

CIRS Observations of Titan 2004-2017: Time-Ordered Lists and Spatial Coverage

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1.0 Introduction

Although a significant amount of science is done by CIRS (Composite InfraRed Spectrometer) at large distances from Titan, the extended fields-of-view of the instrument mean that the greatest spatial resolution is achieved at the smallest ranges, in flybys of Saturn's largest moon. Within approximately ± 1 day of closest approach, the TOST (Titan Orbiter Science Team) working group is responsible for allocating the time-line on all of the targeted flybys of Titan in the Cassini mission (45 in the Prime Mission, 25 in the Extended Mission, 56 in the Solstice Mission). Due to high competition with other instruments for the time <5 hours from closest approach, most of the CIRS allocations are further out, and consist of a series of planned observation types, each of which occur within a specified range from Titan (see Figure 1.)

The CIRS instrument consists of two interferometers, sharing a common telescope and scan mechanism. They operate in the far-infrared (10-600 cm^{-1}) and mid-infrared (600-1400 cm^{-1}) with a controllable apodized spectral resolution as high as 0.5 cm^{-1} . The far-IR interferometer (focal plane 1 or FP1) has a circular field-of-view (FOV), which subtends 3.9 milliradians, and the mid-IR interferometer has two focal plane arrays (FP3 and FP4), each consisting of ten detectors with 0.273 milliradian FOV per pixel.

Due to the nature of the focal planes, different pointing designs are required for study in the mid-IR and far-IR, and the varying science requirements of the mission put constraints on the spectral resolution required. This, along with constraints of time and the performance of the Cassini spacecraft has led to the CIRS team using a selection of different observation types within TOST periods, each of which has specific science objectives (Table 1). This document outlines each observation type, detailing briefly the scientific objectives in each case, and gives a description of how the focal planes are orientated and articulated throughout. Also included are tables which list all of the CIRS-led requests of each type, the times at which they occur and any relevant pointing information. Locations chosen for each request were done so to a vast set of criteria, but in general the limb observations are centred around 'points of least blur' (see **Appendix**), and nadir observations are constrained by the visible hemisphere and emission angle. In all cases every effort has been made to ensure comprehensive spatial coverage of Titan of the duration Cassini's primary tour. Where applicable, an attempt to represent spatial coverage by CIRS diagrammatically has also been made.

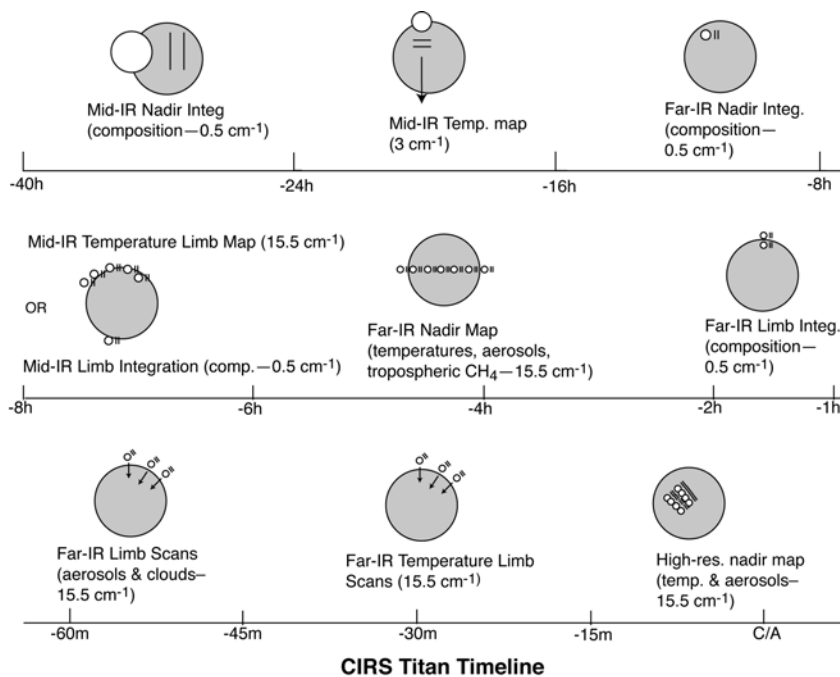


Figure 1: CIRS early mission observation types as a function of distance.

Table 1: CIRS Early/Prime Mission Observation Types

Observation Type	Time to/from CA (HH:MM)	Distance to/from CA (km)	Typical Duration (HH:MM)	Scan Rate ($\mu\text{rad s}^{-1}$)	Spectral Resol. (cm^{-1})	Science Objective	Positioning/ Implementation
<i>Far-Infrared Types</i>							
FIRLMBT	$\pm 00:15$ to $\pm 00:45$	< 15,000	00:30 to 00:45	43	15.5	Temperature profile from N_2 at 20-100 cm^{-1} .	Z perpendicular to limb, one or more latitude, 10° separation.
FIRLMB AER	$\pm 00:45$ to $\pm 01:15$	15,000 to 25,000	00:30 to 00:45	55	15.5	Aerosol opacity 250-600 cm^{-1} .	FP1 at -120 km scanned towards 480 km.
FIRLMB INT	$\pm 01:15$ to $\pm 02:15$	25,000 to 40,000	01:00	N/A	0.5	CH_4 , HCN, CO, and H_2O .	Z Perpendicular to limb, 125 and 225 km altitude.
FIRNADMAP (or EUVFUV*)	$\sim \pm 02:15$ to $\pm 05:00$	40,000 to 100,000	03:00	7	15.5	Tropospheric temperatures at 40—200 mbar.	Slow slew across disk.
FIRNADCMP	$\pm 08:00$ to $\pm 13:00$	160,000 to 270,000	00:30 to 00:45	N/A	0.5	CH_4 , HCN and CO.	FP1 at fixed position on disk, ideally about 1/3 of the radius from the body center, emission angles of 45-60°.
<i>Mid-Infrared Types</i>							
MIRLMB INT	$\pm 05:00$ to $\pm 09:00$	100,000 to 180,000	4 hrs: 2 hrs per altitude)	N/A	0.5	Abundance of trace hydrocarbons and nitriles.	Z perpendicular to limb; FP3/4 at 125 and 225 km. Single latitude.
MIRLMBMAP	$\pm 05:00$ to $\pm 09:00$	100,000 to 180,000	00:03 to 00:04 per altitude; 10 mins for each latitude.	N/A	15.5	Vertical temperature profiles in stratosphere and mesosphere.	Z perpendicular to limb; FP3 and FP4 at 125 and 225 km. 12-15 Latitudes spaced by 5° .
MIDIRTMAP	$\pm 13:00$ to $\pm 19:00$	260,000 to 380,000	5-7 hrs.	4	3.0	Thermal mapping in stratosphere via $\text{CH}_4 \nu_4$ band at 7 μm .	Full disk/ hemisphere coverage, typically 5-7 push-broom scans. Partial disk maps when time-constrained.
COMPMAP	$\pm 19:00$ to $\pm 30:00$	380,000 to 600,000	5-10 hrs.	N/A	0.5	Gas composition in lower stratosphere.	FP3/FP4 are fixed or moved across disk N-S or W-E

*EUVFUV observations were CIRS riders on UVIS primes

Table 2: CIRS Late Mission/Evolved Additional Observation Types

Observation Type	Time to/from CA (HH:MM)	Distance to/from CA	Duration (HH:MM)	Turn Rate? Scan Rate?	Spectral Resol. (cm ⁻¹)	Objective	Positioning
FIRLMBBAER (revised)							
FIRLMBCON	±01:15 to ±02:15	25,000 to 40,000 km	01:00	N/A	3.0	Ices/condensates in range 250-600 cm ⁻¹ .	Z perpendicular to limb, 125, 175, 225 km altitudes.
FIRLMBWTR	±01:15 to ±02:15	25,000 to 40,000 km	01:00	N/A	0.5	Weak water lines at 100-300 cm ⁻¹ .	Z perpendicular to limb, 175 km altitude.
MIRLMPAIR	±05:00 to ±09:00	100,000 to 180,000 km	2 to 4 hrs (2hr per altitude)	N/A	0.5	Integration/search for undetected trace gases and isotopes.	FP3 and FP4 at 125 and 225 km.
TEA	±40:00 to ±100:00	800,000 to 2,000,000 km	12:00 to 36:00	N/A	0.5	Distant prime observations.	Dependent on range and hemisphere coverage.

2.0 Far-Infrared Limb Observations

2.1 Observation Descriptions

2.1.1 Far-infrared Limb Temperature Sounding (FIRLMBT)

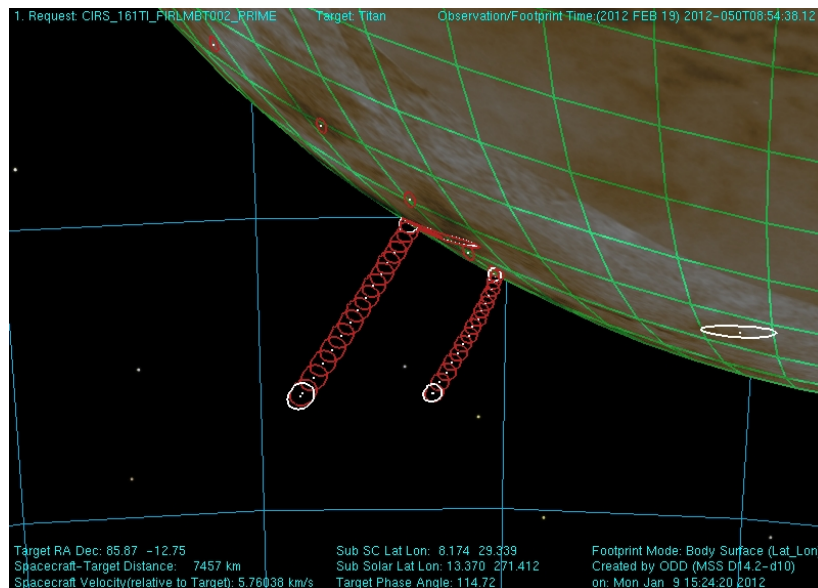
2.1.1.1 Science Description

FIRLMBT observations are intended to obtain information on the thermal structure of Titan's lower stratosphere and tropopause by measurements of the N₂ collision-induced absorption lines at 20-100 cm⁻¹, using the CIRS far-infrared focal plane (FP1). Radial slews perpendicular to the limb are performed with a spectral resolution of 15.0 cm⁻¹, allowing profiles of temperature between 8 and 100 mbar to be obtained.

2.1.1.2 Implementation

FIRLMBT observations typically occur between ±45 and ±15 minutes of closest approach, at ranges of less than 15,000 km. FIRLMBT sequences are the closest to Titan of the FIRLMB triplet and often must absorb turn time to/from the closest approach pointing, with duration of 30 to 45 minutes. Although originally envisaged to be triplet, the scans were implemented as a pair due to turn overhead, separated by 10 degrees of latitude, or sometimes a single scan. Short durations and rapidly changing geometry prevent slow slew rates and higher resolution, but an effective rate on the limb of 50 μrad/s or less and a length of 28 mrad ensures adequate signal-to-noise for the required objectives. The effects of unresolved rotational lines in the spectra are corrected by the use of far-infrared limb integrations acquired at a spectral resolution of 0.5 cm⁻¹.

2.1.1.3 Example: CIRS_161TI_FIRLMT002_PRIME



2.1.2 Far-infrared Limb Aerosol Scan (FIRLIMBAER)

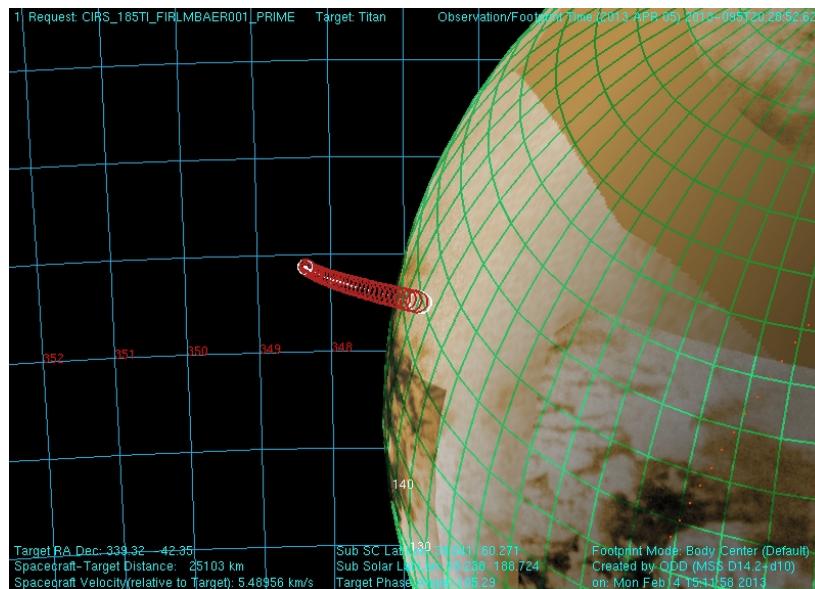
2.1.2.1 Science Description

FIRLIMBAER observations are purposed to distinguish aerosols from clouds with spectra in the range $250\text{-}600\text{ cm}^{-1}$, using the CIRS far-infrared focal plane (FP1). This is possible due to the wavenumber-dependence of condensate opacity, which enables distinguishing the abundances of the two as a function of latitude. This is important for determining Titan's weather and climatology, and for determining tropospheric abundances and surface temperatures from nadir-viewing observations.

2.1.2.2 Implementation

FIRLIMBAER observations occur at spacecraft positions on the order of 15,000 to 25,000 km, or between ± 0.45 and ± 1.15 from closest approach. The circular far-infrared focal plane (FP1) is positioned first at -120 km , and then in one scan it is shifted towards $+480\text{ km}$ (adjust scan lengths by around 30 mrad). Scan rates should be ideally 17 but up to $21\text{ }\mu\text{rad/sec}$ (slower scan rates are preferred).

2.1.2.3 Example: CIRS_185TI_FIRLIMBAER001_PRIME



This is an example FIRLIMBAER observation: note the FOV of FP1 in red decreasing in size as the altitude is increased; this is due to the changing spacecraft position over the observation duration.

2.1.3 Far-infrared Limb Composition Integration (FIRLMBINT)

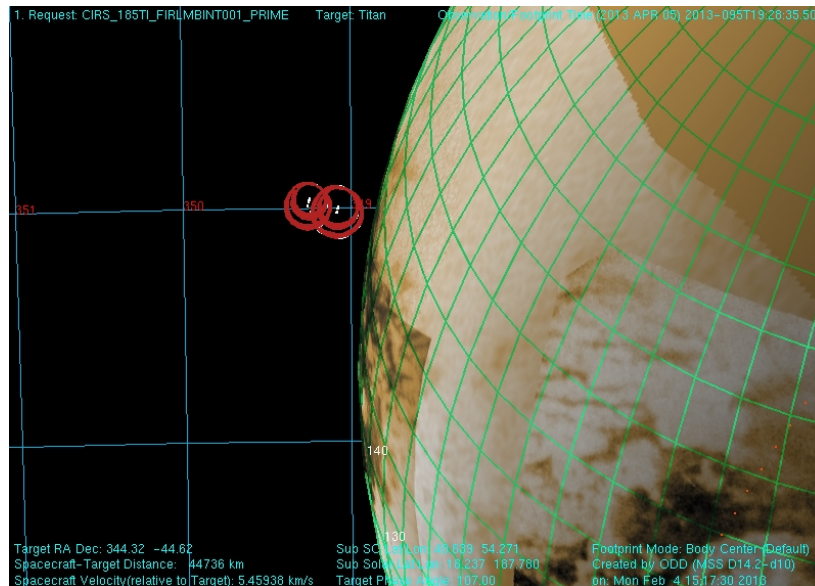
2.1.3.1 Science Description

FIRLMBINT observations are designed to obtain information on the composition of Titan's stratosphere, specifically, to provide coarse vertical profiles of CH₄, HCN, CO, and H₂O. They also allow a search for new molecular species, given long enough integration times.

2.1.3.2 Implementation

FIRLMBINT observations occur at spacecraft positions on the order of 25,000 to 40,000 km, or from $\pm 1:15$ to $\pm 2:15$ hours from closest approach. The circular far-infrared focal plane (FP1) is positioned for two integrations centred at altitudes of 125 and 225 km (repeated 125-225-125-225) off of Titan's limb for a specified latitude, as with the corresponding mid-infrared limb sequences. The integration times are typically 30 minutes in length. Longer observations are required to resolve CO and H₂O with sufficient confidence. Since only one position on the limb may be sampled in a single sequence, comprehensive latitude mapping is achieved by the compositing of several Titan flybys. If possible, the mid-infrared arrays (FP3 and FP4) are orientated perpendicular to the limb so that they may also obtain useful data as described in later observation types.

2.1.3.3 Example: CIRS_185TI_FIRLMBINT001_PRIME



This is an example FIRLMBINT observation. FP1 is shown in red, at two different elevations above the limb.

2.1.4 Far-infrared Limb Condensate Integration (FIRLMBCON)

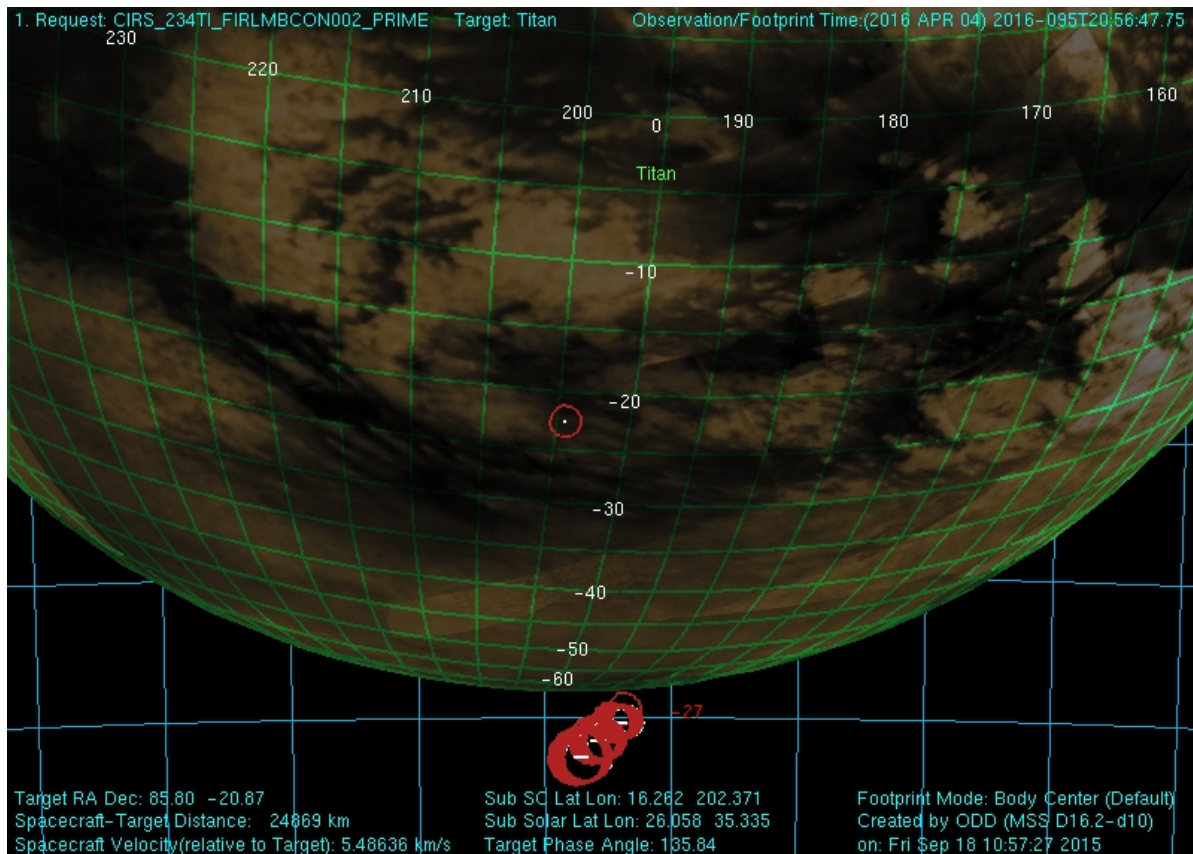
2.1.4.1 Science Description

FIRLMBCON observations evolved from the FIRLMBINT observations, and were designed specifically to search for condensates in the far-infrared spectrum at medium spectral resolution (3.0 cm^{-1}).

2.1.4.2 Implementation

FIRLMBCON observations replaced FIRLMBINT observations on T67 and T118 in the time from $\pm 1:15$ to $\pm 2:15$ from closest approach (60 minutes duration). Three dwells of approximately 20 mins each are targeted at altitudes of 125, 175 and 225 km.

