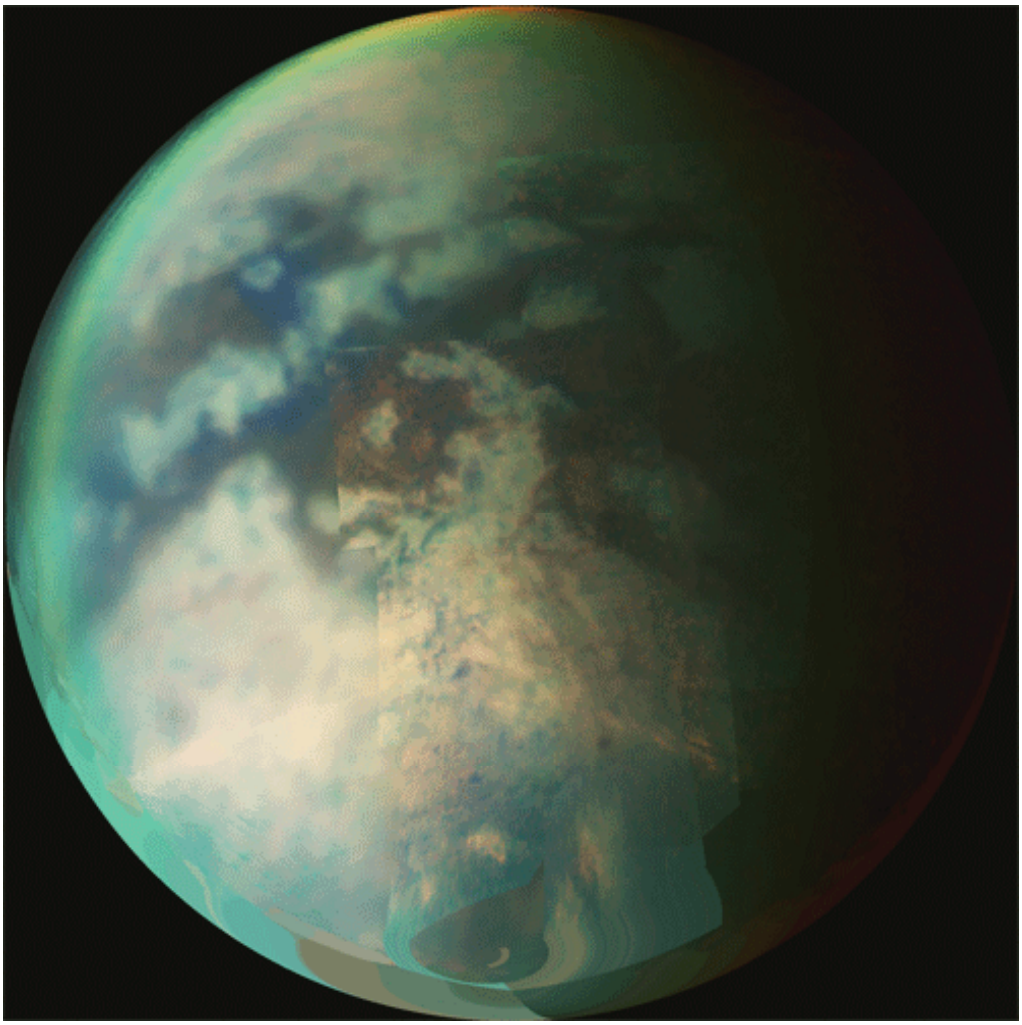
C A S S I N I



T I T A N **0 4 4 T I (T 3 0)** MISSION DESCRIPTION

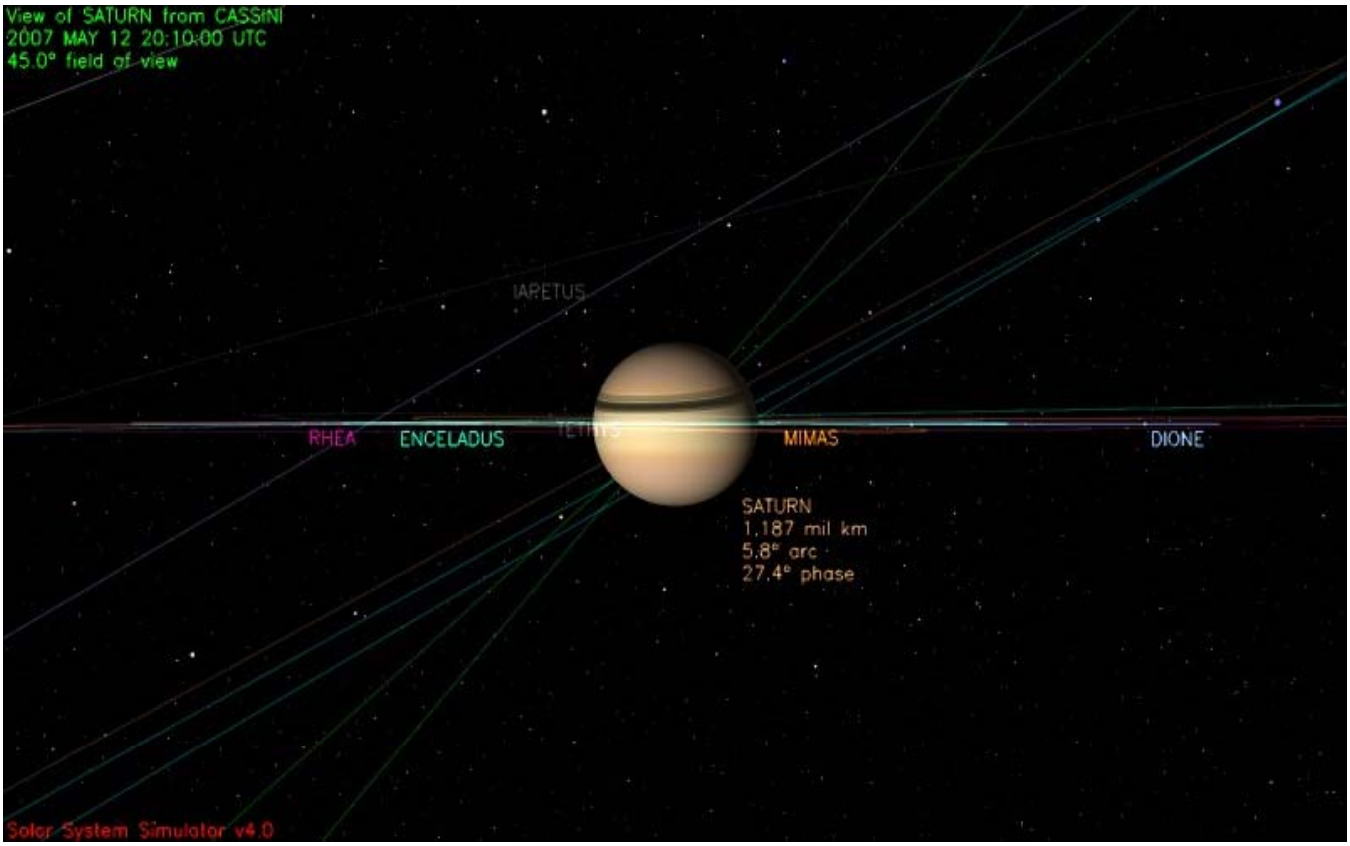
May 2007

Jet Propulsion Laboratory
California Institute of Technology

1.0 OVERVIEW

Sixteen days after Cassini's Titan-29 flyby, the spacecraft returns to Titan for its thirty-first targeted encounter. The closest approach to Titan occurs on Saturday, May 12, at 2007-132T20:09:58 spacecraft time at an altitude of 960 kilometers (~597 miles) above the surface and at a speed of 6.2 kilometers per second (13,870 mph). The latitude at closest approach is 68.9 degrees N and the encounter occurs on orbit number 44.

This encounter is set up with two maneuvers: an apoapsis maneuver on May 4, and a Titan approach maneuver, scheduled for May 8. This is the sixth in a series of outbound Titan encounters (until T34), and occurs about two days after Saturn closest approach.



1.1 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.

1.2 TITAN-30 SCIENCE HIGHLIGHTS

Cassini completes its exploration of the Fensal/Aaru region on Titan with its highest resolution pass of the area.

