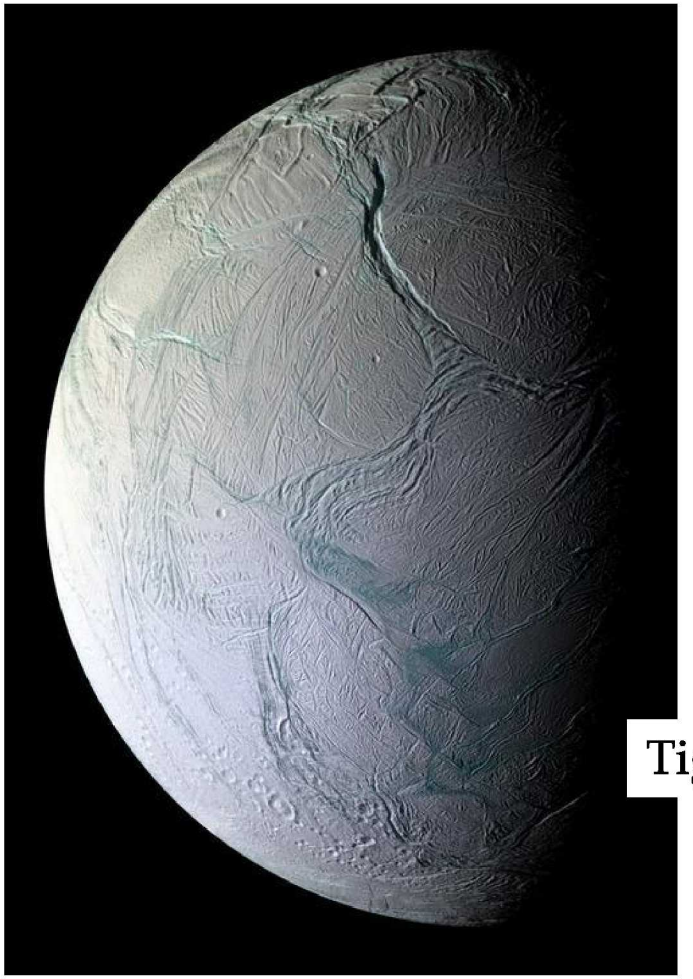
"Pacman" thermal structure on Mimas



Enceladus venting during Nov 2009 Flyby



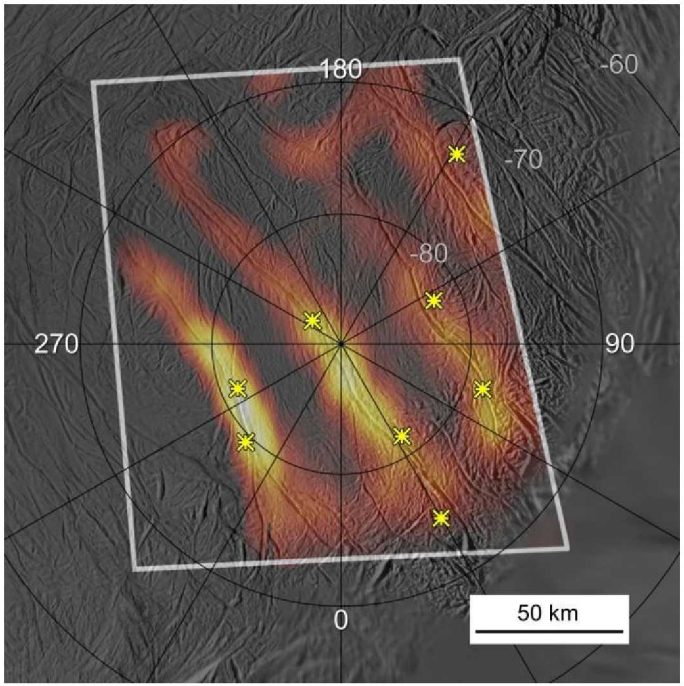
Hot Fissures on Enceladus

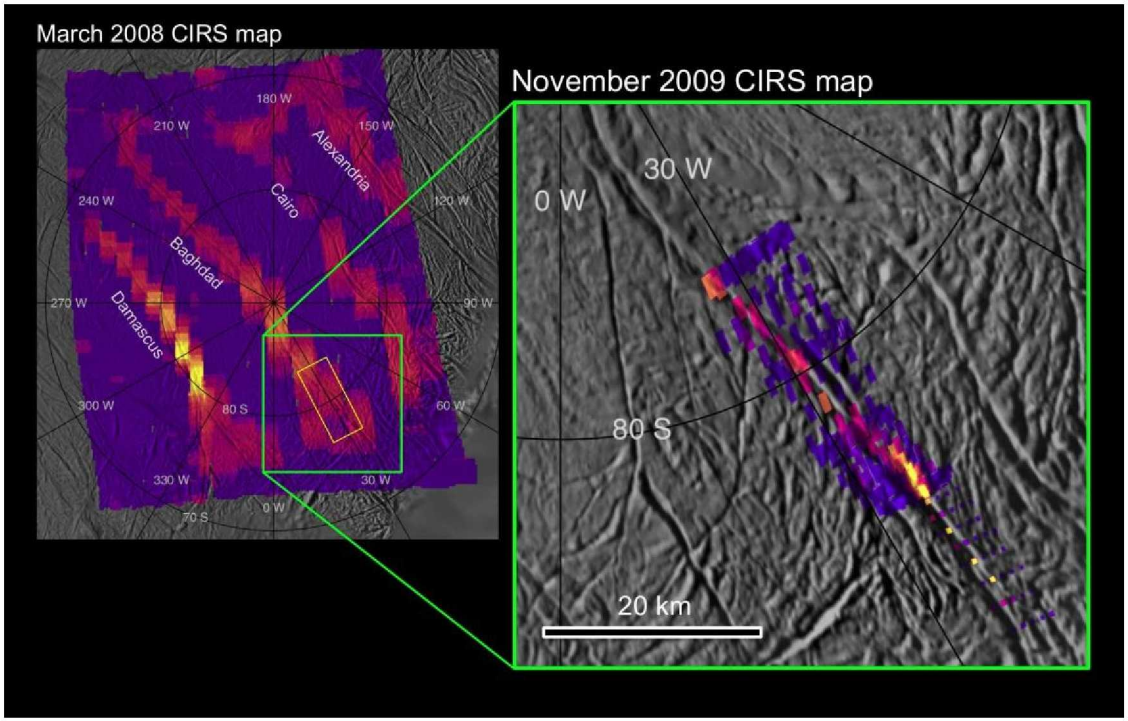