2.1.4.3 Example: CIRS_243TI_FIRLMBCON002_PRIME



2.1.5 Far-infrared Limb Water Integration (FIRLMBWTR)

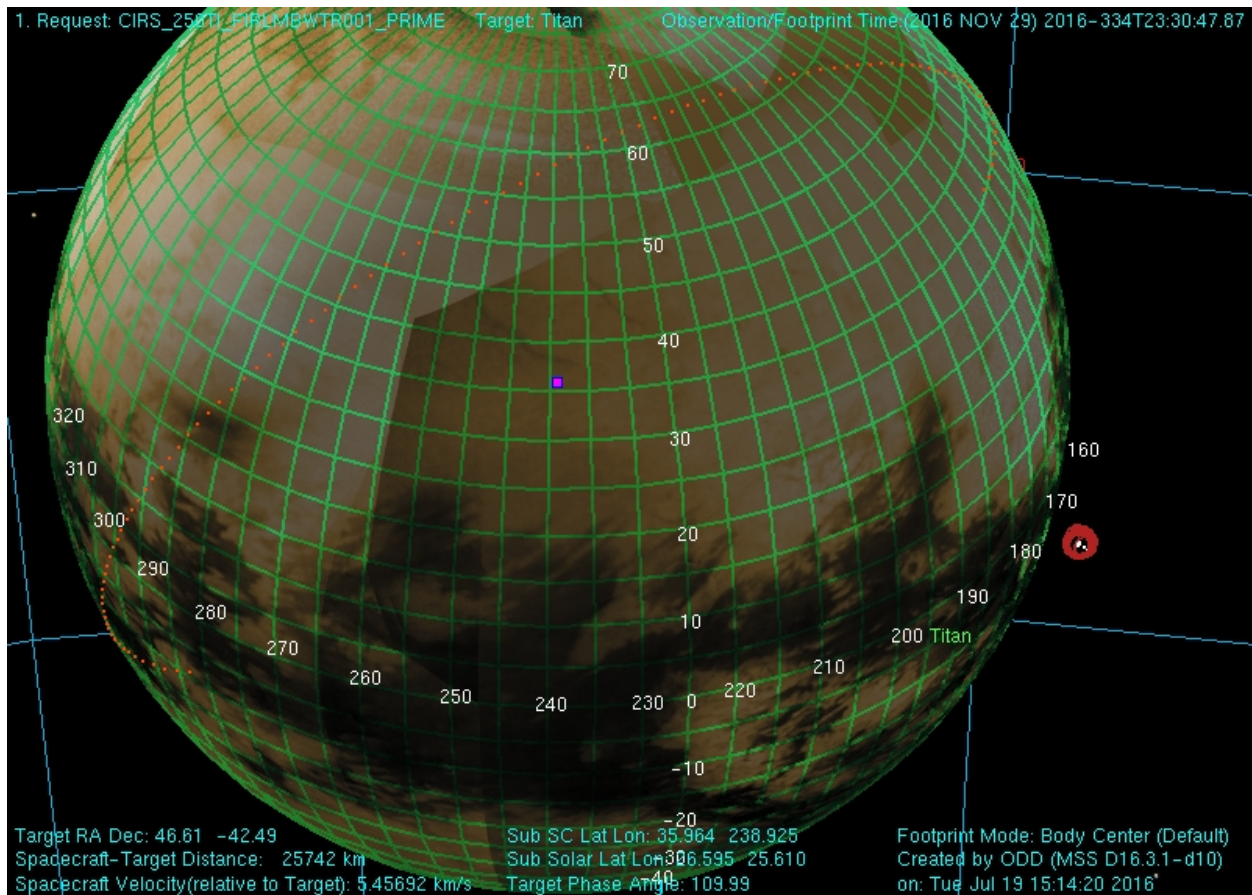
2.1.5.1 Science Description

The FIRLMBWTR observation was designed to supplement the FIRLMBINT observation, by providing a third altitude point at 175 km. This provides an intermediate data point between the 125 and 225 km altitudes normally sampled by a FIRLMBINT which was required to further constrain the vertical profile of water. Note that (i) *only* the 175 km altitude is sampled in the FIRLMBWTR, not in addition to 125 and 225 km; (ii) the spectral resolution is 0.5 cm⁻¹ as in FIRLMBINT, and therefore the 175 km altitude integration from FIRLMBCON does not provide the necessary information.

2.1.5.2 Implementation

Three FIRLMBWTR observations were implemented, replacing FIRLMBINT observations on T100, T123 and T125, during the usual time slot between $\pm 1:15$ and $\pm 2:15$ from closest approach. FP1 is positioned at 175 km altitude and remains at that position for ~ 1 hr.

2.1.5.3 Example: CIRS_250TI_FIRLMBWTR001_PRIME



2.2 Time-ordered Table of FIRLMB Observations

Flyby #	Observation Name	Start Time	Duration (HR:MN)	Pointing (Latitudes)
T4	CIRS_005TI_FIRLMBT002_PRIME	2005-090T20:05:16	0:45	80N, 70N
	CIRS_005TI_FIRLMBT002_PRIME	2005-090T20:50:16	0:30	85N, 75N
	CIRS_005TI_FIRLMBINT002_PRIME	2005-090T21:20:16	0:45	85N
T6	CIRS_013TI_FIRLMBINT002_PRIME	2005-234T06:38:37	1:00	55S
	CIRS_013TI_FIRLMBT002_PRIME	2005-234T07:38:37	0:30	50S
	CIRS_013TI_FIRLMBT002_PRIME	2005-234T08:08:37	0:35	50S, 55S
	CIRS_013TI_FIRLMBT003_PRIME	2005-234T09:03:37	0:35	45S, 40S
	CIRS_013TI_FIRLMBT003_PRIME	2005-234T09:38:37	0:30	40S
	CIRS_013TI_FIRLMBINT003_PRIME	2005-234T10:08:37	1:00	45S
	T10	CIRS_020TI_FIRLMBINT003_PRIME	2006-015T12:41:27	1:00
T14	CIRS_024TI_FIRLMBINT002_PRIME	2006-140T09:48:11	1:25	50N
	CIRS_024TI_FIRLMBINT003_PRIME	2006-140T13:45:11	0:48	50N
T15	CIRS_025TI_FIRLMBT003_PRIME	2006-183T09:50:47	1:00	62N
	CIRS_025TI_FIRLMBINT003_PRIME	2006-183T10:50:47	1:00	62N
T16	CIRS_026TI_FIRLMBINT003_PRIME	2006-203T01:40:26	1:00	45N
T17	CIRS_028TI_FIRLMBINT002_PRIME	2006-250T17:52:51	1:00	15S
	CIRS_028TI_FIRLMBT002_PRIME	2006-250T18:52:51	0:39	15S
	CIRS_028TI_FIRLMBT002_PRIME	2006-250T19:31:51	0:30	15S, 25S
T18	CIRS_029TI_FIRLMBINT003_PRIME	2006-266T16:58:49	1:15	30N
T24	CIRS_038TI_FIRLMBINT001_PRIME	2007-029T05:15:55	0:45	28N
	CIRS_038TI_FIRLMBT001_PRIME	2007-029T06:00:55	0:52	28N
T26	CIRS_040TI_FIRLMBINT001_PRIME	2007-068T23:34:00	0:51	10N
	CIRS_040TI_FIRLMBT002_PRIME	2007-069T02:12:00	0:30	3N, 17N
	CIRS_040TI_FIRLMBT002_PRIME	2007-069T02:42:00	0:30	15N
	CIRS_040TI_FIRLMBINT002_PRIME	2007-069T03:35:00	0:37	15N
T27	CIRS_041TI_FIRLMBINT002_PRIME	2007-085T01:56:27	0:42	44N
T32	CIRS_046TI_FIRLMBINT903_PRIME	2007-164T18:32:11	0:16	45N
T35	CIRS_049TI_FIRLMBINT001_PRIME	2007-243T04:32:34	1:00	70N
T37	CIRS_052TI_FIRLMBINT001_PRIME	2007-322T22:47:25	0:21	80S
	CIRS_052TI_FIRLMBT001_PRIME	2007-322T23:08:25	0:54	80S, 70S
	CIRS_052TI_FIRLMBT001_PRIME	2007-323T00:02:25	0:30	65S, 75S
T38	CIRS_053TI_FIRLMBINT001_PRIME	2007-338T21:36:50	1:15	0N
	CIRS_053TI_FIRLMBT001_PRIME	2007-338T22:51:50	0:25	0N
	CIRS_053TI_FIRLMBT001_PRIME	2007-338T23:16:50	0:35	5S, 5N
T40	CIRS_055TI_FIRLMBINT001_PRIME	2008-005T19:30:20	0:55	30S
T42	CIRS_062TI_FIRLMBINT003_PRIME	2008-085T12:28:48	0:44	55S
	CIRS_062TI_FIRLMBT001_PRIME	2008-085T13:12:48	0:25	55S
	CIRS_062TI_FIRLMBT001_PRIME	2008-085T13:37:48	0:29	52, 62S
T46	CIRS_091TI_FIRLMBCON001_PRIME	2008-308T14:06:24	1:39	BIU anomaly
	CIRS_091TI_FIRLMBINT001_PRIME	2008-308T15:45:24	0:22	
	CIRS_091TI_FIRLMBINT002_RIDER	2008-308T19:03:24	0:24	
T47	CIRS_093TI_FIRLMBINT002_PRIME	2008-324T16:58:28	1:13	45S
T48	CIRS_095TI_FIRLMBINT001_PRIME	2008-340T11:25:45	1:00	35S
	CIRS_095TI_FIRLMBINT002_PRIME	2008-340T15:20:45	1:20	25S
T49	CIRS_097TI_FIRLMBINT001_PRIME	2008-356T09:59:52	1:00	10N
T53	CIRS_109TI_FIRLMBT001_PRIME	2009-109T22:45:45	0:37	Downlink

	CIRS_109TI_FIRLMBT001_PRIME	2009-109T23:22:55	0:48	
	CIRS_109TI_FIRLMBT002_PRIME	2009-110T00:46:45	0:49	
T54	CIRS_110TI_FIRLMBINT001_PRIME	2009-125T20:39:16	1:00	20N
	CIRS_110TI_FIRLMBT001_PRIME	2009-125T21:39:16	0:30	30N
	CIRS_110TI_FIRLMBT001_PRIME	2009-125T22:09:16	0:35	10N, 5N
T57	CIRS_113TI_FIRLMBINT001_PRIME	2009-173T16:17:35	1:05	10S
T59	CIRS_115TI_FIRLMBT002_PRIME	2009-205T15:49:04	0:35	50S, 55S
	CIRS_115TI_FIRLMBT002_PRIME	2009-205T16:24:04	0:30	60S
	CIRS_115TI_FIRLMBINT002_PRIME	2009-205T16:54:04	0:55	60S
T62	CIRS_119TI_FIRLMBT001_PRIME	2009-285T07:45:25	0:30	75S
	CIRS_119TI_FIRLMBT001_PRIME	2009-285T09:01:25	0:50	70S
	CIRS_119TI_FIRLMBINT002_PRIME	2009-285T09:51:25	1:00	75S
T64	CIRS_123TI_FIRLMBINT001_PRIME	2009-361T22:01:59	0:59	45N
	CIRS_123TI_FIRLMBT001_PRIME	2009-361T23:01:59	0:37	50N
T66	CIRS_125TI_FIRLMBINT001_PRIME	2010-028T19:58:49	1:08	30N
	CIRS_125TI_FIRLMBT001_PRIME	2010-028T21:06:49	0:34	20N
	CIRS_125TI_FIRLMBT001_PRIME	2010-028T21:40:19	0:34	23N, 28N
T67	CIRS_129TI_FIRLMBCON001_PRIME	2010-095T13:35:39	1:00	70N
	CIRS_129TI_FIRLMBT001_PRIME	2010-095T14:35:39	0:30	70N
	CIRS_129TI_FIRLMBT001_PRIME	2010-095T15:05:39	0:30	70N
T70	CIRS_133TI_FIRLMBINT001_PRIME	2010-171T23:12:18	1:02	55N
T72	CIRS_138TI_FIRLMBINT001_PRIME	2010-267T16:23:41	1:00	87S
	CIRS_138TI_FIRLMBT001_PRIME	2010-267T17:23:41	0:30	87S
	CIRS_138TI_FIRLMBT001_PRIME	2010-267T17:53:41	0:30	82S, 87S
T73	CIRS_140TI_FIRLMBT002_PRIME	2010-315T13:12:01	1:10	
	CIRS_140TI_FIRLMBT002_PRIME	2010-315T14:22:01	0:30	Safing event
	CIRS_140TI_FIRLMBINT002_PRIME	2010-315T14:52:01	1:00	
T76	CIRS_148TI_FIRLMBINT001_PRIME	2011-128T20:23:45	1:00	50N
	CIRS_148TI_FIRLMBT001_PRIME	2011-128T21:23:45	0:45	50N
	CIRS_148TI_FIRLMBT001_PRIME	2011-128T22:08:45	0:35	55N, 60N
T78	CIRS_153TI_FIRLMBINT001_PRIME	2011-255T00:35:06	1:00	73S
	CIRS_153TI_FIRLMBT001_PRIME	2011-255T01:35:06	0:32	73S
	CIRS_158TI_FIRLMBINT501_PRIME	2011-347T17:56:24	1:00	57S
T79	CIRS_158TI_FIRLMBT501_PRIME	2011-347T18:56:24	0:30	57S
	CIRS_158TI_FIRLMBT501_PRIME	2011-347T19:26:24	0:45	37S
T82	CIRS_161TI_FIRLMBINT001_PRIME	2012-050T06:28:17	1:00	75N
	CIRS_161TI_FIRLMBT001_PRIME	2012-050T07:28:17	0:30	75N
	CIRS_161TI_FIRLMBT001_PRIME	2012-050T07:58:17	0:45	56S
	CIRS_161TI_FIRLMBT002_PRIME	2012-050T08:43:17	0:45	56S, 51S
	CIRS_161TI_FIRLMBT002_PRIME	2012-050T09:28:17	0:30	56S
	CIRS_161TI_FIRLMBINT002_PRIME	2012-050T09:58:17	1:00	56S
T85	CIRS_169TI_FIRLMBINT001_PRIME	2012-206T17:33:08	1:15	37N
	CIRS_169TI_FIRLMBT001_PRIME	2012-206T18:48:08	0:30	37N
	CIRS_169TI_FIRLMBT001_PRIME	2012-206T19:19:08	0:34	37N, 32N
T86	CIRS_172TI_FIRLMBINT001_PRIME	2012-270T12:20:39	1:00	50N
	CIRS_172TI_FIRLMBT001_PRIME	2012-270T13:20:39	0:25	50N
	CIRS_172TI_FIRLMBT001_PRIME	2012-270T13:46:39	0:31	50N, 45N

	CIRS_172TI_FIRLMBIER002_PRIME	2012-270T15:10:39	0:40	49N
	CIRS_172TI_FIRLMBINT002_PRIME	2012-270T16:12:39	0:38	49N
T88	CIRS_175TI_FIRLMBINT001_PRIME	2012-334T06:41:59	1:00	2S
	CIRS_175TI_FIRLMBIER001_PRIME	2012-334T07:41:59	0:30	2S
	CIRS_175TI_FIRLMBT001_PRIME	2012-334T08:12:59	0:29	2S
T90	CIRS_185TI_FIRLMBINT001_PRIME	2013-095T19:28:31	1:00	14N
	CIRS_185TI_FIRLMBIER001_PRIME	2013-095T20:28:31	0:30	14N
	CIRS_185TI_FIRLMBT001_PRIME	2013-095T20:58:31	0:30	14N
T94	CIRS_197TI_FIRLMBIER002_PRIME	2013-255T08:23:56	0:35	19N
	CIRS_197TI_FIRLMBINT002_PRIME	2013-255T08:58:56	1:00	18N
T96	CIRS_199TI_FIRLMBIER002_PRIME	2013-335T01:11:19	0:45	10S
	CIRS_199TI_FIRLMBINT002_PRIME	2013-335T01:56:19	1:00	10S
T97	CIRS_200TI_FIRLMBIER002_PRIME	2014-001T22:29:41	0:45	24S
	CIRS_200TI_FIRLMBINT002_PRIME	2014-001T23:14:41	1:00	24S
T100	CIRS_203TI_FIRLMBWTR001_PRIME	2014-097T11:26:14	0:53	22S
	CIRS_203TI_FIRLMBIER002_PRIME	2014-097T13:50:14	1:06	40S
	CIRS_203TI_FIRLMBINT002_PRIME	2014-097T15:18:14	0:38	40S
T103	CIRS_206TI_FIRLMBINT005_PRIME	2014-201T08:25:58	1:00	3S
	CIRS_206TI_FIRLMBIER001_PRIME	2014-201T09:25:58	0:30	3S
T104	CIRS_208TI_FIRLMBIER001_PRIME	2014-265T05:53:19	0:45	28N
	CIRS_208TI_FIRLMBINT002_PRIME	2014-265T06:38:19	1:00	28N
T109	CIRS_212TI_FIRLMBIER001_PRIME	2015-043T17:38:04	0:45	47N
	CIRS_212TI_FIRLMBINT002_PRIME	2015-043T18:45:04	0:38	47N
T110	CIRS_213TI_FIRLMBIER002_PRIME	2015-075T14:59:49	0:45	49N
	CIRS_213TI_FIRLMBINT002_PRIME	2015-075T15:44:49	1:00	49N
T111	CIRS_215TI_FIRLMBT002_PRIME	2015-127T23:00:24	0:35	60S, 55S
	CIRS_215TI_FIRLMBIER003_PRIME	2015-127T23:35:24	0:30	60S
	CIRS_215TI_FIRLMBINT002_PRIME	2015-128T00:05:24	1:00	60S
T112	CIRS_218TI_FIRLMBINT001_PRIME	2015-188T05:54:51	1:00	80S
	CIRS_218TI_FIRLMBIER001_PRIME	2015-188T06:54:51	0:30	80N
	CIRS_218TI_FIRLMBT001_PRIME	2015-188T07:24:51	0:45	80N, 70N
	CIRS_218TI_FIRLMBT002_PRIME	2015-188T08:09:51	0:45	65S, 75S
	CIRS_218TI_FIRLMBIER002_PRIME	2015-188T08:54:51	0:30	79S
	CIRS_218TI_FIRLMBINT002_PRIME	2015-188T09:24:51	1:00	79S
T113	CIRS_222TI_FIRLMBINT002_PRIME	2015-271T23:14:12	0:53	36S
T114	CIRS_225TI_FIRLMBIER002_PRIME	2015-317T06:01:31	1:10	80S*, 85S
	CIRS_225TI_FIRLMBINT002_PRIME	2015-317T07:11:31	0:50	85S
T115	CIRS_230TI_FIRLMBINT001_PRIME	2016-016T00:05:24	1:00	65S
	CIRS_230TI_FIRLMBIER004_PRIME	2016-016T01:05:24	0:30	65S
	CIRS_230TI_FIRLMBT001_PRIME	2016-016T01:35:24	0:45	60S, 70S
	CIRS_230TI_FIRLMBT002_PRIME	2016-016T02:20:24	0:45	70S, 75S
	CIRS_230TI_FIRLMBIER005_PRIME	2016-016T03:05:24	0:30	75S
	CIRS_230TI_FIRLMBINT002_PRIME	2016-016T03:35:24	1:00	75S
T116	CIRS_231TI_FIRLMBINT001_PRIME	2016-031T22:30:05	1:18	57S
T118	CIRS_234TI_FIRLMBCON002_PRIME	2016-095T20:47:42	1:10	66S
T119	CIRS_235TI_FIRLMBINT001_PRIME	2016-127T14:37:37	1:02	54S

	CIRS_235TI_FIRLMB001_PRIME	2016-127T15:39:37	0:30	54S
	CIRS_235TI_FIRLMBT001_PRIME	2016-127T16:09:37	0:30	54S x2
T120	CIRS_236TI_FIRLMBINT001_PRIME	2016-159T11:36:17	1:15	51S
	CIRS_236TI_FIRLMB002_PRIME	2016-159T12:52:17	0:44	51S
T123	CIRS_243TI_FIRLMBT002_PRIME	2016-271T04:31:59	0:30	40N, 50N
	CIRS_243TI_FIRLMB002_PRIME	2016-271T05:01:59	0:30	50N
	CIRS_243TI_FIRLMBWTR001_PRIME	2016-271T05:31:59	1:00	50N
T125	CIRS_250TI_FIRLMBT002_PRIME	2016-334T22:29:32	0:30	10S
	CIRS_250TI_FIRLMB002_PRIME	2016-334T22:59:32	0:30	10S
	CIRS_250TI_FIRLMBWTR001_PRIME	2016-334T23:29:32	1:00	10S

**The 80S scan during T114 was a FIRLMBT profile during an expanded FIRLMB001.*

Table 3: Time-ordered list of CIRS FIRLMB observations of Titan. Red-highlighted observations were lost due to the specified reason.

2.3 Distribution of CIRS Far-infrared Limb Observations

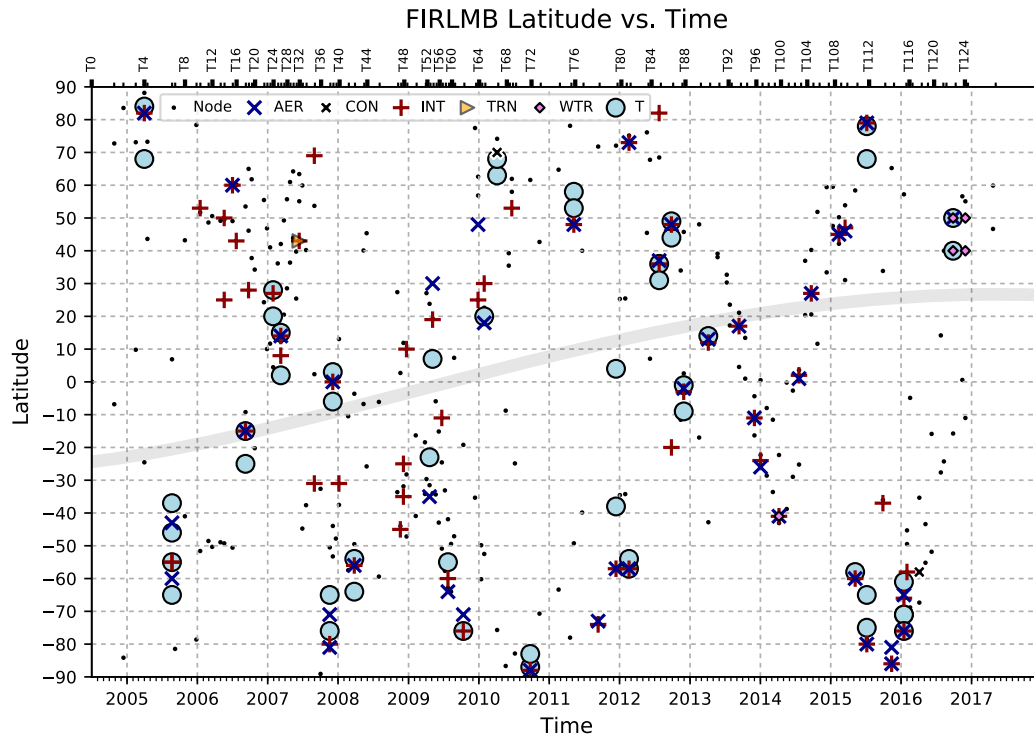


Figure 2: latitude distribution of far-infrared limb observations during the Cassini mission. Circle: FIRLMBT. Diamond: FIRLMBWTR. Triangle: FIRLMBTRN. Cross: FIRLMBINT. Small x: FIRLMBCON. Large X: FIRLMB AER. Dot: limb horizon nodes. The grey shaded line shows the sub-solar latitude.

