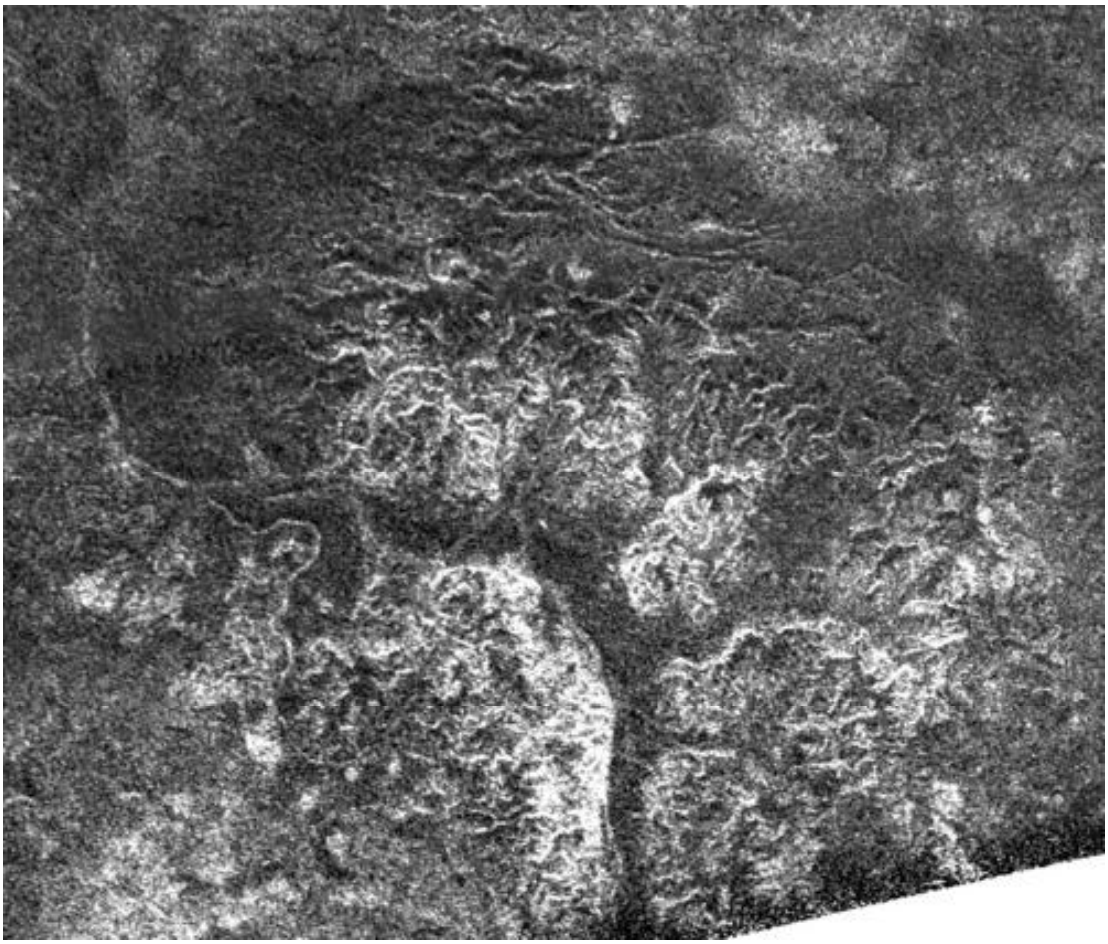
C A S S I N I



T I T A N 1 1 3 T I (T 5 7)
MISSION DESCRIPTION

June 22, 2009

Jet Propulsion Laboratory
California Institute of Technology

Cover image: Southern Canyons of Titan

Complex and unique canyon systems appear to have been intricately carved into older terrain by the ample flow of liquid methane rivers on Saturn's moon Titan, as seen in this radar image taken by NASA's Cassini spacecraft on May 21, 2009.

The channels seen here indicate that fluids flowed from high plateaus on the right to lowland areas on the left. In the center of the image, the wide distribution of the channels' tributaries suggests that rainfall is effectively eroding the surface. The bright terrain toward the bottom of the image is interpreted as high cliffs and broken bedrock.

These canyon systems remind us that Titan is (or has recently been) a dynamic world with a complicated geological history. Multiple channels have flowed into a wide, dark arc in the center of this mountainous region. Here, the canyons appear to have been filled by fine-grained materials that appear dark (smooth) to Cassini's synthetic aperture radar.

These canyon-filling materials were later carved by a large river channel that winds from the bottom left of the image toward the left center.

The image center is at 71 degrees south latitude, 240 degrees west longitude, and its dimensions are 335 by 289 kilometers (208 by 179 miles). The radar illuminated this area from the top of the image at 18 degrees incidence angle. The areas seen here are typical of other regions observed near Titan's south pole in other flybys (see Radar Sees Lakes in Titan's Southern Hemisphere).

