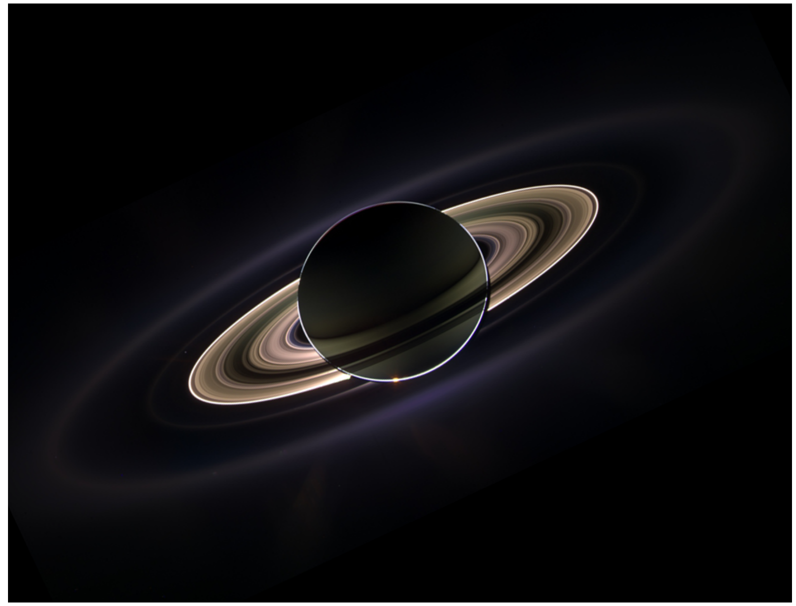
Linda Spilker
Cassini Project Scientist

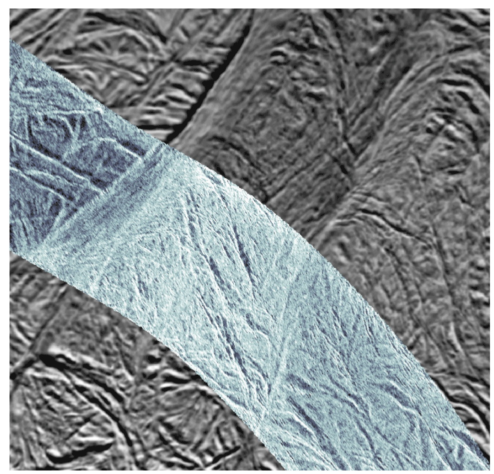
Outer Planets Assessment Group

29 March 2012

Cassini Solstice Mission: Introduction

- Key Cassini events since Oct. 2011 OPAG
  - Cassini Smithsonian Award
  - New Participating Scientists
- Latest Science Highlights (LPSC)
  - Recent images
  - Enceladus: Radar-bright
  - Enceladus: First detection of VIMS thermal emission
  - Rhea/Dione: Exosphere detection
  - Titan Haze: Seasonal evolution
  - Titan surface brightness changes
- Cassini Senior Review update





Cassini Award: Trophy for Current Achievement

Bob Mitchell (center) accepting award for Cassini

- Cassini received Smithsonian's National Air and Space Museum's highest group honor, the Trophy for Current Achievement
- Trophy presented March 21st

New Cassini Participating Scientists

- 12 new Cassini Participating Scientists (PSs) added
  - 8 U.S. and 4 European scientists
  - PS's participating on one to three science teams
- Competitively selected through Cassini Data Analysis Participating Scientist Program (CDAPS)
- Attended first Cassini Project Science Group (PSG) meeting end of January

- Additional Participating Scientists will be added in next CDAPS cycle
  - Step-1 proposals were due March 23rd

New Cassini Participating Scientists

PI	Instruments	Institution	Title	Discipline
Alberto Adriani	VIMS, INMS, UVIS	INAF-IASF (Italy)	Seasonal variability of the chemical composition of Titan's upper atmosphere	Titan atmosphere
Carrie Anderson	CIRS	GSFC	Aerosol and Ice Properties of Titan's Stratosphere from a Combined Cassini CIRS and DISR Analysis	Titan stratosphere
Jason Barnes	ISS, VIMS, RADAR	Univ. ID	Distribution, Composition, and Texture of Titan's Evaporites	Titan evaporites
Gianrico Filacchione	VIMS	INAF-IASF (Italy)	From rings to satellites: a VIS-IR spectrophotometric investigation of water ice and cromophores distribution on Saturnian system icy bodies	Rings & Icy satellites
Matthew Hedman	ISS, VIMS	Cornell	The Seasonal and Temporal Evolution of Saturn's Faint Rings	Rings
Brigette Hesman	CIRS	GSFC	Cassini/CIRS Studies of Saturn's Storm Systems	Saturn storms
Carly Howett	CIRS	SWRI	Thermal Mapping of Saturn's Icy Satellites	Icy satellites
Ozgur Karatekin	RSS, RADAR	Royal Obs. of Belgium	Seasonal and Temporal Variations of Titan's Seas and Atmospheres	Titan
Panayotis Lavvas	UVIS, ISS	University of Reims (France)	Aerosol properties in Titan's upper atmosphere	Titan atmosphere
Carol Paty	CAPS, MAG	Georgia Tech	Seasonal Variability of Saturn's Magnetosphere	Saturn magnetosphere
Paul Schenk	ISS	LPI	The Snowpack of Enceladus	Enceladus craters
Jason Soderblom	VIMS	Univ. AZ	Organics on Titan's Surface	Titan surface organics

New Cassini Participating Scientists

Alberto Adriani

Carrie Anderson

Jason Barnes

Gianrico Filacchione

Matt Hedman

Brigette Hesman

New Cassini Participating Scientists

Carly Howett

Ozgur Karatekin

Panayotis Lavvas

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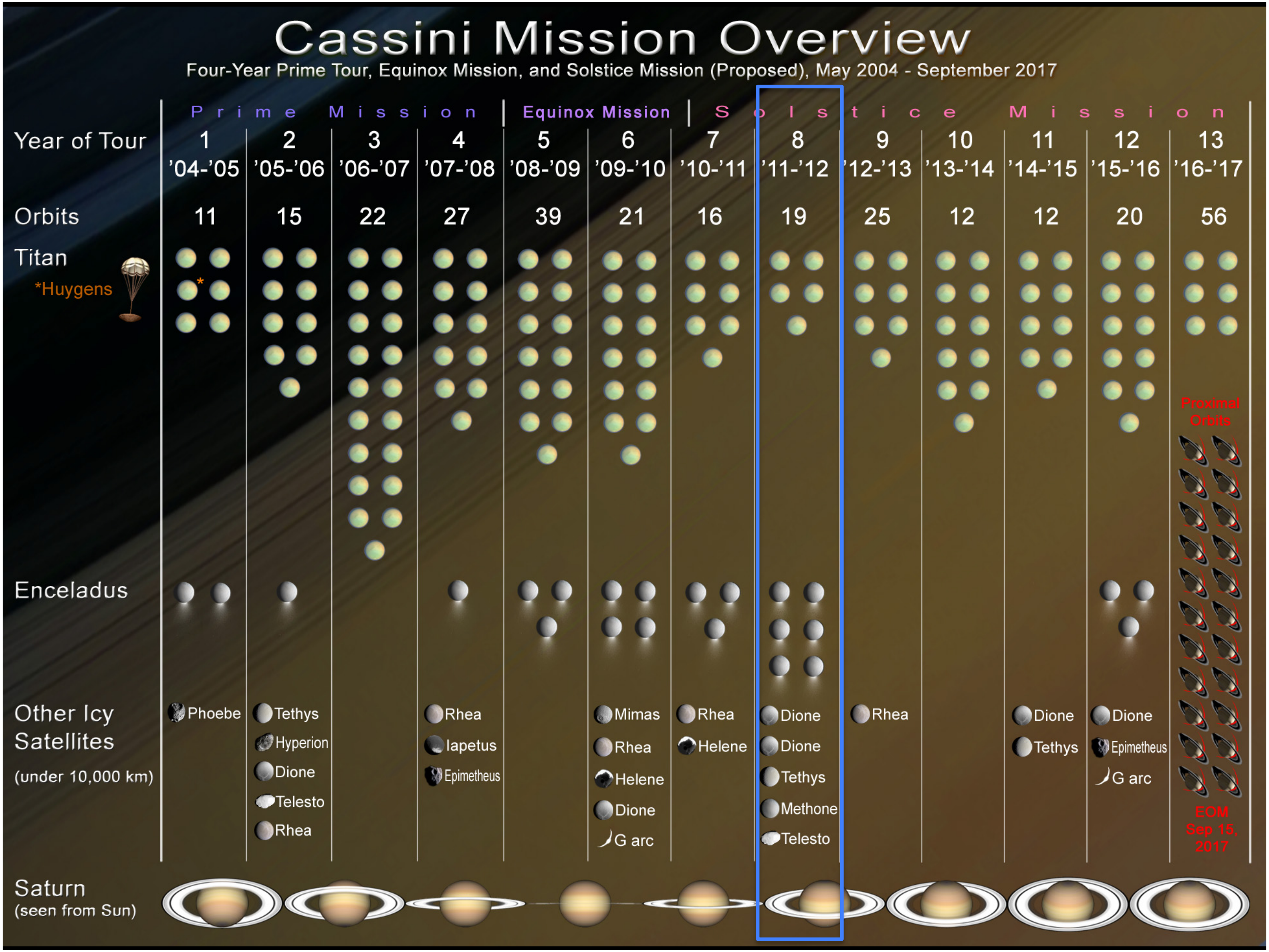
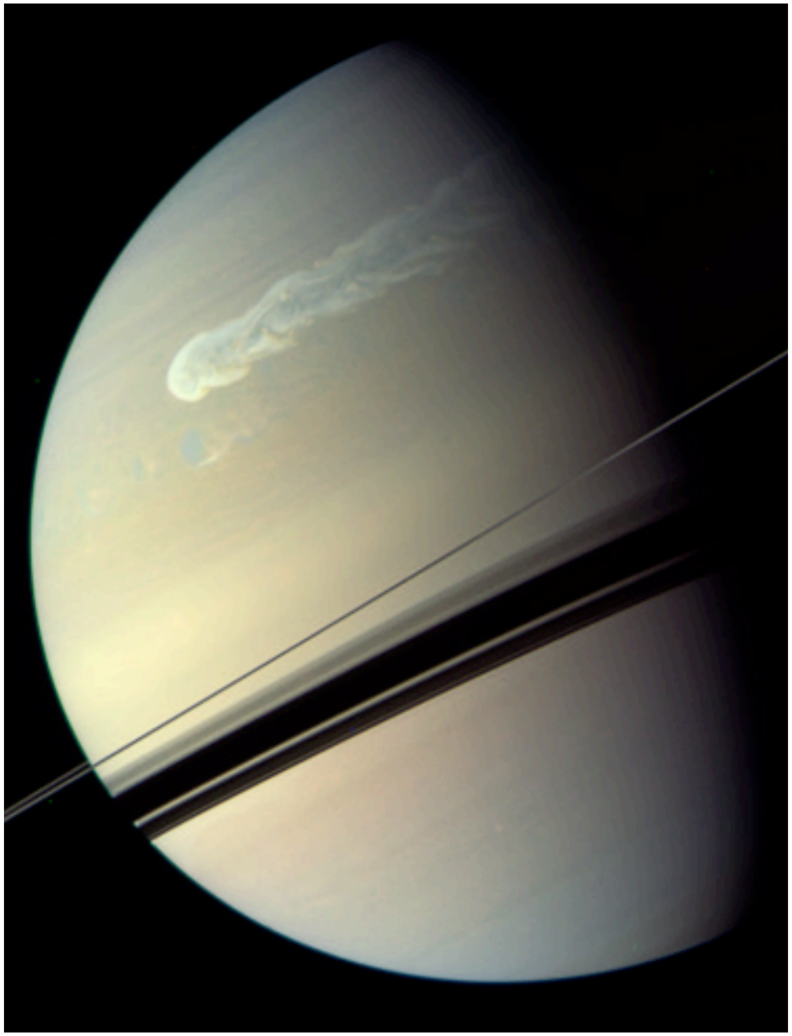
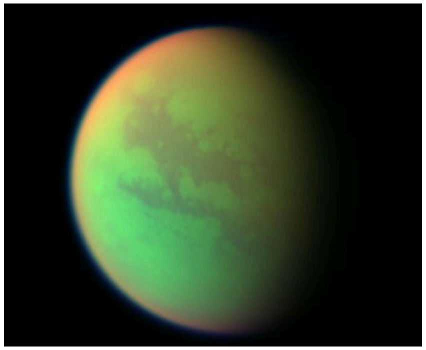

Cassini Mission Overview
Four-Year Prime Tour, Equinox Mission, and Solstice Mission (Proposed), May 2004 - September 2017
Prime Mission
Equinox Mission
Solstice Mission
Year of Tour
1 '04-'05
2 '05-'06
3 '06-'07
4 '07-'08
5 '08-'09
6 '09-'10
7 '10-'11
8 '11-'12
9 '12-'13
10 '13-'14
11 '14-'15
12 '15-'16
13 '16-'17
Orbits
11 15 22 27 39 21 16 19 25 12 12 20 56
Titan
*Huygens
Proximal Orbits
Enceladus
Other Icy Satellites
(under 10,000 km)
Phoebe
Tethys
Hyperion
Dione
Telesto
Rhea
Rhea
Iapetus
Epimetheus
Mimas
Rhea
Helene
Dione
G arc
Rhea
Helene
Dione
Dione
Tethys
Methone
Telesto
Rhea
Dione
Tethys
Dione
Epimetheus
G arc
EOM Sep 15, 2017
Saturn
(seen from Sun)

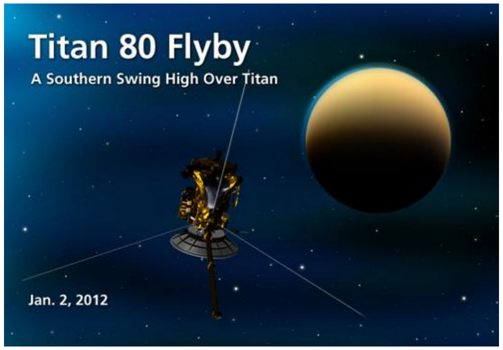
Key Events Since Oct. 2011 OPAG

- Titan flybys:
  - T79 (3,586 km): CIRS limb sounding, ISS and VIMS surface observations
  - T80 (29,415 km): High resolution ISS
  - T81 (31,131 km): ISS, last chance to see Ontario Lacus before sun sets
  - T82 (3,800 km): CIRS limb sounding, VIMS cloud and climatic detection, magnetic tail sampling
- Targeted Icy Satellite flybys:
  - E16 (~500 km): Enceladus SAR data, plume observations, CIRS thermal scans
  - E17 (~74 km): MAPS (esp. INMS) plume sampling, ORS imaging
  - D3 (100 km): RSS gravity flyby, MAPS data



Four Titan Flybys Since October 2011





Dec. 13, 2011 -- Titan flyby (3586 km) **T79**: CIRS limb sounding and mapping of surface and atmospheric temperatures. Far-IR limb sounding reached high latitudes, providing insights into north polar circulation transition from spring to summer, and searched for condensates. Excellent for VIMS to observe near Belet (1km/pixel), where ISS observed extensive surface changes in Fall 2010. VIMS also observed Adiri and the Huygens Landing Site at 10 km/pixel, and ISS mosaicked the North pole lakes and mares. (This was originally a CAPS flyby.)

Jan. 2, 2012 -- Titan flyby (29,415 km) **T80**: ISS performed high-resolution observations around closest-approach along the anti-saturnian and trailing hemispheres at mid- to high southern latitudes.

