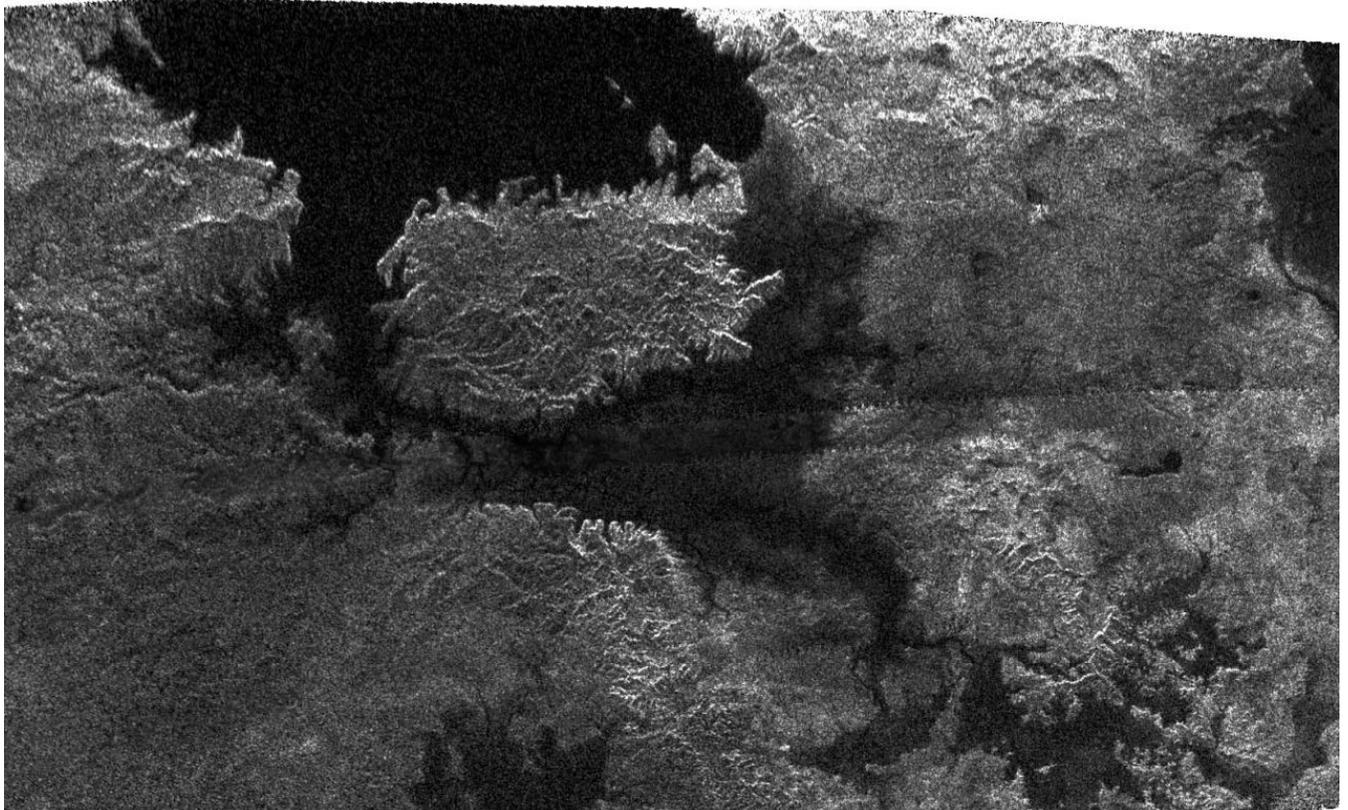


C A S S I N I



TITAN 045TI(T31)
MISSION DESCRIPTION

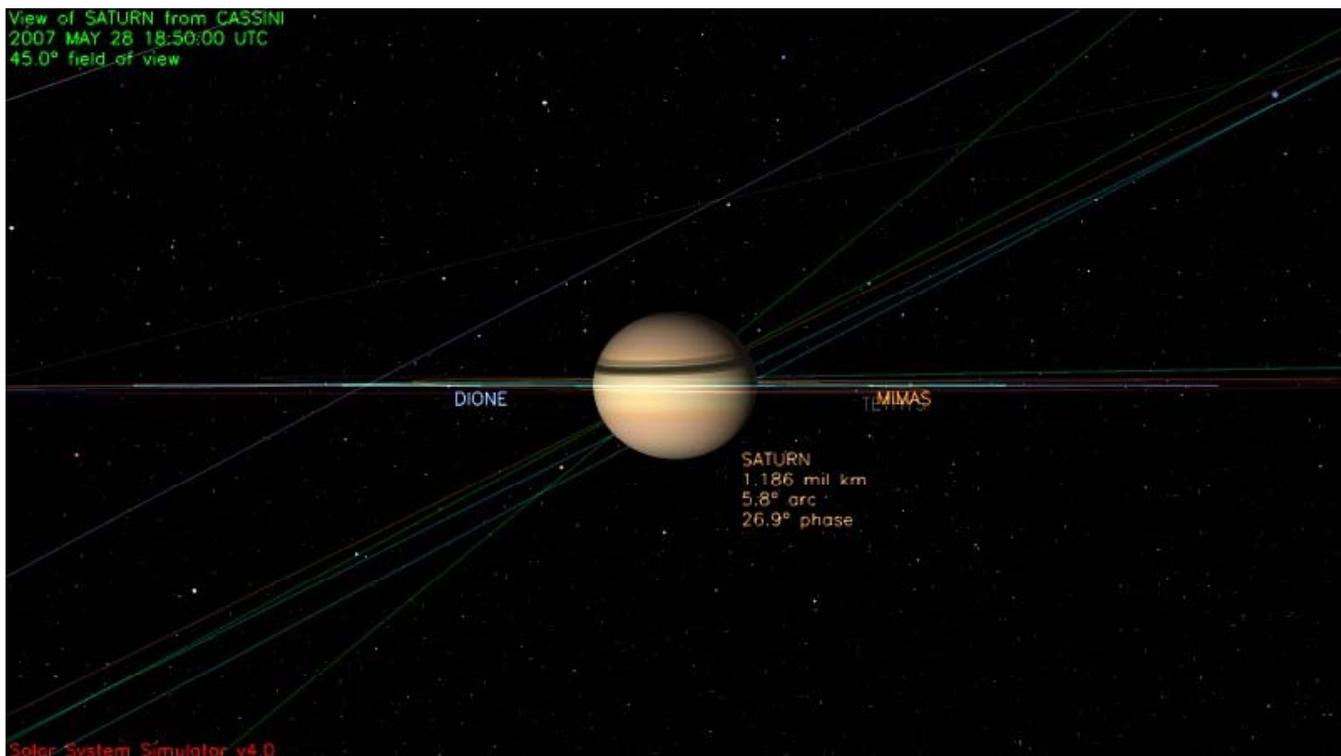
May 2007

Jet Propulsion Laboratory
California Institute of Technology

1.0 OVERVIEW

Just sixteen days after Cassini's Titan-30 flyby, the spacecraft revisits Titan for its thirty-second targeted encounter. The closest approach to Titan occurs on Monday, May 28, at 2007-148T18:51:56 spacecraft time at an altitude of 2300 kilometers (~1,429 miles) above the surface and at a speed of 6.1 kilometers per second (13,645 mph). The latitude at closest approach is 76.7 degrees N and the encounter occurs on orbit number 45.

This encounter is set up with two maneuvers: an apoapsis maneuver on May 20, and a Titan approach maneuver, scheduled for May 25. This is the seventh in a series of outbound Titan encounters (until T34), and occurs just under 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-31 SCIENCE HIGHLIGHTS

- RSS will use the time surrounding and including closest approach for occultation observations of the atmosphere during ingress. During egress, RSS will observe both the atmosphere and the ionosphere. This is the slowest occultation event for the entire tour. The occultation observation itself is made by DSN observations of the spacecraft signal as it passes through Titan's atmosphere. Refraction by the Titan's atmosphere produces a Doppler shift in the received frequency. This allows the retrieval of very high resolution vertical profiles of electron density in the ionosphere, and of density, pressure, and temperature in the neutral atmosphere.
- ISS will obtain regional scale mapping of Dilmun and global-scale mapping of Dilmun, Shangri-La, and Adiri and the (as yet unnamed) terrain to its north.
- VIMS will obtain the first medium resolution maps of the trailing hemisphere. The observations will focus on the northern hemisphere. VIMS will also be seeking northern latitude clouds.
- CIRS will obtain information on the distribution of CO, HCN, and CH₄, as well as the thermal structure of Titan's stratosphere.
- UVIS will perform slow scans across Titan's visible hemisphere to form spectral images.