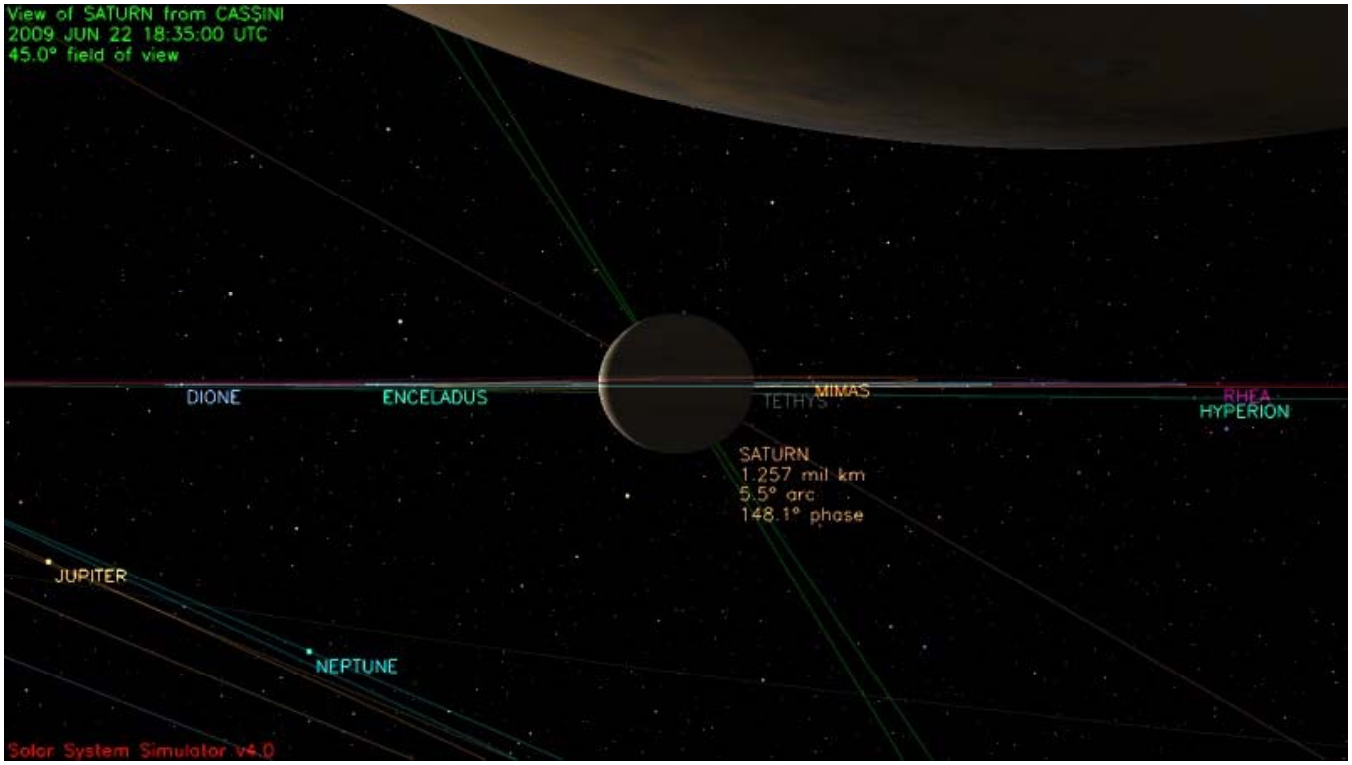
The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency.

Credit: NASA/JPL/Space Science Institute

1.0 OVERVIEW

Just under 16 days since its previous visit, Cassini returns to Saturn's largest moon for the mission's fifty-eighth targeted encounter with Titan. The closest approach to Titan occurs on Monday, June at173T18:32:35 spacecraft time at an altitude of 955 kilometers (~594 miles) above the surface and at a speed of 6.0 kilometers per second (~13,400 mph). The latitude at closest approach is 42.2 degrees S and the encounter occurs on orbit number 113.

This encounter is set up with two maneuvers: an apoapsis maneuver on June 14, and a Titan approach maneuver, scheduled for June 19. T57 is the sixth flyby in a series of eleven inbound encounters and the thirteenth Titan encounter in Cassini's Solstice Mission. It occurs just under three days before Saturn closest approach.


View of SATURN from CASSINI
2009 JUN 22 18:35:00 UTC
45.0° field of view
DIONE
ENCELADUS
TETHYS
MIMAS
RHEA
HYPERION
SATURN
1.257 mil km
5.5° arc
148.1° phase
JUPITER
NEPTUNE
Solar System Simulator v4.0

ABOUT TITAN

If Titan were a planet, it would likely stand out as the most important planet in the solar system for humans to explore. Titan, the size of a terrestrial planet, has a dense atmosphere of nitrogen and methane and a surface covered with organic material. It is Titan that is arguably Earth's sister world and the Cassini-Huygens mission considers Titan among its highest priorities.

Although it is far colder and lacks liquid water, the chemical composition of Titan's atmosphere resembles that of early Earth. This, along with the organic chemistry that takes place in Titan's atmosphere, prompts scientists to believe that Titan could provide a laboratory for seeking insight into the origins of life on Earth. Data from the Huygens probe, which touched down on Titan's surface in January 2005, and the Cassini orbiter has shown that many of the processes that occur on Earth also apparently take place on Titan – wind, rain, volcanism, tectonic activity, as well as river channels, and drainage patterns all seem to contribute in shaping Titan's surface. However, at an inhospitable -290 degrees Fahrenheit (-179 degrees Celsius), the chemistry that drives these processes is fundamentally different from Earth's. For example it is methane that performs many of the same functions on Titan that water does on Earth.