3 Far-infrared Nadir Temperature Maps

3.1 Observation Descriptions

3.1.1 Far-Infrared Nadir Map (FIRNADMAP)

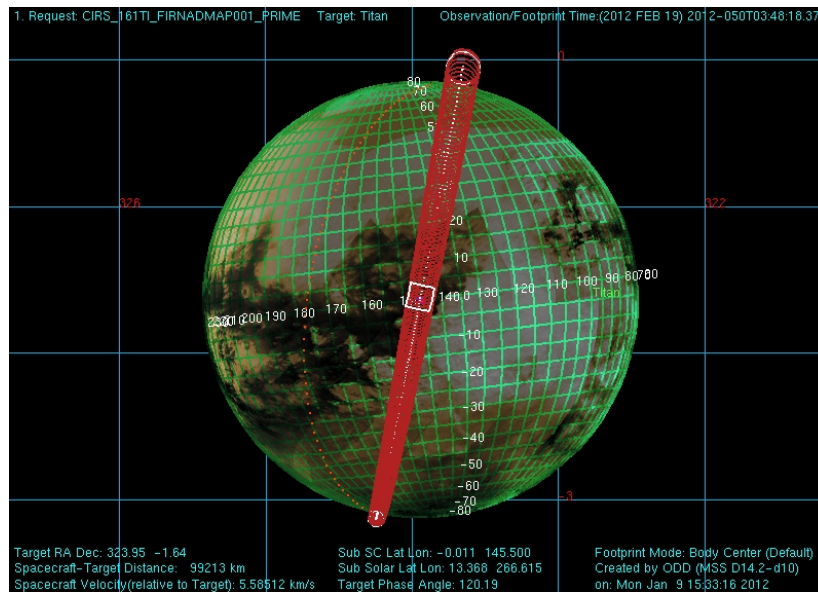
3.1.1.1 Science Description

The objective of FIRNADMAP sequences is to map the thermal structure of Titan's upper troposphere and tropopause by nadir sounding with the CIRS far-infrared focal plane (FP1). Temperatures are obtained with a precision of 0.2 K via the N_2 absorption lines at 20-100 cm^{-1} , CH_4 super-saturation at 150-400 cm^{-1} and surface temperatures at around 520 cm^{-1} .

3.1.1.2 Implementation

FIRNADMAP sequences typically occur 60,000 km or ± 3 hours from closest approach, at which time FP1 subtends 5 degrees of body-centric arc at the sub-spacecraft point. During these sequences a single slew is executed across the entire visible disk with a spectral resolution of 15.5 cm^{-1} , at a rate of around 7 $\mu rad s^{-1}$. Tailored scans over less than a diameter may target areas of particular interest, such as the northern lakes. Also, if time permits, a deep-space calibration is performed at the end of the slew by offsetting the FOV by around 20 milliradians to beyond Titan's exosphere and integrating over a period of at least 10 minutes.

3.1.1.3 Example: CIRS_161TI_FIRNADMAP001_PRIME



3.2 Time-ordered Table of Observations

Flyby #	Request Name	Start Time	Duration (HR:MN)	Pointing (Lat., Lon)
TB	CIRS_00BTI_FIRNADMAP001_UVIS	2004-348T03:38:13	4:00	6S 159W
	CIRS_00BTI_FIRNADMAP002_UVIS	2004-348T14:08:13	2:30	10N 347W
T3	CIRS_003TI_FIRNADMAP003_UVIS	2005-046T08:30:53	3:27	2N 340W
T5	CIRS_006TI_FIRNADMAP003_UVIS	2005-106T11:11:46	5:00	8N 27W
T6	CIRS_013TI_FIRNADMAP002_PRIME	2005-234T03:53:37	2:45	3N 32W
	CIRS_013TI_FIRNADMAP003_PRIME	2005-234T11:08:37	2:45	15S 208W
T9	CIRS_019TI_FIRNADMAP005_UVIS	2005-360T21:29:30	6:24	0N 28W
T11	CIRS_021TI_FIRNADMAP003_UVIS	2006-058T13:25:19	3:30	0N 344W
T13	CIRS_023TI_FIRNADMAP003_UVIS	2006-121T02:18:14	5:10	0N 10W
T14	CIRS_024TI_FIRNADMAP002_UVIS	2006-140T04:48:11	5:00	0N 158W
	CIRS_024TI_FIRNADMAP003_PRIME	2006-140T14:33:11	2:45	0N 155W
T15	CIRS_025TI_FIRNADMAP003_UVIS	2006-183T11:50:47	5:30	0N 200W
T16	CIRS_026TI_FIRNADMAP003_PRIME	2006-203T02:40:26	2:45	6S 339W
T17	CIRS_028TI_FIRNADMAP002_UVIS	2006-250T12:46:51	4:45	10N 149W
T18	CIRS_029TI_FIRNADMAP002_UVIS	2006-266T11:28:49	4:30	14N 141W
T21	CIRS_035TI_EUVFUV001_UVIS	2006-346T04:11:31	5:00	32N 129W
T22	CIRS_036TI_FIRNADMAP002_PRIME	2006-362T04:35:22	3:00	41N 133W
	CIRS_036TI_FIRNADMAP003_PRIME	2006-362T13:35:22	2:00	42S 319W
T24	CIRS_038TI_EUVFUV001_UVIS	2007-028T22:15:55	6:00	59N 116W
	CIRS_038TI_FIRNADMAP002_PRIME	2007-029T11:15:55	1:00	53S 307W
T26	CIRS_040TI_FIRNADMAP001_PRIME	2007-068T20:49:00	2:45	47S 43W
	CIRS_040TI_FIRNADMAP002_PRIME	2007-069T06:04:00	0:45	46N 228W
	CIRS_040TI_EUVFUV002_UVIS	2007-069T06:49:00	3:00	
T27	CIRS_041TI_EUVFUV001_UVIS	2007-084T20:49:27	2:23	36S 35W
	CIRS_041TI_FIRNADMAP002_PRIME	2007-085T02:38:27	0:45	32N 218W
	CIRS_041TI_EUVFUV002_UVIS	2007-085T03:23:27	5:00	39N 223W
T29	CIRS_043TI_FIRNADMAP001_PRIME	2007-116T16:32:58	2:50	27S 28W
T30	CIRS_044TI_EUVFUV001_UVIS	2007-132T11:09:58	3:50	
T31	CIRS_045TI_EUVFUV001_UVIS	2007-148T09:51:55	6:00	11S 24W
	CIRS_045TI_FIRNADMAP004_PRIME	2007-148T22:51:55	1:00	13N 212W
T32	CIRS_046TI_FIRNADMAP002_UVIS	2007-164T12:46:11	2:00	7S 24W
	CIRS_046TI_FIRNADMAP901_UVIS	2007-164T16:12:11	0:51	
	CIRS_046TI_FIRNADMAP902_PRIME	2007-164T20:04:11	2:42	4N 212W
T33	CIRS_047TI_EUVFUV001_UVIS	2007-180T11:59:46	3:00	
	CIRS_047TI_FIRNADMAP002_PRIME	2007-180T20:59:46	1:15	0N 209W
T34	CIRS_048TI_EUVFUV001_UVIS	2007-199T16:11:20	6:00	
	CIRS_048TI_FIRNADMAP002_PRIME	2007-200T05:11:20	1:00	0N 339W
T35	CIRS_049TI_FIRNADMAP001_PRIME	2007-243T01:32:34	3:00	6S 159W
	CIRS_049TI_FIRNADMAP004_PRIME	2007-243T10:32:34	1:00	10N 347W
T36	CIRS_050TI_EUVFUV001_UVIS	2007-274T19:42:43	3:49	
T37	CIRS_052TI_FIRNADMAP001_PRIME	2007-322T19:47:25	3:00	4S 22W
	CIRS_052TI_FIRNADMAP002_PRIME	2007-323T04:47:25	1:00	1N 205W
T38	CIRS_053TI_FIRNADMAP001_PRIME	2007-338T18:36:50	3:00	8N 27W

	CIRS_053TI_FIRNADMAP002_PRIME	2007-339T04:06:50	1:00	10N 215W
T40	CIRS_055TI_EUVFUV001_UVIS	2008-005T12:30:20	4:00	21S 32W
	CIRS_055TI_FIRNADMAP002_PRIME	2008-006T01:30:20	1:00	5S 211W
T41	CIRS_059TI_EUVFUV002_UVIS	2008-053T20:02:07	2:30	25N 227W
T42	CIRS_062TI_FIRNADMAP001_PRIME	2008-085T09:27:48	3:00	0N 28W
	CIRS_062TI_FIRNADMAP002_PRIME	2008-085T18:27:48	1:00	0N 189W
T43	CIRS_067TI_FIRNADMAP002_PRIME	2008-133T12:11:58	2:50	0N 344W
T44	CIRS_069TI_EUVFUV001_UVIS	2008-148T23:24:32	6:00	
T46	CIRS_091TI_FIRNADMAP001_PRIME	2008-308T14:06:23	2:01	BIU anomaly
	CIRS_091TI_EUVFUV002_UVIS	2008-308T19:27:23	7:08	
T47	CIRS_093TI_FIRNADMAP002_PRIME	2008-324T18:11:28	2:45	34N 253W
T48	CIRS_095TI_EUVFUV001_UVIS	2008-340T16:40:45	6:45	
T50	CIRS_102TI_EUVFUV001_UVIS	2009-038T14:50:51	3:00	BIU anomaly
	CIRS_102TI_EUVFUV001_ISS	2009-038T17:50:51	1:00	
	CIRS_102TI_EUVFUV001_UVIS	2009-038T21:50:51	0:13	
T51	CIRS_107TI_FIRNADMAP002_PRIME	2009-086T06:32:45	3:11	54N 266W
T52	CIRS_108TI_FIRNADMAP002_PRIME	2009-094T03:37:47	1:40	58S 257W
T54	CIRS_110TI_FIRNADMAP001_PRIME	2009-125T18:04:16	2:35	55N 82W*
	CIRS_110TI_EUVFUV001_UVIS	2009-126T00:54:16	7:00	
T55	CIRS_111TI_EUVFUV001_UVIS	2009-141T12:26:41	6:30	
	CIRS_111TI_FIRNADMAP002_PRIME	2009-141T23:56:41	2:30	55S 270W*
T56	CIRS_112TI_EUVFUV001_UVIS	2009-157T21:41:01	7:19	
T57	CIRS_113TI_EUVFUV001_UVIS	2009-173T09:32:35	6:45	
	CIRS_113TI_EUVFUV002_UVIS	2009-174T00:02:35	3:00	
T58	CIRS_114TI_EUVFUV001_UVIS	2009-189T08:04:03	6:40	
	CIRS_114TI_FIRNADMAP002_PRIME	2009-189T19:04:03	1:30	24S 294W*
T59	CIRS_115TI_FIRNADMAP002_PRIME	2009-205T18:10:09	2:23	23S 326W
T60	CIRS_116TI_EUVFUV001_UVIS	2009-221T05:03:53	3:50	Downlink
T62	CIRS_119TI_EUVFUV001_UVIS	2009-284T23:36:25	6:51	
	CIRS_119TI_EUVFUV002_UVIS	2009-285T11:12:30	6:24	
T63	CIRS_122TI_FIRNADMAP002_PRIME	2009-346T03:48:14	1:00	0N 200W
T64	CIRS_123TI_FIRNADMAP001_PRIME	2009-361T19:16:59	2:45	4N 121W
T65	CIRS_124TI_FIRNADMAP001_PRIME	2010-012T18:10:37	2:45	Angled track
	CIRS_124TI_FIRNADMAP002_PRIME	2010-013T01:10:37	3:00	Angled track
T66	CIRS_125TI_EUVFUV001_UVIS	2010-028T13:28:49	6:30	
	CIRS_125TI_EUVFUV002_UVIS	2010-029T00:28:49	7:00	
T67	CIRS_129TI_FIRNADMAP001_PRIME	2010-095T10:50:39	2:45	25S 130W*
	CIRS_129TI_FIRNADMAP002_PRIME	2010-095T19:50:39	1:00	10N 310W*
T69	CIRS_132TI_EUVFUV001_UVIS	2010-156T04:26:27	7:00	
T70	CIRS_133TI_FIRNADMAP001_PRIME	2010-171T20:27:43	2:45	0N 9W
T72	CIRS_138TI_FIRNADMAP001_PRIME	2010-267T13:38:41	2:45	5S 50W*
	CIRS_138TI_EUVFUV002_UVIS	2010-267T20:53:41	6:45	
T73	CIRS_140TI_FIRNADMAP001_PRIME	2010-315T08:37:01	2:45	Safing event
T75	CIRS_147TI_EUVFUV001_UVIS	2011-109T07:30:39	6:30	
T76	CIRS_148TI_FIRNADMAP001_PRIME	2011-128T17:53:45	2:45	0N 20W*
	CIRS_148TI_EUVFUV001_UVIS	2011-129T01:53:45	6:00	

T77	CIRS_149TI_EUVFUV001_UVIS	2011-171T06:37:00	9:25	
	CIRS_149TI_FIRNADMAP002_PRIME	2011-171T21:02:01	2:30	0N 217W
T78	CIRS_153TI_FIRNADMAP001_PRIME	2011-254T21:50:06	2:45	0N 118W*
	CIRS_153TI_EUVFUV001_UVIS	2011-255T06:50:06	7:32	Withdrawn?
T79	CIRS_158TI_FIRNADMAP501_PRIME	2011-347T15:11:24	2:45	0N 15W
T80	CIRS_159TI_FIRNADMAP001_PRIME	2012-002T10:13:38	2:45	25S 138W
T81	CIRS_160TI_EUVFUV001_UVIS	2012-030T04:39:47	6:45	
	CIRS_160TI_EUVFUV002_UVIS	2012-030T16:39:47	6:00	
T82	CIRS_161TI_FIRNADMAP001_PRIME	2012-050T03:43:17	2:45	0N 148W
	CIRS_161TI_FIRNADMAP002_PRIME	2012-050T10:58:17	2:45	0N 330W*
T83	CIRS_166TI_FIRNADMAP001_PRIME	2012-142T20:10:11	2:33	0N 20W
T84	CIRS_167TI_FIRNADMAP001_PRIME	2012-158T19:07:21	2:45	22N 18W
	CIRS_167TI_EUVFUV002_UVIS	2012-159T02:22:21	6:45	
T85	CIRS_169TI_FIRNADMAP002_PRIME	2012-206T22:18:08	2:45	18S 202W
T86	CIRS_172TI_EUVFUV001_UVIS	2012-270T05:35:38	6:45	
	CIRS_172TI_EUVFUV002_UVIS	2012-270T16:50:38	6:45	
T88	CIRS_175TI_FIRNADMAP001_PRIME	2012-334T03:56:59	2:45	35N 30W
T90	CIRS_185TI_FIRNADMAP001_PRIME	2013-095T16:43:31	2:45	42N 48W
T93	CIRS_195TI_EUVFUV001_UVIS	2013-207T02:56:19	6:45	
T94	CIRS_197TI_EUVFUV001_UVIS	2013-255T09:58:56	6:45	
T96	CIRS_199TI_FIRNADMAP002_PRIME	2013-335T02:56:19	2:45	90S 0W*
T97	CIRS_200TI_EUVFUV001_UVIS	2014-001T12:59:41	6:45	
	CIRS_200TI_EUVFUV002_UVIS	2014-002T00:14:41	6:45	
T100	CIRS_203TI_EUVFUV001_UVIS	2014-097T15:56:14	6:45	
T101	CIRS_204TI_EUVFUV001_UVIS	2014-137T02:12:15	5:15	
	CIRS_204TI_FIRNADMAP002_PRIME	2014-137T18:57:15	2:15	78N 240W, 72N 313W ¹
T102	CIRS_205TI_FIRNADMAP002_PRIME	2014-169T16:31:25	1:57	65N 195W*
T103	CIRS_206TI_FIRNADMAP002_PRIME	2014-201T13:40:58	2:00	78N 240W ²
T105	CIRS_208TI_EUVFUV001_UVIS	2014-265T02:23:19	0:45	
	CIRS_208TI_EUVFUV002_UVIS	2014-265T11:08:19	1:30	
	CIRS_208TI_FIRNADMAP002_PRIME	2014-265T07:38:19	3:30	57N 200W*
T109	CIRS_212TI_EUVFUV001_UVIS	2015-043T08:08:04	6:45	
	CIRS_212TI_EUVFUV002_UVIS	2015-043T19:23:04	6:45	
T110	CIRS_213TI_FIRNADMAP002_PRIME	2015-075T16:44:49	2:45	6S 200W
T111	CIRS_215TI_FIRNADMAP002_PRIME	2015-128T01:05:24	2:45	10S 340W
T112	CIRS_218TI_FIRNADMAP002_PRIME	2015-188T10:24:51	2:45	6N 220W
T113	CIRS_222TI_FIRNADMAP001_PRIME	2015-271T16:37:12	3:00	0N 150W
	CIRS_222TI_FIRNADMAP002_PRIME	2015-272T00:07:12	2:30	0N 335W
T114	CIRS_225TI_EUVFUV002_UVIS	2015-317T08:01:31	6:45	
T115	CIRS_230TI_EUVFUV001_UVIS	2016-015T17:20:24	6:45	
	CIRS_230TI_FIRNADMAP002_PRIME	2016-016T04:35:24	2:45	0N 218W
T116	CIRS_231TI_EUVFUV001_UVIS	2016-032T04:20:05	1:40	
	CIRS_231TI_FIRNADMAP001_PRIME	2016-031T20:00:05	2:30	5S 24W
T117	CIRS_232TI_FIRNADMAP002_PRIME	2016-048T02:28:41	2:21	13N 207W
T118	CIRS_234TI_EUVFUV001_UVIS	2016-095T10:42:42	6:45	
	CIRS_234TI_EUVFUV002_UVIS	2016-095T21:57:42	6:45	

T119	CIRS_235TI_FIRNADMAP001_PRIME	2016-127T11:54:37	2:42	25S 30W*
	CIRS_236TI_FIRNADMAP001_PRIME	2016-159T09:06:17	2:30	36S 20W
T120	CIRS_236TI_FIRNADMAP002_PRIME	2016-159T16:21:17	2:45	38N 207W
T121	CIRS_238TI_FIRNADMAP001_PRIME	2016-207T04:58:23	2:45	41S 26W
	CIRS_243TI_EUVFUV001_UVIS	2016-270T19:16:59	6:45	
T123	CIRS_243TI_EUVFUV002_UVIS	2016-271T06:31:59	6:45	
T124	CIRS_248TI_FIRNADMAP002_PRIME	2016-319T02:27:56	2:28	33N 244W
T125	CIRS_250TI_FIRNADMAP002_PRIME	2016-335T00:29:32	2:45	31N 246W
N/A	CIRS_275TI_FIRNADMAP002_PRIME	2017-144T01:18:00	4:15	20S 305W*
N/A	CIRS_292TI_FIRNADMAP001_PRIME	2017-254T23:46:00	3:00	N Pole mosaic

Table 4: CIRS and UVIS-led far-infrared nadir map observations. Pointing entries indicate the sub-spacecraft point at the midpoint of the duration. Where the observation track is offset from the sub-spacecraft point, the midpoint of the scan is given; these entries are marked with an asterisk. ¹Two scans on T101, both targeted at northern lakes (Ligeia Mare, Kraken Mare). ²Continuous mosaic, seven short scans over Ligeia Mare.

3.3 Maps of FIRNADMAP and EUVFUV Surface Coverage of Titan

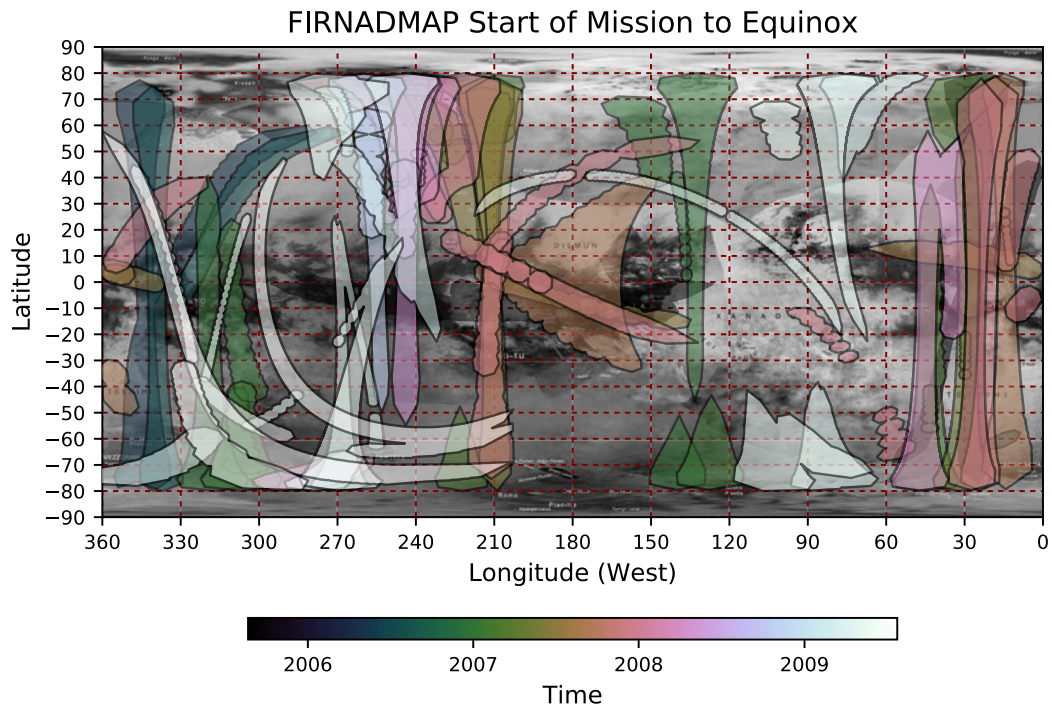


Figure 3: FIRNADMAP surface coverage from the start of the mission to equinox (2009), rectangular projection.