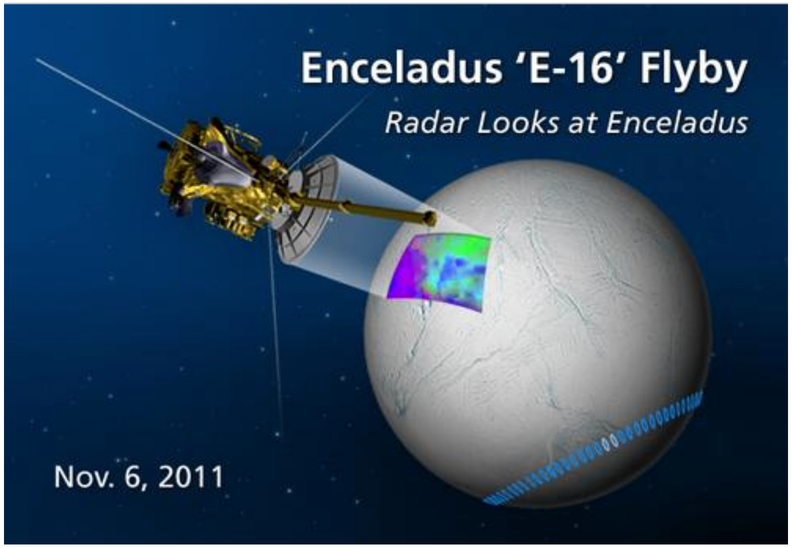
Jan. 30, 2012 -- Titan flyby (31,131 km) **T81**: ISS performed high-resolution observations around closest approach along Titan's leading hemisphere at high southern latitudes, including a late view of Ontario Lacus before the Sun set for southern winter. ISS also rode along with CIRS' inbound high-phase angle observations and CIRS' outbound observations over Titan's anti-Saturnian hemisphere at low phase angles. This encounter was one of the last views of Titan's high southern latitudes.

Feb. 19, 2012 -- Titan flyby (31,131 km) **T82:** : CIRS limb sounding, and mapping of surface and atmospheric temperatures. Far-IR limb sounding near closest approach reaches the most northerly latitude of the Solstice Mission (75°N) until 2015, providing insights into north polar circulation transition from spring to summer, and searches for possible condensates.

Three Icy Satellite Flybys Since October 2011

Nov. 6, 2011 – Enceladus flyby (~500 km)
E16: Unique Radar SAR flyby on thrusters with two goals: compared an object with known composition to Titan SAR data, and provided the first close SAR passage of an icy satellite.

Other highlights: Plume observations on approach and CIRS scan to monitor variability of plumes and heat on Enceladus; ISS snapped images as Cassini exited.



Dec. 12, 2011 – Dione flyby (100 km)
D3: RSS flyby to study the internal structure of Dione, specifically how differentiated it is and whether it is in hydrostatic equilibrium. CIRS was prime between the wings and C/A to seek any thermal signal from Dione. ORS observed Enceladus for a mid-range (19,900 km) moderate solar phase angle (90º) observation of the leading side. During lit exit, ORS observed Dione.

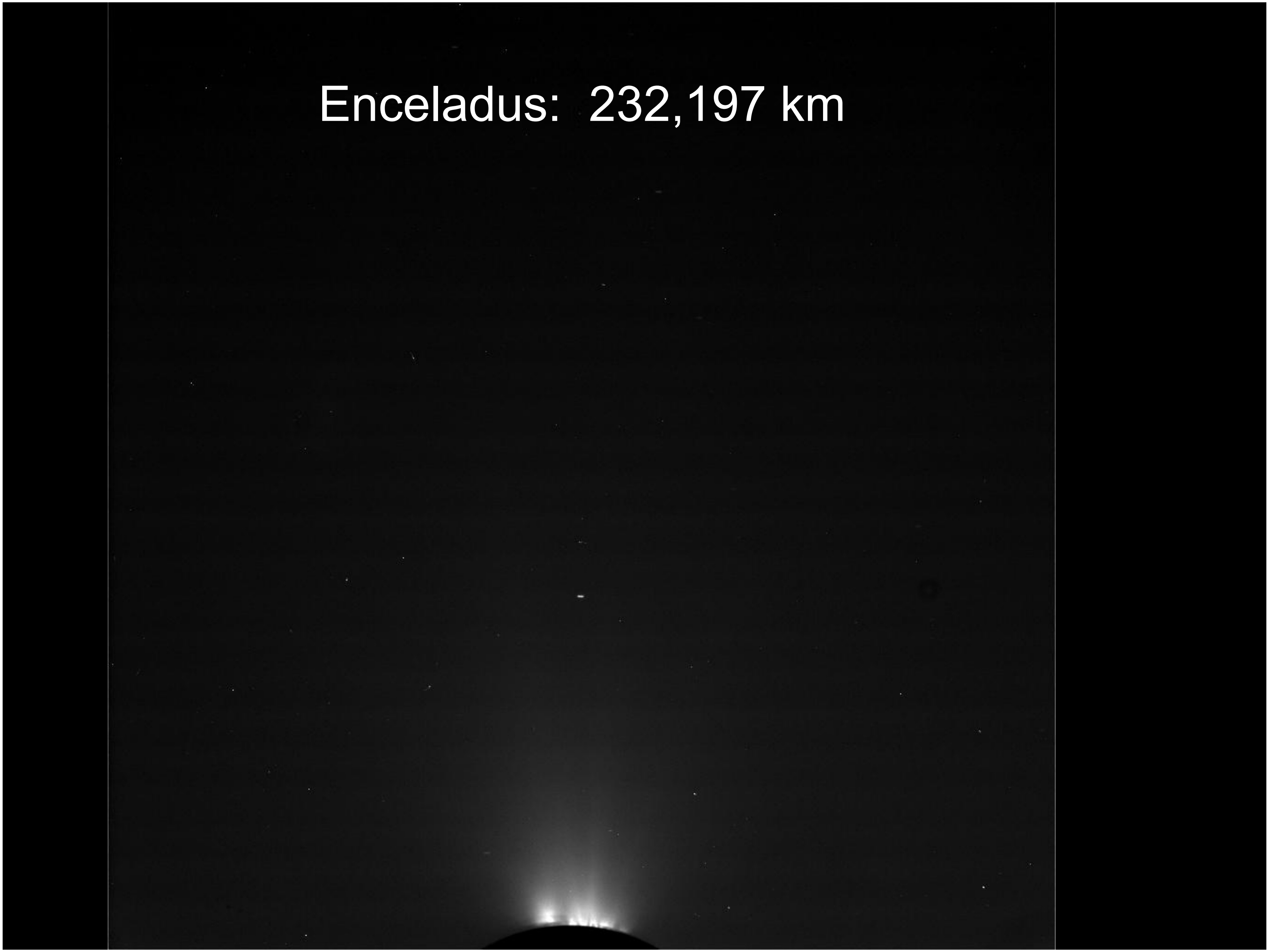
Enceladus Flyby Tuesday, March 27th!

Mar. 27, 2012 – Enceladus flyby (74 km)
E17: closest-ever passage through the south-polar plume to measure composition, density, 3-D structure, and variability of plume gasses and icy particles.

This trajectory was carefully designed in coordination with E14 (1 Oct 2011, 99 km alt) and E18 (14 April 2012, 74 km alt) trajectories, to allow for extensive mapping of the plume by the fields and particles instruments

During dark approach, CIRS monitored hot spots, and during lit exit, ISS acquired images ”