The Huygens probe landed near a bright region now called Adiri, and photographed light hills with dark river beds that empty into a dark plain. It was believed that this dark plain could be a lake or at least a muddy material, but it is now known that Huygens landed in the dark region, and it is solid. Scientists believe it only rains occasionally on Titan, but the rains are extremely fierce when they come.

Only a small number of impact craters have been discovered. This suggests that Titan's surface is constantly being resurfaced by a fluid mixture of water and possibly ammonia, believed to be expelled from volcanoes and hot springs. Some surface features, such as lobate flows, appear to be volcanic structures. Volcanism is now believed to be a significant source of methane in Titan's atmosphere. However, there are no oceans of hydrocarbons as previously hypothesized. Dunes cover large areas of the surface.

The existence of oceans or lakes of liquid methane on Saturn's moon Titan was predicted more than 20 years ago. Radar and imaging data from Titan flybys have provided convincing evidence for large bodies of liquid. With Titan's colder temperatures and hydrocarbon-rich atmosphere, these lakes and seas most likely contain a combination of liquid methane and ethane (both hydrocarbons), not water.

The Cassini-Huygens mission, using wavelengths ranging from ultraviolet to radio, is methodically and consistently revealing Titan and answering long-held questions regarding Titan's interior, surface, atmosphere, and the complex interaction with Saturn's magnetosphere. While many pieces of the puzzle are yet to be found, with each Titan flyby comes a new data set that furthers our understanding of this world as we attempt to constrain scenarios for the formation and evolution of Titan and its atmosphere.

1.1 TITAN-57 SCIENCE HIGHLIGHTS

- **INMS:** INMS has a prime observation at closest approach of the night side outer flank at mid Southern latitudes.
- **RADAR** conducts a ridealong SAR on INMS, outbound altimetry, scatterometry, and radiometry. The SAR runs parallel to tracks from T55 and T56 in the southern hemisphere hemisphere mapping sequence.
- **RSS** observes an ingress only Titan ionospheric/atmospheric occultation on T57 . The occultation probes a northern latitude of 78.7 degrees, the highest in both the nominal and extended missions. The occultations will shed more light on Titan's polar vortex, and together with previous occultations, on the latitudinal variability of the electron density profile of the ionosphere, temperature/pressure profile, absorptivity profile, and small scale-structure of the neutral atmosphere.
- **CIRS** conducts mid-southern latitude far and mid infrared vertical composition section.
- **ISS**: 0.5-hour illuminated prime observation primarily for photometry. ISS will ride along with VIMS to observe Titan's trailing hemisphere at mid-southern latitudes and relatively low phase angle and with CIRS to monitor clouds.
- **VIMS:** On the inbound leg, the phase angle is much larger than 90 degrees and VIMS ridealong observations will provide information on Titan's atmospheric composition. After closest approach, VIMS will observe the South Pole region riding along with CIRS far from Titan. Only cloud monitoring will be possible.
- **UVIS**: The instrument will obtain an image cube of Titan's atmosphere at EUV and FUV wavelengths by sweeping its slit across the disk. These cubes provide spectral and spatial information on nitrogen emissions, H emission and absorption, absorption by simple hydrocarbons, and the scattering properties of haze aerosols. This is one of many such cubes gathered over the course of the mission to provide latitude and seasonal coverage of Titan's middle atmosphere and stratosphere.
- **MIMI** measures energetic ion and electron energy input to Titan's atmosphere.
- **MAG**: T57 is another flank-out, post-dusk flyby, with a minimum altitude of 1000 km.

As in T55 and T56 MAG measurements will provide a description of the draping and the pileup of the external magnetic field around Titan on the nightside hemisphere. It will be also a good complement to T52, T53, T54, T55 and T56 in order to characterize the background field for a similar local time with respect to Saturn and different SKR longitudes.

- **RPWS** will measure thermal plasmas in Titan's ionosphere and surrounding environment; search for lightning in Titan's atmosphere; and investigate the interaction of Titan with Saturn's magnetosphere.