- RADAR has a large number of observations during the T30 flyby. High resolution observations will help nail down the shape of smaller scale topographic features. As with other recent flybys, overlapping coverage from previous flybys will make some stereo views possible. The team's ideas of what they most want to observe are changing as more data come in. For instance, the T30 SAR observation was changed after the RADAR team looked at observations from earlier Titan flybys. CIRS will obtain a surface temperature map of a region in Titan's southern hemisphere, and will do limb mapping for hydrocarbons. Observations will yield information on surface and tropopause temperatures, and on the prevalence of tropospheric CH4. On the outbound leg of the encounter, CIRS will be looking for information on the thermal structure of Titan's stratosphere.
- ISS will obtain a global map with resolution of 1 km/pixel, and will perform monitoring of the disk at 1.5 km/pixel at low solar phase angles. As in the previous Titan encounter, the ISS team will be monitoring for changes in the surface and atmosphere. Scientists will attempt to see if there are any surface color variations and will monitor limb hazes at a resolution of 1-3 km/pixel.
- VIMS will obtain a regional map on the outbound leg of the flyby.
- ISS has a global map on the outbound leg and will also be examining the vertical distributions of particles.
- CIRS will obtain information on the distribution of CO, HCN, and CH4, as well as the thermal structure of Titan's stratosphere.
- MAG considers this Titan encounter one of the most interesting Titan flybys for their instrument. Like T28 and T29, T30 has a very close encounter with the northern polar flyby feature from the inner flank towards the upstream region. Near the dawn side, the magnetic field is no longer vertical or dipolar. Rather, it's equatorial, pointing towards Saturn, which indicates that the spacecraft is located below a disk of plasma of unknown structure. MAG scientists will use these observations of the magnetic field to "see" the plasma disk. MAG might also have a good chance of looking at lobe of

induced magnetosphere of Titan. The solar wind might be strong enough to push the magnetopause in the direction of Saturn, causing the Titan flyby to occur in the solar wind, something Cassini hasn't yet observed. This means there might be the interesting possibility of encountering the solar wind in an unpredictable way