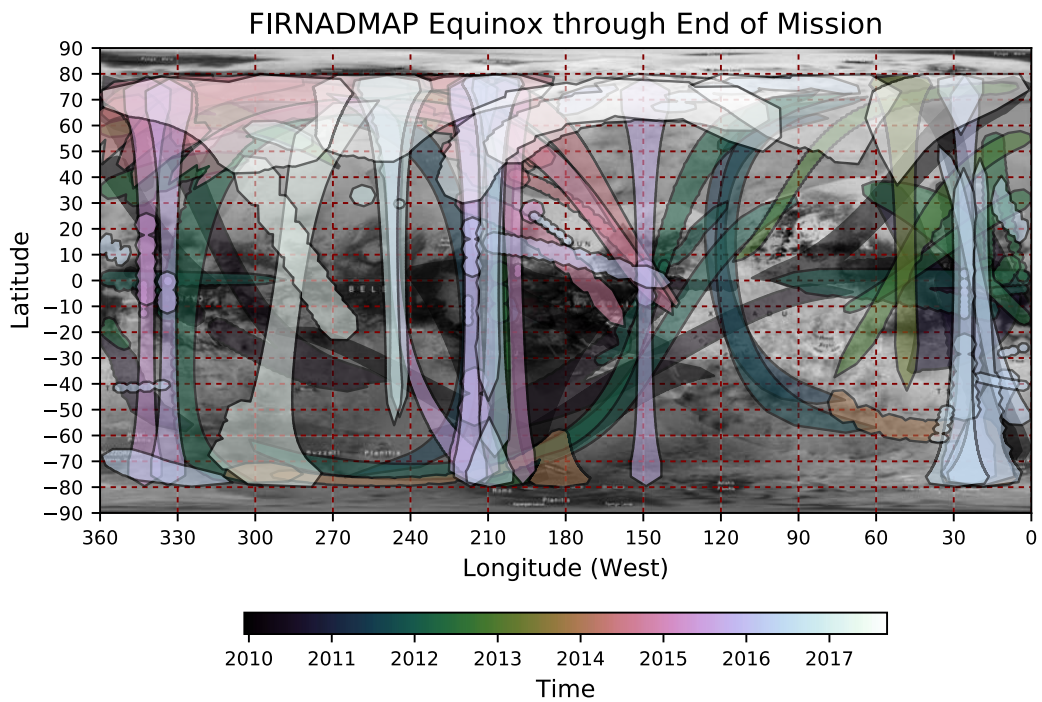


Figure 4: FIRNADMAP surface coverage from equinox (2009) to end of mission, rectangular projection.

FIRNADMAP through Equinox

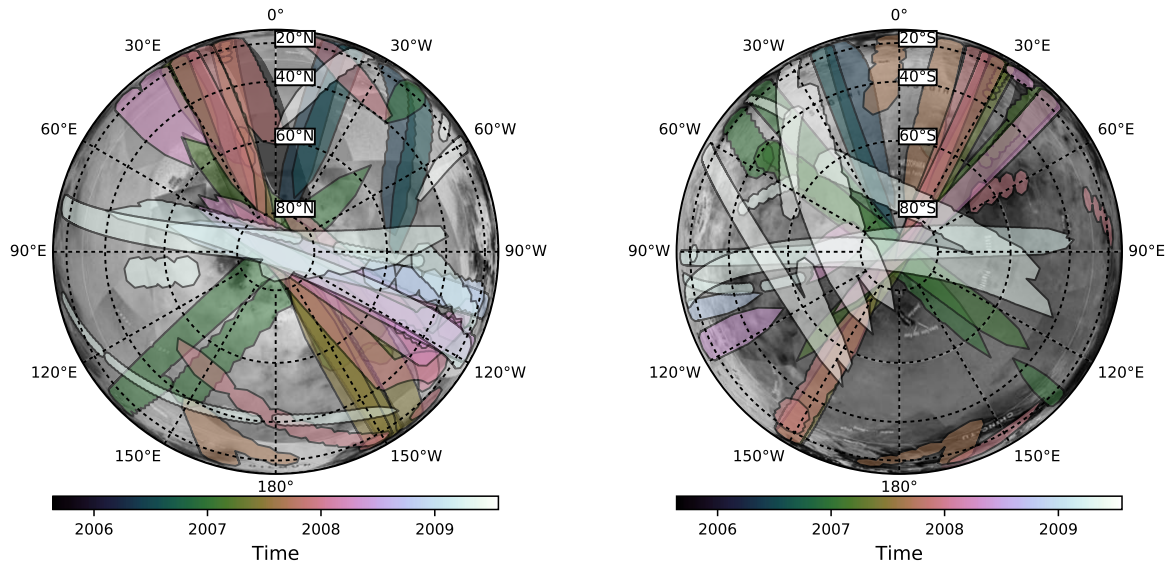


Figure 5: FIRNADMAP surface coverage in polar projection from the start of the mission to equinox (2009).

FIRNADMAP Equinox through End of Mission

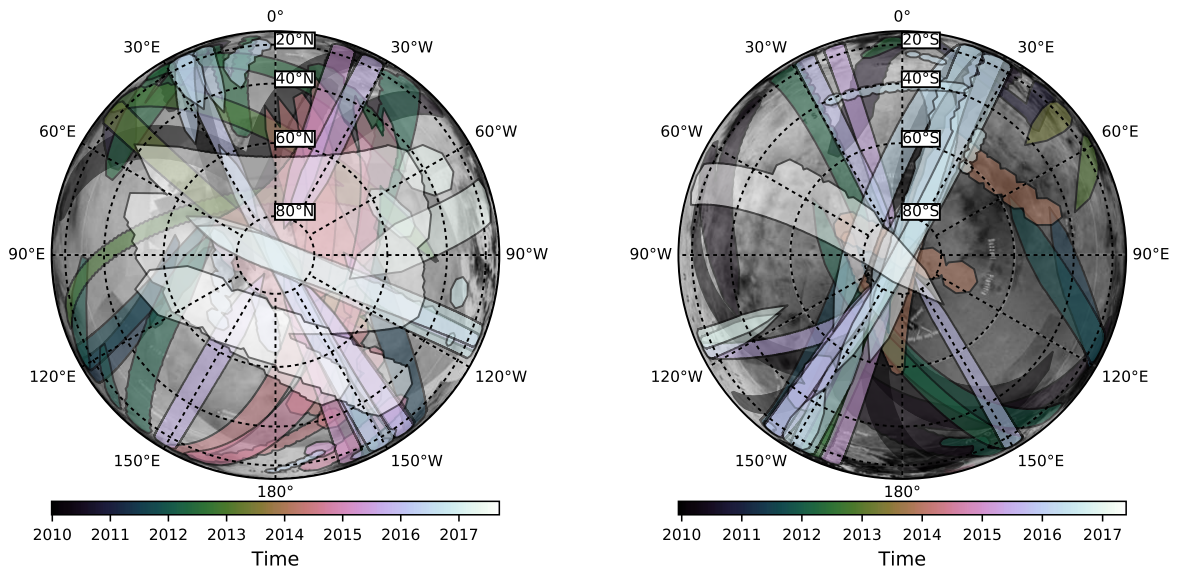


Figure 6: FIRNADMAP surface coverage in polar projection from the start of the mission to equinox (2009).

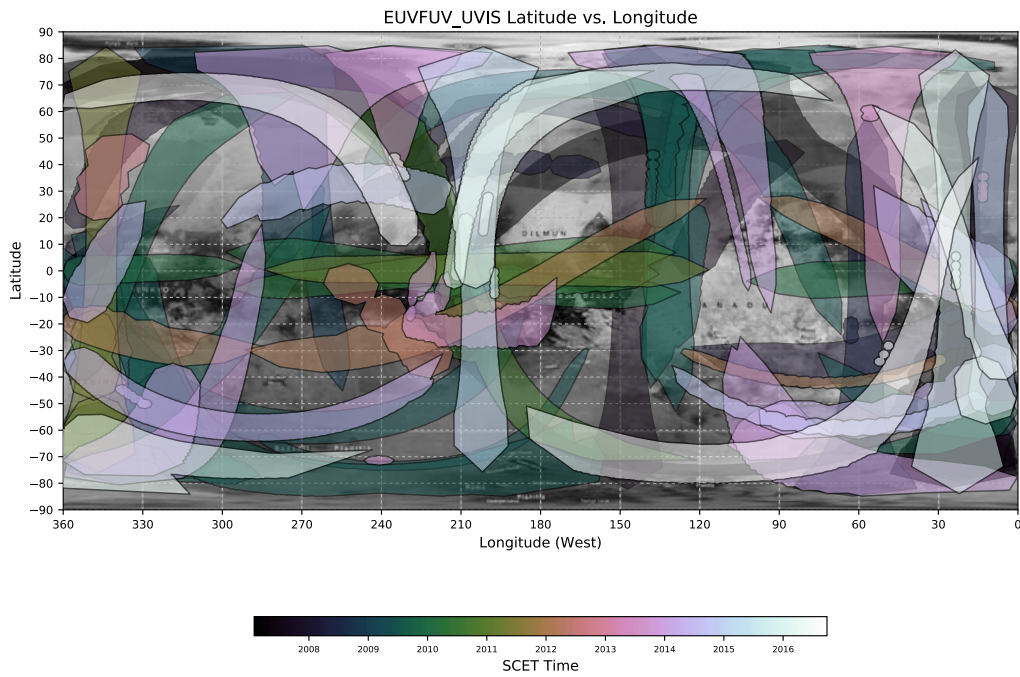


Figure 7: EUVFUV surface coverage during the entire mission, rectangular projection.

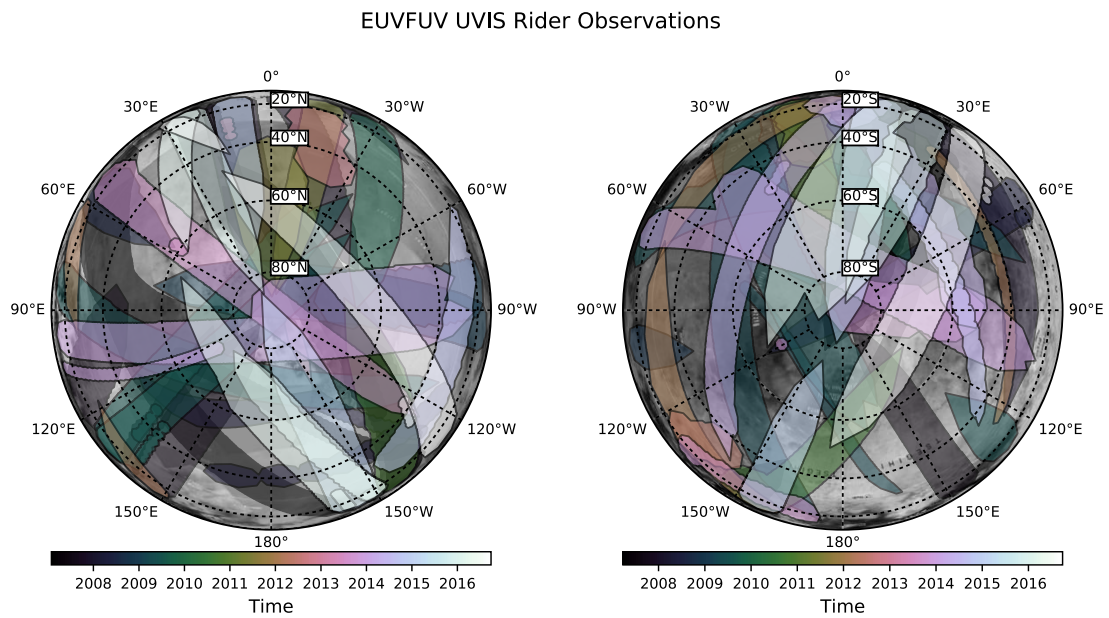


Figure 8: EUVFUV surface coverage during the entire mission, polar projection.

4 Far-infrared Nadir Integrations

4.1 Far-Infrared Nadir Composition Integration (FIRNADCMP)

4.1.1 Observation Description

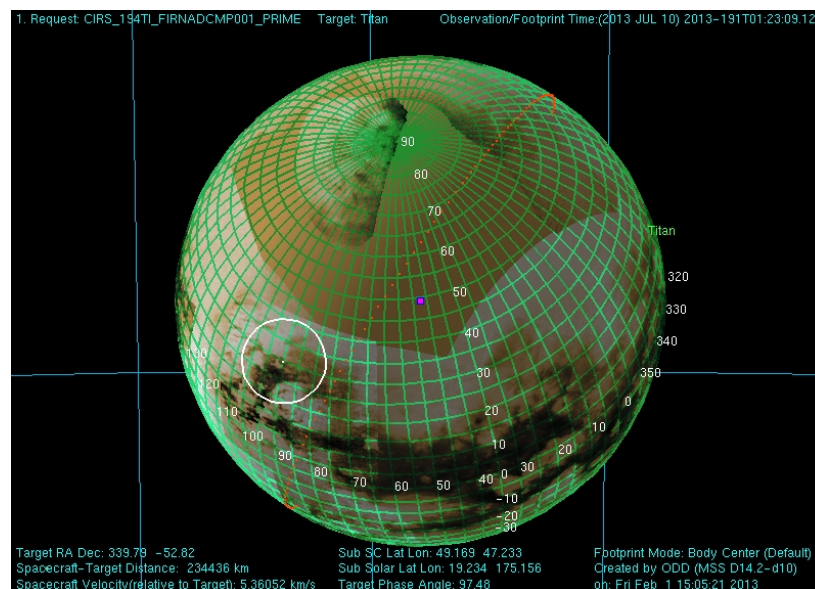
4.1.1.1 Science Description

The objective of FIRNADCMP designs is to obtain maps of CH₄, HCN and CO abundances in Titan's stratosphere from measurements of their rotational lines, and possibly detect new compounds. Spatial mapping of the disk is composited from multiple flybys during the tour, with only one location being observed in a single sequence, and measurements are repeated over the lifetime of the tour to search for seasonal variations.

4.1.1.2 Implementation

FIRNADCMP observations are executed at ranges of 160,000 to 270,000 km, or around ± 8 -13 hours from closest approach. Long integration times of typically 5 hours are used to improve signal to noise and provide a high spectral resolution of 0.5 cm⁻¹. Locations are chosen on the visible disk at emission angles of 45-60 degrees, to improve spectral contrast of stratospheric emission while ensuring that the focal plane remains on the disk with the included pointing uncertainty, and to provide comprehensive latitude coverage. During a typical sequence the CIRS far-infrared focal plane (FP1) is positioned at a single chosen position on Titan's disk, with the FPB toward Titan center, ideally about 1/3 of the radius from the body center for most of the duration. If time permits, deep-space calibrations of around 10 minutes are performed before and/or after the long integration, during which FP1 is moved beyond Titan's exosphere by executing an offset of around 25 mrad.

4.1.1.3 Example: CIRS_194TI_FIRNADCMP001_PRIME



4.2 Time-ordered Table of Observations

Table 5: CIRS-led far-infrared nadir integrations.

Flyby #	Request Name	Start Time	Duration (HR:MN)	Pointing (Lat, Lon)
T0	CIRS_000TI_FIRNADCMP017_PRIME	2004-185T01:00:00	2:15	visible center
	CIRS_000TI_FIRNADCMP001_PRIME	2004-185T04:00:00	6:00	visible center
TA	CIRS_00ATI_FIRNADCMP001_PRIME	2004-300T00:00:09	4:00	30S 200W
TB	CIRS_00BTI_FIRNADCMP001_PRIME	2004-347T23:38:13	4:00	10N 120W
T3	CIRS_003TI_FIRNADCMP002_PRIME	2005-046T14:57:53	4:00	18S 35W
T4	CIRS_005TI_FIRNADCMP002_PRIME	2005-090T07:35:16	4:00	40S 15W
	CIRS_005TI_FIRNADCMP003_PRIME	2005-091T04:05:16	4:00	47N 210W
T5	CIRS_006TI_FIRNADCMP002_PRIME	2005-106T07:16:46	3:25	55N 15W
T6	CIRS_013TI_FIRNADCMP003_PRIME	2005-233T22:05:37	3:18	30N 330W
	CIRS_013TI_FIRNADCMP004_PRIME	2005-234T16:23:37	4:30	60S 220W
T7	CIRS_014TI_FIRNADCMP002_PRIME	2005-250T17:11:57	3:00	10S 160W
T8	CIRS_017TI_FIRNADCMP003_PRIME	2005-301T13:15:25	3:00	20N 35W
T9	CIRS_019TI_FIRNADCMP002_PRIME	2005-360T07:49:30	2:10	0N 62W
T10	CIRS_020TI_FIRNADCMP002_PRIME	2006-014T23:41:27	2:00	20N 190W
T11	CIRS_021TI_FIRNADCMP002_PRIME	2006-058T16:55:19	4:40	30S 170W
T12	CIRS_022TI_FIRNADCMP003_PRIME	2006-077T10:05:57	7:00	0N 190W
	CIRS_022TI_FIRNADCMP008_PRIME	2006-078T12:25:57	1:41	25N 315W
T13	CIRS_023TI_FIRNADCMP003_PRIME	2006-120T05:34:14	6:24	25S 320W
	CIRS_023TI_FIRNADCMP002_PRIME	2006-121T07:28:14	4:07	35S 210W
T14	CIRS_024TI_FIRNADCMP003_PRIME	2006-139T20:48:11	6:30	15S 125W
T15	CIRS_025TI_FIRNADCMP003_PRIME	2006-182T19:50:47	3:30	15N 230W
	CIRS_025TI_FIRNADCMP002_PRIME	2006-183T18:20:47	5:30	40N 20W
T17	CIRS_028TI_FIRNADCMP003_PRIME	2006-250T06:16:51	6:00	30N 145W
T18	CIRS_029TI_FIRNADCMP003_PRIME	2006-266T04:58:49	5:30	10N 95W
T19	CIRS_030TI_FIRNADCMP003_PRIME	2006-282T03:30:07	5:00	60S 300W
	CIRS_030TI_FIRNADCMP002_PRIME	2006-283T03:30:07	5:51	35N 115W
T21	CIRS_035TI_FIRNADCMP003_PRIME	2006-345T21:11:31	5:30	65N 130W
	CIRS_035TI_FIRNADCMP023_PRIME	2006-346T22:09:31	3:00	80S 300W
T22	CIRS_036TI_FIRNADCMP003_PRIME	2006-361T20:05:22	5:30	80N 160W
	CIRS_036TI_FIRNADCMP002_PRIME	2006-362T18:35:22	2:30	90S 320W
T23	CIRS_037TI_FIRNADCMP001_PRIME	2007-012T19:38:31	3:00	75N 210W
	CIRS_037TI_FIRNADCMP002_PRIME	2007-013T17:38:31	2:00	70S 210W
T24	CIRS_038TI_FIRNADCMP001_PRIME	2007-028T16:15:55	5:00	85N 290W
	CIRS_038TI_FIRNADCMP002_PRIME	2007-029T16:15:55	5:00	40S 280W
T25	CIRS_039TI_FIRNADCMP001_PRIME	2007-052T14:12:24	3:00	30S 90W
	CIRS_039TI_FIRNADCMP002_PRIME	2007-053T12:12:24	2:00	70N 350W
T26	CIRS_040TI_FIRNADCMP001_PRIME	2007-068T12:49:00	3:00	50S 80W
	CIRS_040TI_FIRNADCMP002_PRIME	2007-069T10:49:00	2:00	90N 60W
T27	CIRS_041TI_FIRNADCMP001_PRIME	2007-084T11:23:27	3:00	70S 20W
	CIRS_041TI_FIRNADCMP002_PRIME	2007-085T09:23:27	2:00	60N 150W
T28	CIRS_042TI_FIRNADCMP001_PRIME	2007-100T07:58:00	2:00	60S 30W
	CIRS_042TI_FIRNADCMP002_PRIME	2007-101T07:58:00	5:00	70N 180W