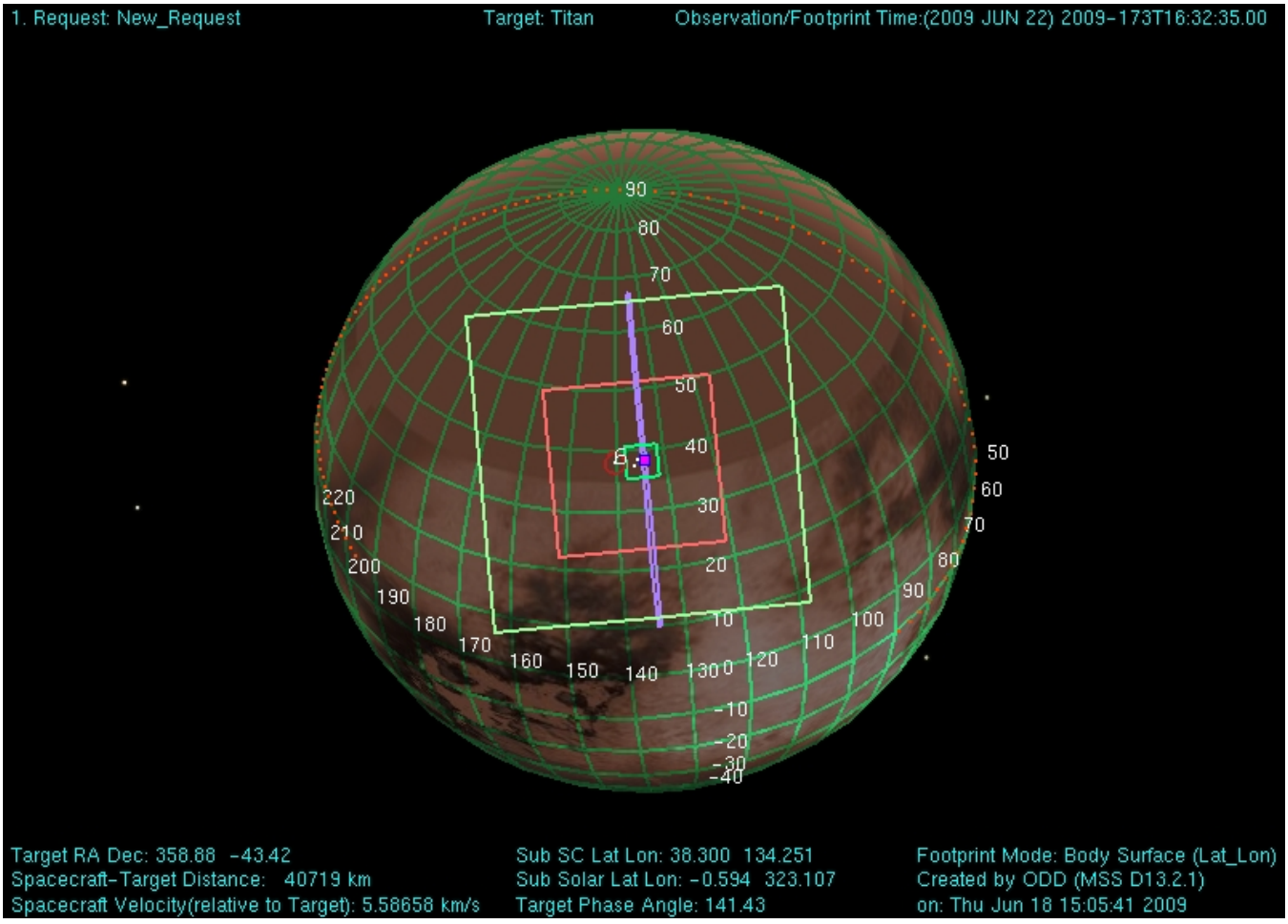
SAMPLE SNAPSHOTS

Three views of Titan from Cassini before, during, and after closest approach to Titan are shown below. The views are oriented such that the direction towards the top of the page is aligned with the Titan North Pole. The optical remote sensing instruments' fields of view are shown assuming they are pointed towards the center of Titan. The sizes of these fields of view vary as a function of the distance between Cassini and Titan. A key for use in identifying the remote sensing instruments fields of view in the figures is listed at the top of the next page.