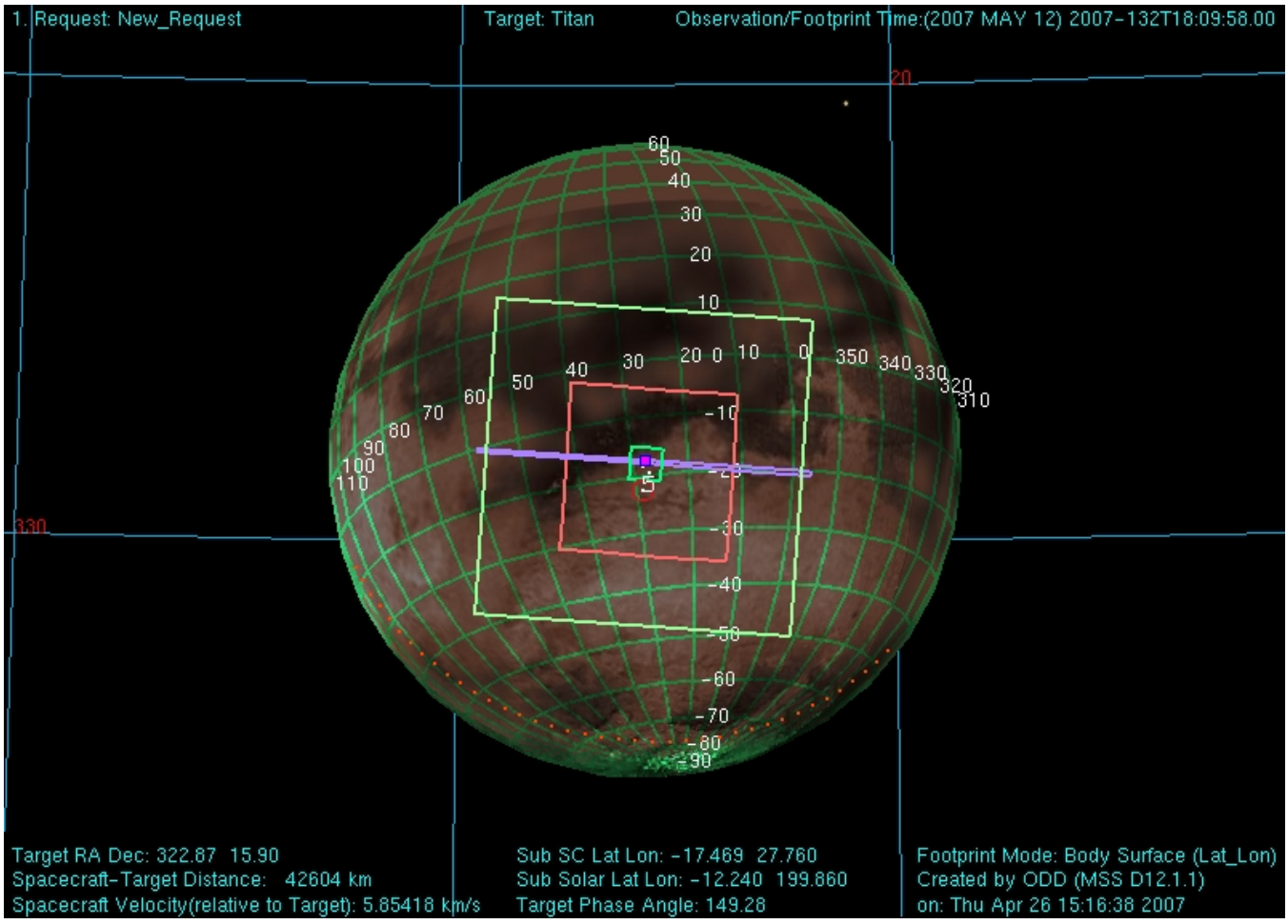
1.3 SAMPLE SNAPSHOTS

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.

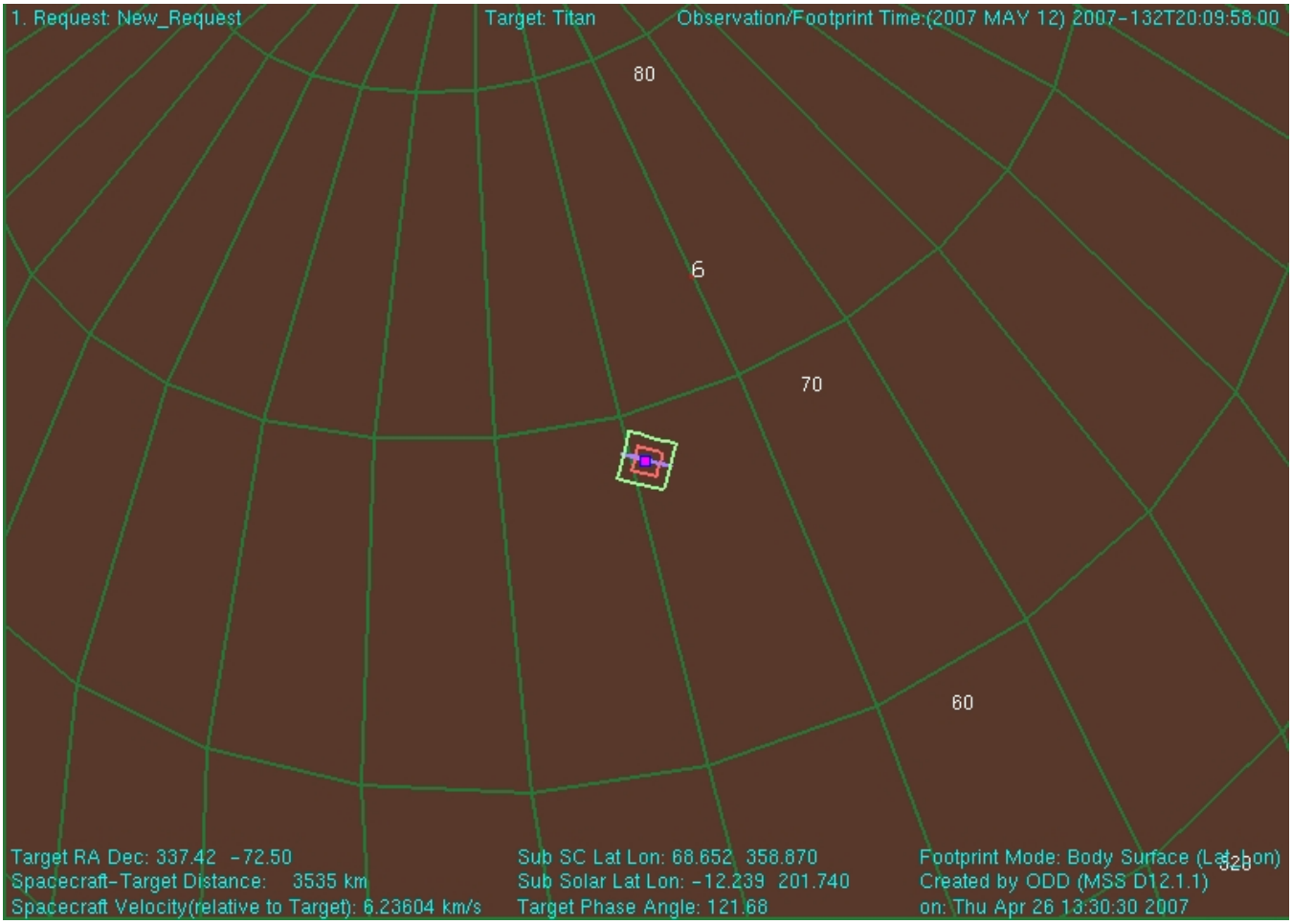
Key to ORS Instrument Fields of View in Figures