CASSINI OBSERVES JANUS, DIONE AND ENCELADUS 27 MARCH 2012 RAW IMAGES

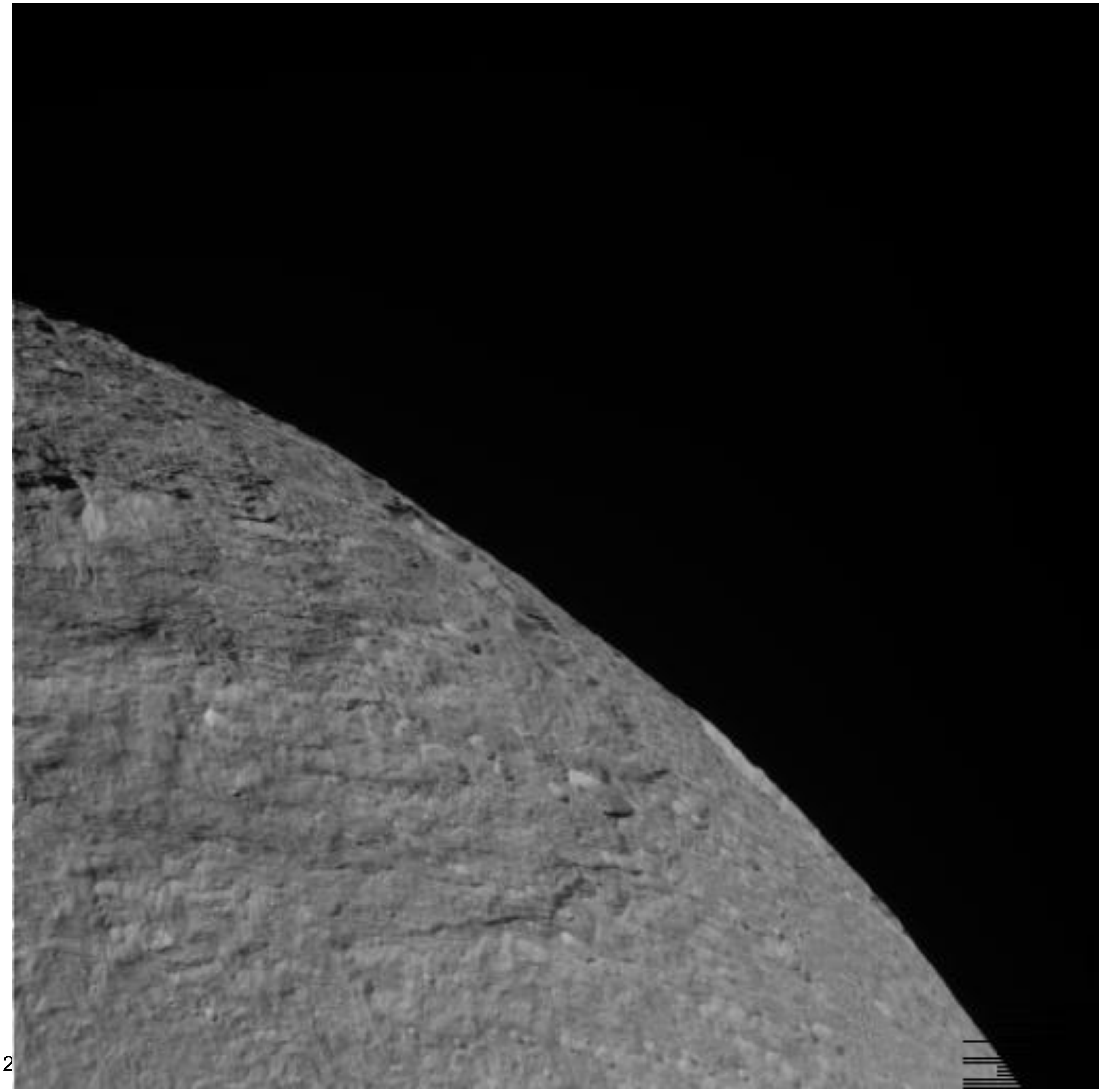

Enceladus: 232,197 km

Enceladus: 111,809 km

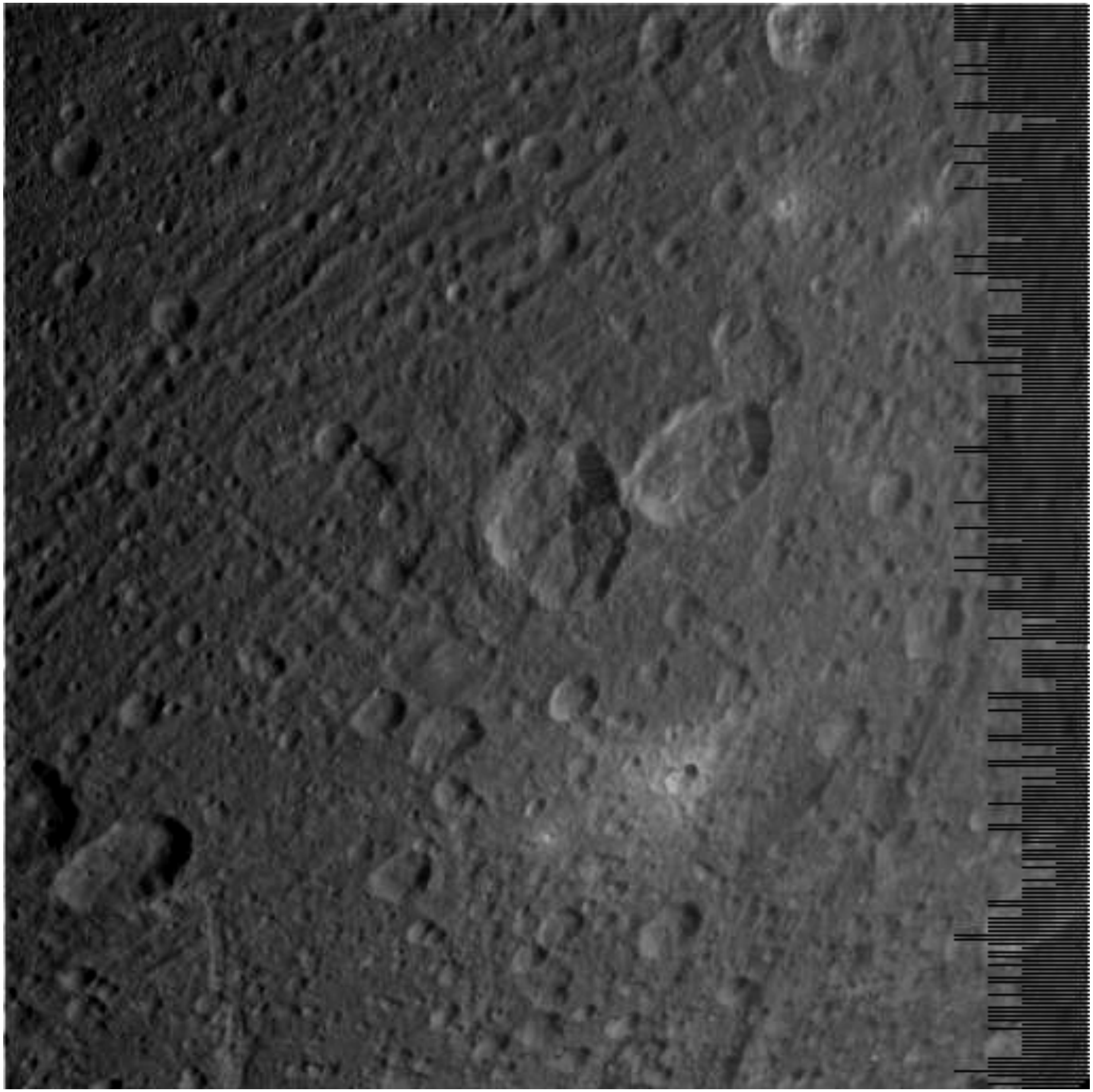

Enceladus: 48,759 km

Enceladus: 31,881 km

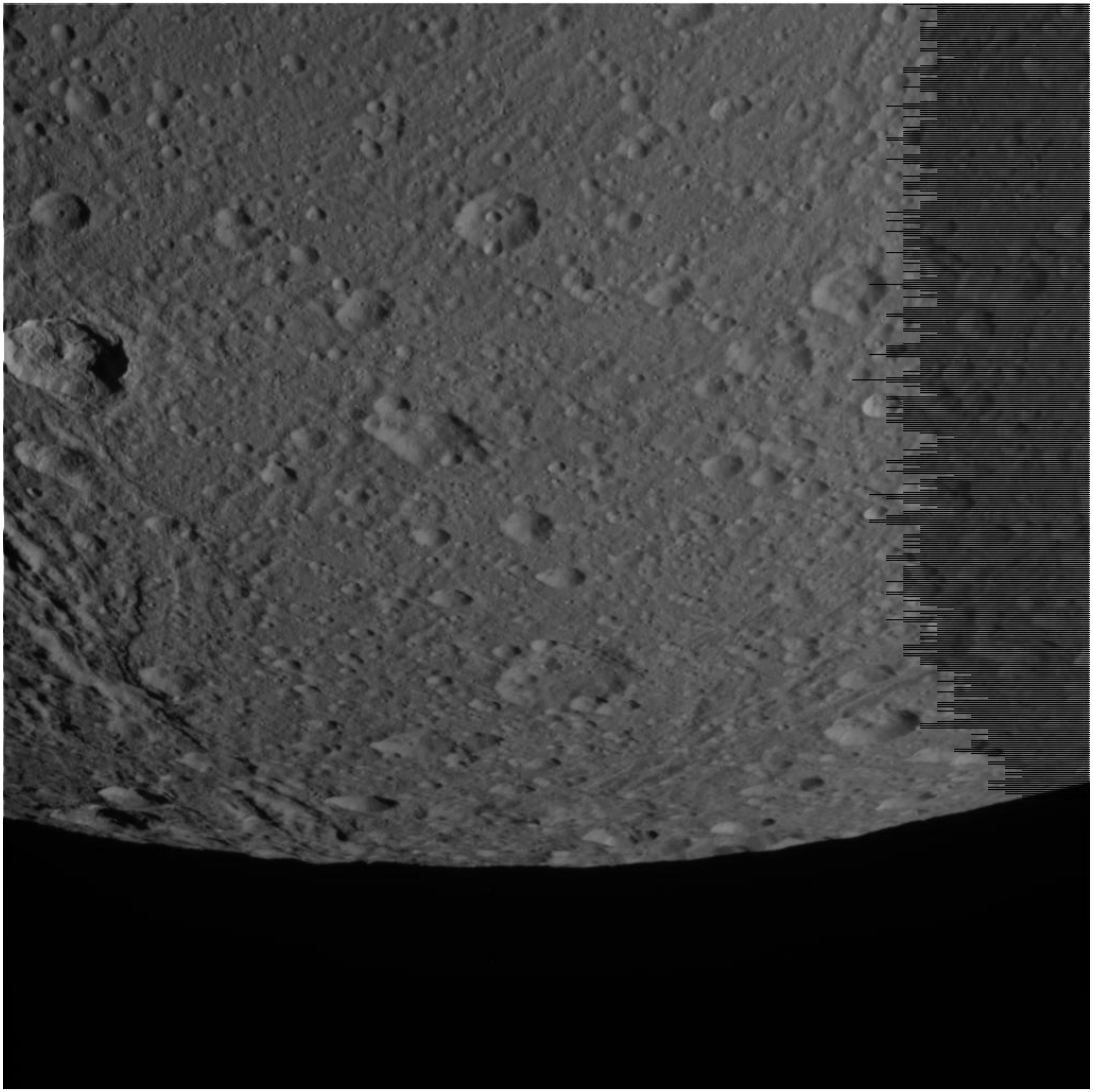
Janus: 44,520 km



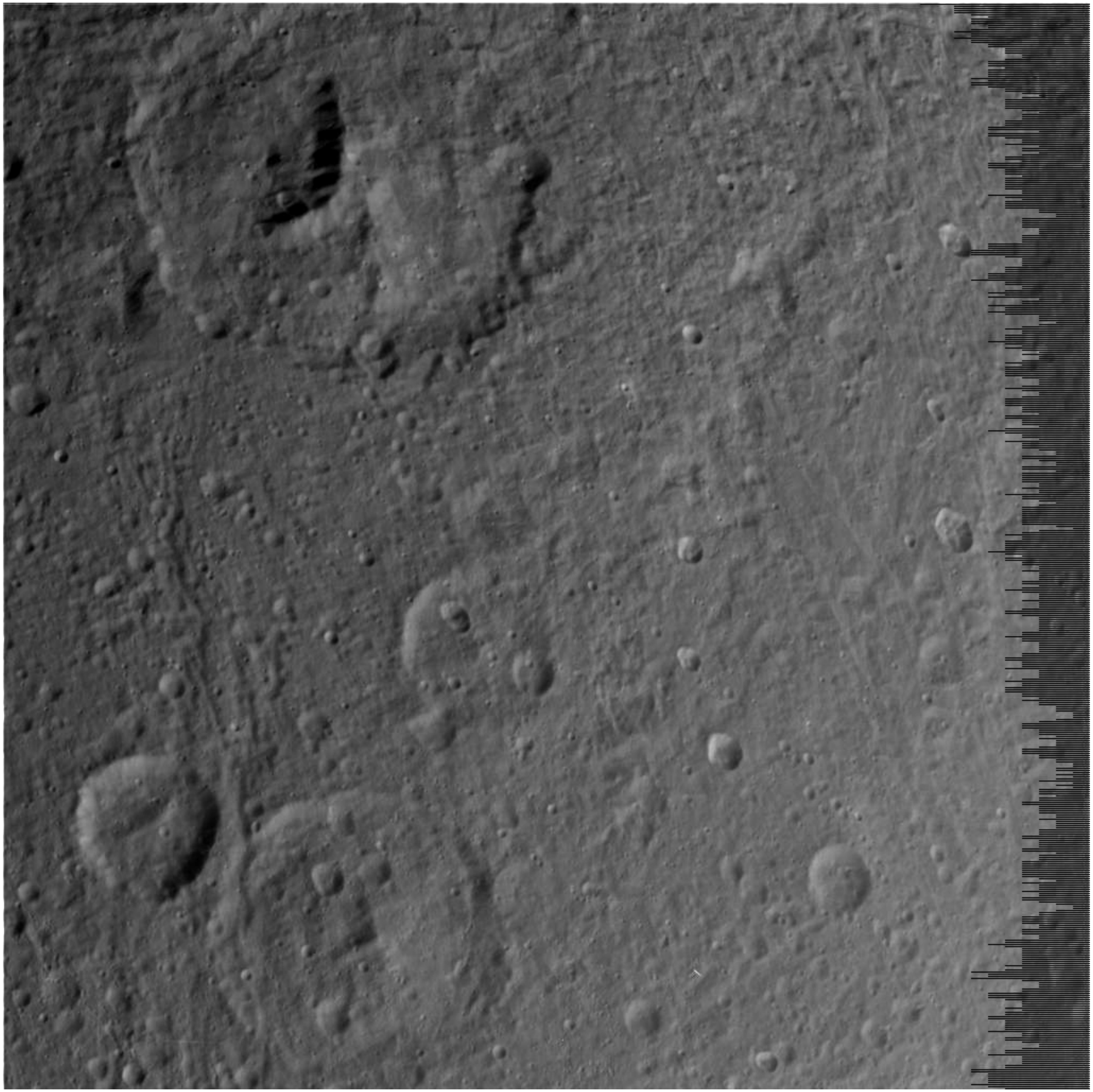
Dione
45,765 km



Dione
45,091 km
Near 25°N, 125°W



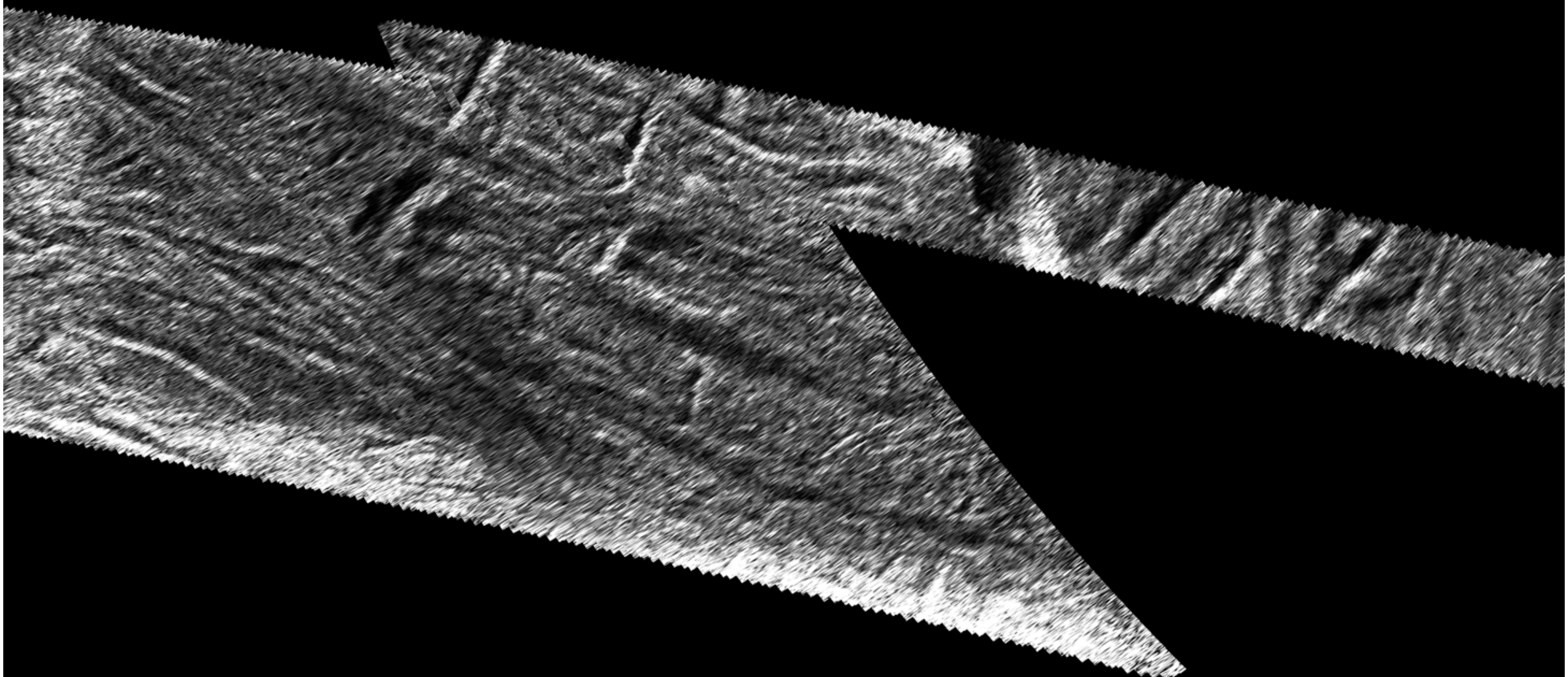
Dione
44,783 km

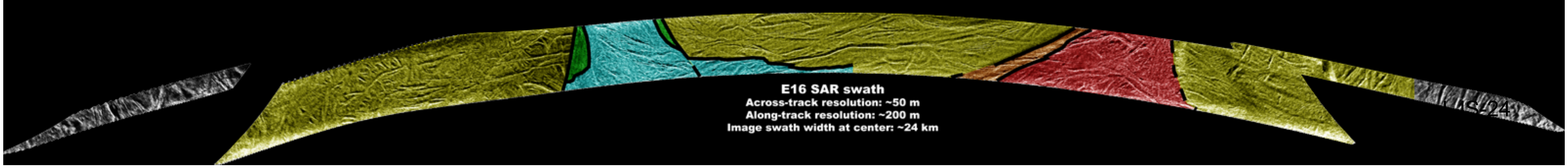


Dione
44,565 km

Dione
44,644 km

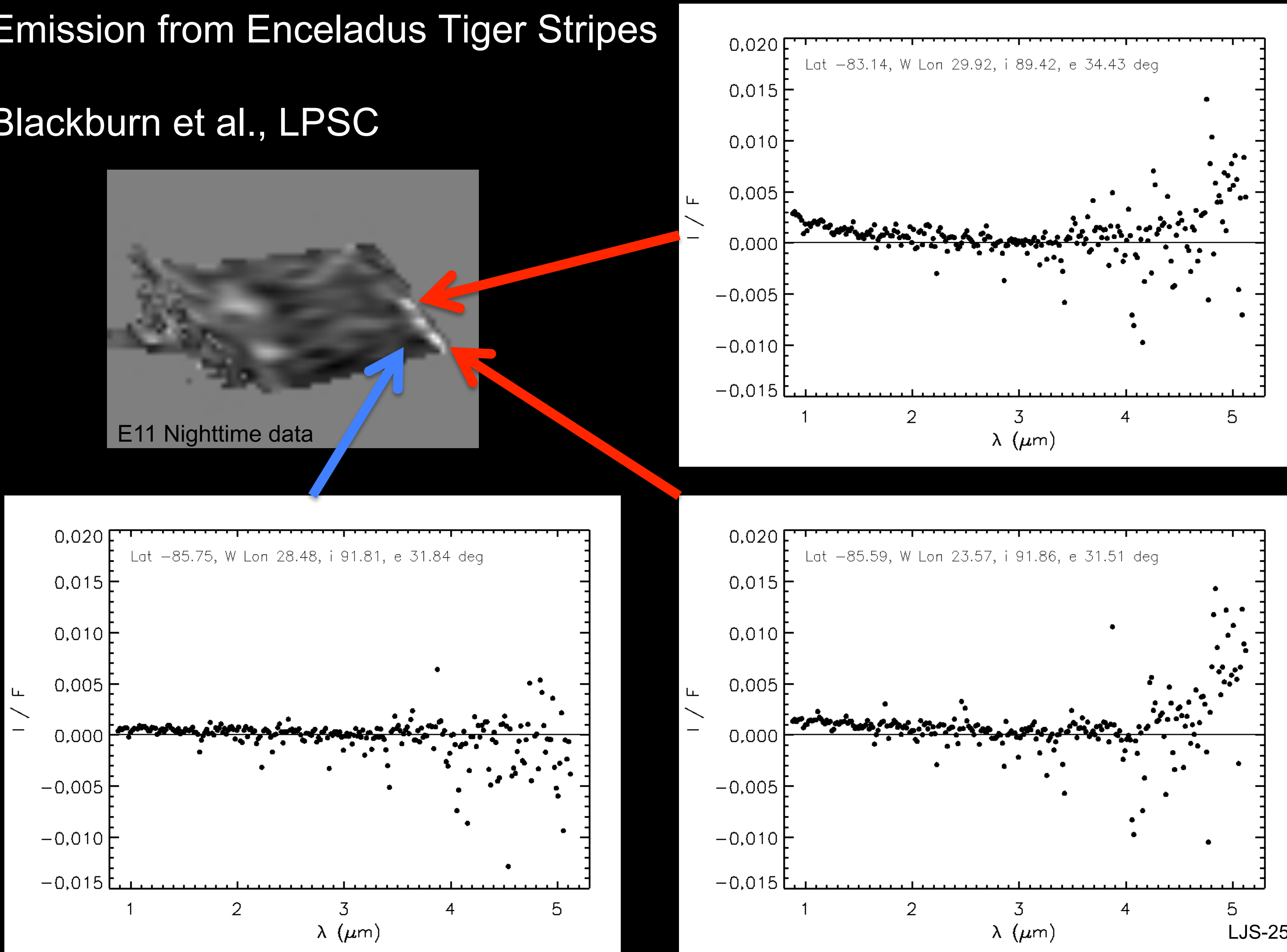
E16 Fly-by




E16 SAR swath
Across-track resolution: ~50 m
Along-track resolution: ~200 m
Image swath width at center: ~24 km

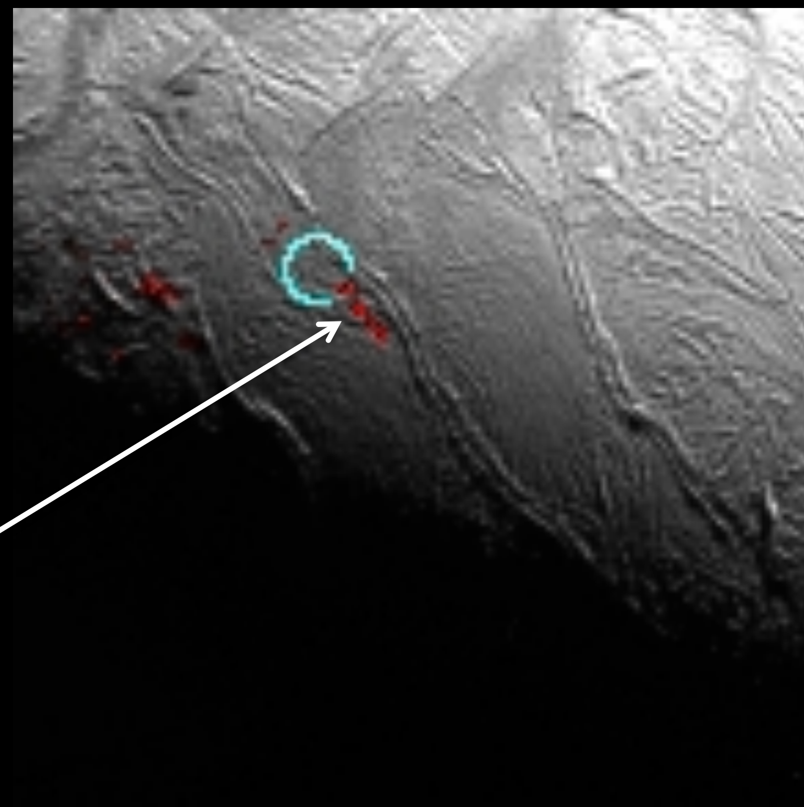
First VIMS Detection of Thermal Emission from Enceladus Tiger Stripes