Tiger Stripes

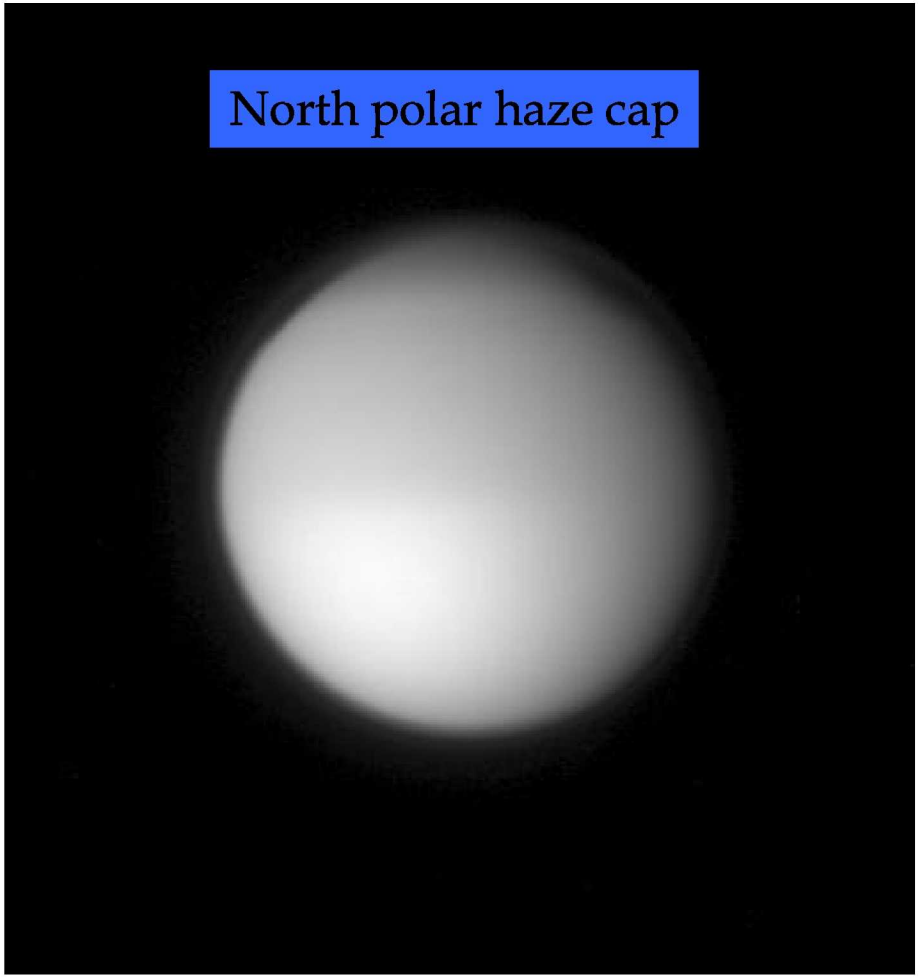
Baghdad Sulcus

Enceladus Hot Stripes in the Infrared

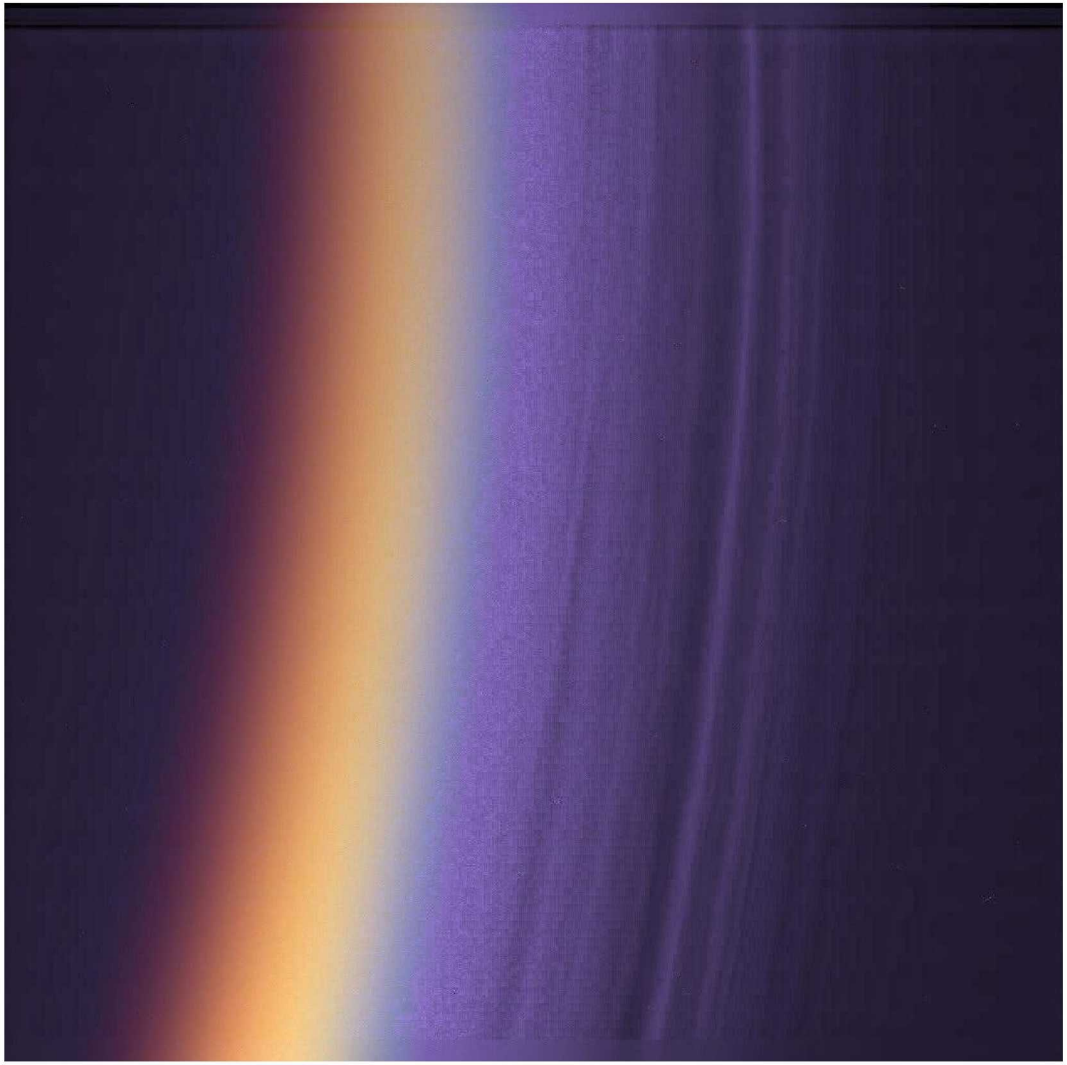




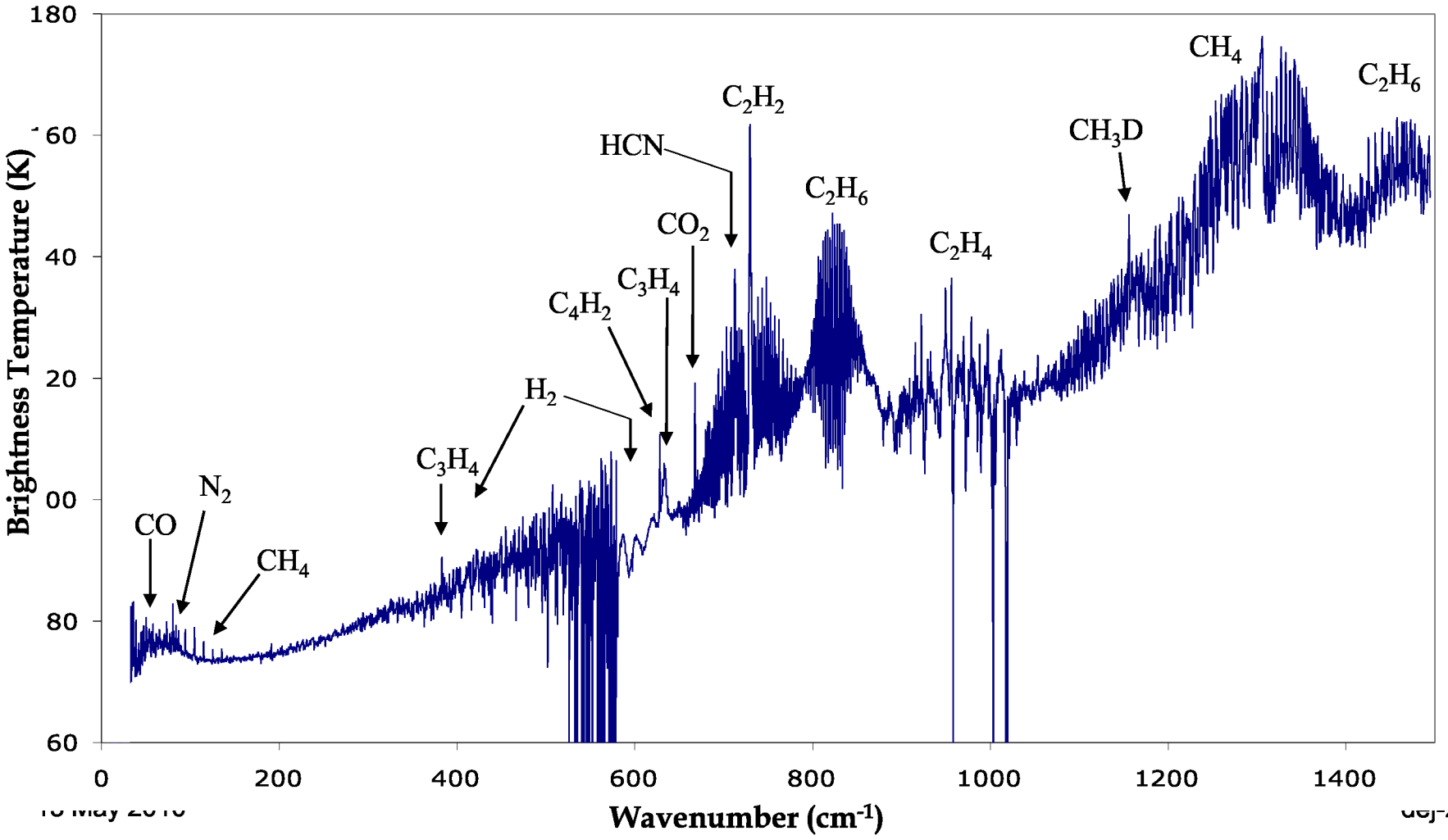
Titan's Atmospheric Haze



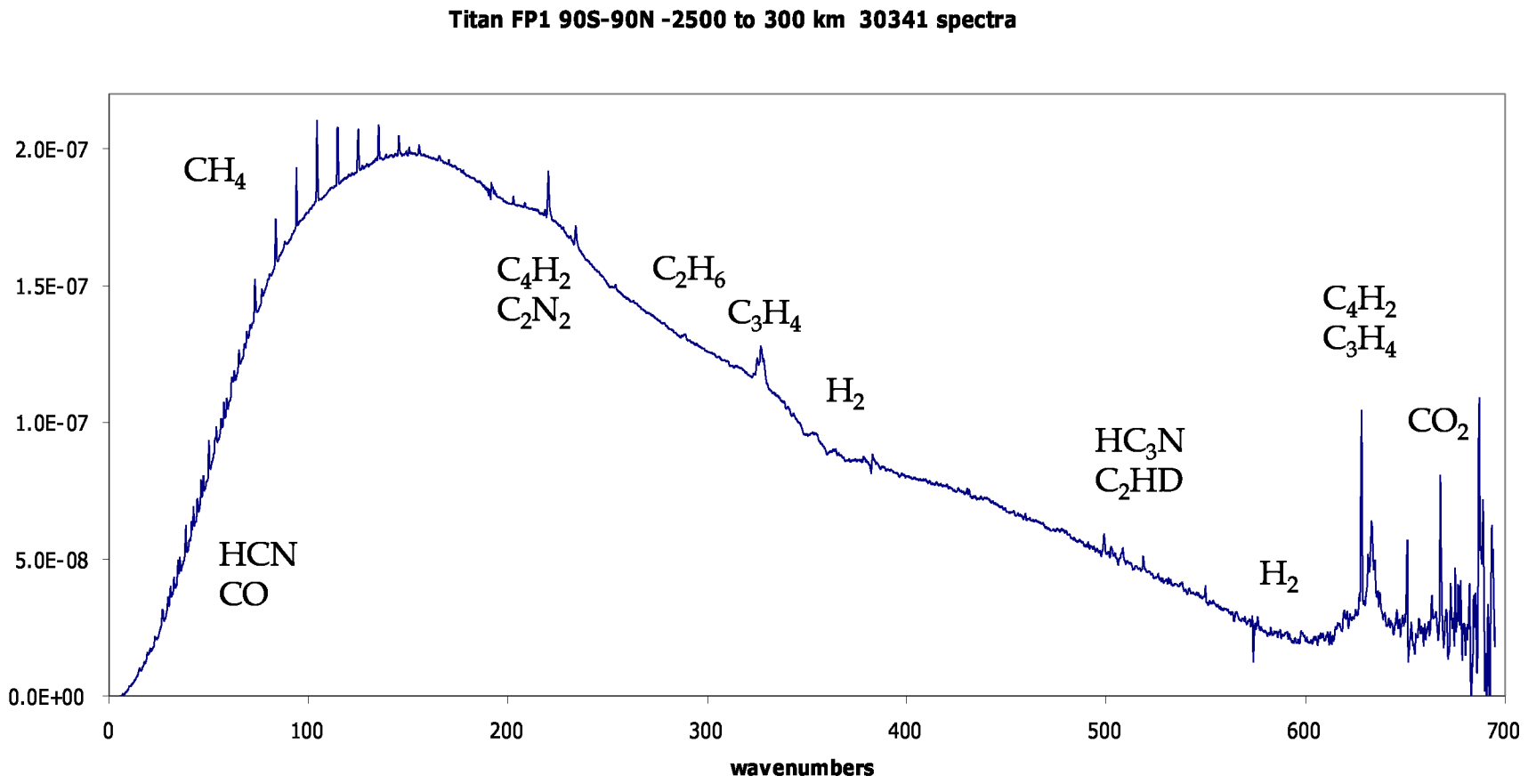