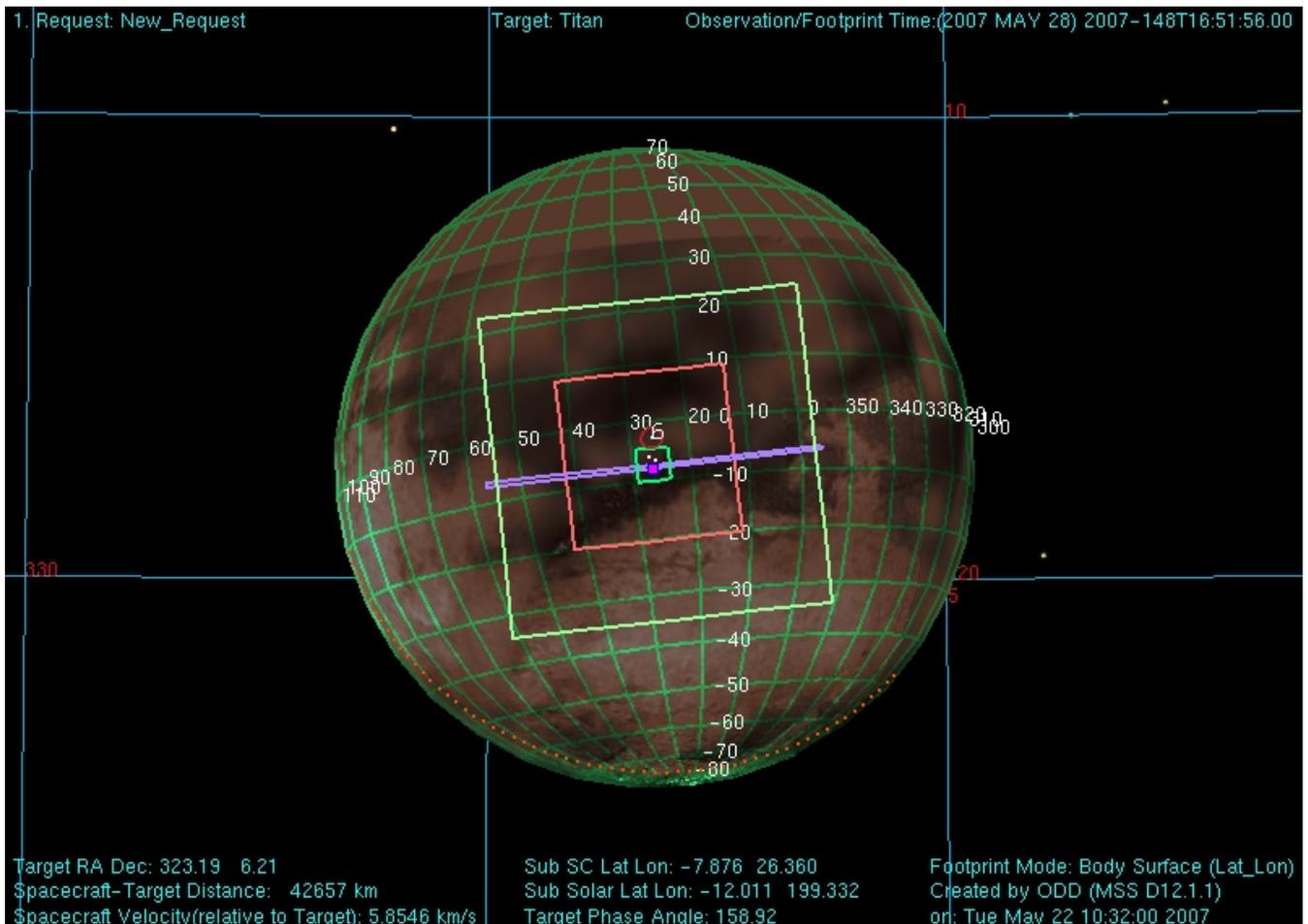
1.3 SAMPLE SNAPSHOTS

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.