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

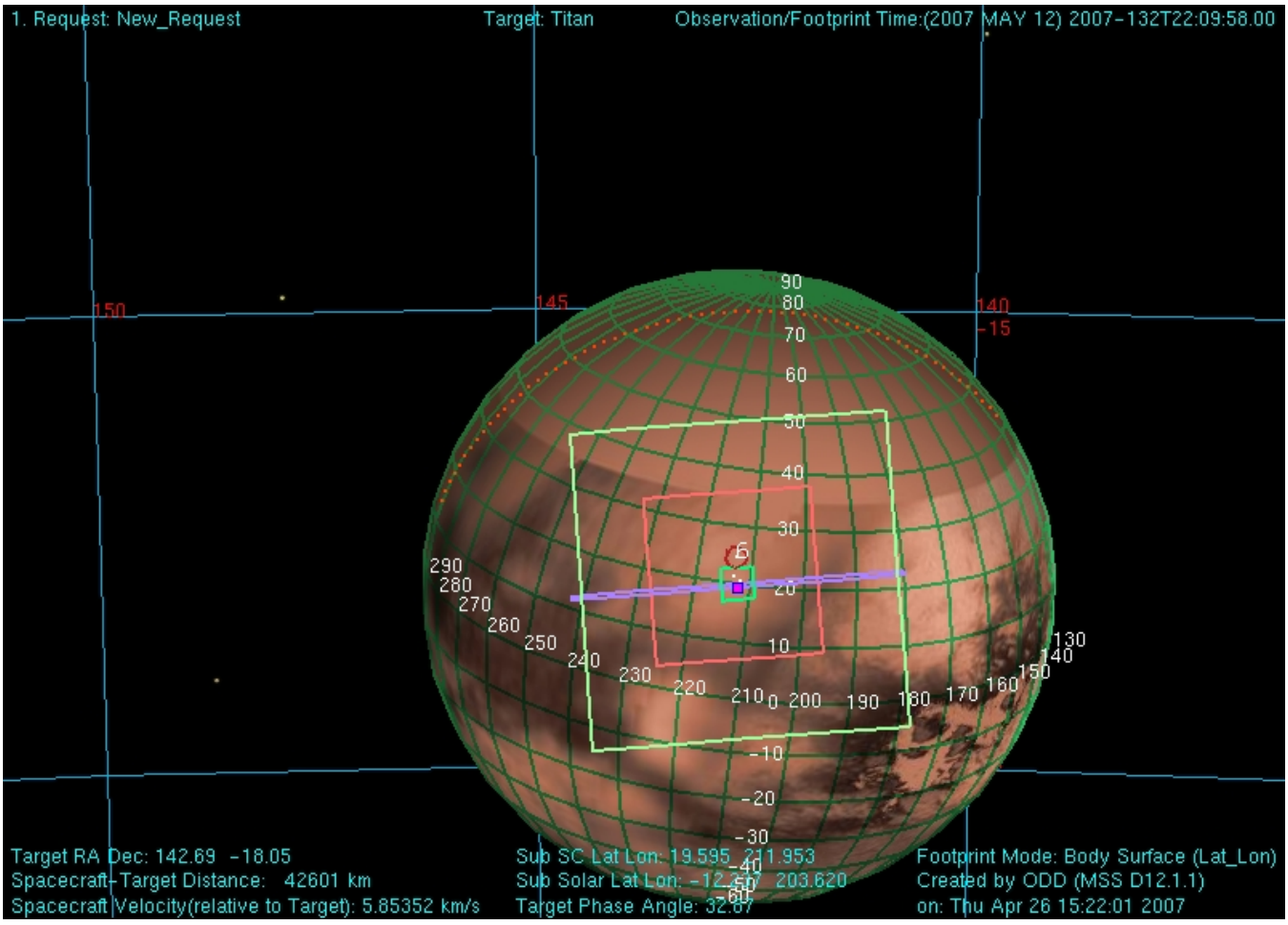
View of Titan from Cassini two hours before Titan-30 closest approach