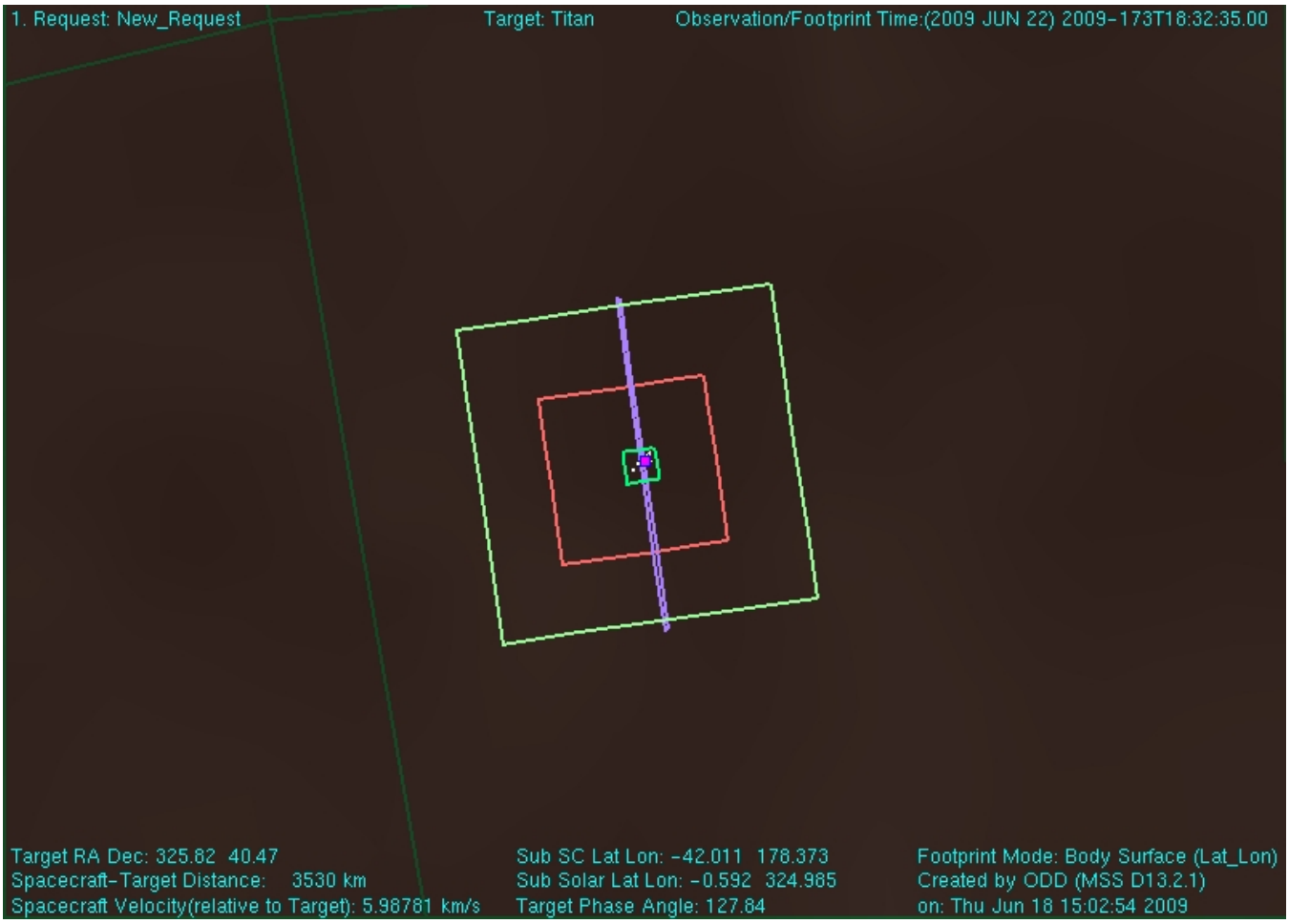
Key to ORS Instrument Fields of View in Figures

Instrument Field of View	Depiction in Figure
ISS WAC (imaging wide angle camera)	Largest square
VIMS (visual and infrared mapping spectrometer)	Next largest pink square
ISS NAC (imaging narrow angle camera)	Smallest green square
CIRS (composite infrared spectrometer) – Focal Plane 1	Small red circle near ISS_NAC FOV
UVIS (ultraviolet imaging spectrometer)	Vertical purple rectangle centered within largest square

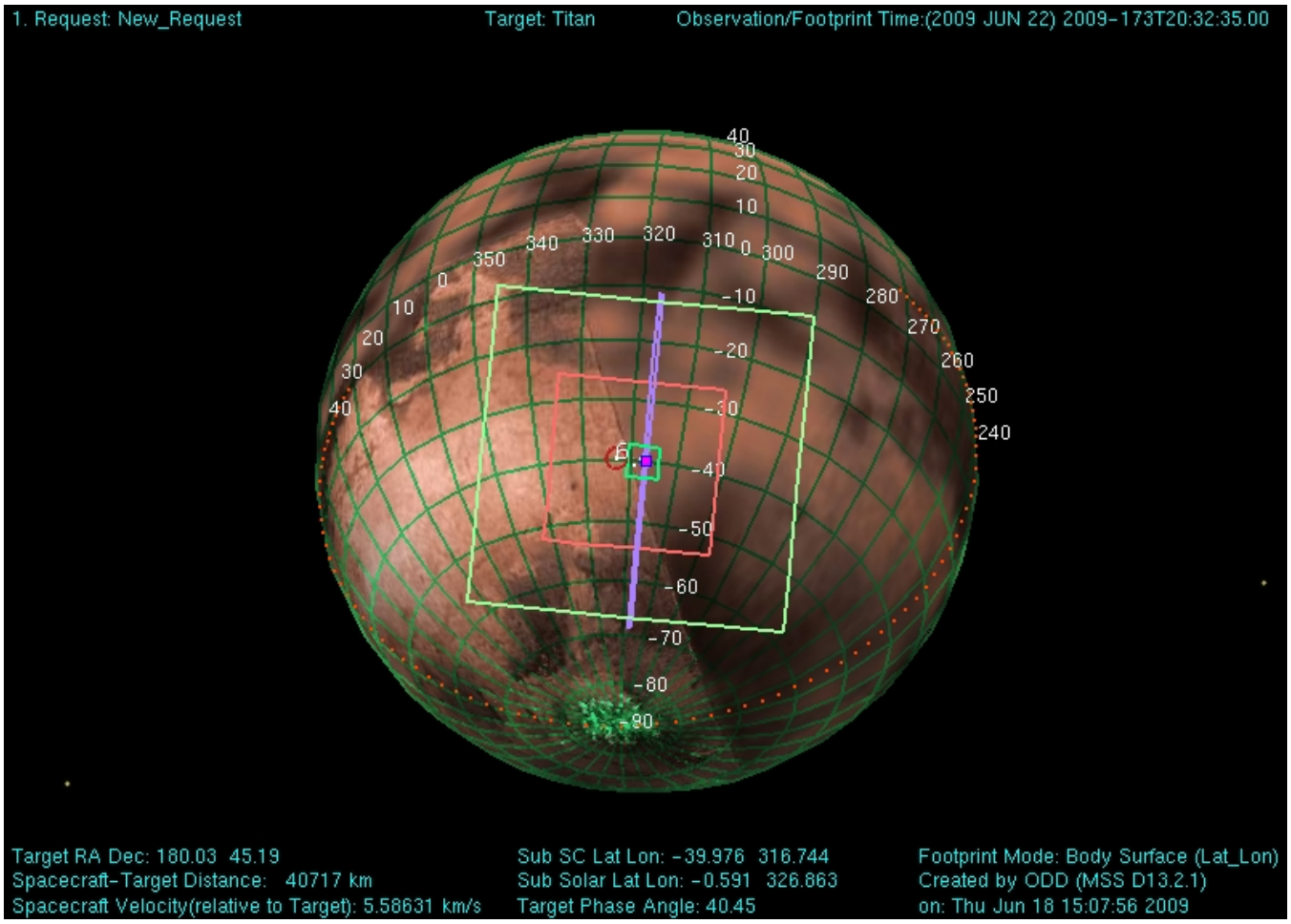
View of Titan from Cassini two hours before Titan-57 closest approach