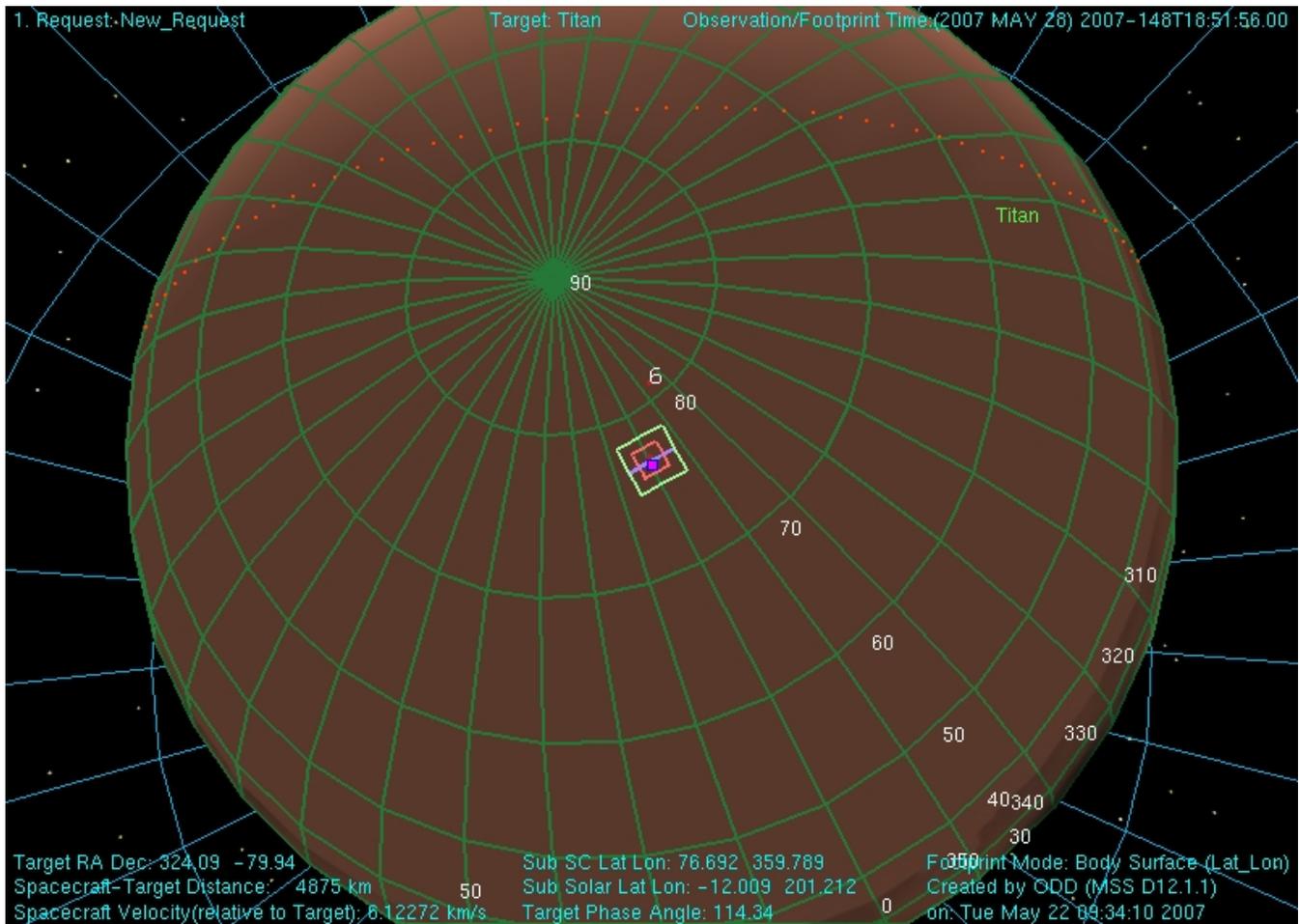
Key to ORS Instrument Fields of View in Figures