Titan high altitude haze



Composite Brightness Temperature of Titan



Titan FP1 Large Average



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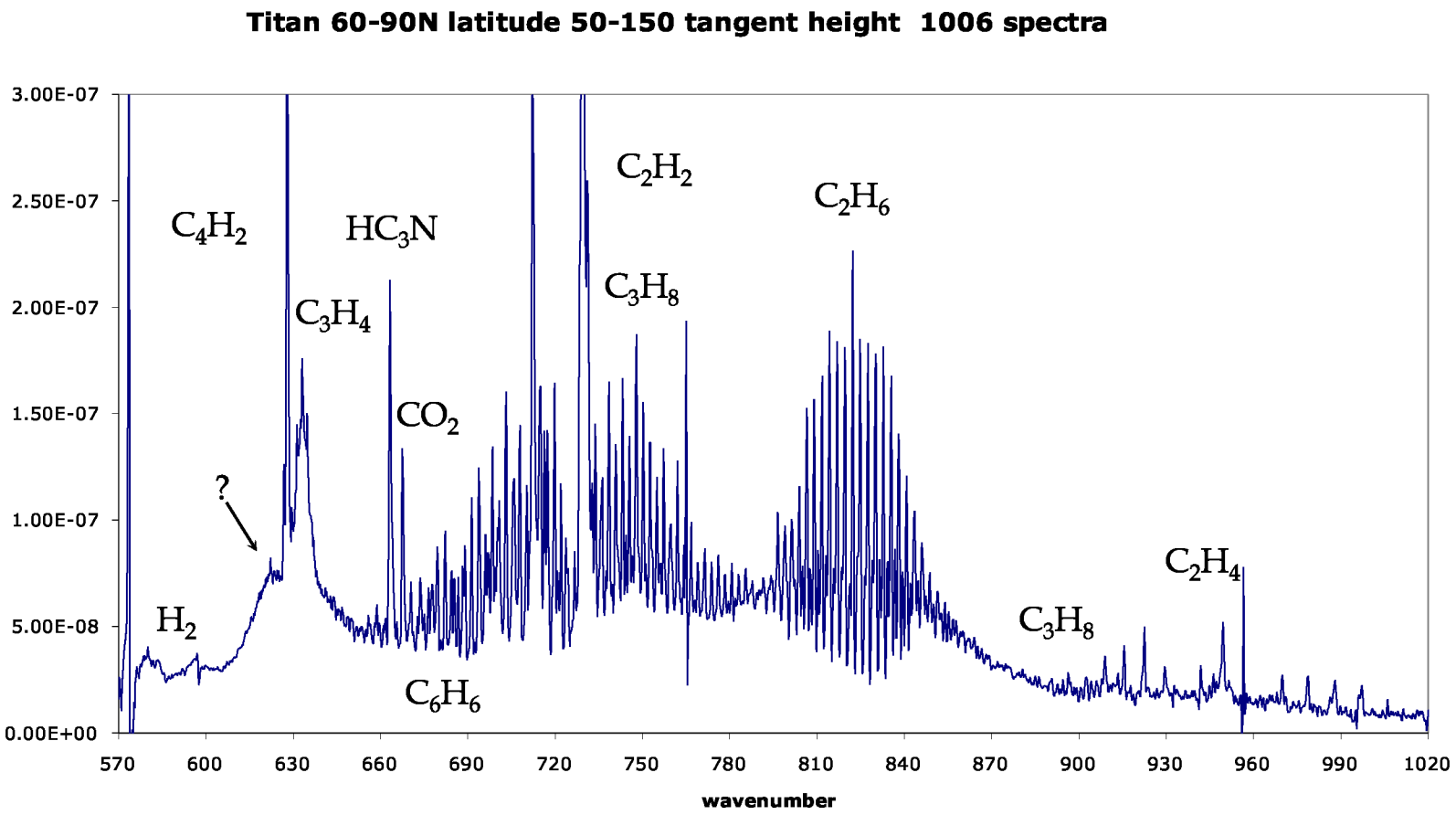
Titan FP3 Large Average