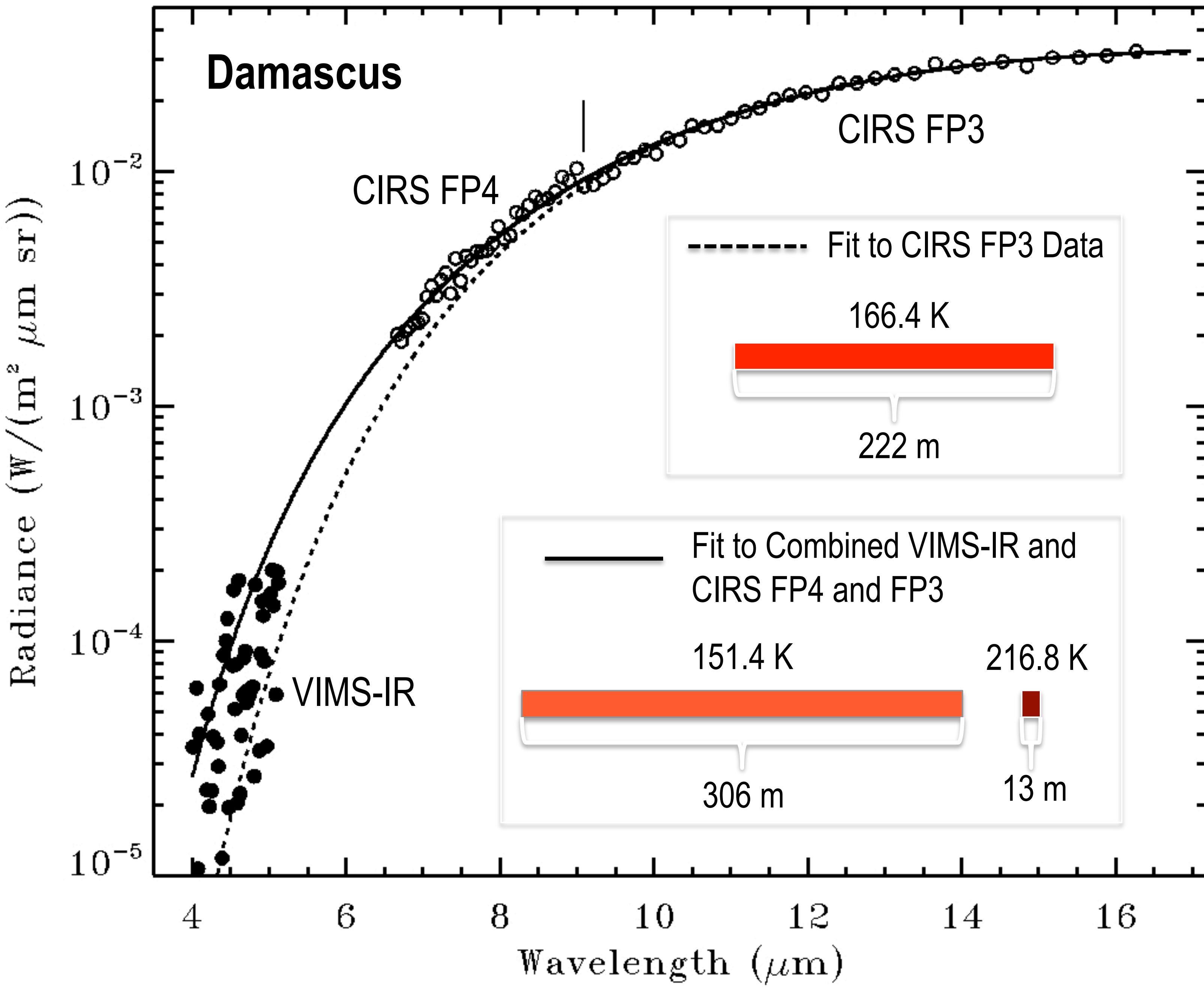
Blackburn et al., LPSC



Emission Map

- Co-registered VIMS image shown in **red**
- Blue circle is the location of plume 1 at Baghdad from Spitale and Porco (2007).

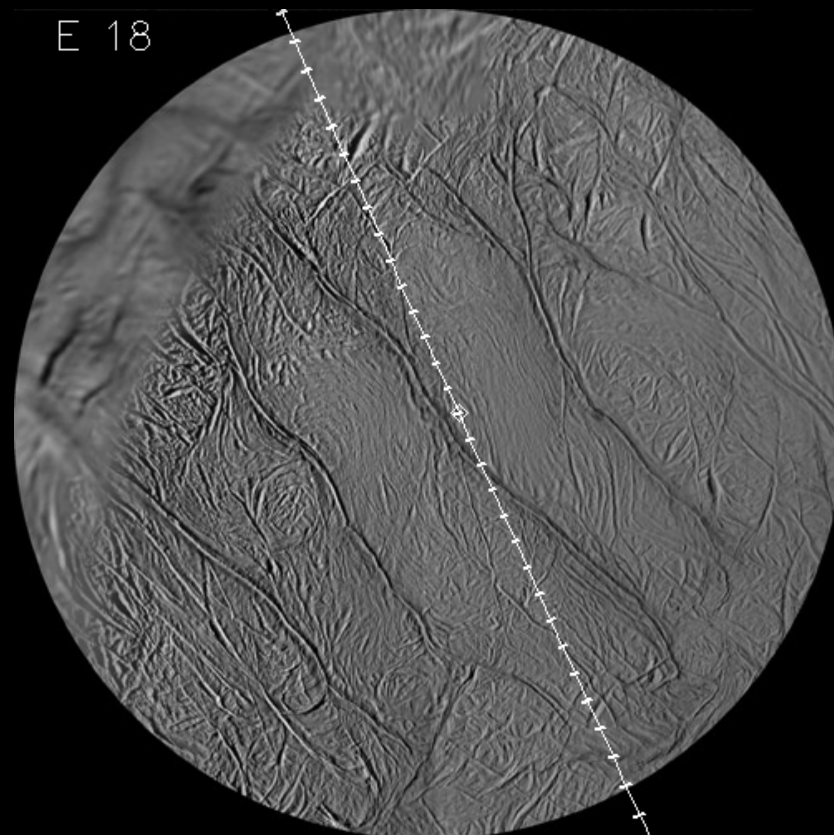



Damascus
CIRS FP4
CIRS FP3
VIMS-IR
Fit to CIRS FP3 Data
166.4 K
222 m
Fit to Combined VIMS-IR and CIRS FP4 and FP3
151.4 K
216.8 K
306 m
13 m
10^{-2}
10^{-3}
10^{-4}
10^{-5}
Radiance (W/(m² μm sr))
4
6
8
10
12
14
16
Wavelength (μm)

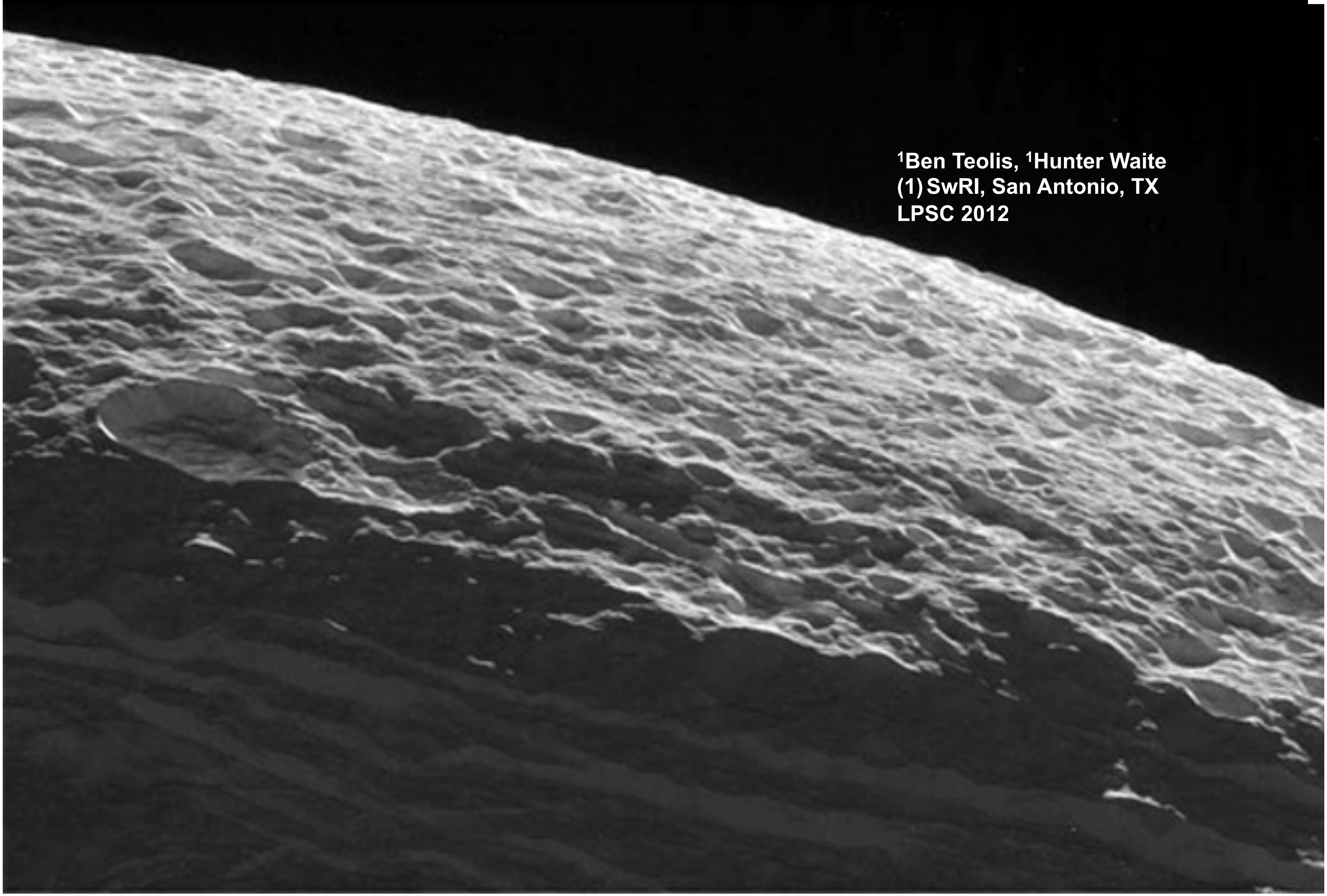
LJS-27

Future Opportunity: E18 Flyby

- E-18 Flyby in April may provide a measurement of the width of the heat source at Baghdad in VIMS data
- Use VIMS occultation mode for very high spatial resolution across tiger stripe



Seasonal O_2 – CO_2 Exospheres detected at Rhea and Dione

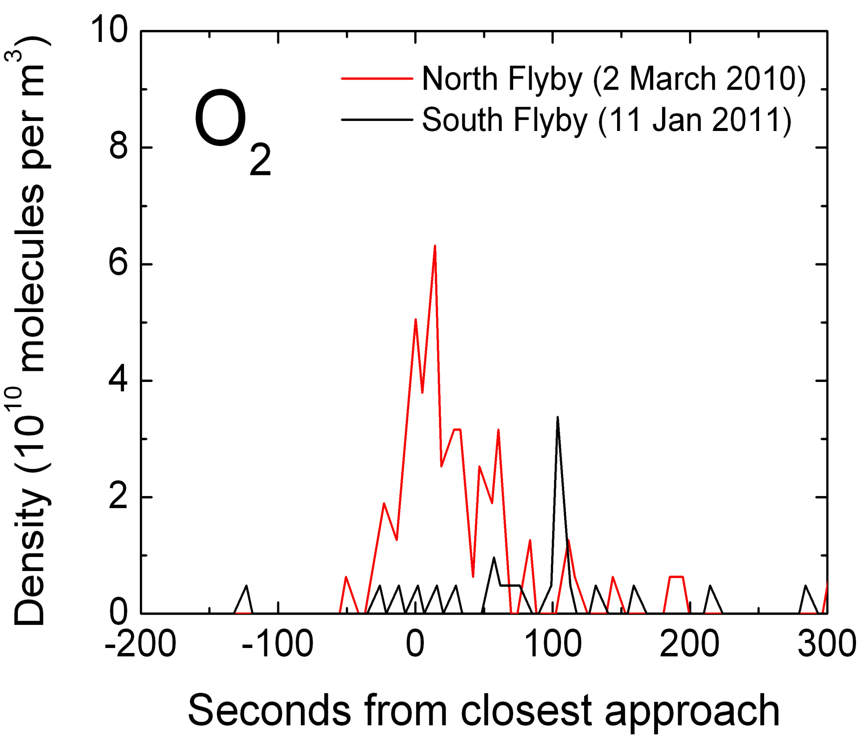


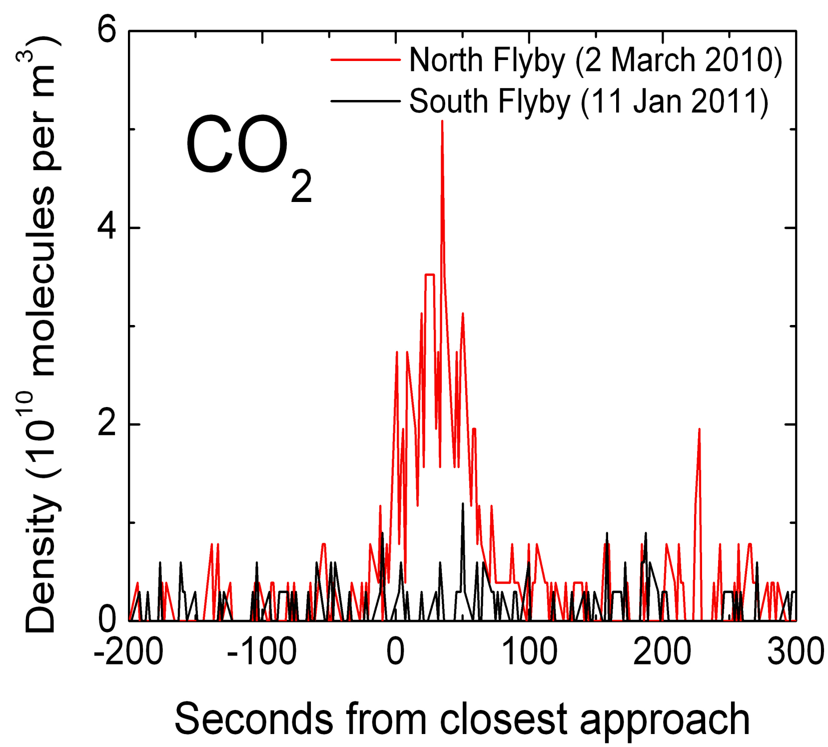
[1]Ben Teolis, [1]Hunter Waite
(1) SwRI, San Antonio, TX
LPSC 2012