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

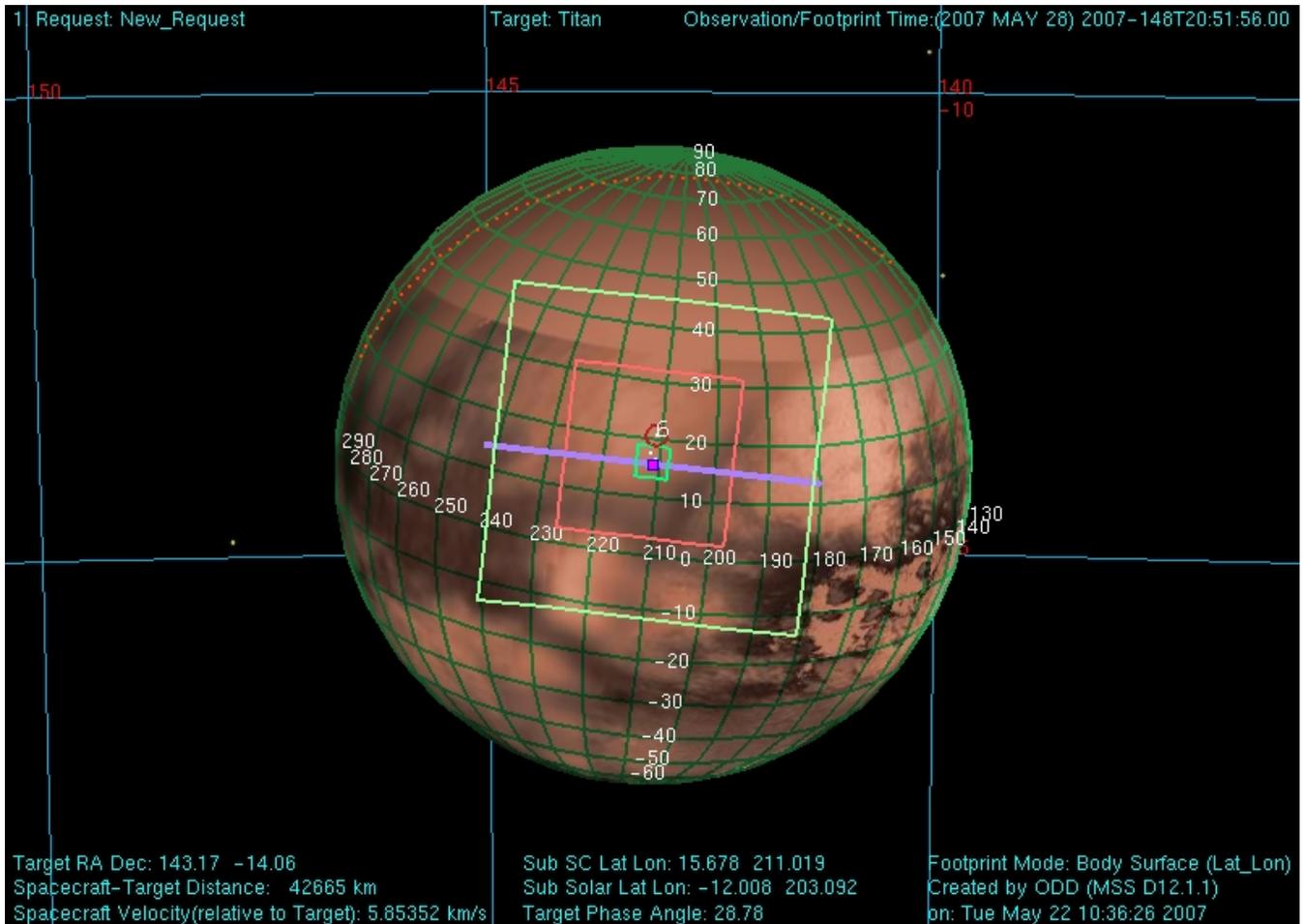
View of Titan from Cassini two hours before Titan-31 closest approach