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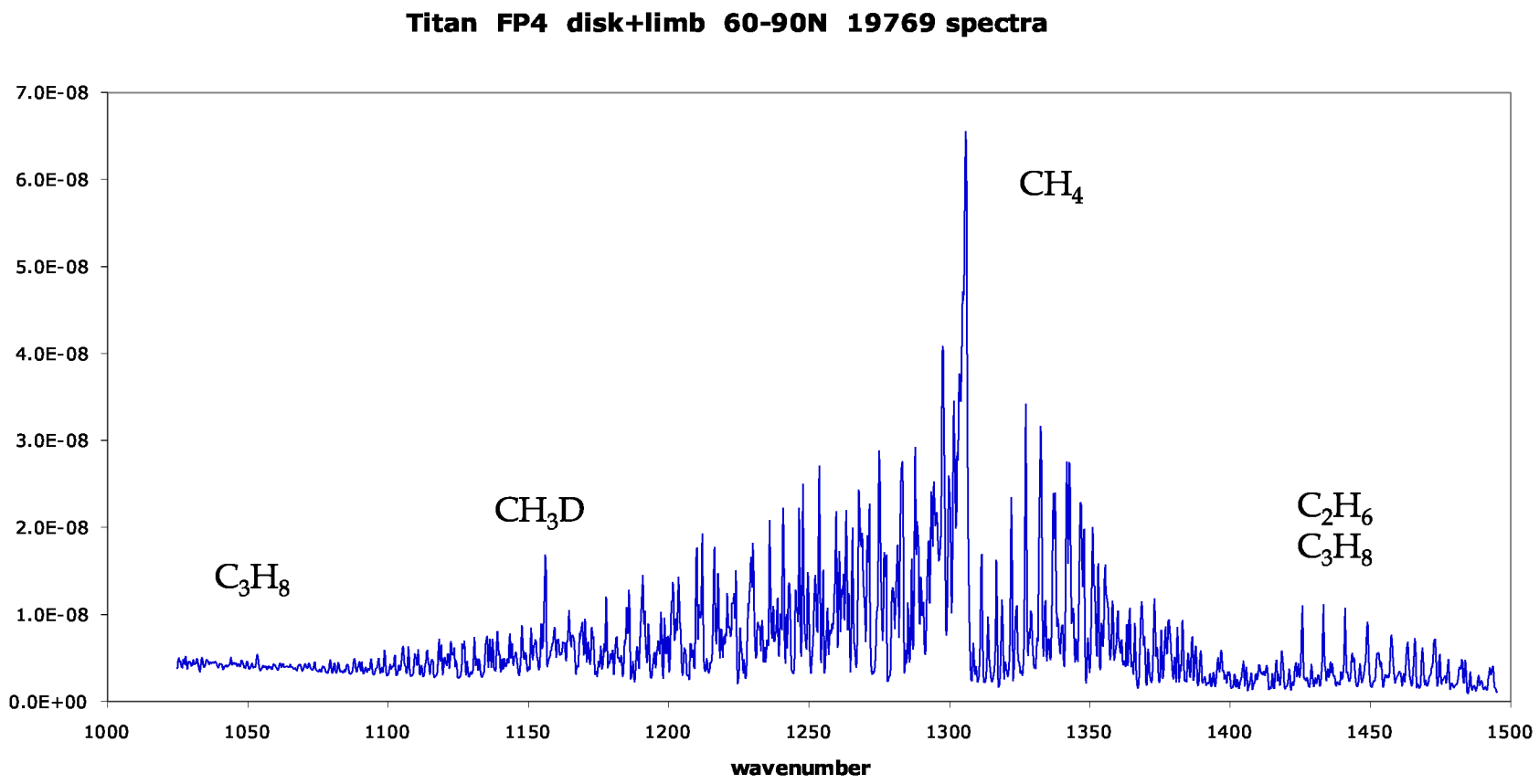
Titan FP4 Large Average



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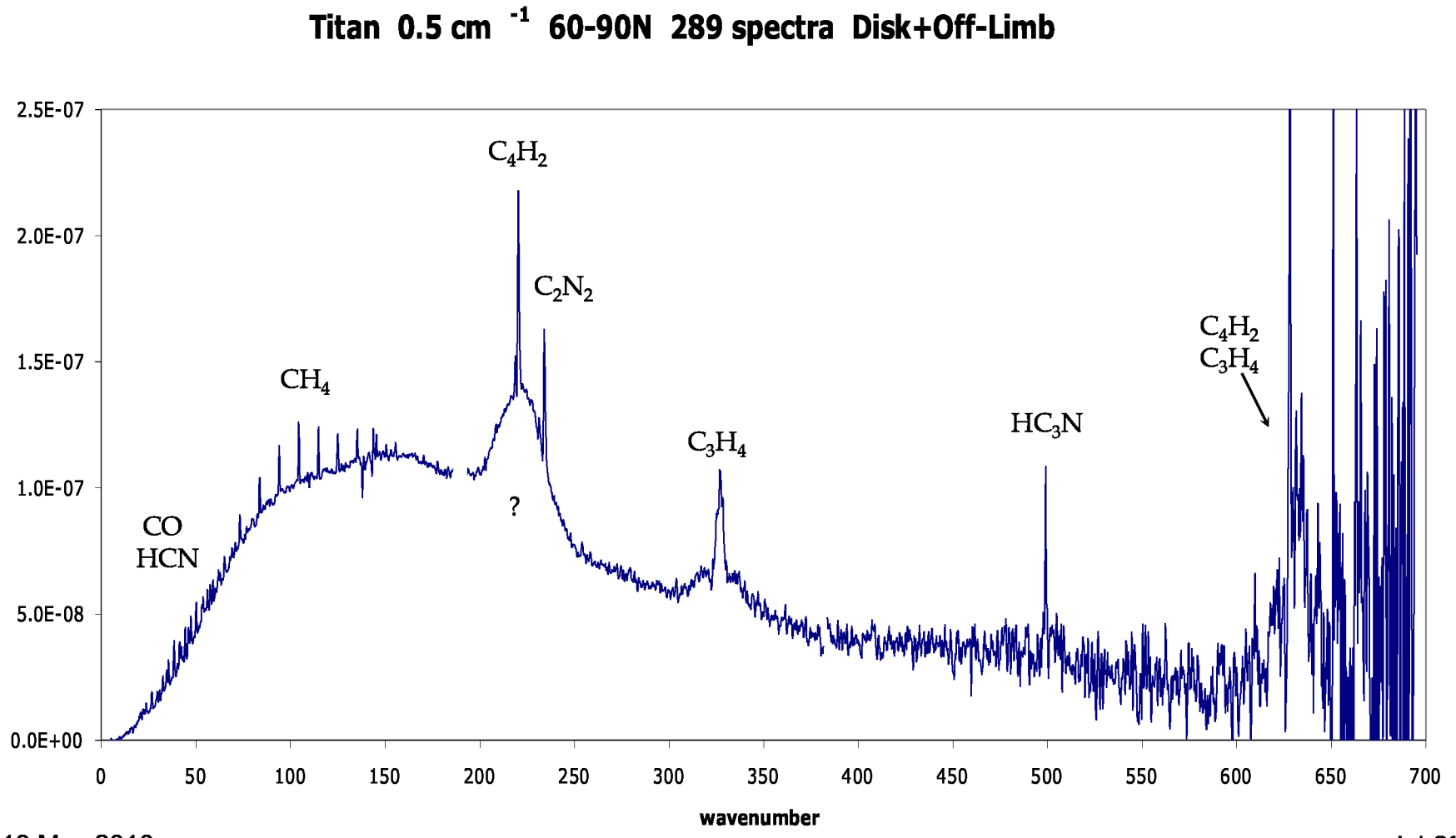
CIRS FP1 spectrum at 0.5 cm^{-1} resolution