T29	CIRS_043TI_FIRNADCMP001_PRIME	2007-116T06:46:58	4:46	50S 30W
	CIRS_043TI_FIRNADCMP002_PRIME	2007-117T06:32:58	2:00	75N 220W
T30	CIRS_044TI_FIRNADCMP002_PRIME	2007-133T05:09:58	2:00	0N 260W
T31	CIRS_045TI_FIRNADCMP001_PRIME	2007-148T04:42:55	4:09	20S 330W
	CIRS_045TI_FIRNADCMP002_PRIME	2007-149T03:51:55	6:14	50N 230W
T32	CIRS_046TI_FIRNADCMP001_PRIME	2007-164T03:39:11	1:07	20N 50W
	CIRS_046TI_FIRNADCMP002_PRIME	2007-165T02:46:11	2:00	20S 257W
T33	CIRS_047TI_FIRNADCMP001_PRIME	2007-180T02:44:46	4:15	10N 330W
	CIRS_047TI_FIRNADCMP002_PRIME	2007-181T02:14:46	4:45	20N 170W
T34	CIRS_048TI_FIRNADCMP001_PRIME	2007-199T10:11:20	2:00	35S 125W
	CIRS_048TI_FIRNADCMP002_PRIME	2007-200T10:11:20	4:49	50N 345W
T35	CIRS_049TI_FIRNADCMP001_PRIME	2007-242T18:17:34	2:15	10S 40W
	CIRS_049TI_FIRNADCMP002_PRIME	2007-243T15:32:34	6:00	37S 240W
T36	CIRS_050TI_FIRNADCMP001_PRIME	2007-274T13:30:43	5:12	10S 320W
	CIRS_050TI_FIRNADCMP002_PRIME	2007-275T13:42:43	2:00	30N 255W
T37	CIRS_052TI_FIRNADCMP002_PRIME	2007-323T09:47:25	5:00	40N 185W
T38	CIRS_053TI_FIRNADCMP001_PRIME	2007-338T09:59:50	4:07	40S 340W
	CIRS_053TI_FIRNADCMP002_PRIME	2007-339T09:06:50	2:00	60N 215W
T39	CIRS_054TI_FIRNADCMP002_PRIME	2007-355T07:57:55	2:00	60N 270W
T40	CIRS_055TI_FIRNADCMP001_PRIME	2008-005T08:07:20	3:23	20N 355W
	CIRS_055TI_FIRNADCMP002_PRIME	2008-006T06:30:20	5:00	45N 280W
T41	CIRS_059TI_FIRNADCMP001_PRIME	2008-053T04:29:07	3:03	25S 65W
	CIRS_059TI_FIRNADCMP002_PRIME	2008-054T02:32:07	2:00	15N 285W
T42	CIRS_062TI_FIRNADCMP002_PRIME	2008-085T23:27:48	2:00	60N 310W
T43	CIRS_067TI_FIRNADCMP001_PRIME	2008-132T23:07:58	0:54	60S 60W
	CIRS_067TI_FIRNADCMP002_PRIME	2008-133T19:01:58	5:00	30N 300W
T44	CIRS_069TI_FIRNADCMP001_PRIME	2008-148T17:24:32	2:00	45S 50W
	CIRS_069TI_FIRNADCMP002_PRIME	2008-149T17:24:32	2:00	10N 300W
T46	CIRS_091TI_FIRNADCMP001_PRIME	2008-308T02:35:24	6:00	BIU anomaly
	CIRS_091TI_FIRNADCMP002_PRIME	2008-309T03:35:24	4:38	
T47	CIRS_093TI_FIRNADCMP002_PRIME	2008-325T01:56:28	3:00	45N 255W
T48	CIRS_095TI_FIRNADCMP001_PRIME	2008-340T01:25:45	4:00	15S 70W
T49	CIRS_097TI_FIRNADCMP001_PRIME	2008-355T23:59:52	4:00	10S 110W
T50	CIRS_102TI_FIRNADCMP001_PRIME	2009-037T19:50:51	3:30	BIU anomaly
T51	CIRS_106TI_FIRNADCMP001_PRIME	2009-085T16:43:36	3:00	60S 150W
	CIRS_107TI_FIRNADCMP002_PRIME	2009-086T14:43:36	3:00	35N 215W
T52	CIRS_108TI_FIRNADCMP002_PRIME	2009-094T10:47:47	3:00	70S 75W
T53	CIRS_109TI_FIRNADCMP001_PRIME	2009-109T09:13:42	5:07	Downlink
T54	CIRS_110I_FIRNADCMP001_PRIME	2009-126T07:54:16	5:00	70S 190W
T55	CIRS_111TI_FIRNADCMP002_PRIME	2009-142T06:26:41	3:00	25S 5W
T56	CIRS_112TI_FIRNADCMP001_PRIME	2009-157T06:07:49	3:52	50N 60W
	CIRS_112TI_FIRNADCMP002_PRIME	2009-158T05:00:01	5:00	60S 255W
T57	CIRS_113TI_FIRNADCMP001_PRIME	2009-173T05:05:48	3:27	15N 75W
T58	CIRS_114TI_FIRNADCMP001_PRIME	2009-190T02:04:03	3:00	70S 340W
T59	CIRS_115TI_FIRNADCMP001_PRIME	2009-205T02:34:04	3:00	50N 100W
T60	CIRS_116TI_FIRNADCMP001_PRIME	2009-221T02:01:49	2:02	Downlink
T62	CIRS_119TI_FIRNADCMP001_PRIME	2009-284T19:36:25	3:00	25S 105W

	CIRS_119TI_FIRNADCMP002_PRIME	2009-285T17:36:25	3:00	0N 20W
T63	CIRS_122TI_FIRNADCMP001_PRIME	2009-345T11:05:56	3:57	40N 0W
T64	CIRS_123TI_FIRNADCMP002_PRIME	2009-362T09:16:59	3:00	45S 190W
T65	CIRS_124TI_FIRNADCMP002_PRIME	2010-013T08:10:37	5:00	0N 170W
T66	CIRS_125TI_FIRNADCMP001_PRIME	2010-028T08:07:18	4:22	40N 40W
	CIRS_125TI_FIRNADCMP002_PRIME	2010-029T07:28:49	5:00	45S 225W
T67	CIRS_129TI_FIRNADCMP001_PRIME	2010-095T03:44:18	2:06	45S 110W
T68	CIRS_131TI_FIRNADCMP001_PRIME	2010-139T14:24:20	3:00	30S 30W
	CIRS_131TI_FIRNADCMP002_PRIME	2010-140T12:24:20	4:00	20S 230W
T69	CIRS_132TI_FIRNADCMP002_PRIME	2010-156T11:26:27	3:00	50N 195W
T70	CIRS_133TI_FIRNADCMP001_PRIME	2010-171T12:06:01	3:21	50S 0W
T71	CIRS_134TI_FIRNADCMP001_PRIME	2010-187T11:07:45	4:15	10S 60W
T72	CIRS_138TI_FIRNADCMP001_PRIME	2010-267T06:12:41	3:26	30S 40W
T73	CIRS_140TI_FIRNADCMP001_PRIME	2010-315T00:37:01	4:00	Safing event
T76	CIRS_148TI_FIRNADCMP001_PRIME	2011-128T09:42:00	4:12	10S 115W
T78	CIRS_153TI_FIRNADCMP001_PRIME	2011-254T13:50:06	4:00	10N 110W
T79	CIRS_158TI_FIRNADCMP501_PRIME	2011-347T04:20:00	6:52	30S 330W
T80	CIRS_159TI_FIRNADCMP001_PRIME	2012-002T01:16:59	4:57	40S 150W
T81	CIRS_160TI_FIRNADCMP001_PRIME	2012-029T23:36:01	5:04	40S 330W
	CIRS_160TI_FIRNADCMP002_PRIME	2012-030T22:39:48	5:36	0N 240W
T82	CIRS_161TI_FIRNADCMP001_PRIME	2012-049T20:43:17	2:00	10N 150W
	CIRS_161TI_FIRNADCMP002_PRIME	2012-050T17:43:17	2:06	15S 290W
T83	CIRS_166TI_FIRNADCMP001_PRIME	2012-143T10:10:11	5:36	15S 170W
T84	CIRS_167TI_FIRNADCMP002_PRIME	2012-159T09:07:21	5:00	45S 255W
T85	CIRS_169TI_FIRNADCMP001_PRIME	2012-206T07:03:07	4:00	10S 345W
T86	CIRS_172TI_FIRNADCMP001_PRIME	2012-270T01:10:59	4:25	45N 315W
	CIRS_172TI_FIRNADCMP002_PRIME	2012-270T23:35:38	5:00	70S 240W
T87	CIRS_174TI_FIRNADCMP002_PRIME	2012-318T19:22:08	5:00	72S 185W
T88	CIRS_175TI_FIRNADCMP001_PRIME	2012-333T21:26:59	2:30	15N 60W
	CIRS_175TI_FIRNADCMP002_PRIME	2012-334T17:56:59	5:00	60S 165W
T90	CIRS_185TI_FIRNADCMP001_PRIME	2013-095T08:43:31	4:00	15N 70W
	CIRS_185TI_FIRNADCMP002_PRIME	2013-096T06:43:31	5:00	89S 245W
T91	CIRS_190TI_FIRNADCMP001_PRIME	2013-143T04:32:55	4:00	0N 50W
	CIRS_190TI_FIRNADCMP002_PRIME	2013-144T02:32:55	5:00	45S 300W
T92	CIRS_194TI_FIRNADCMP001_PRIME	2013-191T01:21:47	3:00	30N 90W
T93	CIRS_195TI_FIRNADCMP001_PRIME	2013-206T23:56:22	3:00	20N 15W
T94	CIRS_197TI_FIRNADCMP001_PRIME	2013-254T17:43:56	5:00	60N 110W
T95	CIRS_198TI_FIRNADCMP001_PRIME	2013-286T16:56:27	3:00	89N 30W
	CIRS_198TI_FIRNADCMP002_PRIME	2013-287T13:56:27	4:53	70S 100W
T96	CIRS_199TI_FIRNADCMP001_PRIME	2013-334T10:41:19	5:00	90N (FPB)
T97	CIRS_200TI_FIRNADCMP001_PRIME	2014-001T09:59:41	3:00	50N 165W
	CIRS_200TI_FIRNADCMP002_PRIME	2014-002T07:21:41	4:00	60S 45W
T98	CIRS_201TI_FIRNADCMP001_PRIME	2014-033T05:12:39	5:00	20N 135W
	CIRS_201TI_FIRNADCMP002_PRIME	2014-034T04:12:39	4:00	40S 20W
T100	CIRS_203TI_FIRNADCMP001_PRIME	2014-097T01:41:14	3:00	75N 90W
	CIRS_203TI_FIRNADCMP002_PRIME	2014-097T22:41:14	4:00	0N 0W
T101	CIRS_204TI_FIRNADCMP002_PRIME	2014-138T01:12:15	4:00	0N 210W

T102	CIRS_205TI_FIRNADCMP001_PRIME	2014-169T01:28:25	3:00	45S 300W
	CIRS_205TI_FIRNADCMP002_PRIME	2014-169T22:28:25	3:00	30N 180W
T103	CIRS_206TI_FIRNADCMP001_PRIME	2014-200T22:40:58	3:00	50S 320W
	CIRS_206TI_FIRNADCMP002_PRIME	2014-201T19:40:58	3:00	30N 240W
T104	CIRS_207TI_FIRNADCMP001_PRIME	2014-232T20:09:09	3:00	70S 110W
	CIRS_207TI_FIRNADCMP002_PRIME	2014-233T17:09:09	3:00	80N 150W
T105	CIRS_208TI_FIRNADCMP001_PRIME	2014-264T15:23:19	5:00	80S 300W
	CIRS_208TI_FIRNADCMP002_PRIME	2014-265T14:38:19	2:45	60N 270W
T106	CIRS_209TI_FIRNADCMP001_PRIME	2014-296T14:40:30	3:00	35S 320W
	CIRS_209TI_FIRNADCMP002_PRIME	2014-297T11:40:30	4:00	50N 255W
T107	CIRS_210TI_FIRNADCMP001_PRIME	2014-344T08:26:35	5:00	70S 0W
	CIRS_210TI_FIRNADCMP002_PRIME	2014-345T07:26:35	4:00	20S 195W
T108	CIRS_211TI_FIRNADCMP001_PRIME	2015-011T07:15:35	3:33	20N 20W
	CIRS_211TI_FIRNADCMP002_PRIME	2015-012T04:48:35	4:00	40N 160W
T109	CIRS_212TI_FIRNADCMP002_PRIME	2015-044T02:08:04	4:00	40S 200W
T110	CIRS_213TI_FIRNADCMP001_PRIME	2015-075T02:29:49	3:00	30S 345W
	CIRS_213TI_FIRNADCMP002_PRIME	2015-075T23:29:49	4:00	25N 205W
T111	CIRS_215TI_FIRNADCMP001_PRIME	2015-127T09:50:24	4:00	50S 140W
	CIRS_215TI_FIRNADCMP002_PRIME	2015-128T07:50:24	4:00	30S 310W
T112	CIRS_218TI_FIRNADCMP001_PRIME	2015-187T19:09:51	4:00	20S 40W
	CIRS_218TI_FIRNADCMP002_PRIME	2015-188T17:09:51	4:00	40S 250W
T113	CIRS_222TI_FIRNADCMP001_PRIME	2015-271T09:27:12	2:10	30N 110W
	CIRS_222TI_FIRNADCMP002_PRIME	2015-272T06:37:12	4:00	0N 310W
T115	CIRS_230TI_FIRNADCMP001_PRIME	2016-015T12:55:31	4:24	15S 345W
T116	CIRS_231TI_FIRNADCMP001_PRIME	2016-031T11:56:59	4:03	15N 345W
	CIRS_231TI_FIRNADCMP002_PRIME	2016-032T10:00:05	4:05	0N 260W
T117	CIRS_232TI_FIRNADCMP001_PRIME	2016-047T10:56:37	3:53	50S 20W
	CIRS_232TI_FIRNADCMP002_PRIME	2016-048T08:49:41	2:00	20S 240W
T118	CIRS_234TI_FIRNADCMP001_PRIME	2016-095T05:42:42	5:00	20N 0W
T119	CIRS_235TI_FIRNADCMP001_PRIME	2016-127T04:54:37	3:00	60S 320W
	CIRS_235TI_FIRNADCMP002_PRIME	2016-128T01:54:37	4:00	15N 255W
T120	CIRS_236TI_FIRNADCMP001_PRIME	2016-159T03:33:39	1:33	70S 10W
	CIRS_236TI_FIRNADCMP002_PRIME	2016-159T23:06:17	4:00	60N 220W
T121	CIRS_238TI_FIRNADCMP002_PRIME	2016-207T18:58:23	3:30	15N 260W
T124	CIRS_248TI_FIRNADCMP001_PRIME	2016-318T11:55:56	3:00	89S 50W
	CIRS_248TI_FIRNADCMP002_PRIME	2016-319T08:55:56	3:00	30N 280W
T125	CIRS_250TI_FIRNADCMP002_PRIME	2016-335T07:14:32	4:00	20S 260W
T126	CIRS_270TI_FIRNADCMP001_PRIME	2017-111T18:08:07	3:00	75S 55W

4.3 Graphical Representation of Far-Infrared Nadir Coverage

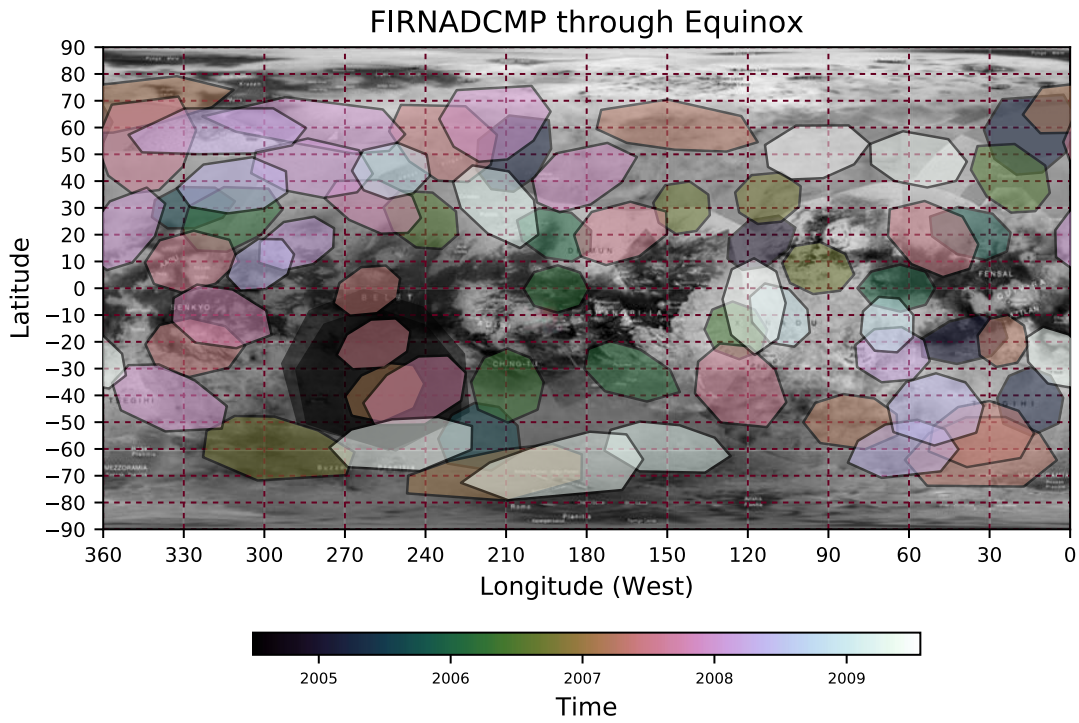


Figure 9: FIRNADCMPs through equinox (2009).

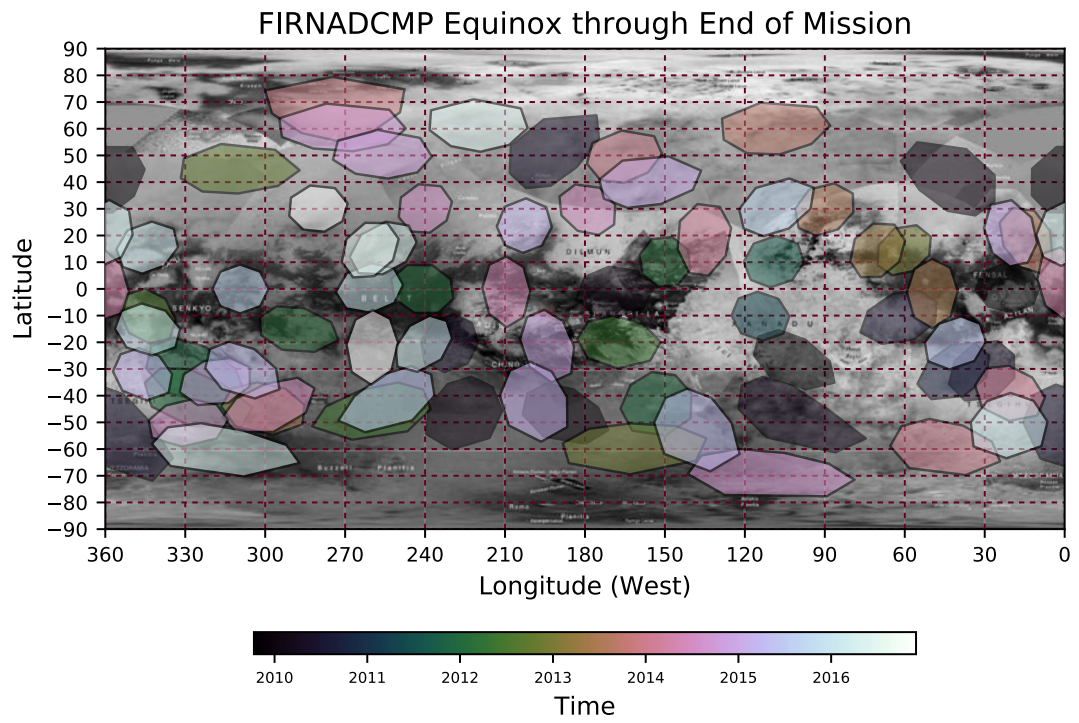


Figure 10: FIRNADCMPs from equinox (2009) to end of mission (2017).

FIRNADCMP through Equinox

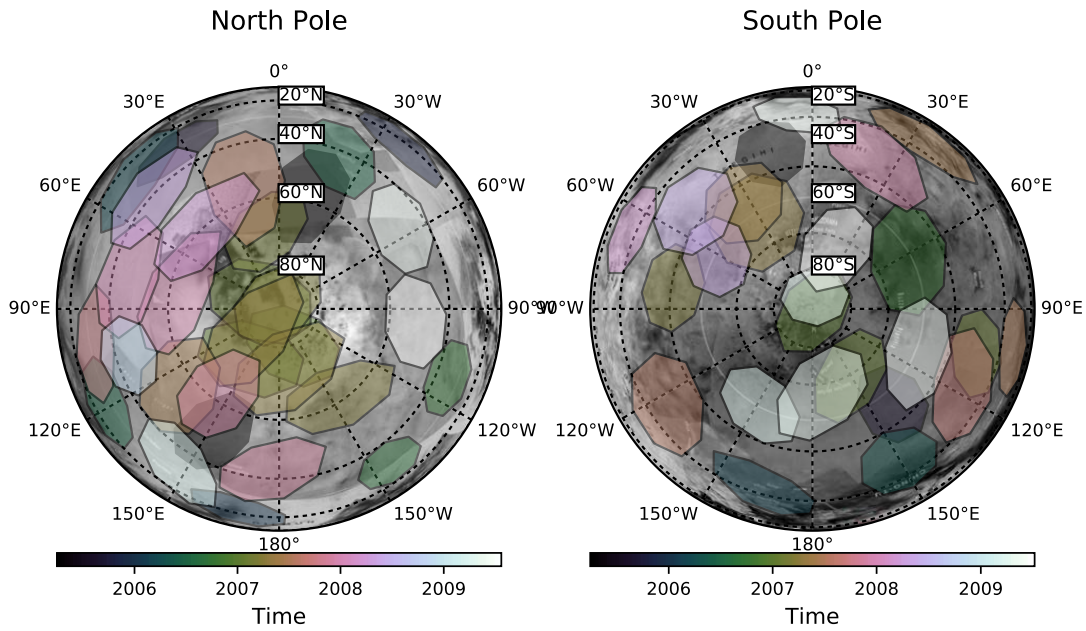


Figure 11: FIRNADCMPs through equinox (2009), polar projection.