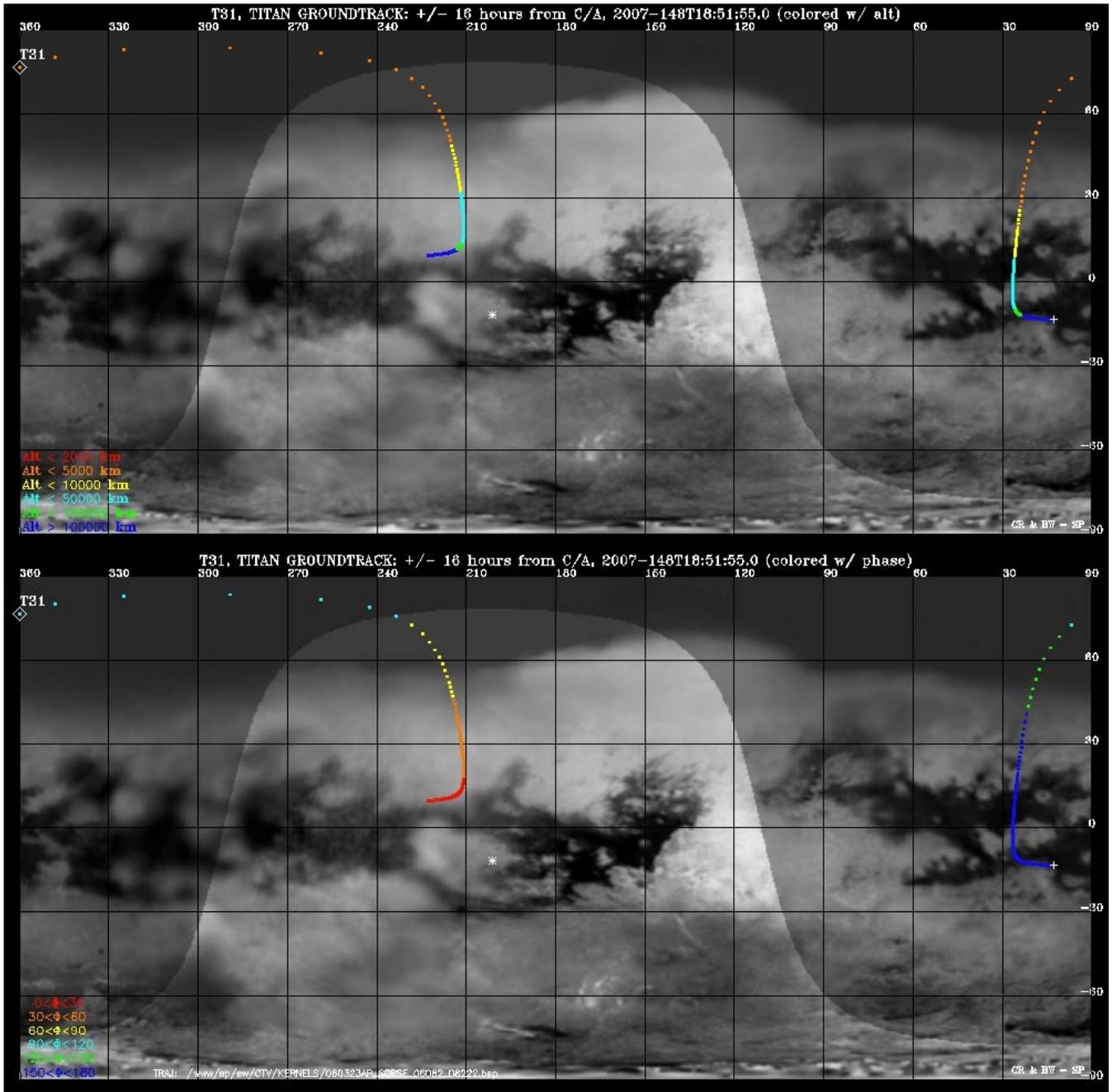
View of Titan from Cassini at Titan-31 closest approach