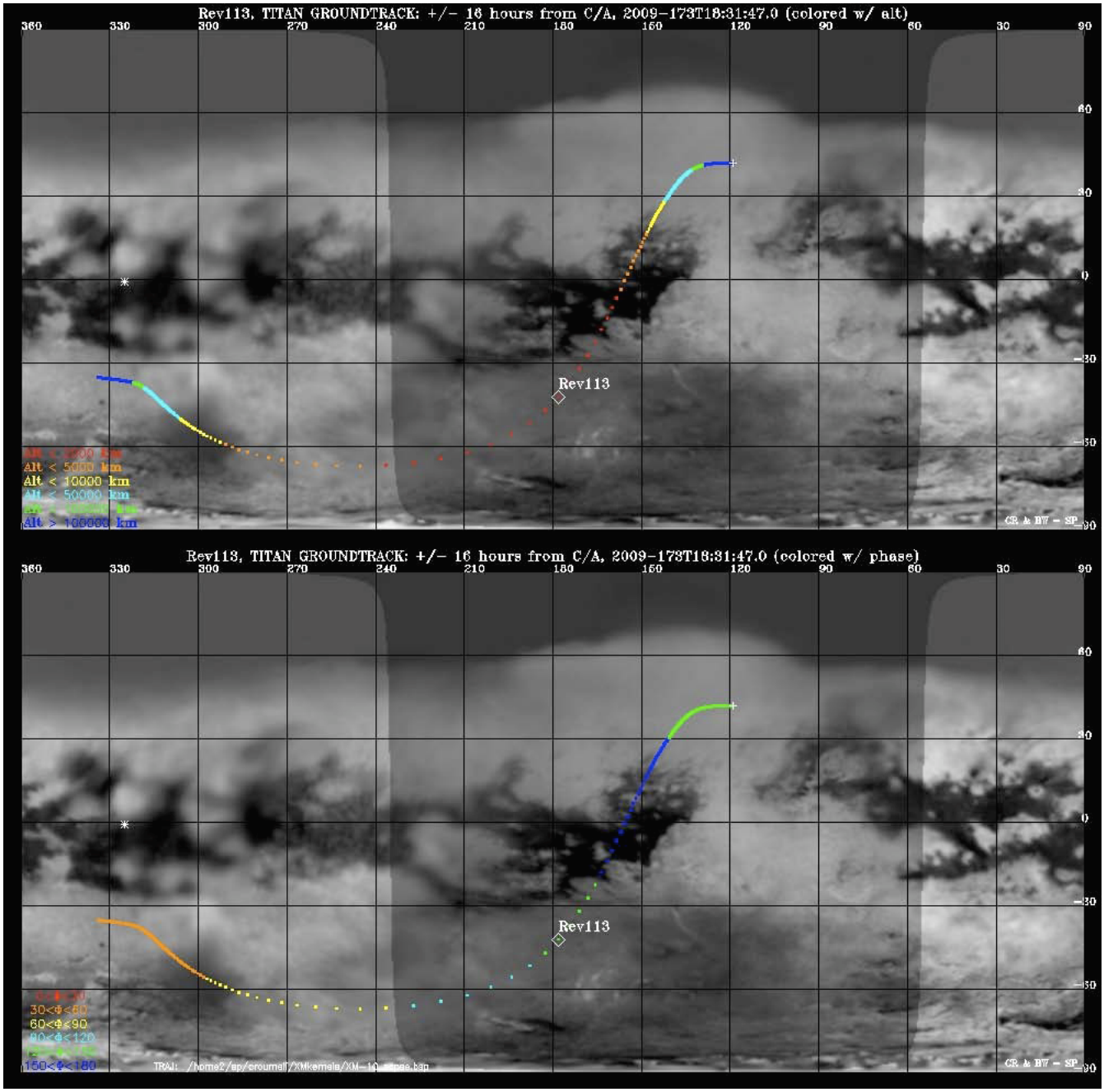
View of Titan from Cassini at Titan-57 closest approach