FIRNADCMP Equinox through End of Mission

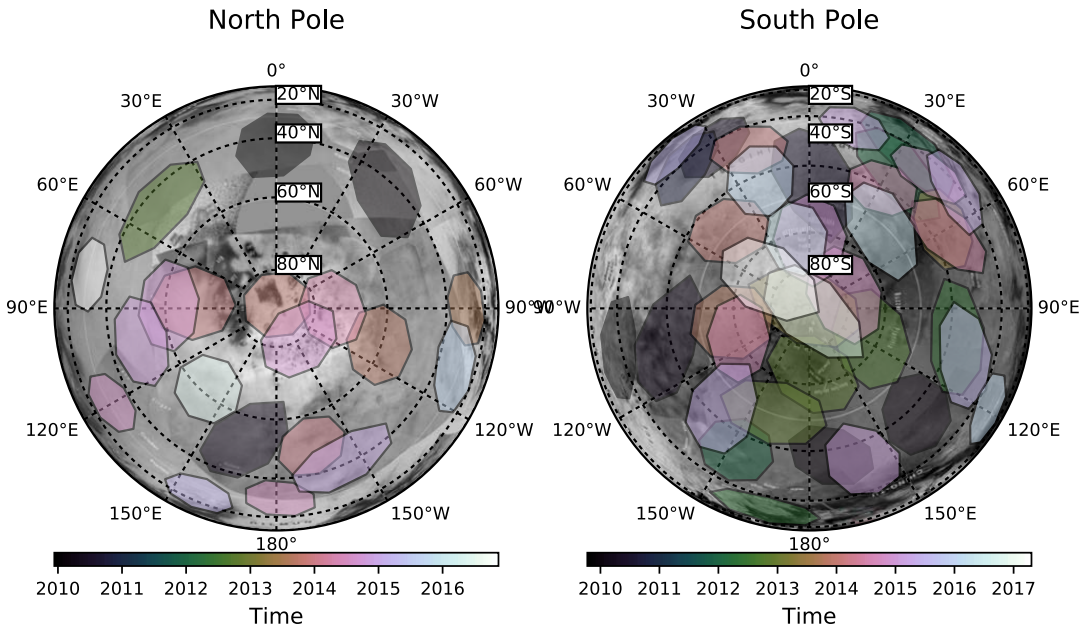


Figure 12: FIRNADCMPs from equinox (2009) to end of mission (2017), polar projection.

5 Mid-infrared Limb Observations

5.1 Observation Descriptions

5.1.1 Mid-infrared Limb Composition Integration (MIRLMBINT)

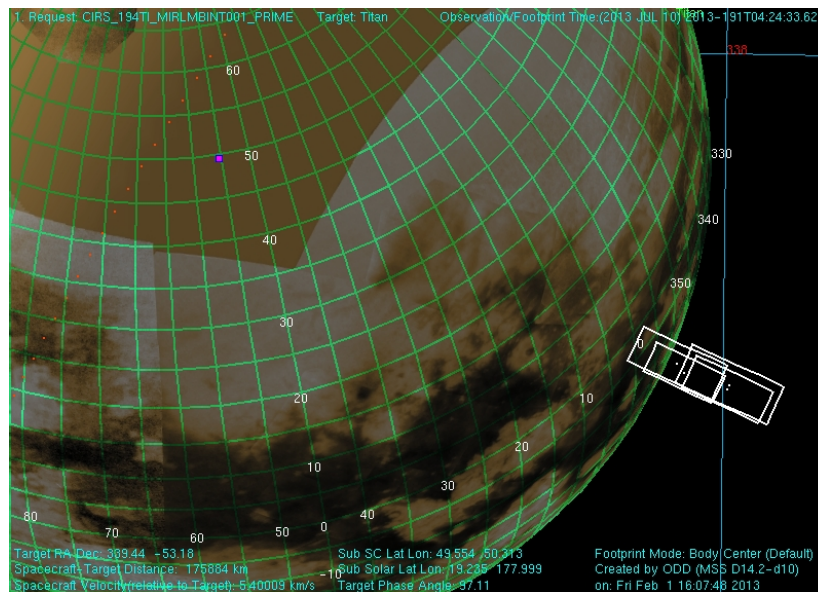
5.1.1.1 Science Description

These sequences are designed to obtain a vertical profile of minor species, as well as to search for new stratospheric species. Similar to a mid-infrared limb map, except that the longer duration of integration allows a spectral resolution of 0.5 cm^{-1} to be obtained at a single location on the limb.

5.1.1.2 Implementation

MIRLMBINT sequences are performed at ranges of 100,000 to 180,000 km, or ± 5 -9 hours from closest approach. The CIRS mid-infrared arrays (FP3 and FP4) are positioned perpendicular to the limb (stepping towards the limb), with integrations centred at two altitudes (two dwells each), 125 and 350 km, in order to retrieve a full profile while maintaining a 20% overlap to allow for pointing uncertainty. The targeted species would be identical to those for a mid-infrared nadir integration; however, the limb-viewing geometry provides better vertical resolution with the arrays.

5.1.1.3 Example: CIRS_193TI_MIRLMBINT001_PRIME



5.1.2 Mid-infrared Limb Map (MIRLMBMAP)

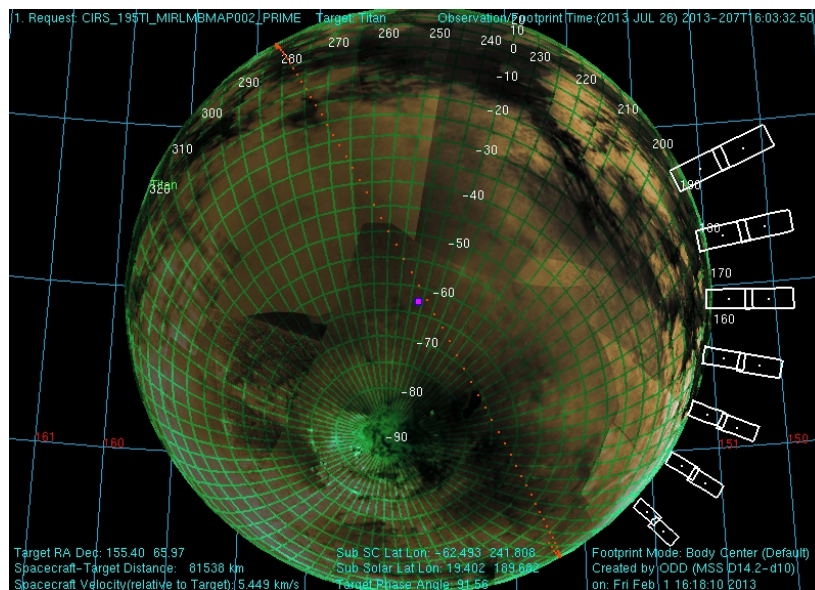
5.1.2.1 Science Description

MIRLMBMAP sequences aim to provide a better vertical temperature resolution in Titan's upper stratosphere and mesosphere. The CIRS mid-infrared focal planes (FP3 and FP4) are used to measure radiances in the ν_4 (1304 cm^{-1}) band of methane. Long durations allow a significant fraction of the limb to be sampled in a single sequence, with a spectral resolution of 15.5 cm^{-1} .

5.1.2.2 Implementation

MIRLMBMAP sequences are performed at a range of 120,000 km, or ± 6 hours from closest approach. The focal planes are positioned perpendicular to the limb (away from the limb), and individual mid-infrared pixels provide a vertical resolution of 36 km, which is typical for this type of observation. Two altitudes are observed at each position on the limb in order to provide a full vertical profile, with integrations of 3 to 4 minutes per altitude ensuring a temperature precision of 0.25 K. An overlap of at least 20% between altitudes ensures a complete profile considering pointing uncertainty. Additionally samples should be conducted over a quarter of the visible disk, for each latitude the offset should be $\pm 2.493\text{ mrad}$ about X. After one location is observed, the arrays are moved to the next position 5 degrees along the limb, with typically a quarter of the limb being covered in a single sequence. The range of limb chosen is generally centered around a flyby stationary point (see Appendix). Note when the SSCLAT point is near the equator, the sampling should be done every 5 degrees of latitude, up to 18 latitudes. At higher SSCLATs, approximate this geometry by reducing the latitude increments.

5.1.2.3 Example: CIRS_195TI_MIRLMBMAP002



5.1.3 Mid-infrared Limb Pair Observation (MIRLMPAIR)

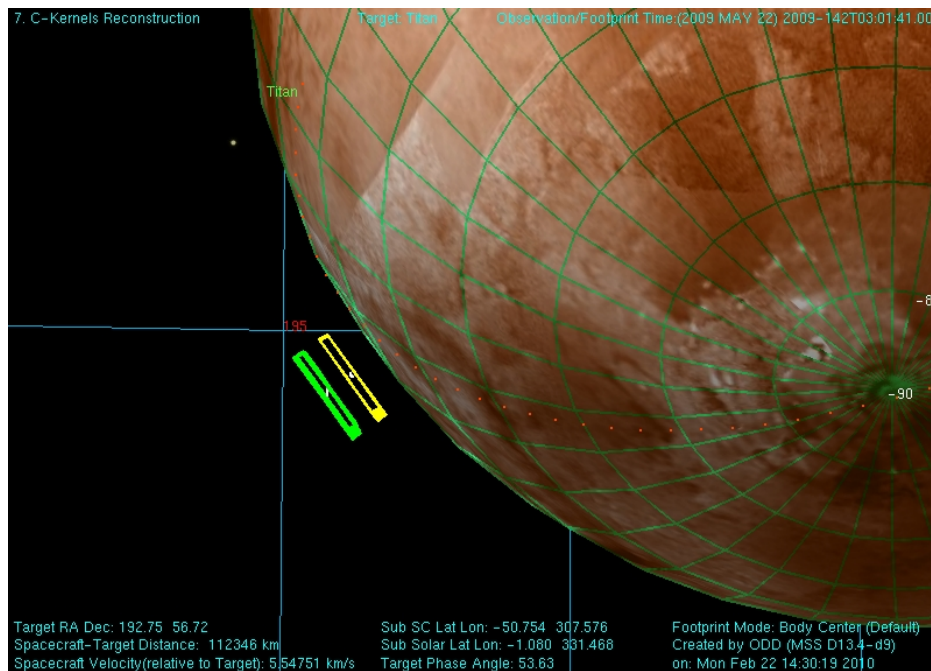
5.1.3.1 Science Description

MIRLMPAIR observations were introduced in an attempt to maximise the chances of detecting trace gases and isotopes in the mid-infrared (FP3 and FP4), by using long dwells with the arrays (z) parallel to the limb, rather than usual perpendicular configuration. This places all detectors from each MIR array at approximately the same altitude, allowing them to be coadded. In addition, the PAIR mode is used to gain an additional effective factor two in integration time over the usual ODD/EVEN mode used in MIRLMBINTs. During a 4-hr dwell, this amounts to typically $4 \times 60 \times 5 = 1200$ spectra from each array, equivalent to 2400 ODD/EVEN spectra for signal to noise purposes. Note that some drawbacks to this approach are evident, namely (i) FP3 and FP4 are now at different altitudes, typically meaning that temperatures to interpret FP3 spectra cannot from FP4 in the same observation, and (ii) since only one altitude is sensed by FP3, choosing the optimum altitude for trace gas detection is of high importance, and may not be the same at different latitudes.

5.1.3.2 Implementation

MIRLMPAIR sequences are performed at a range of 100,000-180,000 km, or ± 5 to 9 hours from closest approach. The focal planes are positioned parallel to the limb, and individual mid-infrared pixels provide a vertical resolution of 36 km, and horizontal resolution of ~ 72 km.

5.1.3.3 Example: CIRS_111TI_MIRLMPAIR002_PRIME



5.2 Time-ordered Table of Observations

Table 6: CIRS-led mid-infrared limb observations. For MIRLMBMAP observations, the pointing range given is covered in 5-degree latitude steps.

Flyby #	Request Name	Start Time	Duration (HR:MN)	Pointing (Lat. range)
TB	CIRS_00BTI_MIRLMBINT002_PRIME	2004-348T16:38:13	2:00	10S
T3	CIRS_003TI_MIRLMBINT002_PRIME	2005-045T19:57:53	4:00	80N
T4	CIRS_005TI_MIRLMBMAP002_PRIME	2005-091T00:35:16	3:30	85N – 0N
T6	CIRS_013TI_MIRLMBMAP002_PRIME	2005-234T01:23:37	2:30	25N – 35S
	CIRS_013TI_MIRLMBMAP003_PRIME	2005-234T13:53:37	2:30	40S – 80S
T7	CIRS_014TI_MIRLMBINT002_PRIME	2005-250T13:30:26	3:20	20N
T8	CIRS_017TI_MIRLMBMAP003_PRIME	2005-301T09:55:25	3:20	85M – 10N
T10	CIRS_020TI_MIRLMBINT002_PRIME	2006-015T02:41:27	4:00	55N
T13	CIRS_023TI_MIRLMBMAP004_PRIME	2006-120T11:58:14	2:00	0N – 40S
	CIRS_023TI_MIRLMBMAP006_PRIME	2006-120T14:58:14	2:00	0N – 40N
T14	CIRS_024TI_MIRLMBINT002_PRIME	2006-140T03:18:11	1:30	32S
	CIRS_024TI_MIRLMBINT003_PRIME	2006-140T17:18:11	5:00	50N
T15	CIRS_025TI_MIRLMBINT002_PRIME	2006-183T01:20:47	2:40	55S
T16	CIRS_026TI_MIRLMBINT002_PRIME	2006-202T15:25:26	2:00	45N
	CIRS_026TI_MIRLMBMAP003_PRIME	2006-203T05:25:26	2:15	30N – 75N
T19	CIRS_030TI_MIRLMBINT002_PRIME	2006-282T08:30:07	3:40	60N
	CIRS_030TI_MIRLMBINT003_PRIME	2006-282T22:50:07	2:40	30N
T20	CIRS_031TI_MIRLMBMAP004_PRIME	2006-298T20:28:07	3:00	15S – 50N
T21	CIRS_035TI_MIRLMBINT004_PRIME	2006-346T02:41:31	1:30	15N
	CIRS_035TI_MIRLMBINT003_PRIME	2006-346T18:41:31	2:00	15N
T23	CIRS_037TI_MIRLMBINT001_PRIME	2007-012T23:38:31	4:00	5N
T24	CIRS_038TI_MIRLMBINT002_PRIME	2007-029T12:15:55	4:00	30N
T25	CIRS_039TI_MIRLMBMAP001_PRIME	2007-052T18:12:24	3:50	25N – 30S
T26	CIRS_040TI_MIRLMBMAP001_PRIME	2007-068T16:49:00	4:00	30N-30S
T27	CIRS_041TI_MIRLMBINT001_PRIME	2007-084T15:23:27	4:00	20S
T28	CIRS_042TI_MIRLMBINT002_PRIME	2007-101T02:58:00	1:00	30S
T32	CIRS_046TI_MIRLMBMAP001_PRIME	2007-164T08:46:11	4:00	15N – 80S
T35	CIRS_049TI_MIRLMBINT001_PRIME	2007-242T21:32:34	4:00	70N
T37	CIRS_052TI_MIRLMBMAP001_PRIME	2007-322T15:47:25	4:00	60S(R)–20S(L)
T39	CIRS_054TI_MIRLMBMAP001_PRIME	2007-354T13:57:55	3:54	25S – 75N
	CIRS_054TI_MIRLMBINT002_PRIME	2007-355T04:02:55	3:55	45S
T42	CIRS_062TI_MIRLMBINT001_PRIME	2008-085T05:27:48	4:00	55S
	CIRS_062TI_MIRLMBMAP002_PRIME	2008-085T19:27:48	4:00	15S-55S
T43	CIRS_067TI_MIRLMBINT002_PRIME	2008-133T15:01:58	4:00	40N
T45	CIRS_078TI_MIRLMBMAP002_PRIME	2008-213T06:58:11	3:30	0N - 45N
T47	CIRS_093TI_MIRLMBMAP002_PRIME	2008-325T20:56:28	4:00	omitted
T49	CIRS_098TI_MIRLMBINT001_PRIME	2008-356T18:29:52	3:30	15N
T50	CIRS_102TI_MIRLMBINT001_PRIME	2009-037T23:20:51	4:00	BIU anomaly
T51	CIRS_107TI_MIRLMBINT002_PRIME	2009-086T09:43:36	4:00	30S
T54	CIRS_110TI_MIRLMBMAP001_PRIME	2009-125T13:54:16	3:50	30N - 20S

T55	CIRS_111TI_MIRLMPAIR002_PRIME	2009-142T02:26:41	4:00	25S
T59	CIRS_115TI_MIRLMBMAP001_PRIME	2009-205T06:34:04	4:00	0N - 60N
	CIRS_115TI_MIRLMBINT002_PRIME	2009-205T20:34:04	2:00	65N
T61	CIRS_117TI_MIRLMBINT001_PRIME	2009-237T03:51:38	3:50	
T63	CIRS_122TI_MIRLMBMAP001_PRIME	2009-345T16:03:14	4:00	85N - 0N
T64	CIRS_123TI_MIRLMPAIR001_PRIME	2009-361T15:16:59	4:00	75N
	CIRS_123TI_MIRLMBINT002_PRIME	2009-362T05:16:59	4:00	75N
T65	CIRS_124TI_MIRLMBINT001_PRIME	2010-012T14:10:36	4:00	75S
	CIRS_124TI_MIRLMBMAP002_PRIME	2010-013T04:10:36	4:00	85S - 0N
T67	CIRS_129TI_MIRLMBINT001_PRIME	2010-095T06:50:39	4:00	88N
T69	CIRS_132TI_MIRLMBMAP001_PRIME	2010-155T17:08:27	4:18	85S - 0N
T70	CIRS_133TI_MIRLMBMAP001_PRIME	2010-171T16:27:43	4:00	5N - 85N
T71	CIRS_134TI_MIRLMBINT001_PRIME	2010-187T15:22:45	3:00	80S
T72	CIRS_138TI_MIRLMPAIR001_PRIME	2010-267T09:38:41	4:00	76N
T73	CIRS_140TI_MIRLMBMAP001_PRIME	2010-315T04:37:01	4:00	Safing event
T76	CIRS_148TI_MIRLMBMAP001_PRIME	2011-128T13:53:45	4:00	0N - 85N
T77	CIRS_149TI_MIRLMBMAP002_PRIME	2011-171T23:32:01	4:00	0N - 85S
T78	CIRS_153TI_MIRLMBINT001_PRIME	2011-254T17:50:06	4:00	85S
T79	CIRS_158TI_MIRLMBINT501_PRIME	2011-347T11:11:24	4:00	80N
T80	CIRS_159TI_MIRLMBMAP001_PRIME	2012-002T06:13:37	4:00	75N - 10S
T82	CIRS_161TI_MIRLMBINT001_PRIME	2012-049T23:43:17	4:00	45S
	CIRS_161TI_MIRLMBMAP002_PRIME	2012-050T13:43:17	4:00	0N - 80S
T83	CIRS_166TI_MIRLMBINT001_PRIME	2012-142T16:10:11	4:00	0N
T84	CIRS_167TI_MIRLMBINT001_PRIME	2012-158T15:07:21	4:00	45N
T85	CIRS_169TI_MIRLMBMAP002_PRIME	2012-207T01:03:07	4:00	15S - 65N
T88	CIRS_175TI_MIRLMBMAP001_PRIME	2012-333T23:56:59	4:00	50S - 30N
T90	CIRS_185TI_MIRLMBINT001_PRIME	2013-095T12:43:31	4:00	25N
T91	CIRS_190TI_MIRLMBMAP001_PRIME	2013-143T08:32:55	3:00	35N - 15S
T92	CIRS_194TI_MIRLMBINT001_PRIME	2013-191T04:21:47	3:00	20S
T93	CIRS_195TI_MIRLMBMAP002_PRIME	2013-207T15:56:22	5:00	15N - 15S
T95	CIRS_198TI_MIRLMPAIR001_PRIME	2013-286T19:56:27	3:00	16N
	CIRS_198TI_MIRLMBINT001_PRIME	2013-287T10:56:27	3:00	2S
T96	CIRS_199TI_MIRLMBINT002_PRIME	2013-335T05:41:19	4:00	12N
T98	CIRS_201TI_MIRLMBMAP002_PRIME	2014-034T01:12:38	3:00	20N - 25N
T101	CIRS_204TI_MIRLMBINT002_PRIME	2014-137T21:12:15	4:00	35S
T102	CIRS_205TI_MIRLMBINT001_PRIME	2014-169T04:28:25	4:44	10N
	CIRS_205TI_MIRLMBMAP002_PRIME	2014-169T18:28:25	4:00	40N - 13S
T103	CIRS_206TI_MIRLMBINT002_PRIME	2014-201T15:40:58	4:00	30N
T105	CIRS_208TI_MIRLMBINT001_PRIME	2014-264T20:23:19	3:45	See MIDIRTMAP
	CIRS_208TI_MIRLMBMAP002_PRIME	2014-265T12:38:19	2:00	40N - 15N
T106	CIRS_209TI_MIRLMBINT001_PRIME	2014-296T17:40:30	4:00	45S
T108	CIRS_211TI_MIRLMBMAP001_PRIME	2015-011T10:48:35	4:00	30S (R) - 55S (L)
	CIRS_211TI_MIRLMBINT002_PRIME	2015-012T00:48:35	3:00	70N
T110	CIRS_213TI_MIRLMBMAP001_PRIME	2015-075T05:29:49	4:00	80S (L) - 85S - 30S (R)
	CIRS_213TI_MIRLMBINT002_PRIME	2015-075T19:29:49	4:00	80S
T111	CIRS_215TI_MIRLMBMAP002_PRIME	2015-128T03:50:24	4:00	80N (L) - 35N (L)