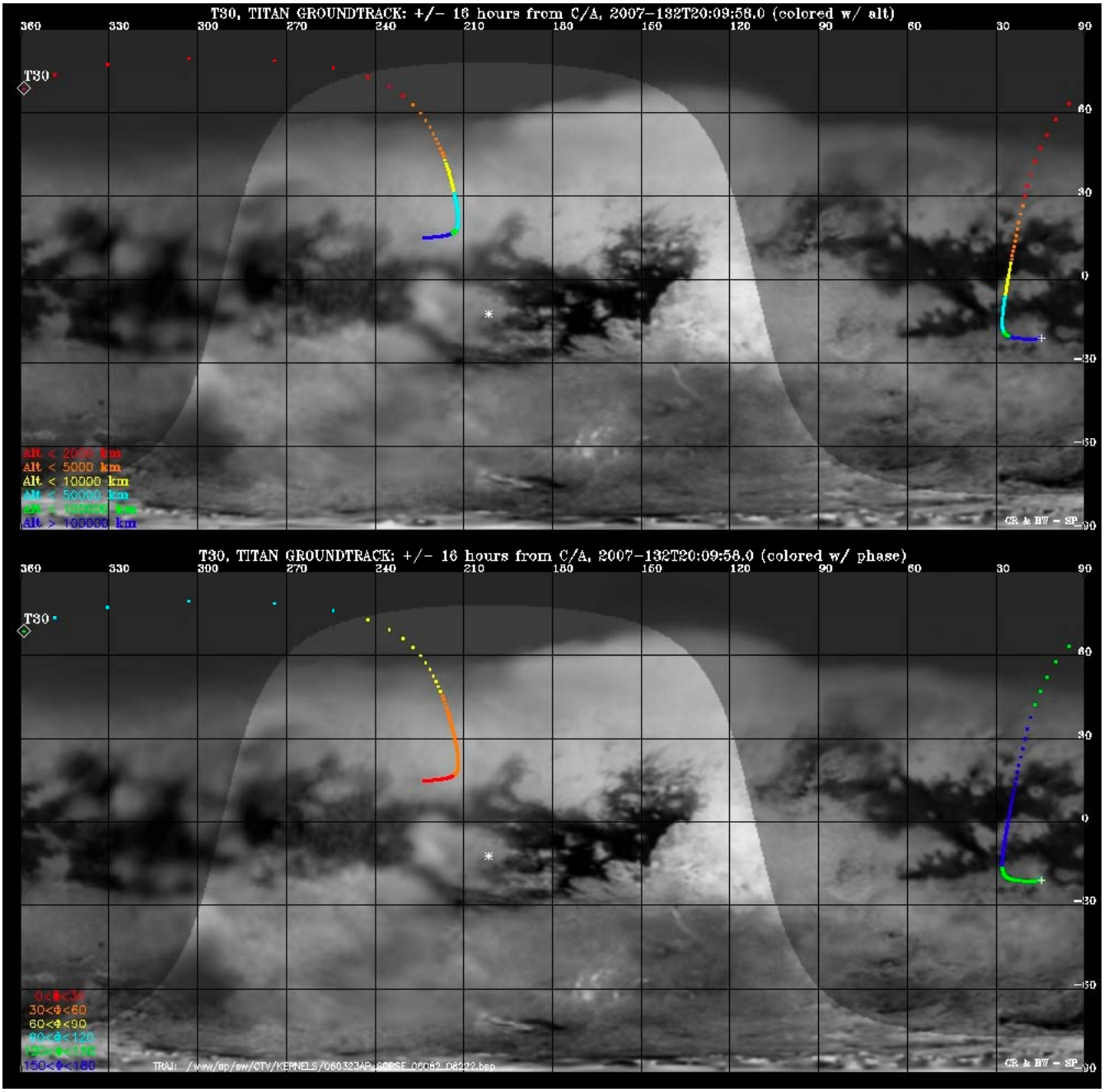
View of Titan from Cassini at Titan-30 closest approach