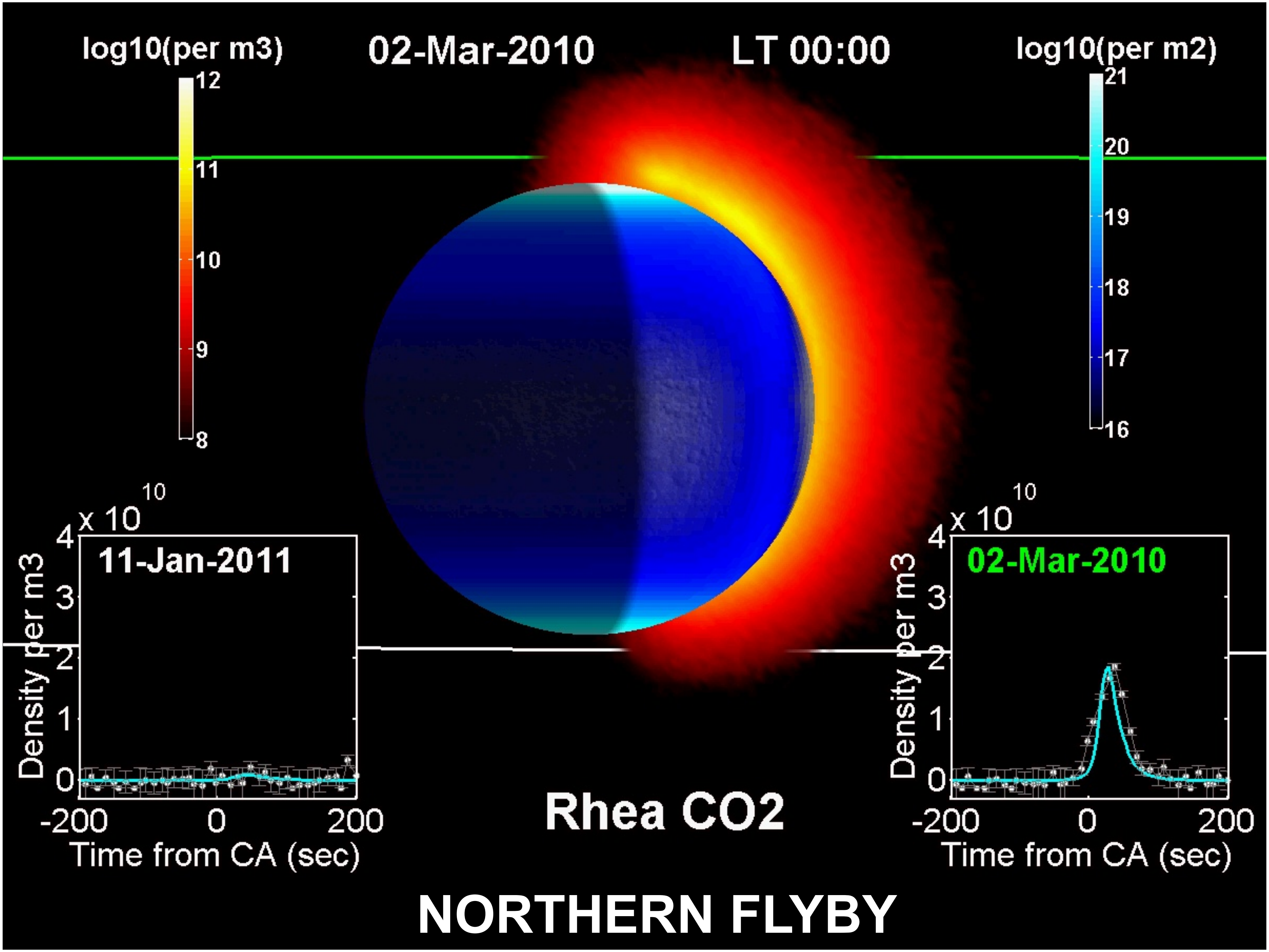
Summary of Rhea Findings by INMS

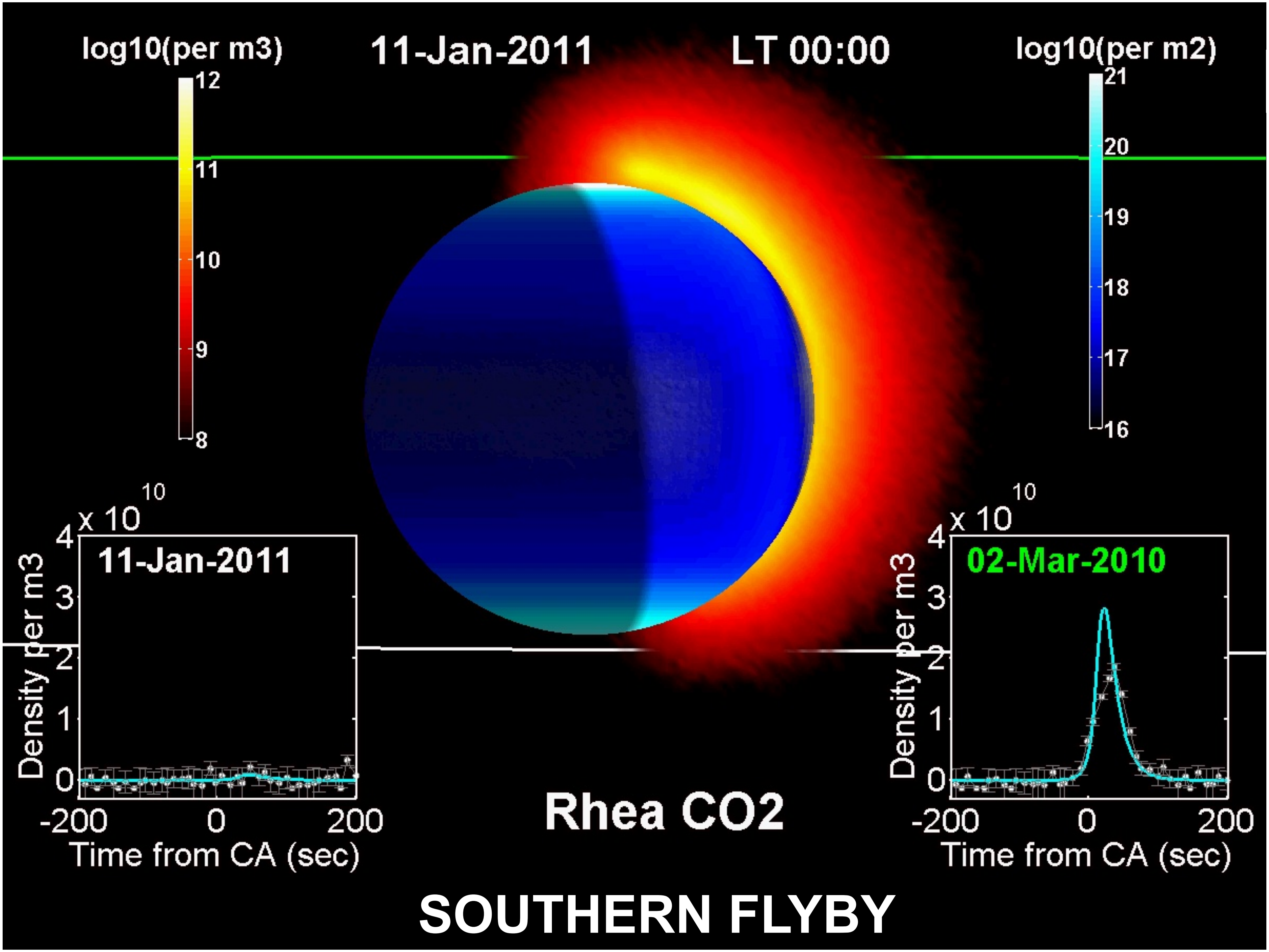
- **Northern Pass (97 km): More O_2 and (especially !) CO_2 on dayside**
- **Southern Pass (72 km): Less O_2, no CO_2, despite lower flyby altitude !!**

1. **Variability spatial, temporal, both ?**
2. **Expectations for Dione ?**






log10(per m3)
02-Mar-2010
LT 00:00
log10(per m2)
12
11
10
9
8
21
20
19
18
17
16
x 10^10
11-Jan-2011
Density per m3
Time from CA (sec)
-200
0
200
4
3
2
1
0
x 10^10
02-Mar-2010
Density per m3
Time from CA (sec)
Rhea CO2
NORTHERN FLYBY

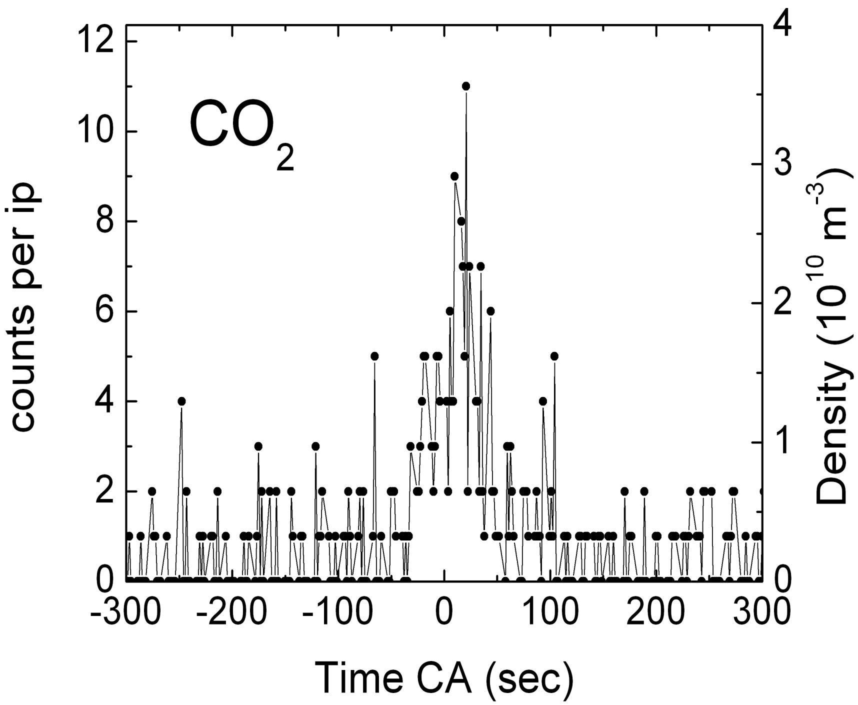


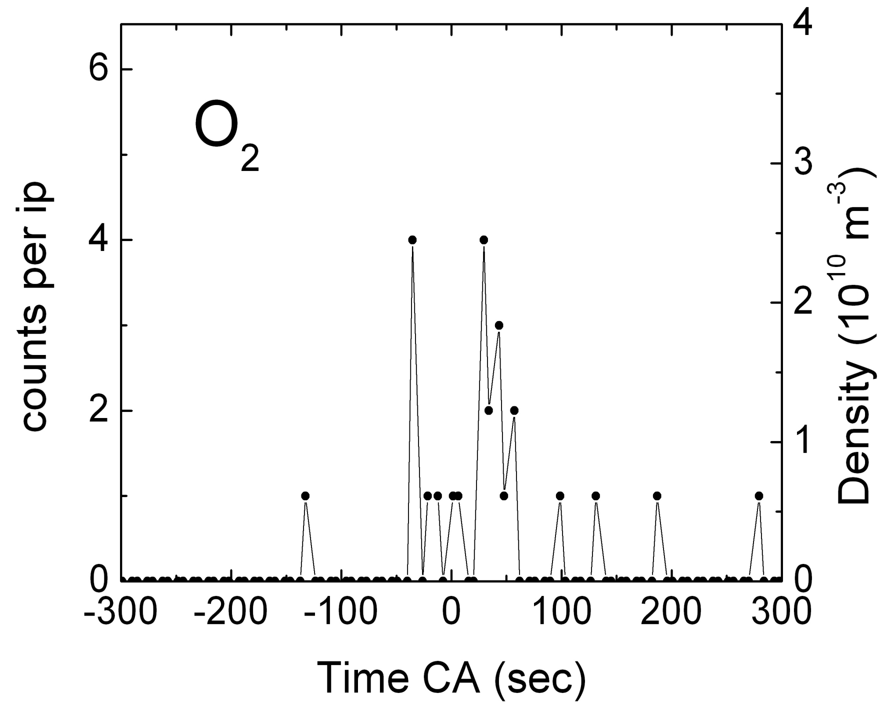
log10(per m3)
11-Jan-2011
LT 00:00
log10(per m2)
12
11
10
9
8
21
20
19
18
17
16
x 10^10
11-Jan-2011
Density per m3
Time from CA (sec)
x 10^10
02-Mar-2010
Density per m3
Time from CA (sec)
Rhea CO2
SOUTHERN FLYBY

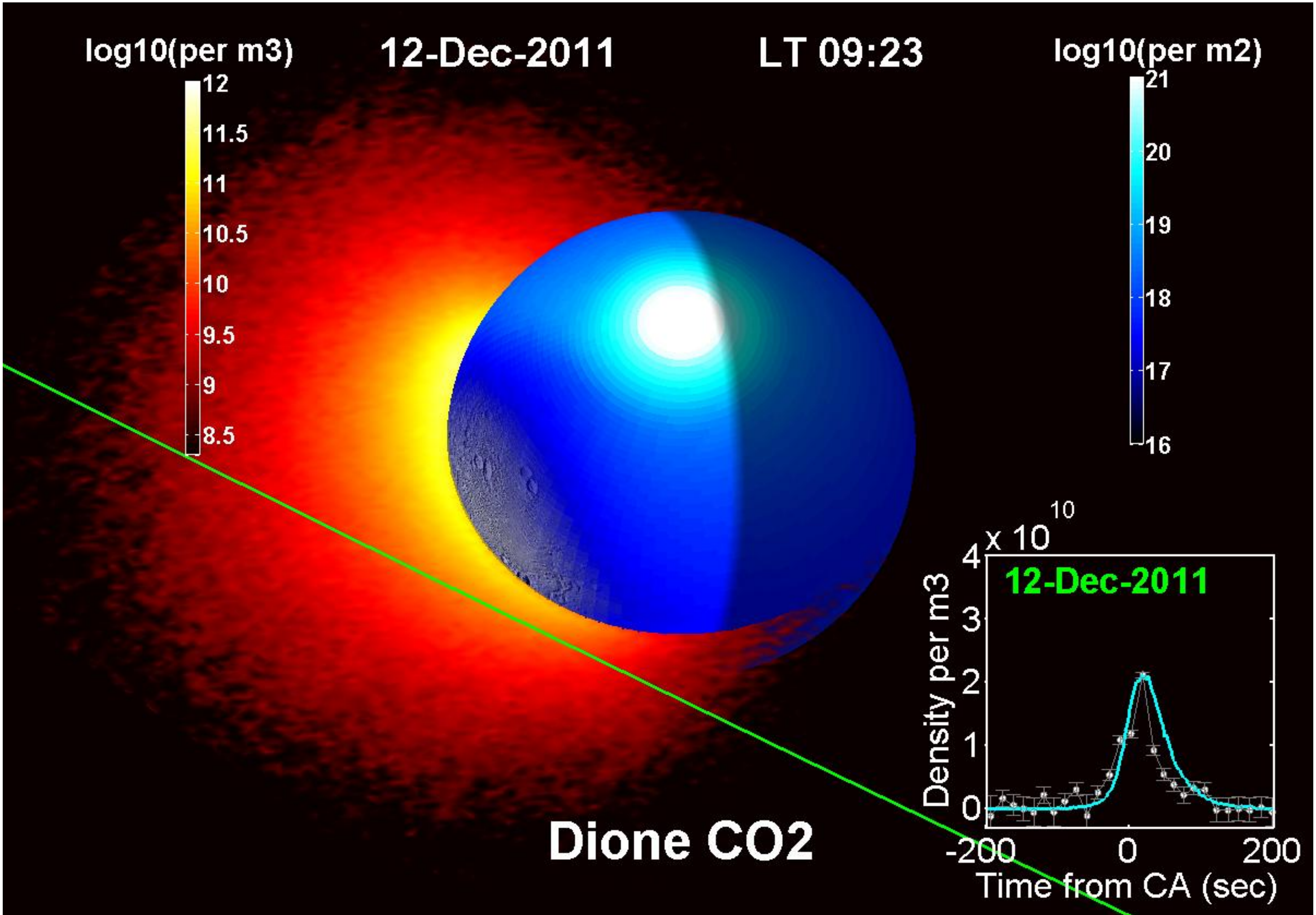
O_2 and CO_2 detected at Dione

- **Densities (~3 x 10^{10} m^{-3}) similar to Rhea northern encounter**
- **But much greater than Rhea southern encounter !!**

Possible to explain Dione & Rhea result with same physics ?