T113	CIRS_222TI_MIRLMBMAP001_PRIME	2015-271T12:37:12	4:00	20S – 85S
	CIRS_222TI_MIRLMBINT002_PRIME	2015-272T02:37:12	4:00	85S
T114	CIRS_225TI_MIRLMBMAP001_PRIME	2015-316T20:46:31	4:00	75N – 5N
T115	CIRS_230TI_MIRLMBMAP002_PRIME	2016-016T07:20:24	4:00	85S – 25S
T116	CIRS_231TI_MIRLMBINT001_PRIME	2016-031T16:00:05	4:00	85S
	CIRS_231TI_MIRLMBMAP002_PRIME	2016-032T06:00:05	4:00	80N – 20N
T117	CIRS_232TI_MIRLMBINT001_PRIME	2016-047T14:49:41	4:00	80S
	CIRS_232TI_MIRLMBMAP002_PRIME	2016-048T04:49:41	4:00	75N – 10N
T119	CIRS_235TI_MIRLMBMAP001_PRIME	2016-127T07:54:37	4:00	50S – 15N
T120	CIRS_236TI_MIRLMBINT001_PRIME	2016-159T05:06:17	4:00	50S
	CIRS_236TI_MIRLMBMAP002_PRIME	2016-159T19:06:17	4:00	50N – 15S
T121	CIRS_238TI_MIRLMBINT002_PRIME	2016-207T00:15:43	4:43	0N
T124	CIRS_248TI_MIRLMBMAP002_PRIME	2016-319T04:55:56	4:00	10S – 50N
T125	CIRS_250TI_MIRLMBINT002_PRIME	2016-335T03:14:32	4:00	50N
N/A	CIRS_259TI_MIRLMBMAP002_PRIME	2017-032T20:21:00	5:15	60S – 15N
N/A	CIRS_261TI_MIRLMBMAP001_PRIME	2017-048T08:41:00	4:00	15N – 35S
	CIRS_261TI_MIRLMBINT001_PRIME	2017-048T13:41:00	3:00	10S
N/A	CIRS_275TI_MIRLMBINT001_PRIME	2017-143T16:44:00	6:34	50S
	CIRS_275TI_MIRLMBMAP002_PRIME	2017-144T06:33:00	4:00	80S – 20S

5.3 Graphical Representation of Mid-Infrared Limb Coverage

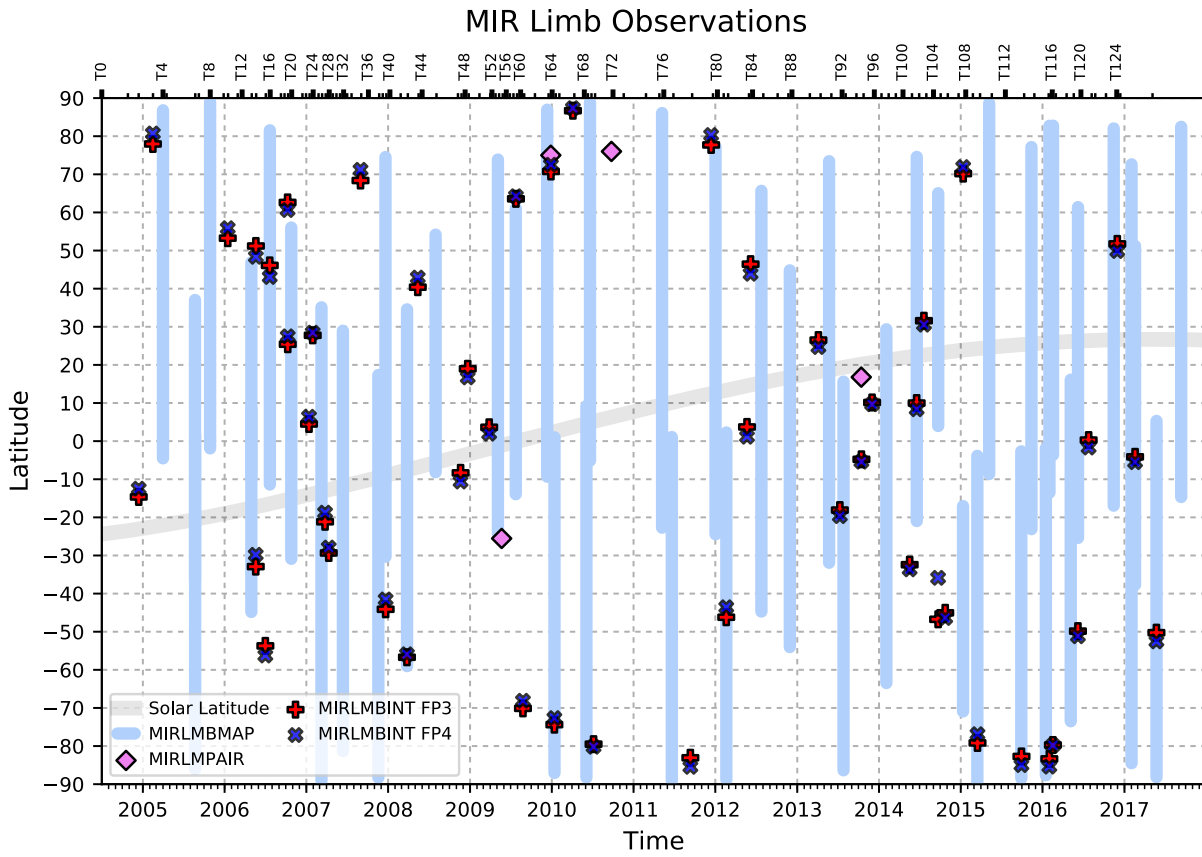


Figure 13: latitude vs time coverage of CIRS mid-infrared limb observations.

6 Mid-infrared Nadir Temperature Maps (MIDIRTMAP)

6.1 Mid-Infrared Nadir Observations

6.1.1 Observation Description

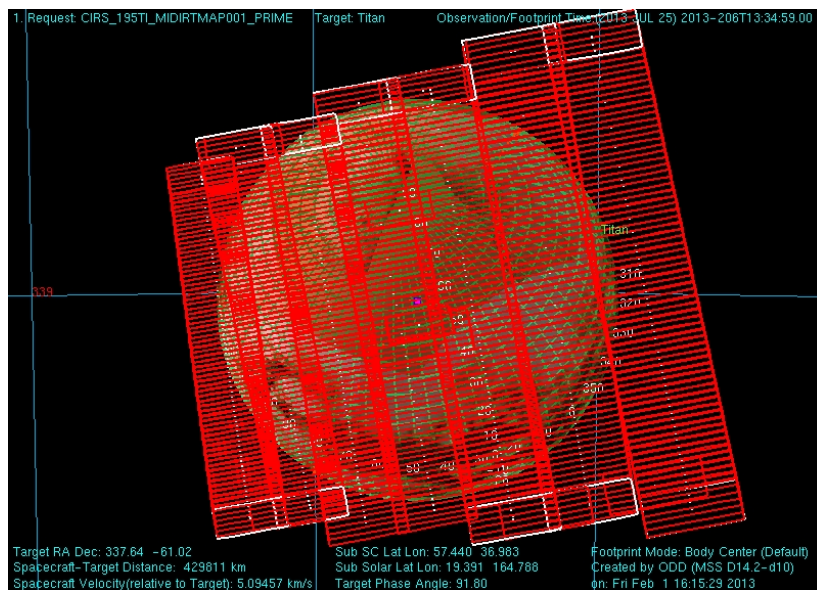
6.1.1.1 Science Description

MIDIRTMAP sequences map temperatures in the upper stratosphere of Titan by measuring radiances in the ν_4 (1304 cm^{-1}) band of methane, obtained using the CIRS mid-infrared focal planes (FP3 and FP4).

6.1.1.2 Implementation

MIDIRTMAP sequences are typically executed within a range of 380,000 km, or ± 19 hours from closest approach. The map is completed as a series of continuous slews executed in a push-broom fashion, covering the entire visible hemisphere with a spectral resolution of 3cm^{-1} , which ensures a precision of 0.25 K in retrieved temperatures. Typically 6 slews are required to cover the disk, of about 2.6 mrad in χ between the scan legs, allowing for pointing uncertainty and around 20% overlap of consecutive slews, at a slew-rate of $4\ \mu\text{rads}^{-1}$. If time permits, deep-space calibrations are performed at the beginning or end of the sequence by positioning the focal planes beyond Titan's exosphere for a period of at least 10 minutes.

6.1.1.3 Example: CIRS_195TI_MIDIRTMAP001_PRIME



6.2 Time-ordered Table of Observations

Table 7: CIRS Mid-infrared nadir mapping observations

Flyby #	Request Name	Start Time	Duration (HR:MN)
TA	CIRS_00ATI_MIDIRTMAP001_PRIME	2004-299T17:30:09	5:15
TB	CIRS_00BTI_MIDIRTMAP001_PRIME	2004-347T15:13:13	8:25
T3	CIRS_003TI_MIDIRTMAP002_PRIME	2005-045T09:57:53	9:00
	CIRS_003TI_MIDIRTMAP003_PRIME	2005-046T18:57:53	4:20
T4	CIRS_005TI_MIDIRTMAP003_PRIME	2005-091T08:05:16	6:30
T6	CIRS_013TI_MIDIRTMAP007_PRIME	2005-234T20:53:37	7:03
T7	CIRS_014TI_MIDIRTMAP006_PRIME	2005-249T06:00:00	5:00
	CIRS_014TI_MIDIRTMAP005_PRIME	2005-250T20:11:57	6:11
T8	CIRS_017TI_MIDIRTMAP008_PRIME	2005-300T01:24:00	7:00
	CIRS_017TI_MIDIRTMAP005_PRIME	2005-301T16:15:25	7:48
T9	CIRS_019TI_MIDIRTMAP009_PRIME	2005-361T14:04:00	13:33
T10	CIRS_020TI_MIDIRTMAP010_PRIME	2006-014T14:23:27	9:18
T14	CIRS_024TI_MIDIRTMAP001_PRIME	2006-141T01:18:11	2:00
	CIRS_024TI_MIDIRTMAP002_PRIME	2006-141T06:18:11	2:58
T15	CIRS_025TI_MIDIRTMAP002_PRIME	2006-183T23:50:47	7:54
T17	CIRS_028TI_MIDIRTMAP006_PRIME	2006-249T21:56:51	7:20
T18	CIRS_029TI_MIDIRTMAP004_PRIME	2006-265T20:58:49	7:00
T19	CIRS_030TI_MIDIRTMAP006_PRIME	2006-281T20:16:07	6:14
T21	CIRS_035TI_MIDIRTMAP006_PRIME	2006-345T16:08:31	4:03
T22	CIRS_036TI_MIDIRTMAP006_PRIME	2006-361T15:04:22	5:01
T23	CIRS_037TI_MIDIRTMAP001_PRIME	2007-012T14:23:31	2:15
	CIRS_037TI_MIDIRTMAP002_PRIME	2007-012T17:38:31	2:00
	CIRS_037TI_MIDIRTMAP003_PRIME	2007-013T22:38:31	3:25
T24	CIRS_038TI_MIDIRTMAP001_PRIME	2007-028T13:00:55	2:15
	CIRS_038TI_MIDIRTMAP002_PRIME	2007-029T21:15:55	5:14
T25	CIRS_039TI_MIDIRTMAP001_PRIME	2007-052T12:12:24	2:00
	CIRS_039TI_MIDIRTMAP002_PRIME	2007-053T17:12:24	7:15
T26	CIRS_040TI_MIDIRTMAP001_PRIME	2007-068T11:08:00	1:41
T27	CIRS_041TI_MIDIRTMAP001_PRIME	2007-084T09:07:27	2:16
T28	CIRS_042TI_MIDIRTMAP002_PRIME	2007-101T12:58:00	7:14
T30	CIRS_044TI_MIDIRTMAP001_PRIME	2007-132T05:45:58	1:24
	CIRS_044TI_MIDIRTMAP002_PRIME	2007-133T10:09:58	1:19
T32	CIRS_046TI_MIDIRTMAP002_PRIME	2007-165T07:46:11	2:15
T34	CIRS_048TI_MIDIRTMAP001_PRIME	2007-199T01:48:20	7:23
T35	CIRS_049TI_MIDIRTMAP002_PRIME	2007-243T21:32:34	6:00
T36	CIRS_050TI_MIDIRTMAP002_PRIME	2007-275T18:42:43	8:46
T37	CIRS_052TI_MIDIRTMAP002_PRIME	2007-323T14:47:25	7:00
T38	CIRS_053TI_MIDIRTMAP002_PRIME	2007-339T14:06:50	9:37
T40	CIRS_055TI_MIDIRTMAP002_PRIME	2008-006T11:30:20	7:00
T41	CIRS_059TI_MIDIRTMAP002_PRIME	2008-054T12:32:07	2:53
T43	CIRS_067TI_MIDIRTMAP002_PRIME	2008-134T02:46:58	6:30

T44	CIRS_069TI_MIDIRTMAP001_PRIME	2008-148T10:24:32	6:00
T45	CIRS_078TI_MIDIRTMAP001_PRIME	2008-212T08:05:21	4:07
T46	CIRS_091TI_MIDIRTMAP001_PRIME	2008-307T20:17:34	BIU anomaly
	CIRS_091TI_MIDIRTMAP002_PRIME	2008-309T07:35:24	omitted
T47	CIRS_093TI_MIDIRTMAP002_PRIME	2008-325T05:56:28	2:00
T48	CIRS_096TI_MIDIRTMAP001_PRIME	2008-341T04:25:45	3:06
T49	CIRS_097TI_MIDIRTMAP001_PRIME	2008-355T17:24:32	6:35
	CIRS_098TI_MIDIRTMAP002_PRIME	2008-357T02:29:52	3:30
T50	CIRS_102TI_MIDIRTMAP002_PRIME	2009-038T18:50:51	BIU anomaly
	CIRS_102TI_MIDIRTMAP003_PRIME	2009-038T22:20:51	
T51	CIRS_106TI_MIDIRTMAP001_PRIME	2009-085T11:00:31	3:43
	CIRS_107TI_MIDIRTMAP002_PRIME	2009-086T18:13:36	5:12
T52	CIRS_107TI_MIDIRTMAP001_PRIME	2009-093T10:29:34	1:48
	CIRS_108TI_MIDIRTMAP002_PRIME	2009-094T15:47:47	7:37
T53	CIRS_109TI_MIDIRTMAP002_PRIME	2009-110T14:20:45	Downlink
T54	CIRS_110TI_MIDIRTMAP001_PRIME	2009-125T08:11:47	4:42
T55	CIRS_111TI_MIDIRTMAP001_PRIME	2009-141T07:09:49	1:17
	CIRS_111TI_MIDIRTMAP002_PRIME	2009-142T11:26:41	8:00
T57	CIRS_113TI_MIDIRTMAP002_PRIME	2009-174T08:32:35	8:00
T59	CIRS_115TI_MIDIRTMAP001_PRIME	2009-204T23:34:04	3:00
T62	CIRS_119TI_MIDIRTMAP001_PRIME	2009-284T14:45:21	4:21
T63	CIRS_122TI_MIDIRTMAP002_PRIME	2009-346T15:03:14	5:00
T64	CIRS_123TI_MIDIRTMAP001_PRIME	2009-361T10:07:24	4:10
T65	CIRS_124TI_CLOUDMAP001_VIMS	2010-012T09:07:41	2:53
	CIRS_124TI_MIDIRTMAP002_PRIME	2010-013T13:10:37	5:21
T68	CIRS_131TI_MIDIRTMAP001_PRIME	2010-139T08:10:04	5:44
	CIRS_131TI_MIDIRTMAP002_PRIME	2010-140T16:24:20	4:40
T73	CIRS_140TI_MIDIRTMAP001_PRIME	2010-314T21:14:00	Safing event
T74	CIRS_145TI_MIDIRTMAP001_PRIME	2011-048T21:26:11	6:38
	CIRS_145TI_MIDIRTMAP002_PRIME	2011-050T04:04:11	6:31
T76	CIRS_148TI_MIDIRTMAP002_PRIME	2011-129T12:53:45	8:13
T77	CIRS_149TI_MIDIRTMAP002_PRIME	2011-172T08:32:01	9:45
T78	CIRS_153TI_MIDIRTMAP001_PRIME	2011-254T07:42:00	6:08
T79	CIRS_158TI_MIDIRTMAP002_PRIME	2011-348T10:11:24	2:29
T82	CIRS_161TI_MIDIRTMAP001_PRIME	2012-049T15:54:00	4:49
T84	CIRS_167TI_MIDIRTMAP001_PRIME	2012-158T08:24:00	2:43
	CIRS_167TI_MIDIRTMAP002_PRIME	2012-159T14:07:21	7:12
T85	CIRS_169TI_MIDIRTMAP001_PRIME	2012-205T21:32:59	9:30
T86	CIRS_172TI_MIDIRTMAP002_PRIME	2012-271T04:35:39	14:45
T87	CIRS_174TI_MIDIRTMAP001_PRIME	2012-317T14:55:59	6:26
	CIRS_174TI_MIDIRTMAP002_PRIME	2012-319T00:22:08	5:14
T88	CIRS_175TI_MIDIRTMAP002_PRIME	2012-334T22:56:59	11:43
T89	CIRS_181TI_MIDIRTMAP001_PRIME	2013-047T09:20:59	2:30
	CIRS_181TI_MIDIRTMAP002_PRIME	2013-048T13:56:36	8:19
T90	CIRS_185TI_MIDIRTMAP001_PRIME	2013-095T05:56:00	2:48
	CIRS_185TI_MIDIRTMAP002_PRIME	2013-096T11:43:31	5:52
T91	CIRS_190TI_MIDIRTMAP001_PRIME	2013-143T02:41:00	1:52

	CIRS_190TI_MIDIRTMAP002_PRIME	2013-144T07:32:55	8:03
T93	CIRS_195TI_MIDIRTMAP001_PRIME	2013-206T13:33:59	8:22
T94	CIRS_197TI_MIDIRTMAP001_PRIME	2013-254T08:57:59	8:46
T95	CIRS_198TI_MIDIRTMAP001_PRIME	2013-286T07:09:59	7:46
T96	CIRS_199TI_MIDIRTMAP001_PRIME	2013-334T04:40:00	6:01
T97	CIRS_200TI_MIDIRTMAP001_PRIME	2014-001T02:42:59	5:17
	CIRS_200TI_MIDIRTMAP002_PRIME	2014-002T10:59:41	3:23
T98	CIRS_201TI_MIDIRTMAP001_PRIME	2014-033T00:46:59	4:26
	CIRS_201TI_MIDIRTMAP002_PRIME	2014-034T08:12:39	5:59
T99	CIRS_202TI_MIDIRTMAP002_PRIME	2014-066T04:26:47	7:19
T100	CIRS_203TI_MIDIRTMAP001_PRIME	2014-096T20:39:59	3:01
	CIRS_203TI_MIDIRTMAP002_PRIME	2014-098T02:41:14	8:24
T101	CIRS_204TI_MIDIRTMAP001_PRIME	2014-136T17:55:59	3:46
	CIRS_204TI_MIDIRTMAP002_PRIME	2014-138T05:12:15	2:54
T102	CIRS_205TI_MIDIRTMAP001_PRIME	2014-168T15:39:00	7:49
	CIRS_205TI_MIDIRTMAP002_PRIME	2014-170T01:28:25	3:06
T103	CIRS_206TI_MIDIRTMAP001_PRIME	2014-200T13:20:59	7:20
T104	CIRS_207TI_MIDIRTMAP001_PRIME	2014-232T11:15:59	6:53
	CIRS_207TI_MIDIRTMAP002_PRIME	2014-233T22:09:09	2:17
T105	CIRS_208TI_MIDIRTMAP001_PRIME	2014-264T09:11:59	6:11
	CIRS_208TI_MIDIRTMAP002_PRIME	2014-265T17:23:19	2:44
T106	CIRS_209TI_MIDIRTMAP001_PRIME	2014-296T07:10:00	5:31
	CIRS_209TI_MIDIRTMAP002_PRIME	2014-297T15:40:30	3:10
T107	CIRS_210TI_MIDIRTMAP001_PRIME	2014-344T04:25:00	4:02
	CIRS_210TI_MIDIRTMAP002_PRIME	2014-345T11:26:35	4:38
T108	CIRS_211TI_MIDIRTMAP001_PRIME	2015-012T08:48:35	6:03
T109	CIRS_212TI_MIDIRTMAP002_PRIME	2015-044T06:08:04	8:17
T110	CIRS_213TI_MIDIRTMAP001_PRIME	2015-074T22:50:00	3:39
	CIRS_213TI_MIDIRTMAP002_PRIME	2015-076T03:29:49	8:31
T111	CIRS_215TI_MIDIRTMAP001_PRIME	2015-127T05:09:59	4:41
	CIRS_215TI_MIDIRTMAP002_PRIME	2015-128T11:50:24	5:29
T112	CIRS_218TI_MIDIRTMAP001_PRIME	2015-187T12:27:00	6:42
	CIRS_218TI_MIDIRTMAP002_PRIME	2015-188T21:09:51	3:54
T113	CIRS_222TI_MIDIRTMAP002_PRIME	2015-272T10:37:12	5:45
T114	CIRS_225TI_MIDIRTMAP001_PRIME	2015-316T06:53:59	8:53
T117	CIRS_232TI_MIDIRTMAP002_PRIME	2016-048T10:49:41	4:00
T118	CIRS_234TI_MIDIRTMAP001_PRIME	2016-094T19:59:00	9:44
T119	CIRS_235TI_MIDIRTMAP001_PRIME	2016-126T20:09:00	6:46
	CIRS_235TI_MIDIRTMAP002_PRIME	2016-128T05:54:37	3:24
T120	CIRS_236TI_MIDIRTMAP002_PRIME	2016-160T03:06:17	3:52
T121	CIRS_238TI_MIDIRTMAP002_PRIME	2016-207T22:28:23	5:04
T123	CIRS_243TI_MIDIRTMAP001_PRIME	2016-270T10:07:58	4:09
T124	CIRS_248TI_MIDIRTMAP001_PRIME	2016-318T07:24:00	2:32
	CIRS_248TI_MIDIRTMAP002_PRIME	2016-319T13:55:56	4:53
T125	CIRS_250TI_MIDIRTMAP002_PRIME	2016-335T11:14:32	6:33