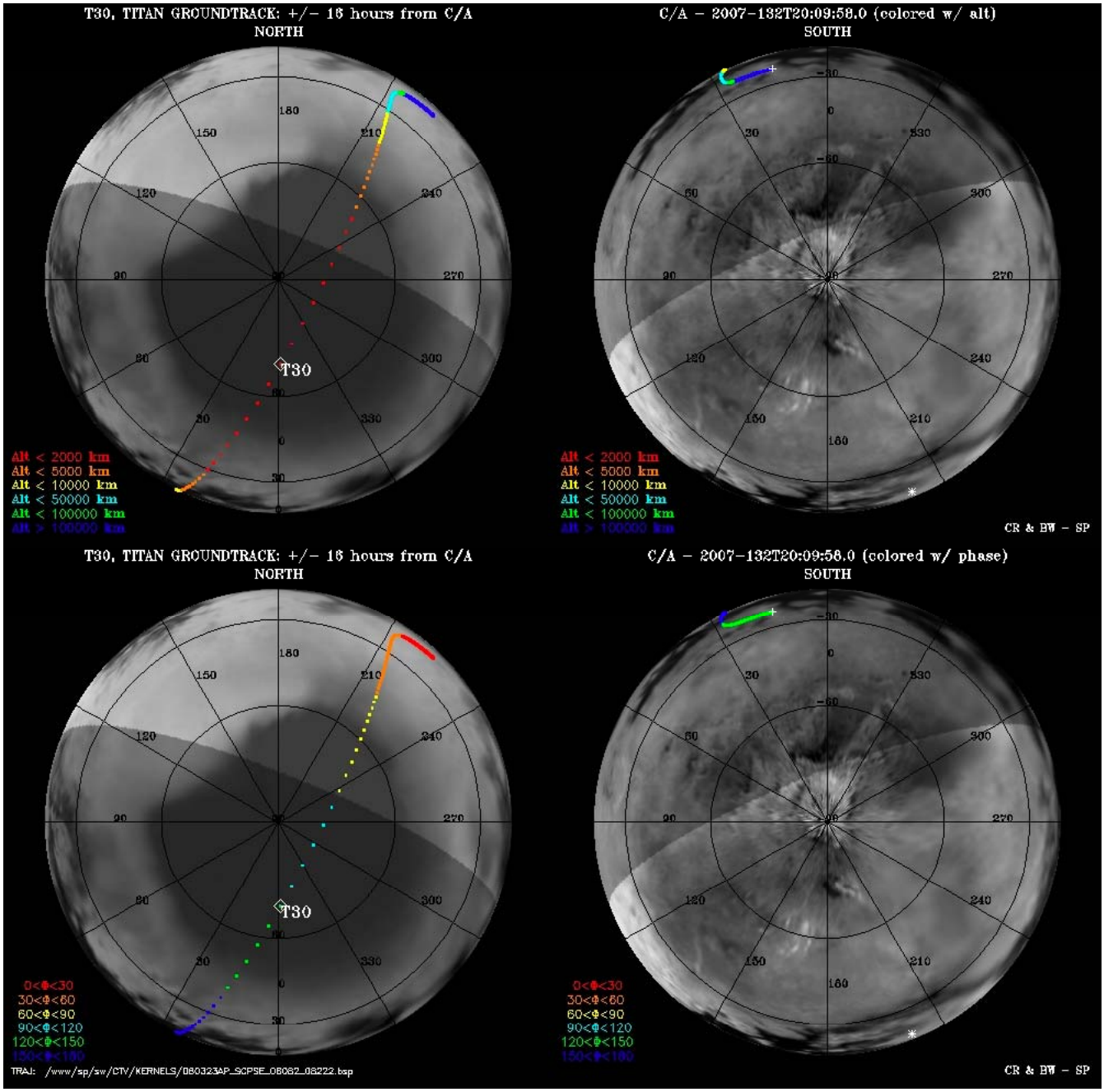
View of Titan from Cassini two hours after Titan-30 closest approach



Titan Groundtracks for T30: Global Plot



Titan Groundtracks for T30: Polar Plot



The T30 timeline is as follows:

Cassini Titan-30 Timeline - May 2007

Colors: yellow = maneuvers; blue = geometry; pink = T29-related; green = data playbacks