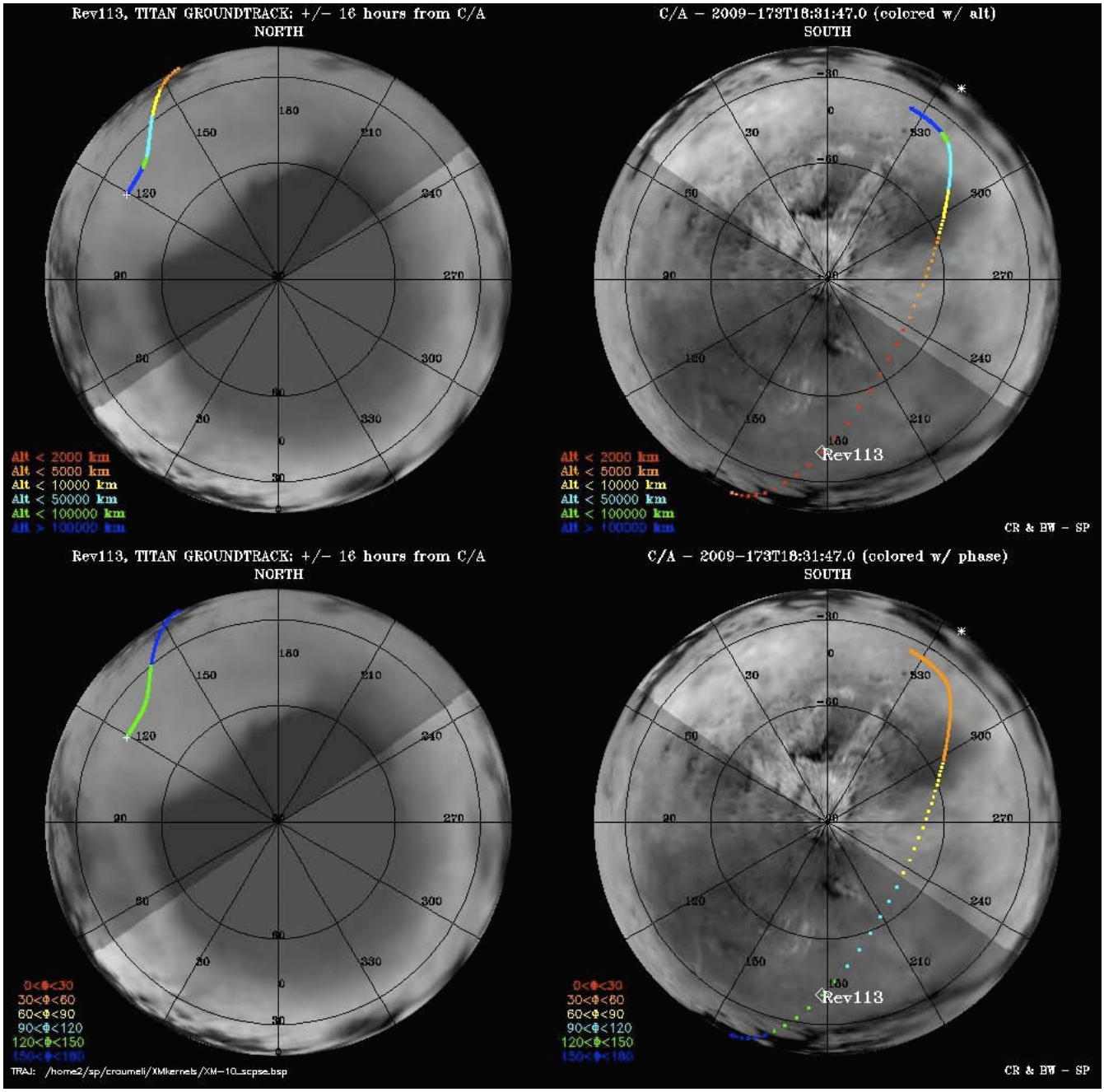
View of Titan from Cassini two hours after Titan-57 closest approach



Titan Groundtracks for T57: Global Plot



Titan Groundtracks for T57: Polar Plot



The T57 timeline is as follows:

Cassini Titan-57 Timeline - June 2009

Colors: yellow = maneuvers; blue = geometry; pink = T57-related; green = data playbacks