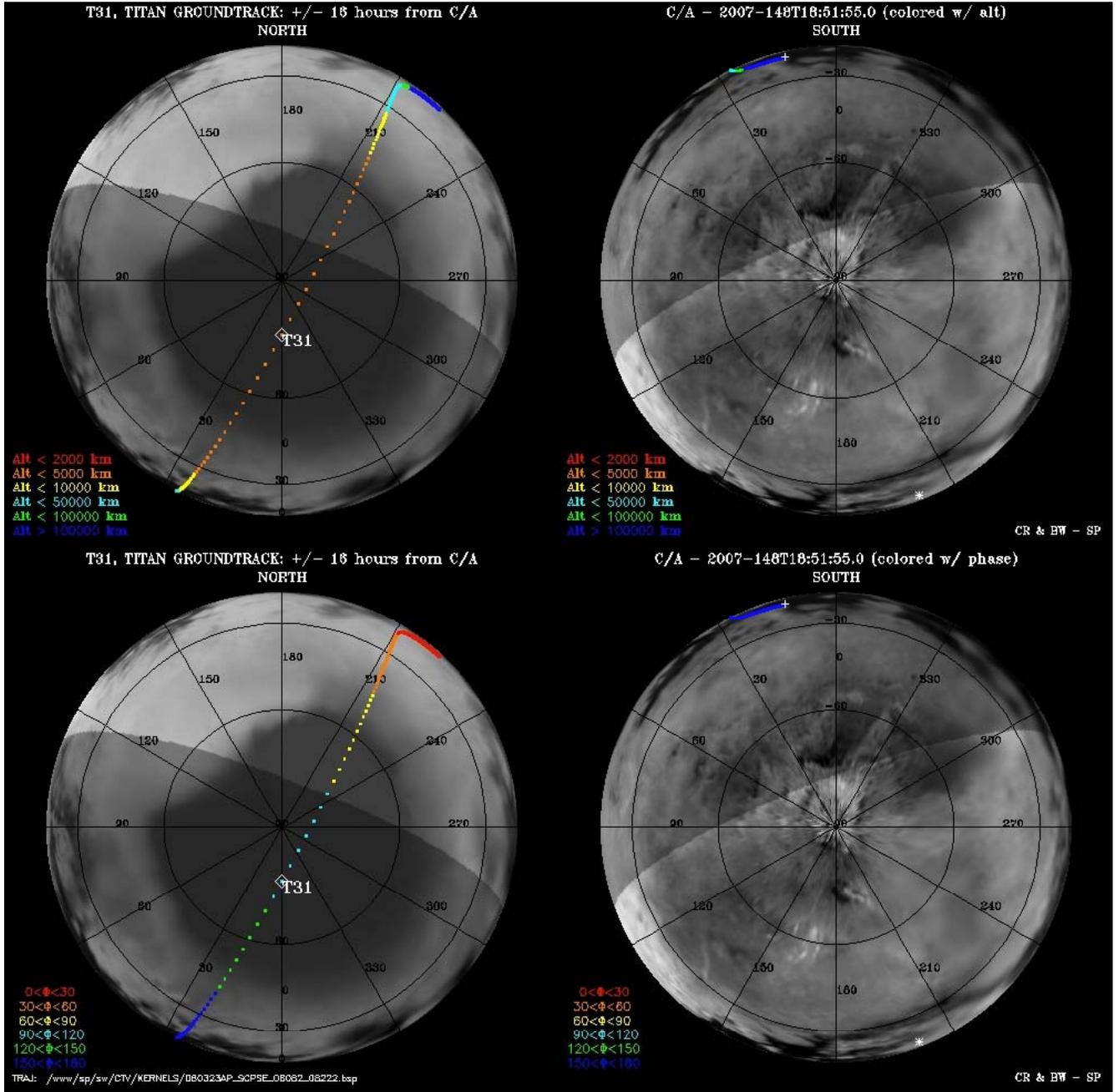
View of Titan from Cassini two hours after Titan-31 closest approach



Titan Groundtracks for T31: Global Plot



Titan Groundtracks for T31: Polar Plot



The T31 timeline is as follows:

Cassini Titan-31 Timeline - May 2007

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

Orbiter UTC	Ground UTC	Pacific Time	Time wrt T31	Activity	Description
124T22:00:00	May 04 23:19	Fri May 04 03:19 PM	T31-23d21h	Start of Sequence S30	Start of Sequence which contains Titan-31
145T19:12:00	May 25 20:31	Fri May 25 12:31 PM	T31-02d24h	OTM #112 Prime	Titan-31 targeting maneuver.
146T09:57:00	May 26 11:16	Sat May 26 03:16 AM	T31-02d09h	OTM #112 Backup	
146T22:41:30	May 27 00:00	Sat May 26 04:00 PM	T31-01d20h	Descending Ring Plane Crossing	
147T00:28:44	May 27 01:47	Sat May 26 05:47 PM	T31-01d18h	Saturn Periapse	Saturn periapse, R = 3.2 Rs, lat = -15 deg, phase = 119 deg
148T03:56:00	May 28 05:15	Sun May 27 09:15 PM	T31-14h55m	Start of the TOST segment	
148T03:56:00	May 28 05:15	Sun May 27 09:15 PM	T31-14h55m	Turn cameras to Titan	
148T04:26:00	May 28 05:45	Sun May 27 09:45 PM	T31-14h25m	Deadtime	16 minutes 55 seconds long; used to accommodate changes in flyby time
148T04:42:55	May 28 06:01	Sun May 27 10:01 PM	T31-14h09m	Titan atmospheric Observations	Obtain information on the thermal structure of Titan's stratosphere. Obtain information on CO, HCN, CH4.
148T08:51:55	May 28 10:10	Mon May 28 02:10 AM	T31-10h00m	ISS Imaging	Wide angle camera photometry examining particle properties and vertical distributions
148T09:51:55	May 28 11:10	Mon May 28 03:10 AM	T31-09h00m	UV images of Titan	Spectral images of hemisphere
148T15:51:55	May 28 17:10	Mon May 28 09:10 AM	T31-03h00m	ISS nightside imaging	Search for and monitor lighting/aurora
148T17:06:55	May 28 18:25	Mon May 28 10:25 AM	T31-01h45m	New Waypoint	
148T17:36:55	May 28 18:55	Mon May 28 10:55 AM	T31-01h15m	Titan atmospheric Observations	Radio science occultation of atmosphere
148T18:09:26	May 28 19:28	Mon May 28 11:28 AM	T31-00h42m	Solar Occultation	32 minute duration
148T18:10:27	May 28 19:29	Mon May 28 11:29 AM	T31-00h41m	Earth Occultation	32 minute duration
148T18:15:26	May 28 19:34	Mon May 28 11:34 AM	T31-00h36m	Titan atmospheric Observations	Radio science occultation of atmosphere and ionosphere after closest approach
148T18:35:52	May 28 19:54	Mon May 28 11:54 AM	T31-00h16m	Ascending Ring Plane Crossing	
148T18:51:56	May 28 20:10	Mon May 28 12:10 PM	T31+00h00m	Titan-31 Flyby Closest Approach Time	Altitude = 960 km (595 miles), speed = 6.2 km/s (13,870 mph); 122 deg phase at closest approach
148T19:31:55	May 28 20:50	Mon May 28 12:50 PM	T31+00h40m	New Waypoint	
148T19:51:55	May 28 21:10	Mon May 28 01:10 PM	T31+01h00m	Titan surface observations	
148T20:51:55	May 28 22:10	Mon May 28 02:10 PM	T31+02h00m	ISS Imaging	regional map
148T22:51:55	May 29 00:10	Mon May 28 04:10 PM	T31+04h00m	Titan atmospheric Observations	Obtain information on surface & tropopause temperatures, and on tropospheric CH4.
148T23:51:55	May 29 01:10	Mon May 28 05:10 PM	T31+05h00m	Titan atmospheric Observations	Medium resolution global mapping.
149T01:51:55	May 29 03:10	Mon May 28 07:10 PM	T31+07h00m	ISS Imaging	Global map
149T03:31:55	May 29 04:50	Mon May 28 08:50 PM	T31+08h40m	ISS Imaging	Wide angle camera photometry examining particle properties and vertical distributions and narrow angle camera global mapping
149T03:51:55	May 29 05:10	Mon May 28 09:10 PM	T31+09h00m	Titan atmospheric Observations	Obtain information on CO, HCN, CH4.
149T10:05:55	May 29 11:24	Tue May 29 03:24 AM	T31+15h14m	Deadtime	15 minutes 5 seconds long; used to accommodate changes in flyby time
149T10:21:00	May 29 11:40	Tue May 29 03:40 AM	T31+15h30m	Turn to Earth-line	
149T10:51:00	May 29 12:10	Tue May 29 04:10 AM	T31+16h00m	Playback of T31 Data	Madrid 70M