Orbiter UTC	Ground UTC	Pacific Time	Time wrt T30	Activity	Description
124T22:00:00	May 04 23:16	Fri May 04 03:16 PM	T30-07d22h	Start of Sequence S30	Start of Sequence which contains Titan-30
128T20:14:00	May 08 21:30	Tue May 08 01:30 PM	T30-03d24h	OTM #109 Prime	Titan-30 targeting maneuver.
129T20:14:00	May 09 21:30	Wed May 09 01:30 PM	T30-02d24h	OTM #109 Backup	
130T19:31:52	May 10 20:47	Thu May 10 12:47 PM	T30-02d01h	Descending Ring Plane Crossing	
130T22:46:55	May 11 00:02	Thu May 10 04:02 PM	T30-01d21h	Saturn Periapse	Saturn periapse, R = 4.3 Rs, lat = -24 deg, phase = 114 deg
132T04:59:00	May 12 06:15	Fri May 11 10:15 PM	T30-15h10m	Start of the TOST segment	
132T04:59:00	May 12 06:15	Fri May 11 10:15 PM	T30-15h10m	Turn cameras to Titan	
132T05:29:00	May 12 06:45	Fri May 11 10:45 PM	T30-14h40m	Deadtime	16 minutes 58 seconds long; used to accommodate changes in flyby time
132T05:45:58	May 12 07:01	Fri May 11 11:01 PM	T30-14h24m	Titan atmospheric Observations	Obtain information on the thermal structure of Titan's stratosphere.
132T07:09:58	May 12 08:25	Sat May 12 12:25 AM	T30-13h00m	Titan atmospheric Observations	Cloud Map
132T11:09:58	May 12 12:25	Sat May 12 04:25 AM	T30-09h00m	Titan atmospheric Observations	Spectral images of hemisphere
132T15:19:58	May 12 16:35	Sat May 12 08:35 AM	T30-04h50m	New Waypoint	
132T15:19:58	May 12 16:35	Sat May 12 08:35 AM	T30-04h50m	RADAR Observations	Radiometry observations
132T18:54:58	May 12 20:10	Sat May 12 12:10 PM	T30-01h15m	RADAR Observations	Mid latitude scatterometry
132T19:17:58	May 12 20:33	Sat May 12 12:33 PM	T30-00h52m	Transition to Thruster Control	
132T19:39:58	May 12 20:55	Sat May 12 12:55 PM	T30-00h30m	RADAR Observations	Altimetry measurements
132T19:42:13	May 12 20:58	Sat May 12 12:58 PM	T30-00h27m	Solar Occultation	22 minute duration
132T19:43:42	May 12 20:59	Sat May 12 12:59 PM	T30-00h26m	Earth Occultation	26 minute duration
132T19:53:58	May 12 21:09	Sat May 12 01:09 PM	T30-00h16m	RADAR Observations	Low resolution SAR imaging
132T20:02:58	May 12 21:18	Sat May 12 01:18 PM	T30-00h07m	RADAR Observations	High resolution SAR imaging
132T20:09:58	**May 12 21:25**	**Sat May 12 01:25 PM**	T30+00h00m	**Titan-30 Flyby Closest Approach Time**	**Altitude = 960 km (595 miles), speed = 6.2 km/s (13,870 mph); 122 deg phase at closest approach**
132T20:10:59	May 12 21:26	Sat May 12 01:26 PM	T30+00h01m	Ascending Ring Plane Crossing	
132T20:16:58	May 12 21:32	Sat May 12 01:32 PM	T30+00h07m	RADAR Observations	Low resolution SAR imaging
132T20:25:58	May 12 21:41	Sat May 12 01:41 PM	T30+00h16m	RADAR Observations	Altimetry measurements
132T20:39:58	May 12 21:55	Sat May 12 01:55 PM	T30+00h30m	Transition off of Thruster Control	
132T21:03:58	May 12 22:19	Sat May 12 02:19 PM	T30+00h54m	RADAR Observations	Mid latitude scatterometry
132T21:26:58	May 12 22:42	Sat May 12 02:42 PM	T30+01h17m	RADAR Observations	Radiometry observations
133T01:04:58	May 13 02:20	Sat May 12 06:20 PM	T30+04h55m	New Waypoint	
133T01:04:58	May 13 02:20	Sat May 12 06:20 PM	T30+04h55m	ISS Imaging	Global map
133T04:45:58	May 13 06:01	Sat May 12 10:01 PM	T30+08h36m	ISS Imaging	Wide angle camera photometry examining particle properties and vertical distributions
133T05:09:58	May 13 06:25	Sat May 12 10:25 PM	T30+09h00m	Titan atmospheric Observations	Obtain information on CO, HCN, CH4.
133T07:09:58	May 13 08:25	Sun May 13 12:25 AM	T30+11h00m	ISS Imaging	Monitoring for surface/atmosphere changes; attempt to see surface color variations; monitor limb hazes
133T09:09:58	May 13 10:25	Sun May 13 02:25 AM	T30+13h00m	Titan map	Global map
133T10:09:58	May 13 11:25	Sun May 13 03:25 AM	T30+14h00m	Titan atmospheric Observations	Obtain information on the thermal structure of Titan's stratosphere.
133T11:28:58	May 13 12:44	Sun May 13 04:44 AM	T30+15h19m	Deadtime	14 minutes two seconds long; used to accommodate changes in flyby time
133T11:43:00	May 13 12:59	Sun May 13 04:59 AM	T30+15h34m	Turn to Earth-line	
133T12:13:00	May 13 13:29	Sun May 13 05:29 AM	T30+16h04m	Playback of T30 Data	Madrid 70M