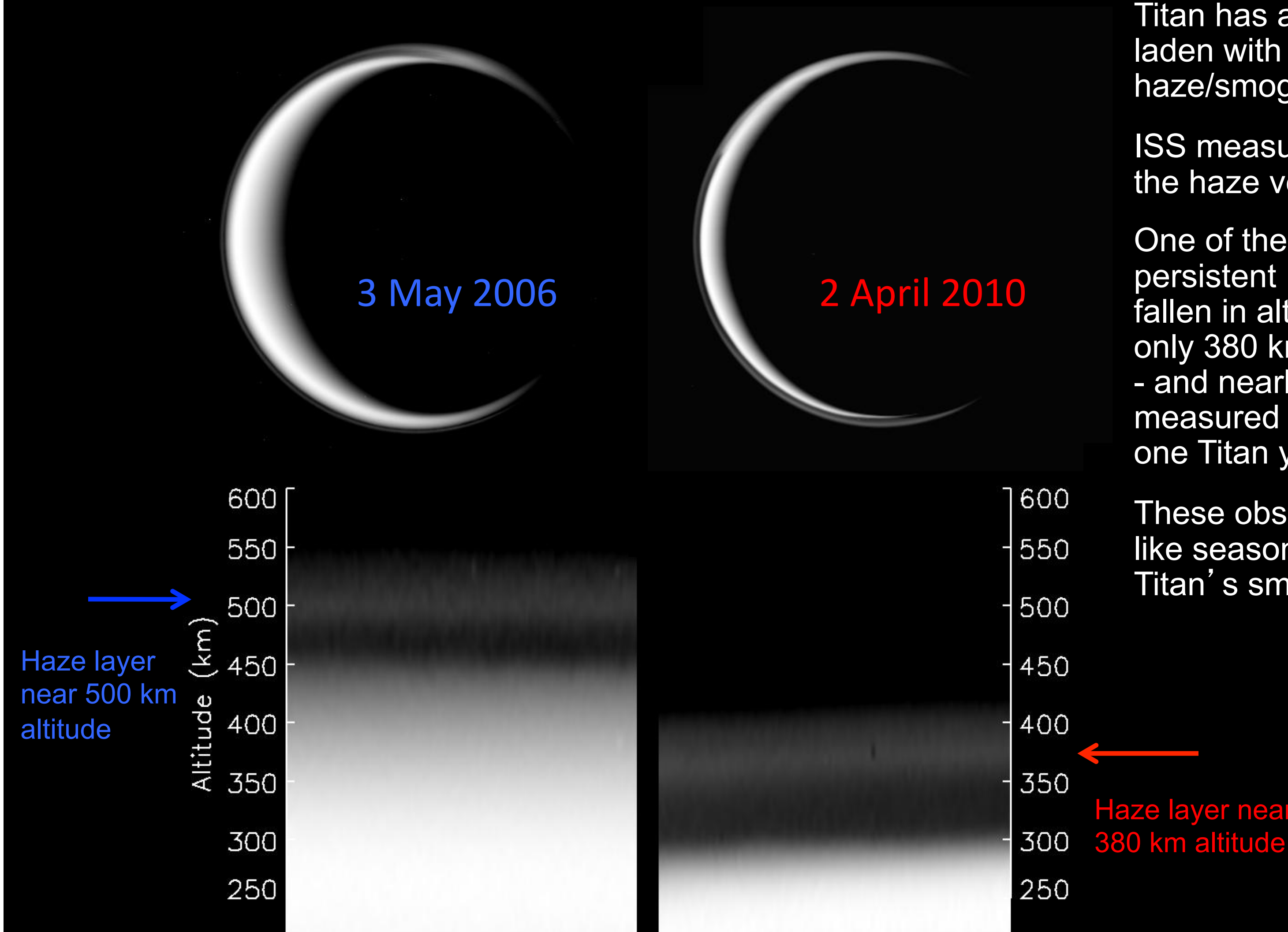






Flyby Simulation

Evolution of Titan's Stratospheric Haze



Titan has a massive atmosphere laden with layers of photochemical haze/smog.

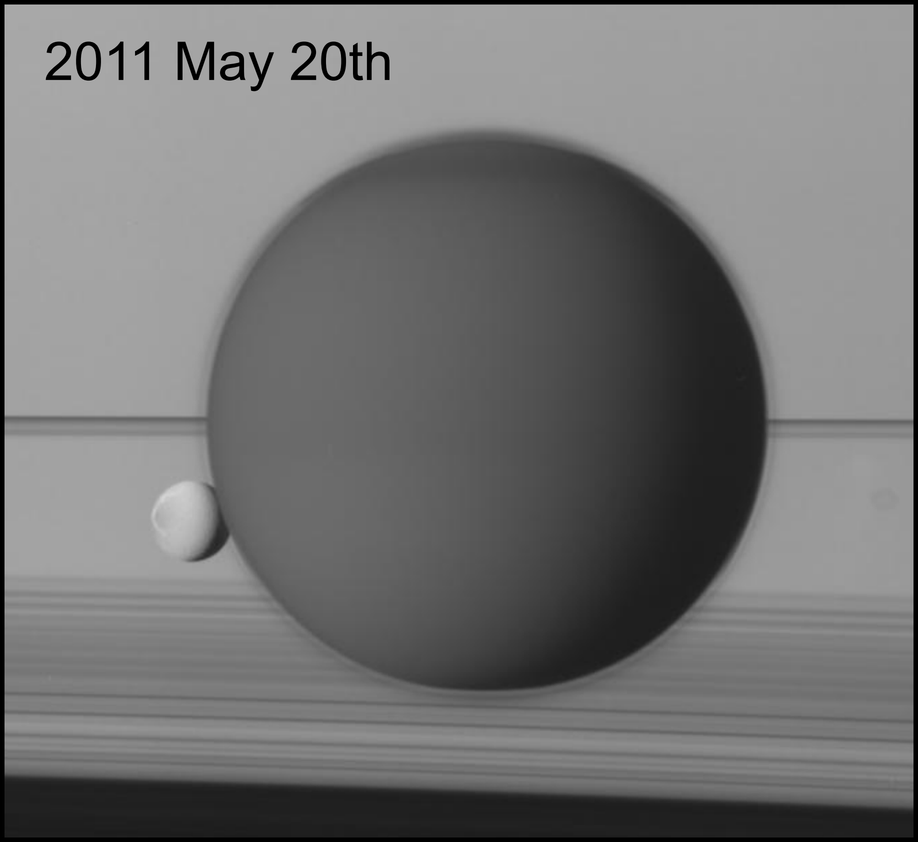
ISS measured a dramatic change in the haze vertical structure.

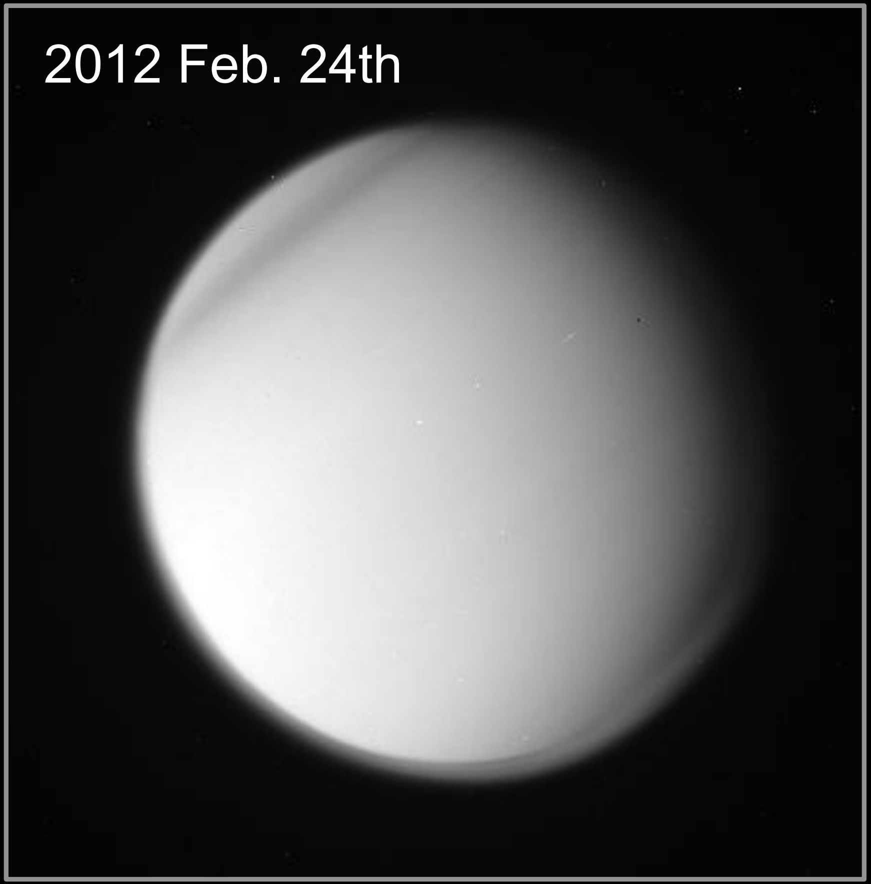
One of the atmospheric layers is a persistent 'detached' layer that has fallen in altitude from over 500 km to only 380 km between 2006 and 2010 - and nearly matches the Voyager measured altitude of 357 km taken one Titan year earlier, in 1981.

These observations indicate a clock-like seasonal cycle in the altitude of Titan's smog.