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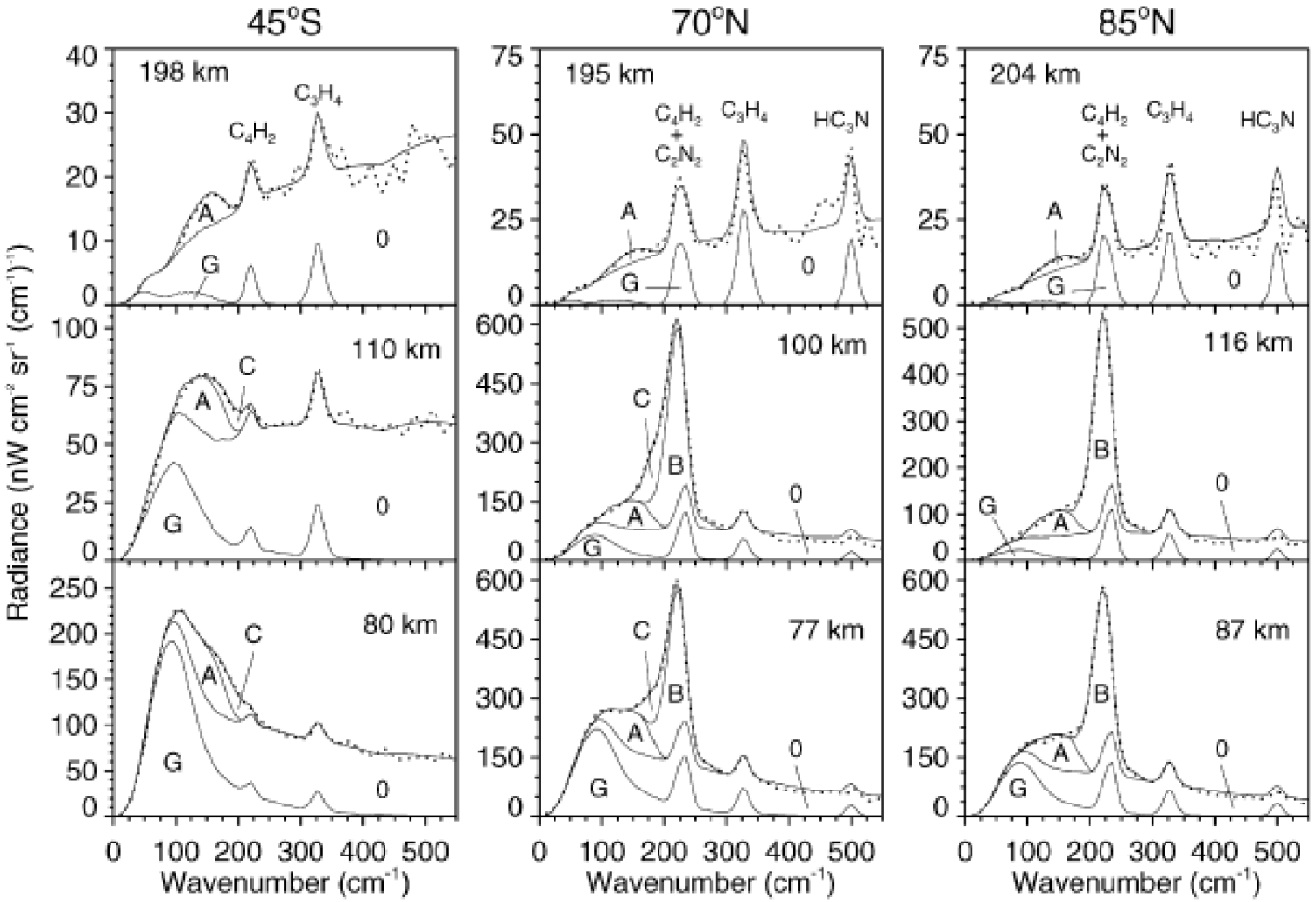
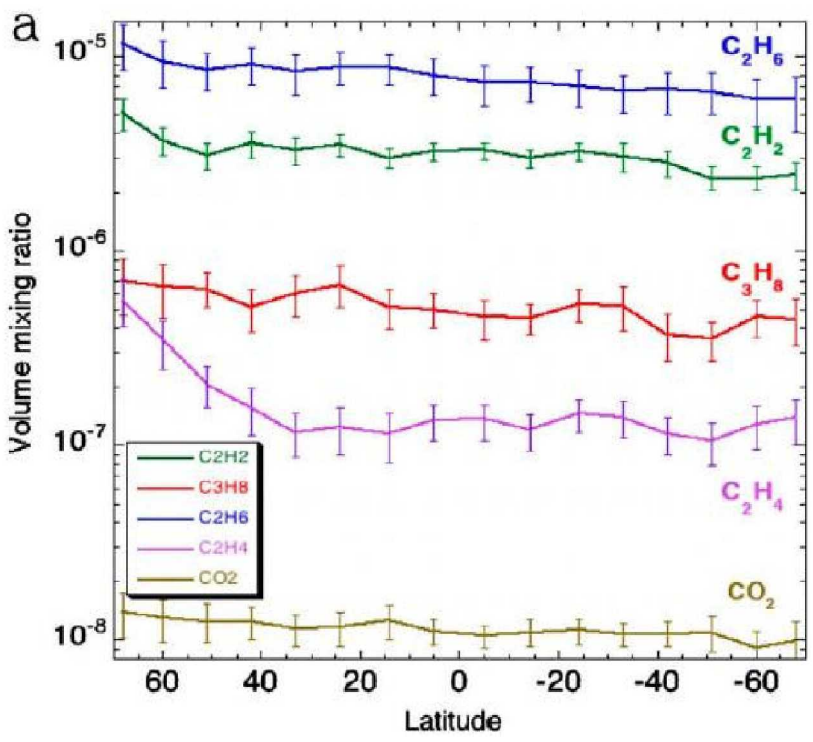
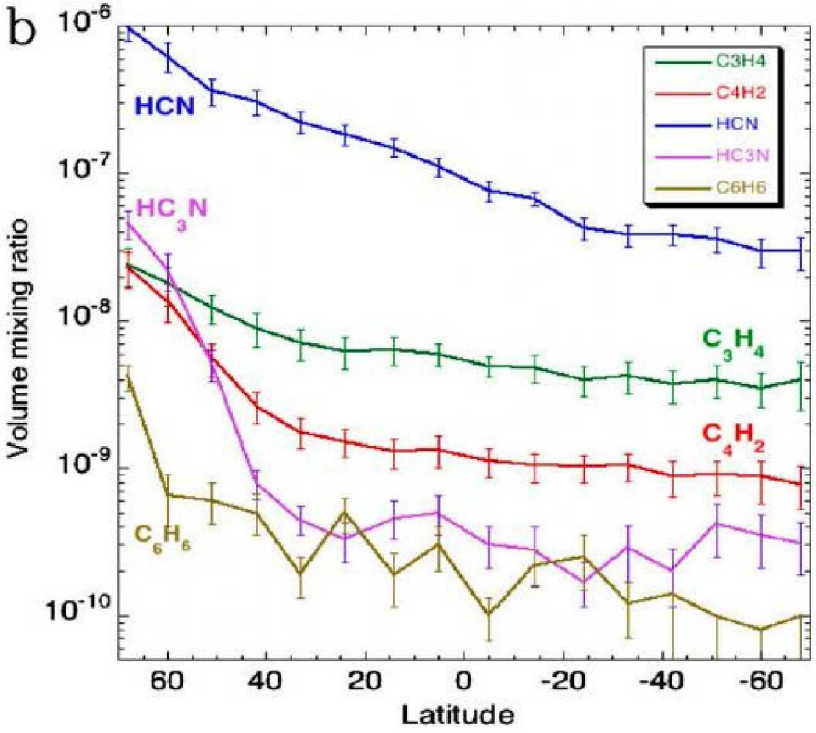
Titan Haze Spectra



de Kok *et al.*, Icarus 191, 223 (2007)