N/A	CIRS_253TI_MIDIRTMAP001_PRIME	2016-350T10:16:00	6:05
N/A	CIRS_253TI_MIDIRTMAP002_PRIME	2016-350T22:21:00	4:00
N/A	CIRS_253TI_MIDIRTMAP003_PRIME	2016-351T05:51:00	1:30
N/A	CIRS_253TI_MIDIRTMAP004_PRIME	2016-351T08:21:00	2:12
N/A	CIRS_259TI_MIDIRTMAP001_PRIME	2017-032T09:19:00	3:47
N/A	CIRS_259TI_MIDIRTMAP002_PRIME	2017-033T02:36:00	7:00
N/A	CIRS_261TI_MIDIRTMAP001_PRIME	2017-048T02:31:00	5:10
N/A	CIRS_270TI_MIDIRTMAP001_PRIME	2017-111T13:24:58	2:43
N/A	CIRS_270TI_MIDIRTMAP002_PRIME	2017-112T19:08:07	9:53
N/A	CIRS_273TI_MIDIRTMAP001_PRIME	2017-127T19:02:00	3:00
N/A	CIRS_275TI_MIDIRTMAP002_PRIME	2017-144T11:33:00	4:00
N/A	CIRS_278TI_MIDIRTMAP001_PRIME	2017-159T12:26:00	3:00
N/A	CIRS_278TI_MIDIRTMAP002_PRIME	2017-159T16:26:00	3:00
N/A	CIRS_278TI_MIDIRTMAP003_PRIME	2017-159T20:26:00	2:00
N/A	CIRS_278TI_MIDIRTMAP004_PRIME	2017-159T23:26:00	3:00
N/A	CIRS_278TI_MIDIRTMAP005_PRIME	2017-160T03:26:00	3:00
N/A	CIRS_278TI_MIDIRTMAP006_PRIME	2017-160T07:26:00	2:54
N/A	CIRS_283TI_MIDIRTMAP001_PRIME	2017-191T09:06:00	4:15
N/A	CIRS_283TI_MIDIRTMAP002_PRIME	2017-191T14:21:00	4:45
N/A	CIRS_283TI_MIDIRTMAP003_PRIME	2017-191T20:36:00	3:00
N/A	CIRS_287TI_MIDIRTMAP001_PRIME	2017-222T16:51:00	6:40
N/A	CIRS_292TI_MIDIRTMAP001_PRIME	2017-254T06:22:00	2:54
N/A	CIRS_292TI_MIDIRTMAP002_PRIME	2017-255T07:46:00	5:00
N/A	CIRS_293TI_MIDIRTMAP003_PRIME	2017-255T13:46:00	4:30

6.3 Graphical representation of spatial coverage

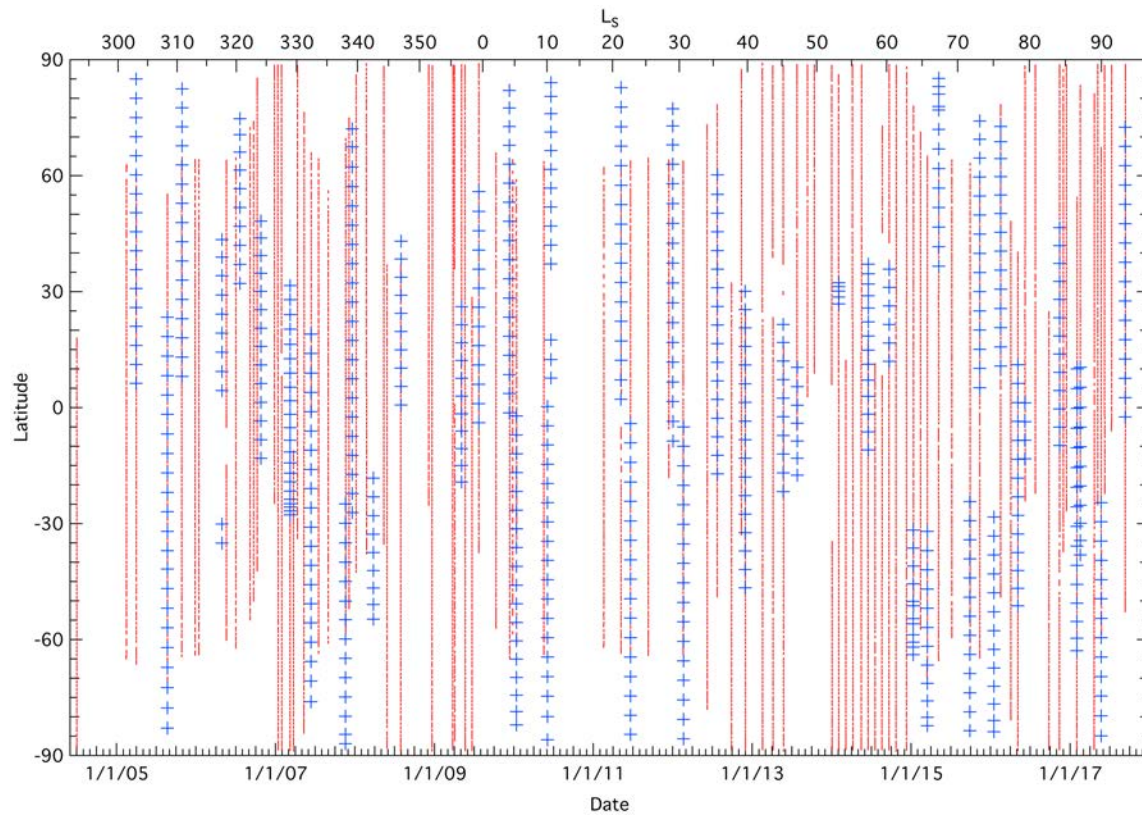


Figure 14: CIRS mid-infrared nadir (red) and limb (blue) observation coverage.

7 Distant Observations

7.1 Observation Descriptions

7.1.1 Composition Maps (COMPMAPs)

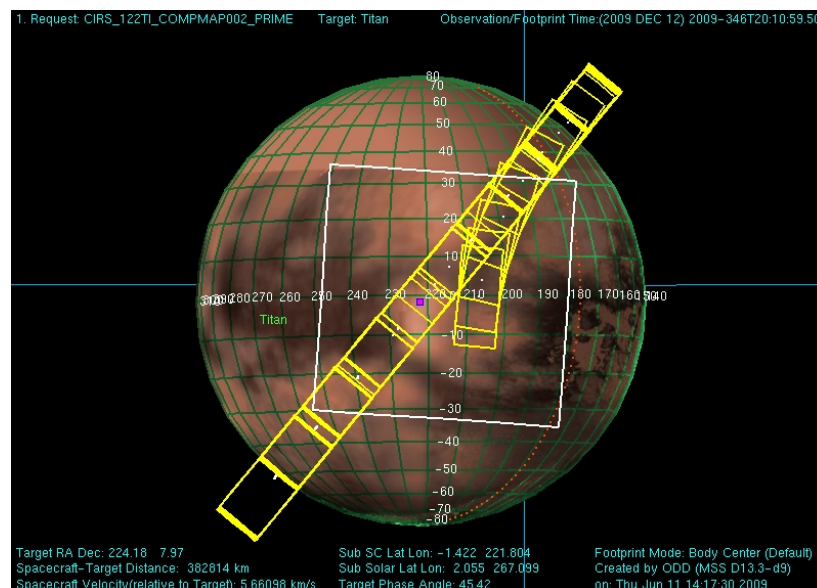
7.1.1.1 Science Description

COMPMAP sequences are designed to search for new species and/or monitor temperatures.

7.1.1.2 Implementation

These observations are generally around 300,000 to 700,000 km distant from Titan, or ± 15 to ± 35 hours from closest approach. FP3/FP4 are either stepped across the disk in a N-S or E-W transects, or they stare at one or two areas of interest for the duration of the observation. Duration is variable, generally between 2 and 6 hours.

7.1.1.3 Example: CIRS_122TI_COMPMAP002_PRIME



This is an example COMPMAP sequence, CIRS_122TI_COMPMAP002_PRIME

7.1.2 Titan Explorations at Apoapse (TEAs)

7.1.2.1 Science Description

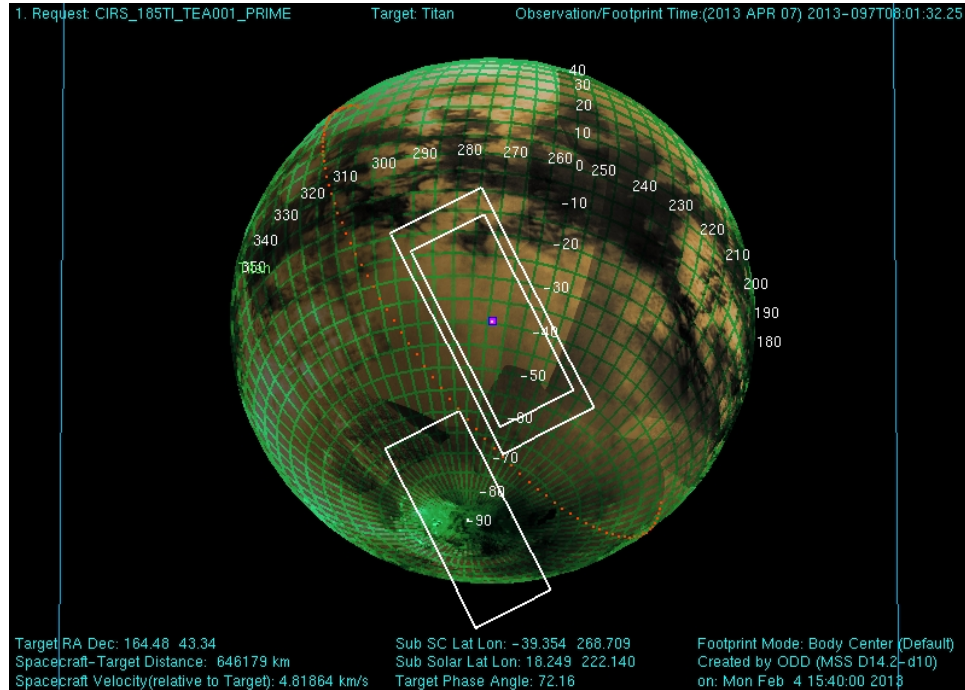
TEA sequences are similar to COMPMAPs, but at a greater distance from Titan, they are designed to search for new species and/or monitor temperatures.

7.1.2.2 Implementation

TEA sequences occur at 800,000 to 2 million km from Titan and for a longer duration of 12 to 36 hours, or between 40 and 100 hours from closest approach. ISS rides, and when angular diameter

is greater than 6 mrad (range less than 860,000 km), an ISS NAC mosaic is performed at intervals until Titan is contained within a NAC field of view.

7.1.2.3 Example: CIRS_185TI_TEA001_PRIME



7.2 Time-ordered Table of Observations

Table 8: CIRS distant Titan observations.

Flyby #	Request Name	Start Time	Duration (HR:MN)
B	CIRS_00BTI_COMPMAP003_ISS	2004-346T08:03:00	000T15:57:00
	CIRS_009TI_COMPMAP002_PRIME	2005-157T09:30:00	000T06:30:00
	CIRS_010TI_COMPMAP003_PRIME	2005-173T03:00:00	000T11:00:00
	CIRS_015TI_COMPMAP005_PRIME	2005-267T19:50:00	000T08:15:00
	CIRS_016TI_COMPMAP006_PRIME	2005-282T20:27:00	000T11:00:00
	CIRS_022TI_COMPMAP002_PRIME	2006-076T08:20:00	000T13:59:00
	CIRS_030TI_COMPMAP007_PRIME	2006-283T19:30:00	000T03:50:00
	CIRS_031TI_COMPMAP008_PRIME	2006-296T11:26:00	000T14:00:00
	CIRS_031TI_COMPMAP101_VIMS	2006-298T15:48:07	000T00:30:00
	CIRS_031TI_COMPMAP001_VIMS	2006-298T23:58:07	000T02:30:00
	CIRS_033TI_COMPMAP009_PRIME	2006-328T18:15:00	000T10:45:00
	CIRS_035TI_COMPMAP010_PRIME	2006-344T19:17:00	000T10:30:00
	CIRS_036TI_COMPMAP024_PRIME	2006-360T19:49:00	000T09:00:00
	CIRS_037TI_COMPMAP026_PRIME	2007-011T16:13:00	000T09:51:00
	CIRS_037TI_COMPMAP012_PRIME	2007-014T14:04:00	000T02:00:00

	CIRS_038TI_COMPMAP013_PRIME	2007-026T17:51:00	000T09:00:00
	CIRS_040TI_COMPMAP026_PRIME	2007-067T19:51:00	000T04:00:00
	CIRS_041TI_COMPMAP028_PRIME	2007-083T16:50:00	000T04:00:00
	CIRS_041TI_COMPMAP029_PRIME	2007-086T07:42:00	000T15:22:00
	CIRS_041TI_COMPMAP030_PRIME	2007-087T08:45:00	000T05:30:00
	CIRS_043TI_COMPMAP002_PRIME	2007-117T11:32:58	000T00:42:00
	CIRS_044TI_COMPMAP015_PRIME	2007-134T02:43:00	000T08:00:00
	CIRS_048TI_COMPMAP013_PRIME	2007-198T10:40:00	000T04:00:00
	CIRS_051TI_COMPMAP016_PRIME	2007-292T20:53:00	000T11:00:00
	CIRS_051TI_COMPMAP017_PRIME	2007-293T20:23:00	000T03:07:00
	CIRS_051TI_COMPMAP018_PRIME	2007-294T02:00:00	000T06:23:00
	CIRS_052TI_COMPMAP016_PRIME	2007-323T21:47:25	000T02:19:09
	CIRS_052TI_COMPMAP015_PRIME	2007-324T10:27:00	000T07:00:00
	CIRS_055TI_COMPMAP001_PRIME	2008-006T18:30:20	000T03:14:00
	CIRS_057TI_COMPMAP018_PRIME	2008-022T14:11:00	000T07:54:00
	CIRS_059TI_COMPMAP001_PRIME	2008-052T12:06:00	000T06:15:00
	CIRS_062TI_COMPMAP019_PRIME	2008-087T01:50:00	000T21:30:00
	CIRS_066TI_COMPMAP021_PRIME	2008-118T07:17:00	000T07:00:00
	CIRS_067TI_COMPMAP001_PRIME	2008-134T09:16:58	000T03:04:00
	CIRS_069TI_COMPMAP001_PRIME	2008-148T08:19:32	000T02:05:00
	CIRS_072TI_COMPMAP021_PRIME	2008-165T09:40:00	000T08:00:00
	CIRS_083TI_COMPMAP001_PRIME	2008-244T17:04:00	000T07:46:00
	CIRS_103TI_COMPMAP001_PRIME	2009-044T13:13:00	000T08:17:00
	CIRS_122TI_COMPMAP002_PRIME	2009-346T20:03:14	000T04:00:00
	CIRS_123TI_COMPMAP001_PRIME	2009-363T15:32:00	000T08:00:00
	CIRS_124TI_COMPMAP002_PRIME	2010-013T18:31:36	000T03:39:00
	CIRS_128TI_COMPMAP001_PRIME	2010-078T03:49:00	000T07:15:00
	CIRS_131TI_COMPMAP001_PRIME	2010-141T09:40:00	000T08:00:00
	CIRS_134TI_COMPMAP001_PRIME	2010-189T12:49:00	000T10:10:00
	CIRS_139TI_COMPMAP001_PRIME	2010-287T04:52:00	000T13:30:00
	CIRS_140TI_COMPMAP001_PRIME	2010-316T22:00:00	000T08:00:00
	CIRS_140TI_COMPMAP002_PRIME	2010-319T09:19:00	000T08:00:00
	CIRS_143TI_COMPMAP001_PRIME	2011-014T17:05:00	000T10:10:00
	CIRS_149TI_TEA001_PRIME	2011-173T09:00:00	000T07:30:00
	CIRS_149TI_TEA002_PRIME	2011-174T05:42:00	000T21:00:00
	CIRS_149TI_TEA003_PRIME	2011-175T11:42:00	000T15:00:00
	CIRS_149TI_TEA004_PRIME	2011-176T11:42:00	001T13:29:00
	CIRS_154TI_COMPMAP001_PRIME	2011-269T22:50:00	000T06:00:00
	CIRS_155TI_TEA003_PRIME	2011-297T05:00:00	000T19:00:00
	CIRS_155TI_TEA004_PRIME	2011-298T14:32:00	000T13:15:00
	CIRS_155TI_TEA005_PRIME	2011-299T14:17:00	000T13:30:00
	CIRS_156TI_TEA003_PRIME	2011-303T14:02:00	000T13:30:00
	CIRS_156TI_TEA004_PRIME	2011-304T14:02:00	000T13:30:00
	CIRS_156TI_TEA005_PRIME	2011-305T14:02:00	001T04:45:00
	CIRS_156TI_TEA006_PRIME	2011-307T03:47:00	000T15:00:00
	CIRS_157TI_COMPMAP001_PRIME	2011-331T18:00:00	000T15:34:00
	CIRS_158TI_TEA001_PRIME	2011-350T11:20:00	000T15:00:00

	CIRS_160TI_TEA002_PRIME	2012-032T15:57:00	001T07:30:00
	CIRS_160TI_TEA003_PRIME	2012-034T08:27:00	000T15:00:00
	CIRS_160TI_TEA004_PRIME	2012-035T08:27:00	000T20:45:00
	CIRS_160TI_TEA005_PRIME	2012-038T17:22:00	000T11:10:00
	CIRS_161TI_TEA001_PRIME	2012-042T17:08:00	000T11:10:00
	CIRS_181TI_TEA001_PRIME	2013-049T09:46:00	001T01:41:00
	CIRS_181TI_TEA002_PRIME	2013-050T21:57:00	000T23:30:00
	CIRS_182TI_TEA001_PRIME	2013-052T07:57:00	000T21:00:00
	CIRS_182TI_TEA002_PRIME	2013-053T15:52:00	000T11:10:00
	CIRS_185TI_TEA001_PRIME	2013-097T07:36:00	000T10:55:00
	CIRS_186TI_TEA001_PRIME	2013-098T05:01:00	000T14:45:00
	CIRS_186TI_TEA002_PRIME	2013-099T04:46:00	000T15:00:00
	CIRS_202TI_TEA001_PRIME	2014-061T21:56:00	000T15:00:00
	CIRS_202TI_TEA002_PRIME	2014-062T21:56:00	000T15:00:00
	CIRS_202TI_TEA003_PRIME	2014-063T21:56:00	000T13:30:00
	CIRS_206TI_TEA001_PRIME	2014-191T00:00:00	000T13:00:00
	CIRS_206TI_TEA002_PRIME	2014-191T13:00:00	000T13:27:00
	CIRS_206TI_TEA003_PRIME	2014-192T12:57:00	001T13:15:00
	CIRS_219TI_TEA001_PRIME	2015-204T13:06:00	000T13:20:00
	CIRS_219TI_TEA002_PRIME	2015-205T12:56:00	000T13:30:00
	CIRS_233TI_TEA001_PRIME	2016-066T16:00:00	000T08:00:00
	CIRS_241TI_TEA002_PRIME	2016-240T11:23:00	001T11:20:00
	CIRS_252TI_COMPMAP001_PRIME	2016-350T06:16:00	000T04:00:00
	CIRS_253TI_COMPMAP001_PRIME	2016-350T17:21:00	000T04:00:00
	CIRS_253TI_COMPMAP002_PRIME	2016-351T03:21:00	000T01:30:00
	CIRS_259TI_COMPMAP001_PIE	2017-032T14:06:00	000T05:15:00
	CIRS_259TI_COMPMAP002_PRIME	2017-033T09:36:00	000T05:45:00
	CIRS_268TI_COMPMAP001_PIE	2017-097T02:36:00	000T05:47:00
	CIRS_268TI_COMPMAP002_PIE	2017-097T09:23:00	000T05:16:00
	CIRS_271TI_COMPMAP001_PRIME	2017-113T23:36:00	000T11:36:00
	CIRS_278TI_COMPMAP001_PRIME	2017-159T08:26:00	000T03:00:00
	CIRS_280TI_COMPMAP001_PIE	2017-176T00:28:00	000T04:24:00
	CIRS_283TI_COMPMAP001_PRIME	2017-191T04:20:00	000T03:46:00
	CIRS_283TI_COMPMAP002_PRIME	2017-192T00:36:00	000T03:42:00
	CIRS_283TI_COMPMAP003_PRIME	2017-192T08:04:00	000T01:51:00
	CIRS_285TI_COMPMAP001_PRIME	2017-207T21:51:00	000T01:30:00
	CIRS_287TI_COMPMAP001_PIE	2017-223T00:31:00	000T05:00:00
	CIRS_288TI_COMPMAP001_PIE	2017-223T06:31:00	000T05:00:00
	CIRS_288TI_COMPMAP002_PIE	2017-223T12:31:00	000T04:30:00
	CIRS_288TI_COMPMAP003_PIE	2017-223T18:01:00	000T06:15:00
	CIRS_290TI_COMPMAP001_PIE	2017-240T00:19:00	000T04:16:00
	CIRS_292TI_COMPMAP001_PRIME	2017-255T03:46:00	000T03:00:00
	CIRS_293TI_COMPMAP002_PRIME	2017-255T18:46:00	000T02:20:00

7.3 Graphical representation of spatial coverage

None.

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