West et al., LPSC 2012

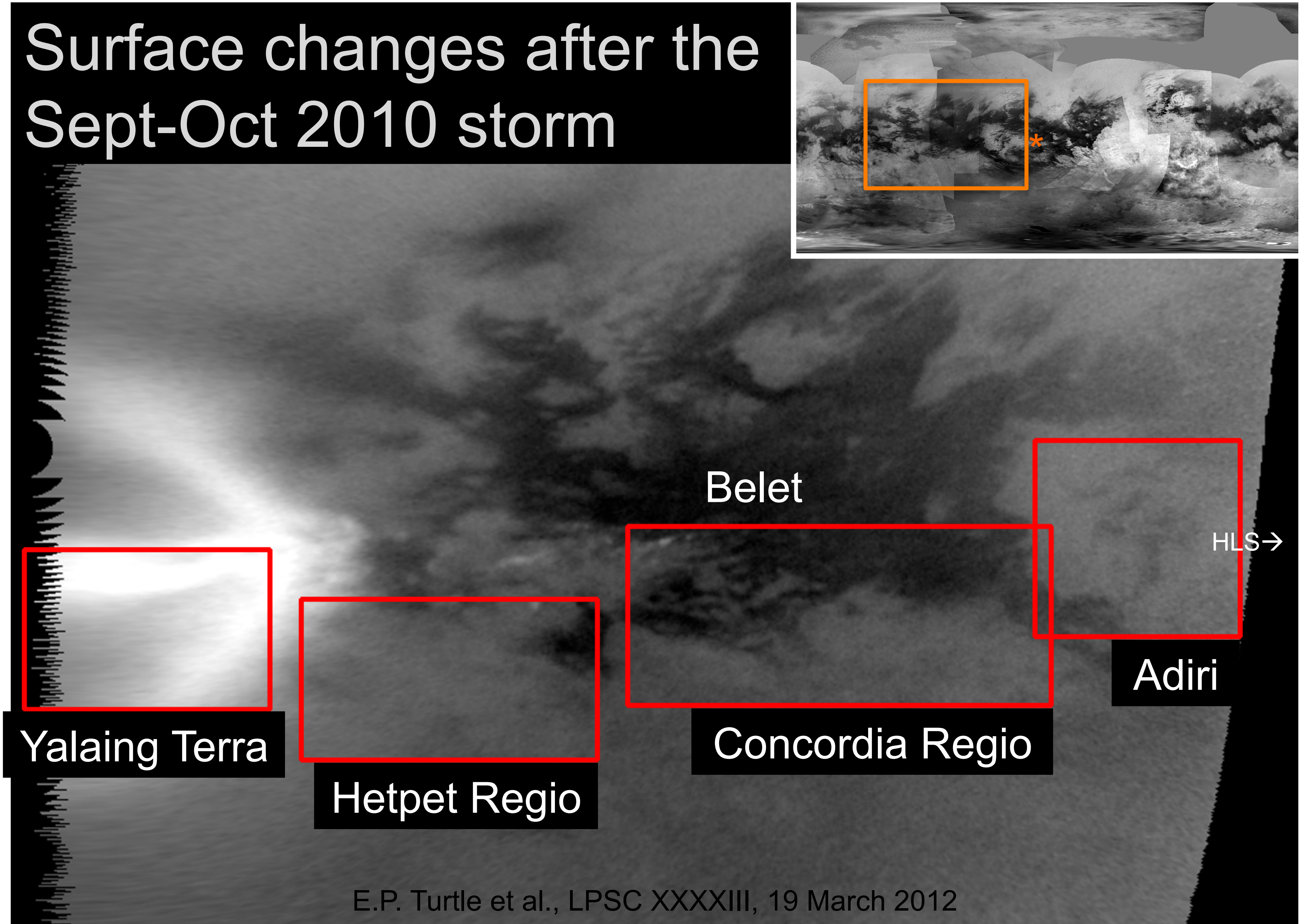
Haze to Polar Hoods in Both Hemispheres



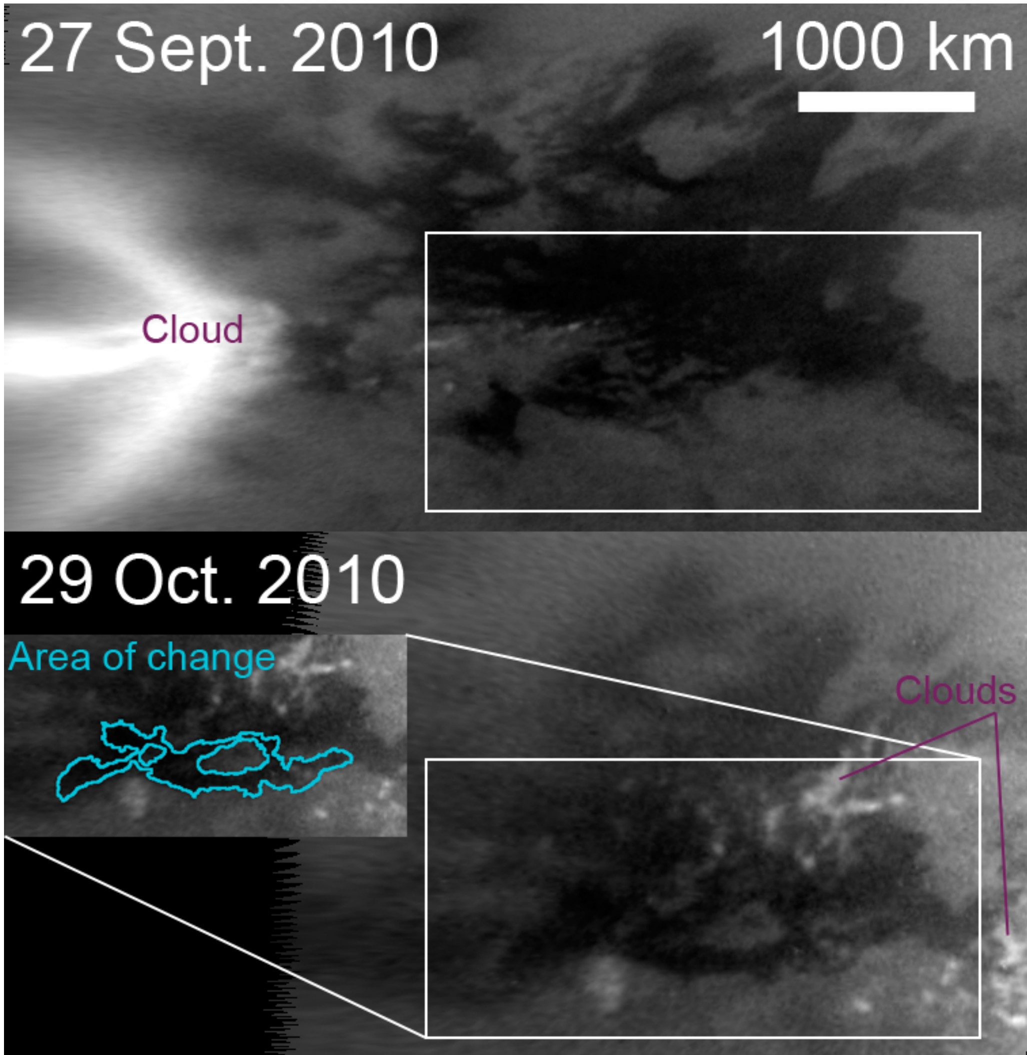


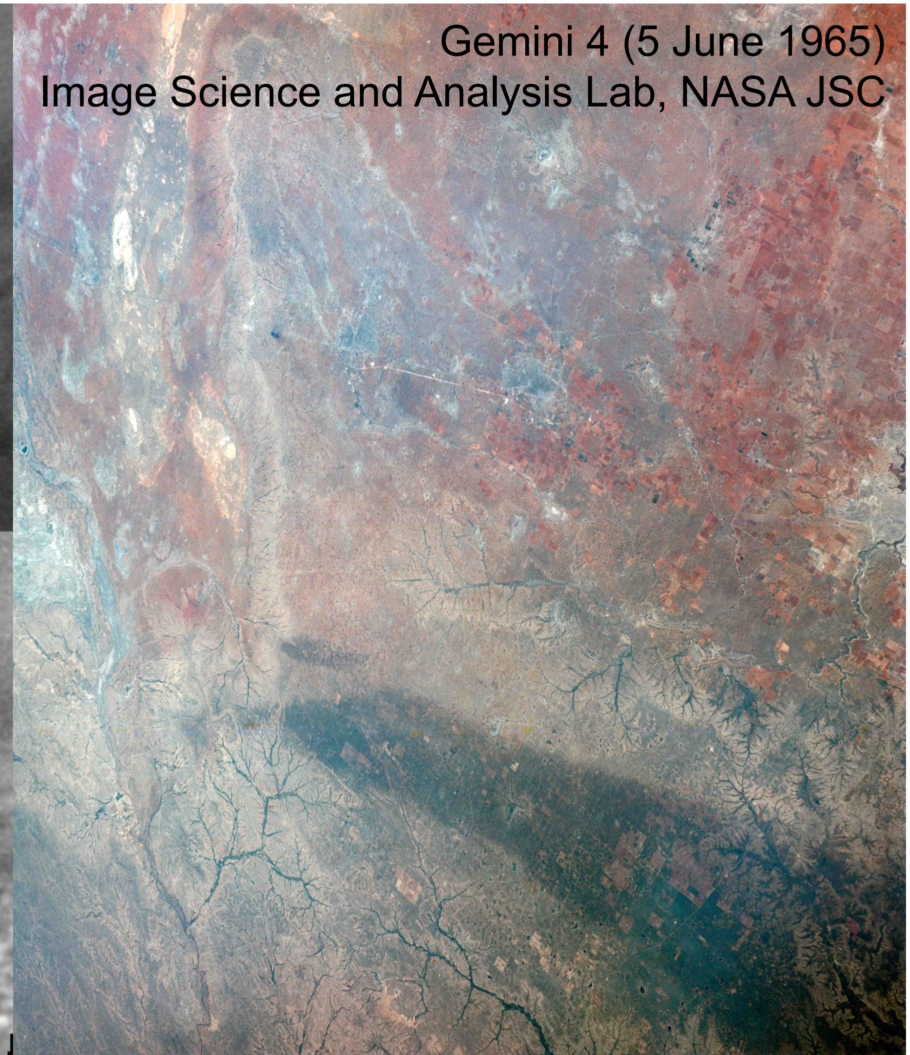
What happened to
the detached haze

Surface changes after the Sept-Oct 2010 storm



E.P. Turtle et al., LPSC XXXXIII, 19 March 2012

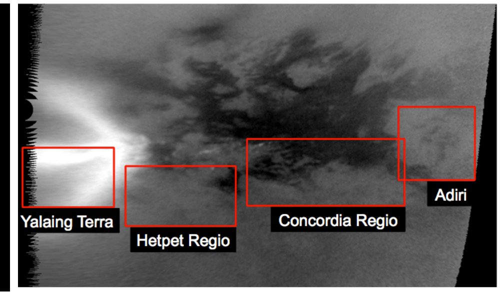


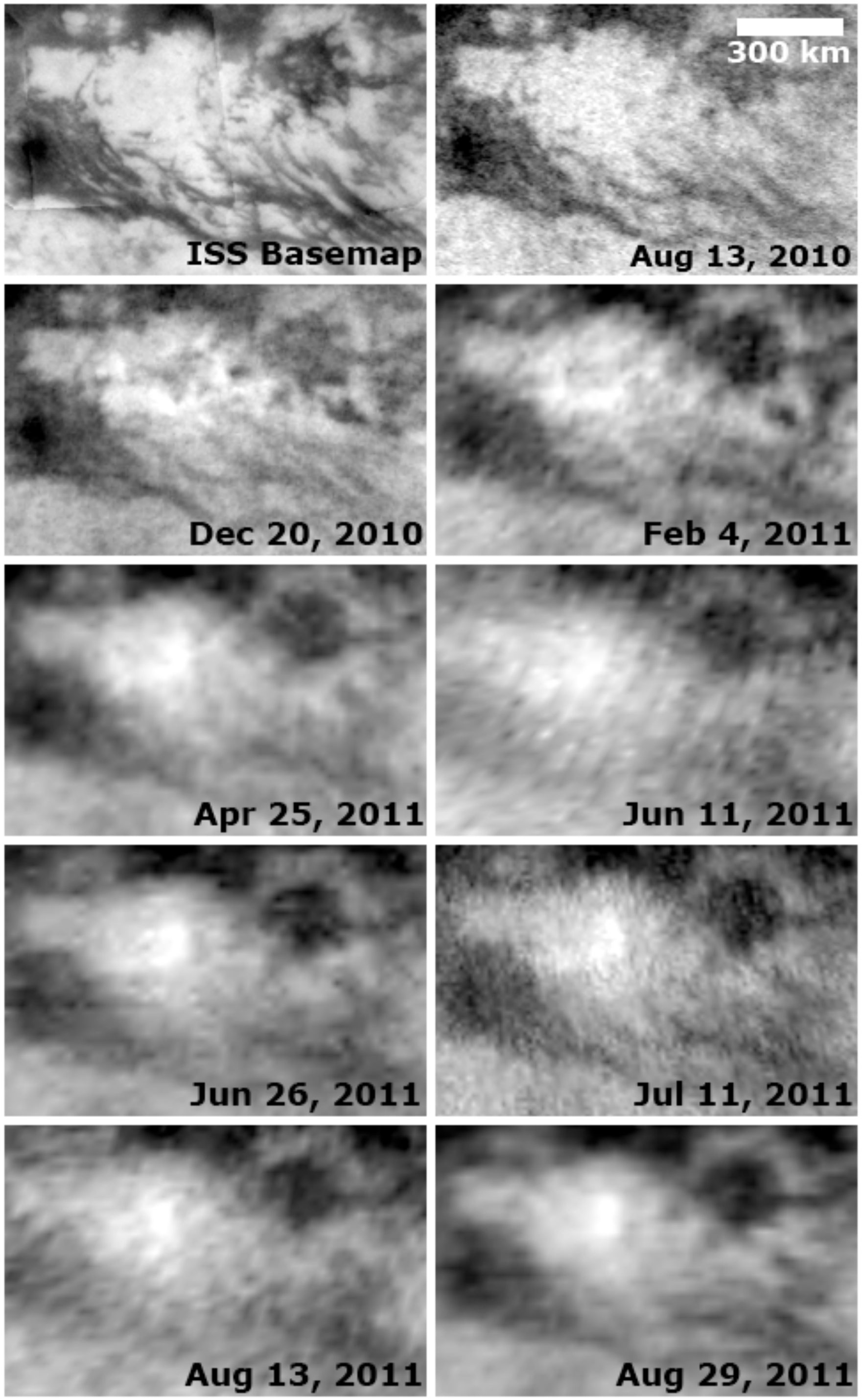


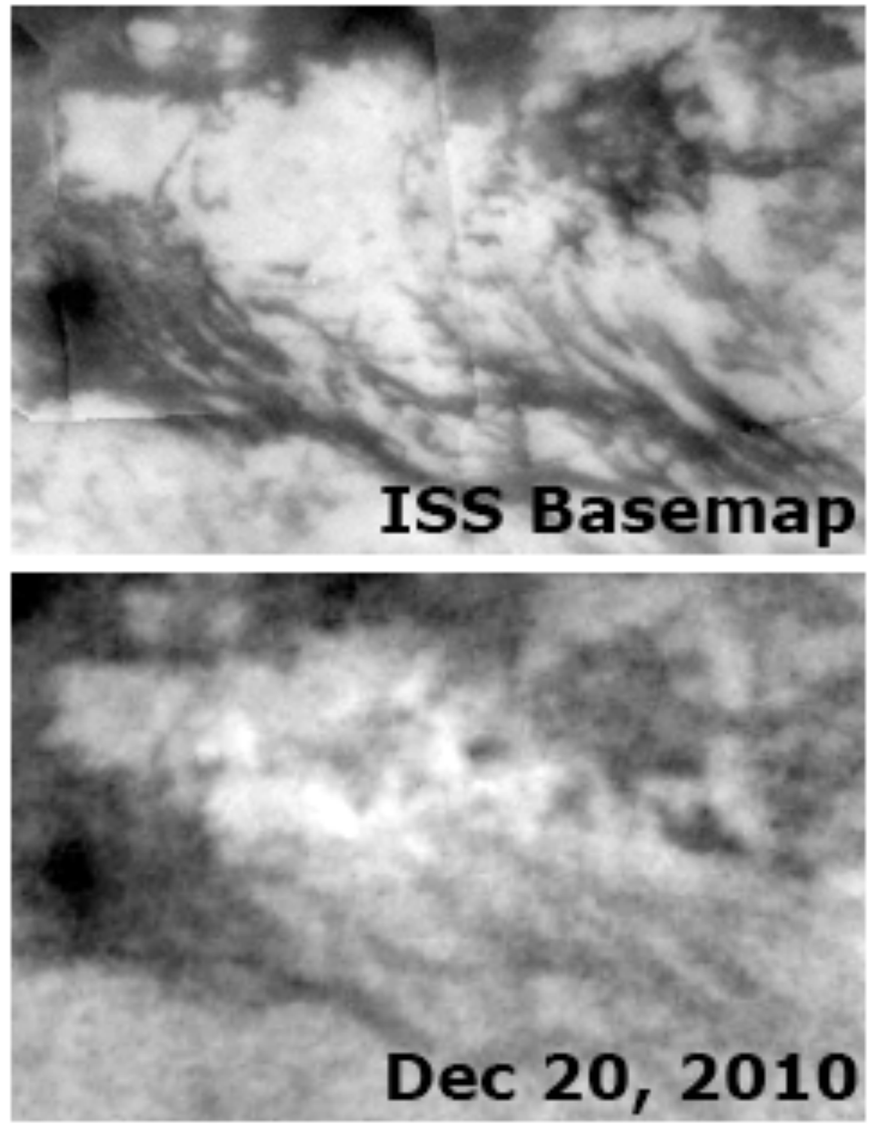
- darkened swath 2000 km long; 510,000 ± 20,000 km^2 = huge distance, short time
- brightening also observed in areas; changes revert over timescales of months to ~1 year
- aeolian transport, sustained free-stream wind ≥2.2 m/s unlikely (Turtle et al. 2011; Tokano 2010)
- precipitation causing surface wetting, possibly ponding, easiest way to cover area of this scale on such a short timescale

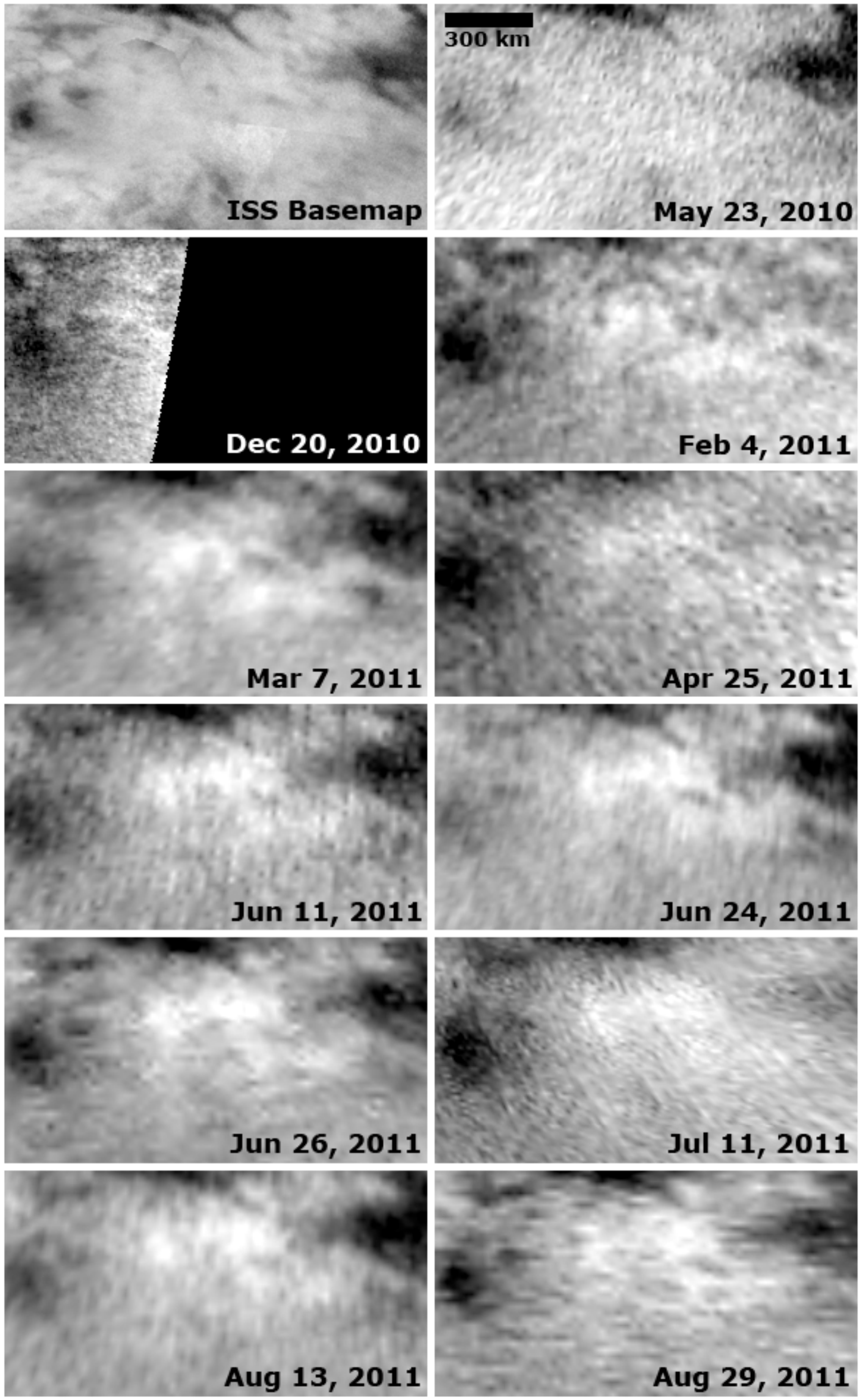
(Turtle et al., Science, 2011)