Orbiter UTC	Ground UTC	Pacific Time (PDT)	Time wrt T57	Activity	Description
164T04:41:00	Jun 13 06:01	Fri Jun 12 11:01 PM	T57-09d14h	Start of Sequence S51	Start of Sequence which contains Titan-57
170T11:40:00	Jun 19 13:00	Fri Jun 19 06:00 AM	T57-03d07h	OTM #202 Prime	Titan-57 targeting maneuver.
171T11:40:00	Jun 20 13:00	Sat Jun 20 06:00 AM	T57-02d07h	OTM #202 Backup	
173T04:10:00	Jun 22 05:30	Sun Jun 21 10:30 PM	T57-14h22m	Start of the TOST segment	
173T04:10:00	Jun 22 05:30	Sun Jun 21 10:30 PM	T57-14h22m	Turn cameras to Titan	
173T04:50:00	Jun 22 06:10	Sun Jun 21 11:10 PM	T57-13h42m	New waypoint	
173T04:50:00	Jun 22 06:10	Sun Jun 21 11:10 PM	T57-13h42m	Deadtime	15 minutes 48 seconds long; used to accommodate changes in flyby time
173T05:05:48	Jun 22 06:25	Sun Jun 21 11:25 PM	T57-13h27m	Titan atmospheric observations-CIRS	Obtain information on CO, HCN, CH4. Integrate on disk at airmass 1.5--2.0.
173T08:32:35	Jun 22 09:52	Mon Jun 22 02:52 AM	T57-10h00m	Titan surface observations-ISS	Nightside NAC. Monitoring for surface/atmosphere changes; attempt to see surface color variations; monitor limb hazes, 1-3 km/px
173T09:32:35	Jun 22 10:52	Mon Jun 22 03:52 AM	T57-09h00m	Titan atmospheric observations-UVIS	EUVFUV Imaging of Titan. Several slow scans across Titan's visible hemisphere to form spectral images
173T15:05:35	Jun 22 16:25	Mon Jun 22 09:25 AM	T57-03h27m	Transition to thruster control	
173T15:06:35	Jun 22 16:26	Mon Jun 22 09:26 AM	T57-03h26m	Titan atmospheric observations-UVIS	EUVFUV Imaging of Titan. Several slow scans across Titan's visible hemisphere to form spectral images
173T16:17:35	Jun 22 17:37	Mon Jun 22 10:37 AM	T57-02h15m	Titan atmospheric observations-CIRS	Vertical sounding of stratospheric compounds on Titan, including H2O. Integrations at 2 locations on the limb displaced vertically.
173T17:22:35	Jun 22 18:42	Mon Jun 22 11:42 AM	T57-01h10m	Titan atmospheric observations-RSS	RSS ingress/egress occultation of Titan's atmosphere and ionosphere
173T18:08:41	Jun 22 19:28	Mon Jun 22 12:28 PM	T57-00h24m	Earth occultation	24 minute duration
173T18:10:16	Jun 22 19:30	Mon Jun 22 12:30 PM	T57-00h22m	Solar occultation	22 minute duration
173T18:12:47	Jun 22 19:32	Mon Jun 22 12:32 PM	T57-00h20m	RADAR/INMS	Ride-along SAR with INMS
173T18:32:35	**Jun 22 19:52**	**Mon Jun 22 12:52 PM**	**T57+00h00m**	**Titan-57 Flyby Closest Approach Time**	**Altitude = 955 km (~593 miles), speed =6.0 km/s (13,400 mph); 128 deg phase at closest approach**
173T18:45:05	Jun 22 20:05	Mon Jun 22 01:05 PM	T57+00h13m	RADAR	Outbound Altimetry
173T18:53:35	Jun 22 20:13	Mon Jun 22 01:13 PM	T57+00h21m	Descending Ring Plane Crossing	
173T19:02:35	Jun 22 20:22	Mon Jun 22 01:22 PM	T57+00h30m	RADAR	Outbound HiSAR
173T19:22:35	Jun 22 20:42	Mon Jun 22 01:42 PM	T57+00h50m	Transition off of thruster control	
173T19:44:16	Jun 22 21:04	Mon Jun 22 02:04 PM	T57+01h12m	RADAR	Outbound scatterometry
173T20:32:35	Jun 22 21:52	Mon Jun 22 02:52 PM	T57+02h00m	RADAR	Outbound radiometry
174T00:02:35	Jun 23 01:22	Mon Jun 22 06:22 PM	T57+05h30m	Titan atmospheric observations-UVIS	EUVFUV Imaging of Titan. Several slow scans across Titan's visible hemisphere to form spectral images
174T03:02:35	Jun 23 04:22	Mon Jun 22 09:22 PM	T57+08h30m	Titan surface observations-ISS	WAC Photometry. Monitoring for surface/atmosphere changes; attempt to see surface color variations; monitor limb hazes, 1-3 km/px
174T03:32:35	Jun 23 04:52	Mon Jun 22 09:52 PM	T57+09h00m	Titan surface observations-VIMS	Map of Titan
174T08:32:35	Jun 23 09:52	Tue Jun 23 02:52 AM	T57+14h00m	Titan atmospheric observations-CIRS	Obtain information on the thermal structure of Titan's stratosphere.
174T16:32:35	Jun 23 17:52	Tue Jun 23 10:52 AM	T57+22h00m	Deadtime	27 minutes 24 seconds long; used to accommodate changes in flyby time
174T17:00:00	Jun 23 18:20	Tue Jun 23 11:20 AM	T57+22h28m	Turn to Earth-line	
174T17:40:00	Jun 23 19:00	Jun 23 12:00	T57+23h08m	Playback of T57 Data	Goldstone 70m
175T03:40:00	Jun 24 05:00	Jun 23 22:00	T57+01d09h	Playback of T57 Data	Canberra 70m