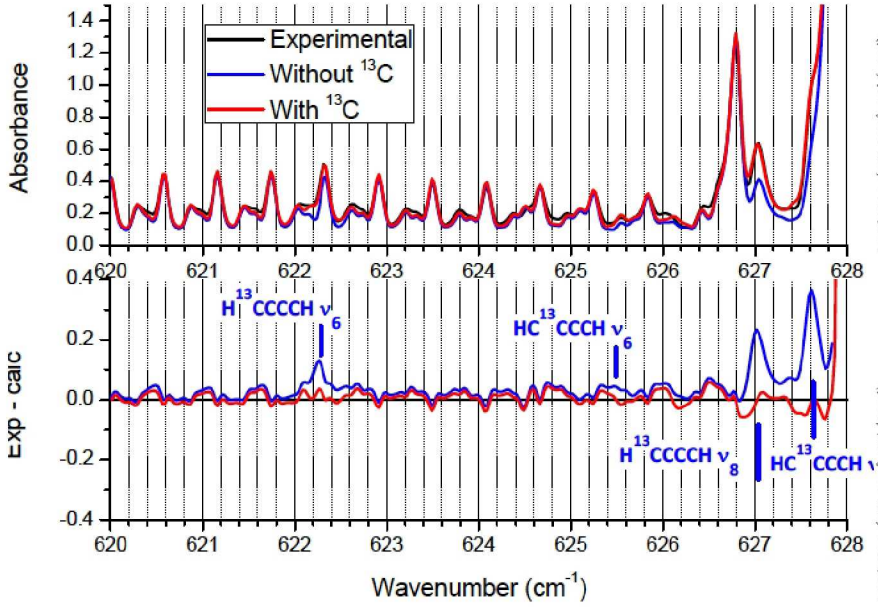
Trace gases on Titan variation with latitude



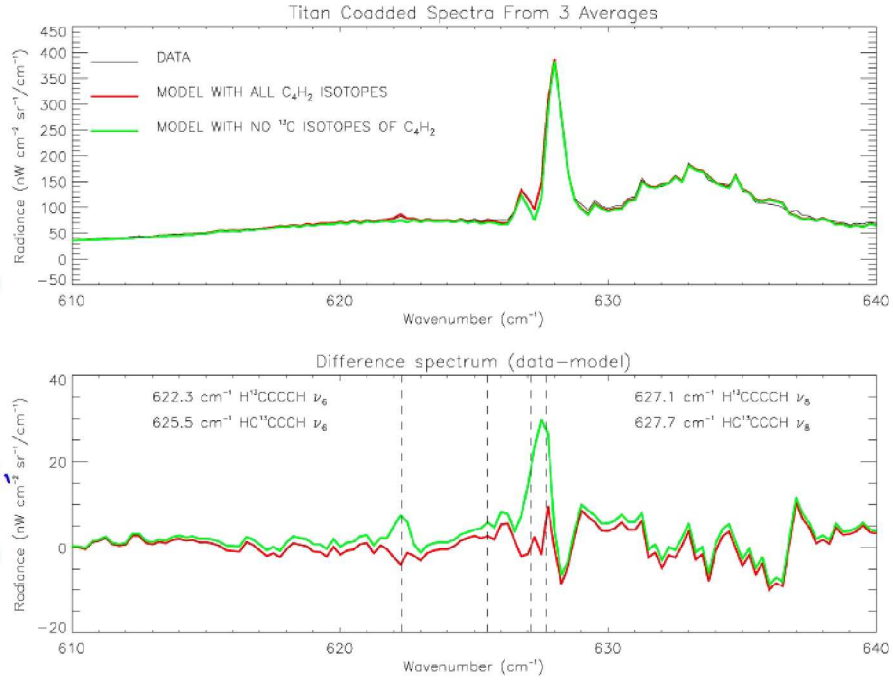


Coustenis *et al.*, Icarus 207, 461 (2010)

Isotopic species: identification of ^{13}C-diacetylene in Titan from laboratory measurements



Laboratory spectra of $H^{13}CCCCH$ and $HC^{13}CCCH$

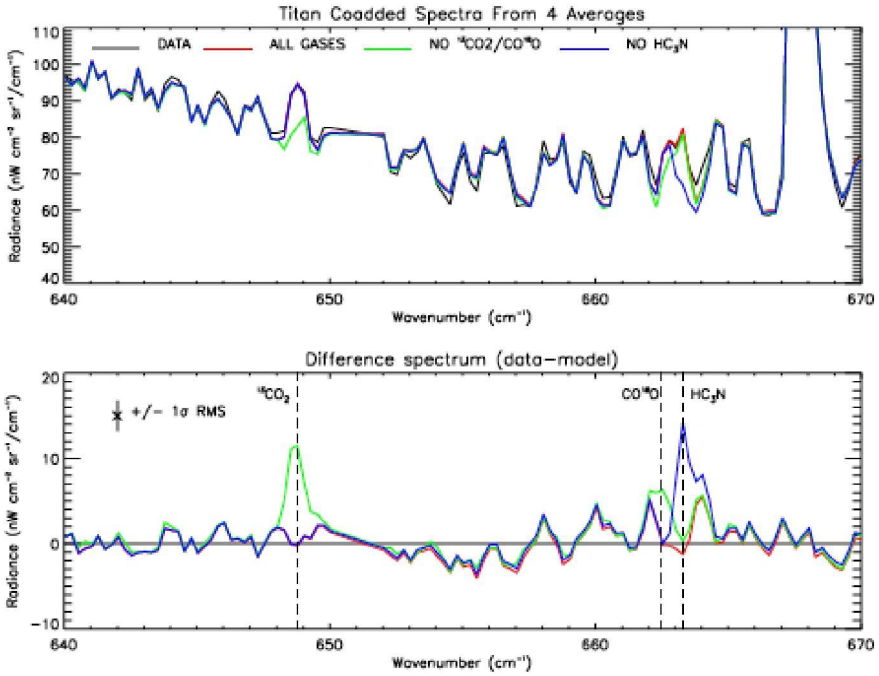


Titan from CIRS observations

Jolly *et al.*, *Astrophys. J.* 714, 852 (2010).

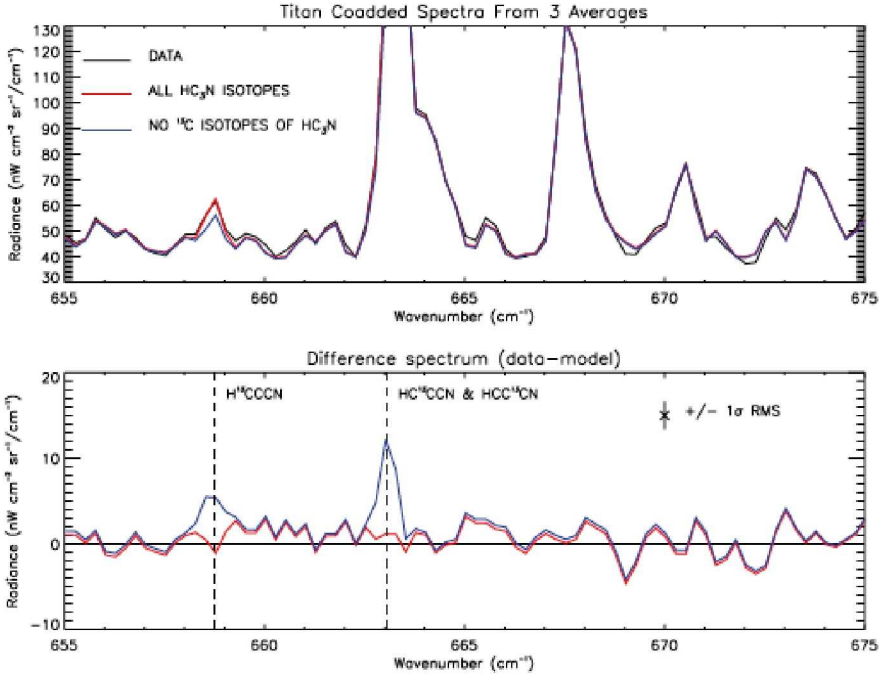
^{13}C and ^{18}O on Titan

Isotopic CO_2



Nixon *et al.*, Ap J 681, L101 (2008)

Isotopic HC_3N

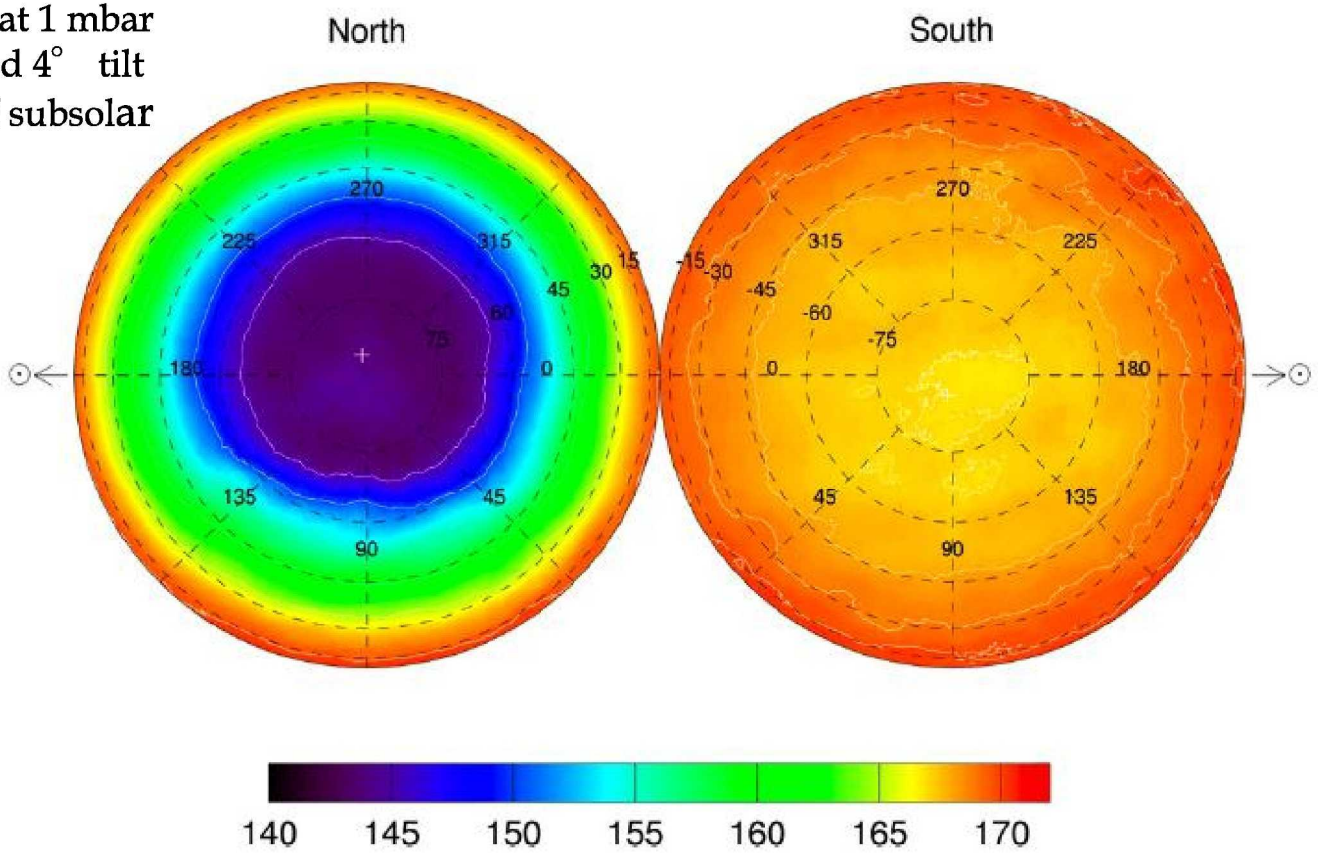


Jennings *et al.*, Ap J 681, L109 (2008)

Temperature asymmetry in Titan's stratosphere

Temperatures at 1 mbar

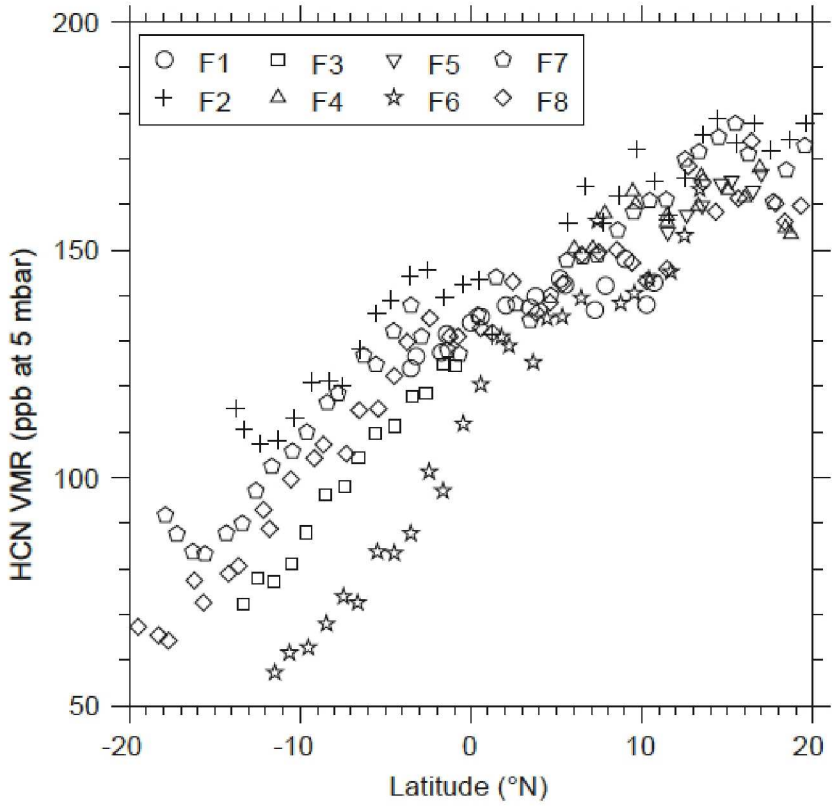
Temperature at 1 mbar
Tilted 4° tilt
at 76 W of subsolar



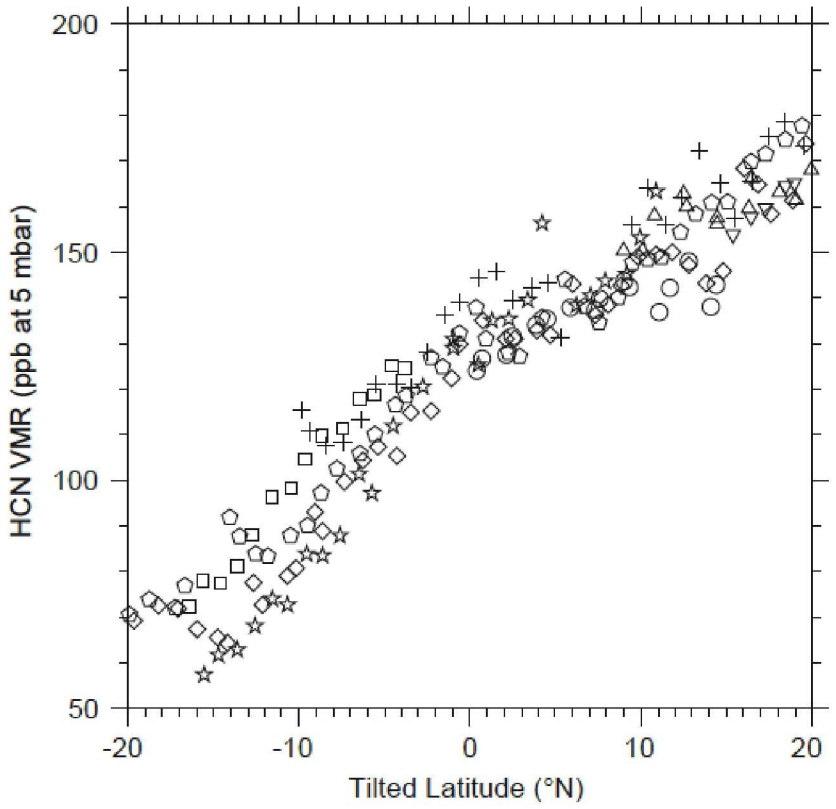
Achterberg *et al.*, Icarus 197, 549 (2008)

Stratospheric Tilt from Titan's Rotation Axis

No tilt

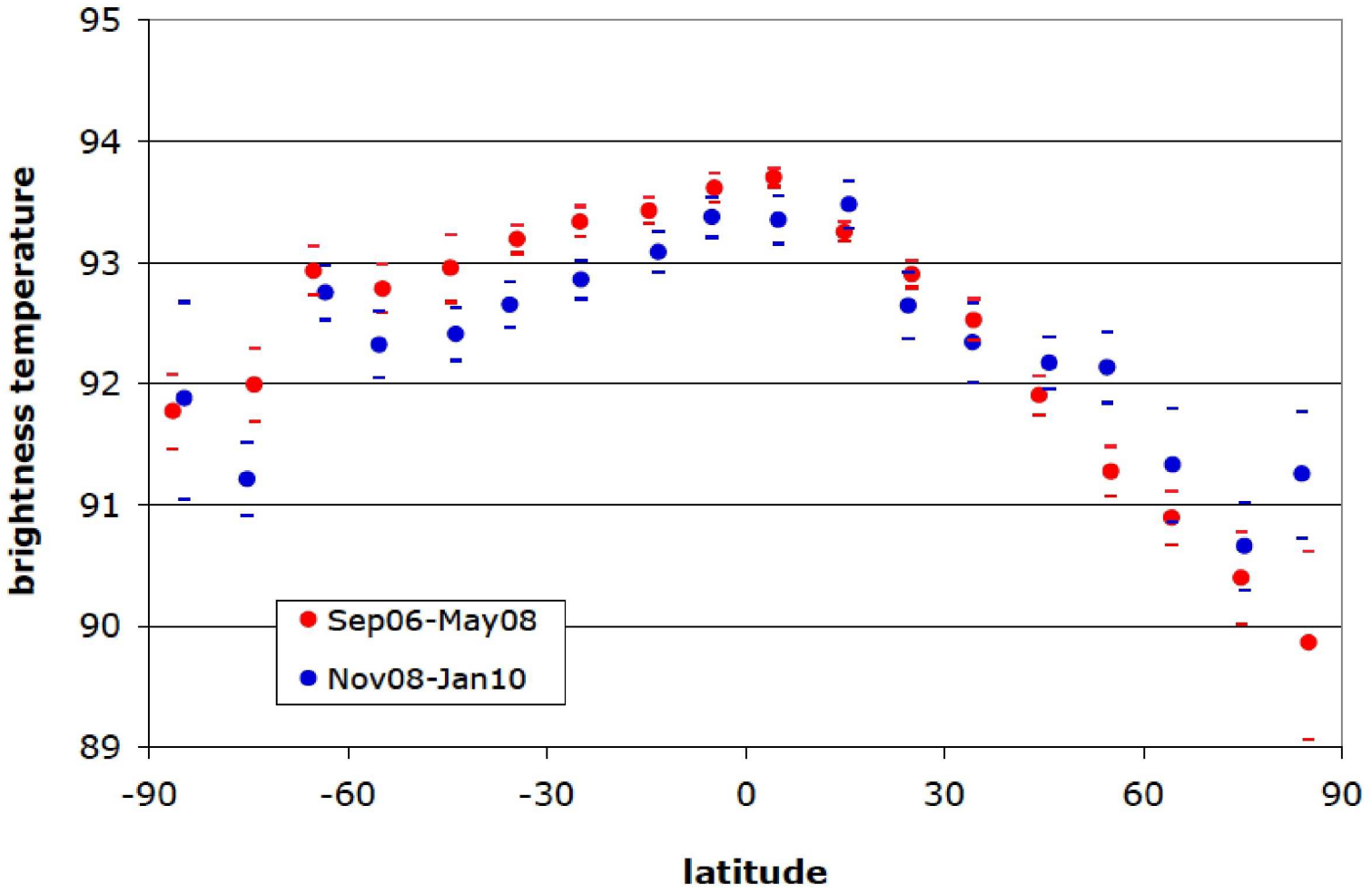


4° tilt at 76 W of subsolar
from Achterberg *et al.* (2008)

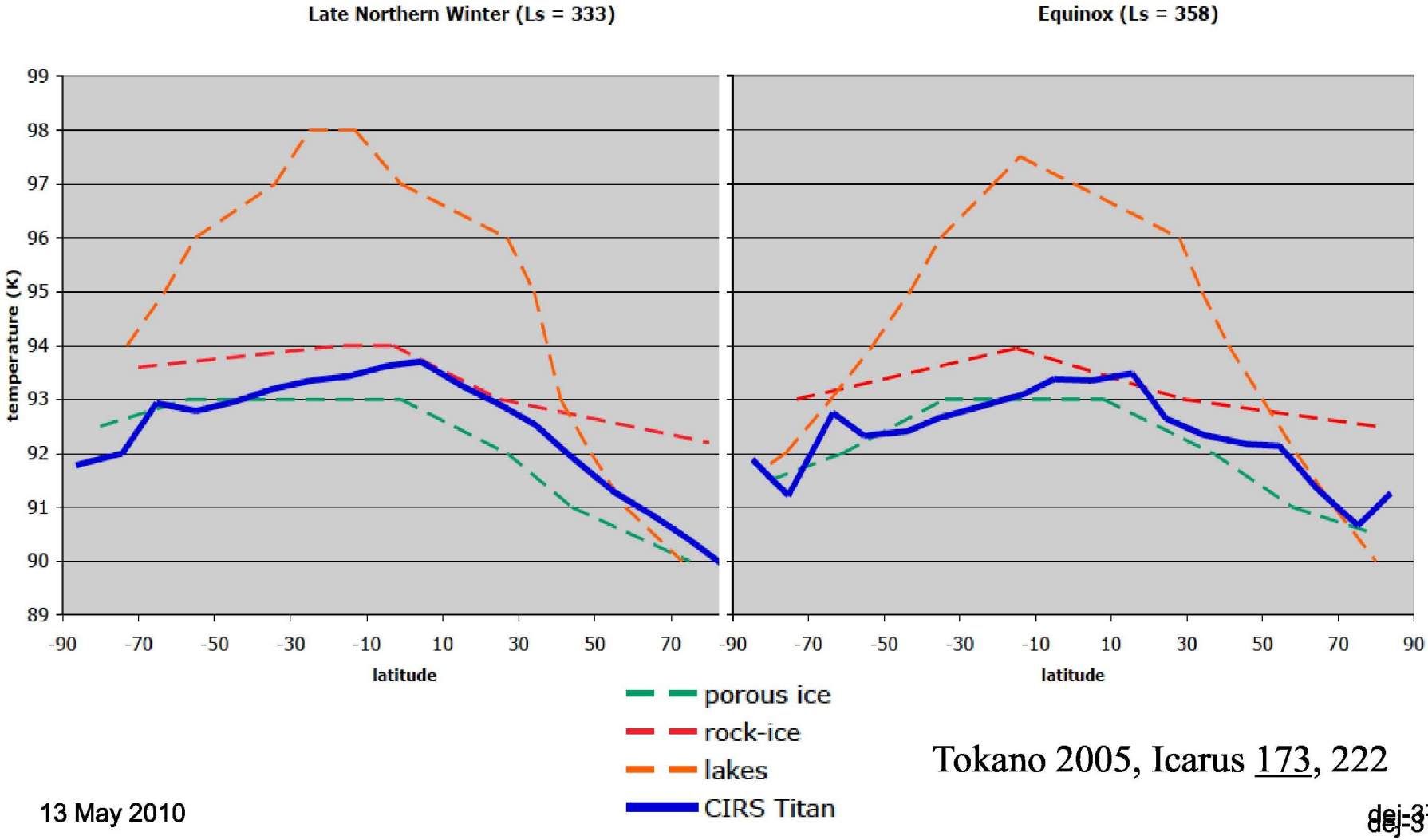


Teanby, Irwin and de Kok, Plan. Sp. Sci. 58, 792 (2010)

Titan Surface Temperature vs Latitude Seasonal Variation



Titan Surface Temperature Seasonal Variation Comparison with Predictions for Surface Types



Tokano 2005, Icarus 173, 222

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COMPOSITE INFRARED SPECTROMETER
CASSINI CIRS
OBS. PARIS-MEUDON
QMW-LONDON
UNIV. OF OXFORD
CEA/ASTROPHYSIQUE
NASA/GSFC