Yalaing Terra brightening

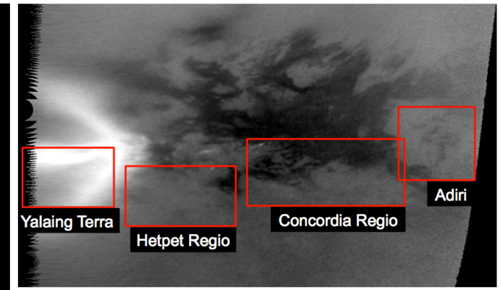


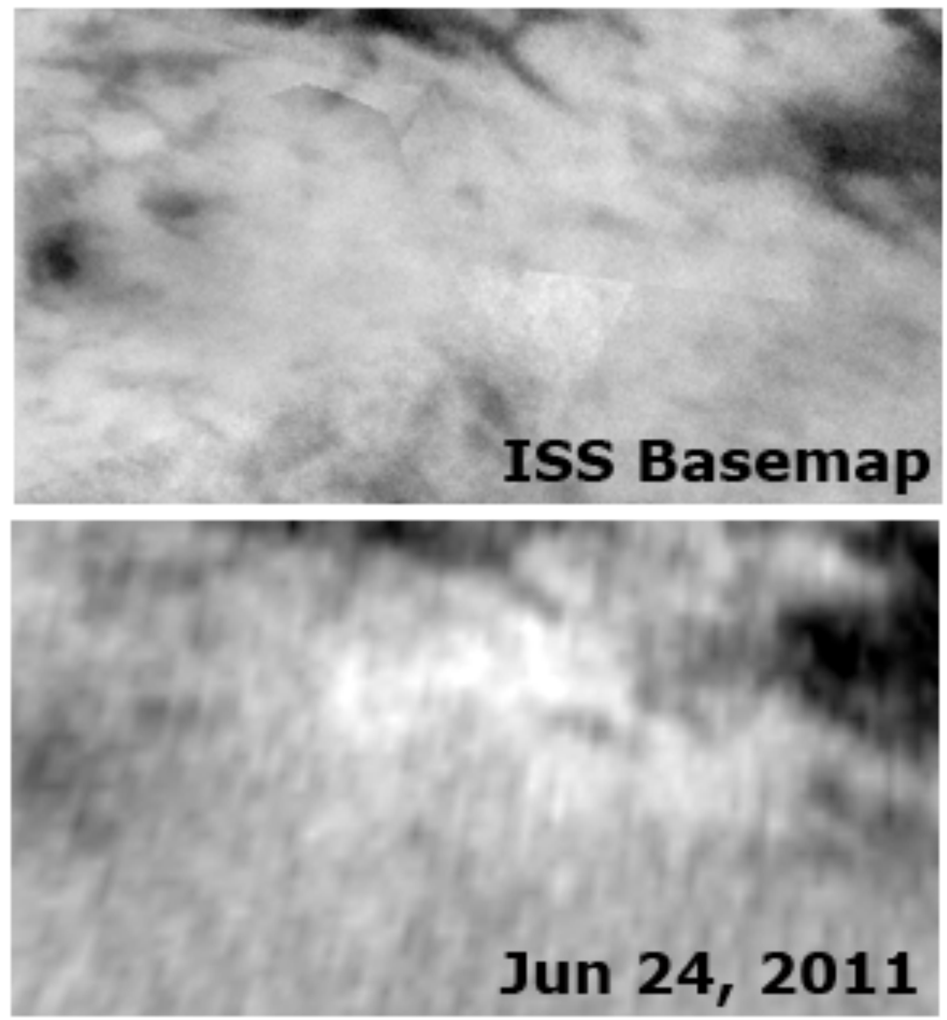




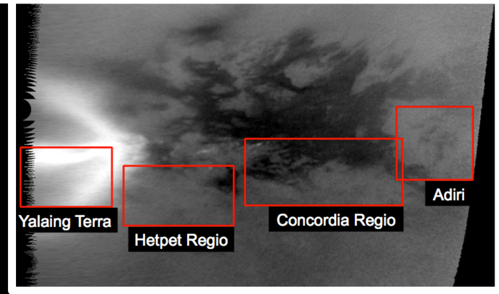


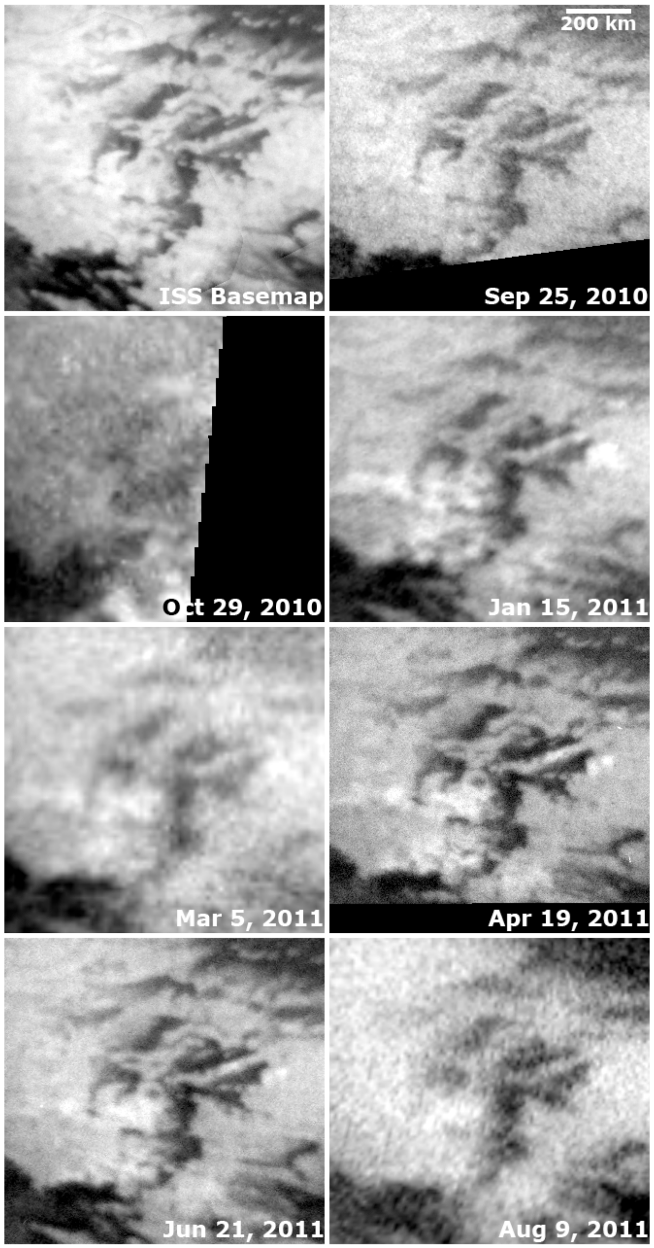
Hetpet Regio brightening





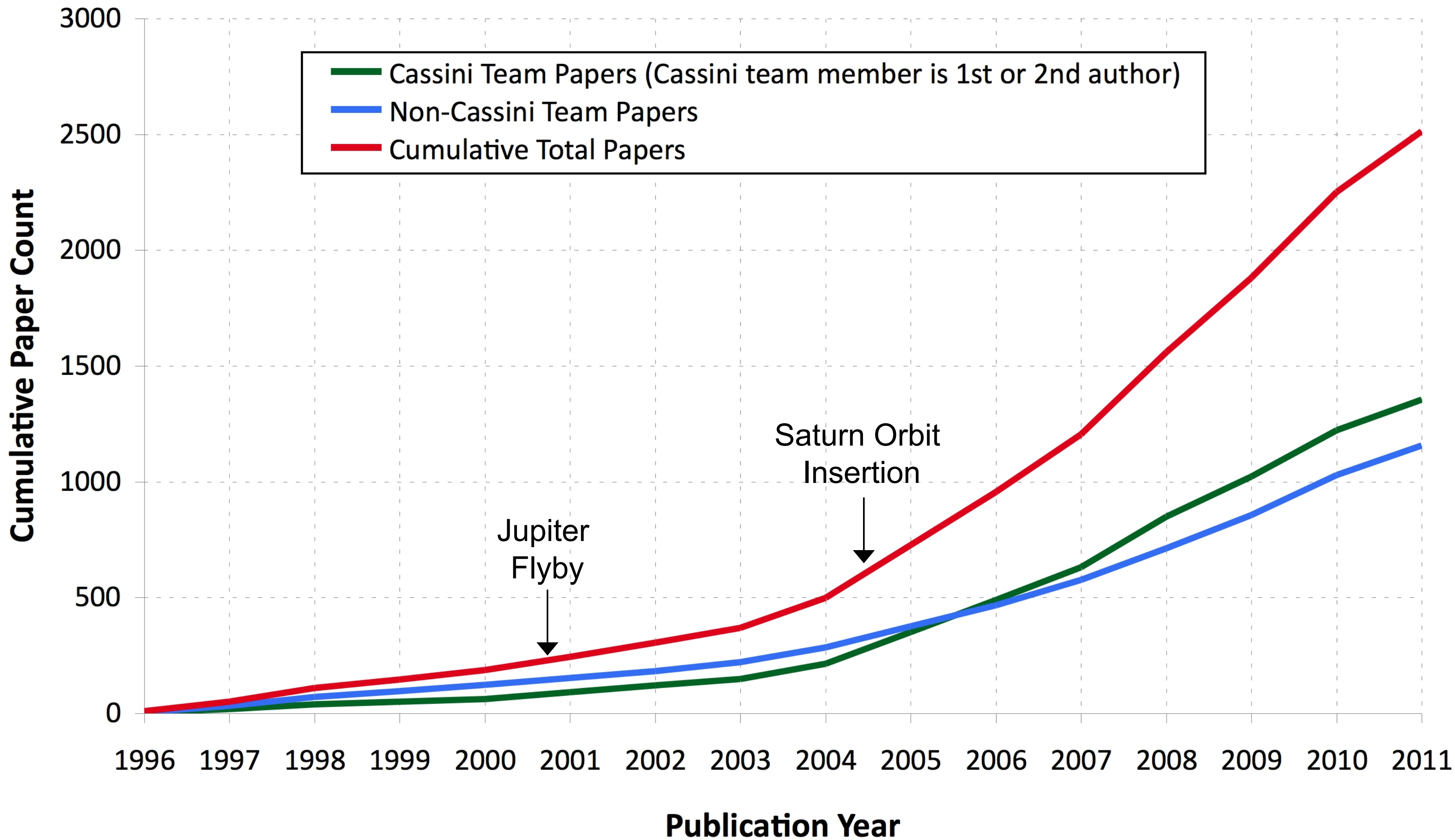
Implications of brightening





- Bright areas have persisted for longer than darkened areas, but also appear to be fading although not well constrained by observations.
- Persistence and consistent patterns in ISS observations and VIMS spectral information (Barnes et al. 2012) indicate surface features.
- If the result of cleaning by removal of hydrocarbon material precipitating out of atmosphere, rate of fading could provide constraints on rate of re-deposition of hydrocarbon materials by aeolian transport.
- Deposition and subsequent melting/sublimation of volatile hydrocarbon (Barnes et al. 2012)?

Cassini Peer-Reviewed Publications



Consolidated Senior Review Process

- Planetary Science Division (PSD) directed to hold a single Consolidated Senior review
  - Senior review every 2 years to provide best balanced science for scarce funding available
- Science merits and performance for 6 extended missions will be evaluated this cycle
  - Cassini, LRO, MER, MEX, MRO, Mars Odyssey concepts
- 35-page proposal to address FY13 - FY14 extended mission
  - Two options: baseline and 85% option
- Final guidelines released January 31st
- Proposals due to NASA HQ May 30th

Schedule

• Final Guidelines Released	January 31, 2012
• Final Proposal Due	May 30, 2012
• Questions from Panel to Project Offices	Mid-June
• Face to Face visit/oral presentation	Late June
• Senior Review Report submitted to PSD	Mid-July
• PSD Notification to Project Offices	FY13 start – 2 months

Senior Review Proposal Content: 35 pages

- *Each mission must complete two scenarios and include a traceability matrix for each, as well as a relevant budget in a PPBE format*

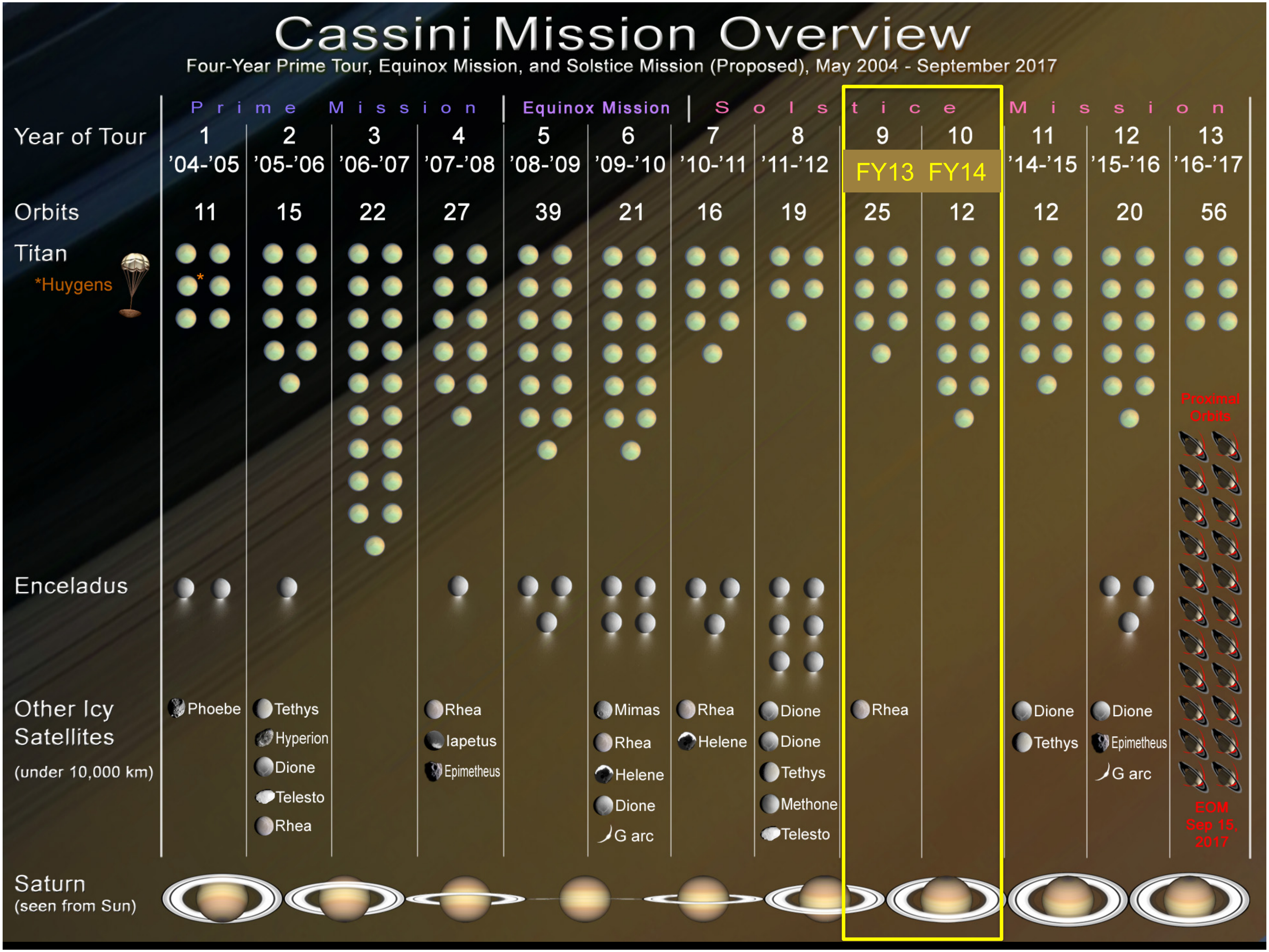
- Executive Summary
- Current Mission Objectives and Historical Accomplishments
- Current Performance Status of the Mission and Mission's Instruments
- Proposed Extended Mission Objectives
- Programmatic Objectives
- Technical Plan to Meet Objectives
- Management Plan
- Traceability Matrix (science goals, objectives, associated measurement, relevant instruments, mission constraints)
- Guideline budget
- 85% budget
- Summary
- Acronym List (Not in page count)
- Appendices (Not in page count)

Cassini Budget Allocations

Cassini Budget Numbers

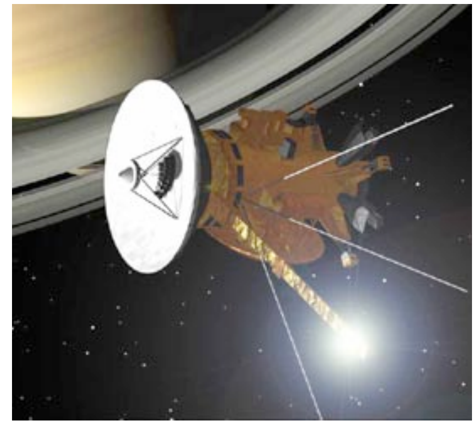
	Prime	Equinox		Solstice			
	FY08	FY09	FY10	FY11	FY12	FY13	FY14
2009 SR:	$80.2M	$79.5M	$80.5M	$65.8M	$60.3M	$61.0M	$62.8M
Baseline Allocation:						$59.65M	$59.0M
85% Allocation:						$50.7M	$50.15M

- SR Allocations represent decreases (FY13: $1.35M, FY14: $2.8M) from 2009 Senior review numbers
- The Cassini Solstice Mission encompasses more than FY13 and FY14, it runs through FY17
  - Cuts in funding in FY13 and FY14 will adversely ripple through the remainder of the mission



Cassini Mission Overview
Four-Year Prime Tour, Equinox Mission, and Solstice Mission (Proposed), May 2004 - September 2017
Prime Mission
Equinox Mission
Solstice Mission
Year of Tour
1 '04-'05
2 '05-'06
3 '06-'07
4 '07-'08
5 '08-'09
6 '09-'10
7 '10-'11
8 '11-'12
9 FY13
10 FY14
11 '14-'15
12 '15-'16
13 '16-'17
Orbits
11 15 22 27 39 21 16 19 25 12 12 20 56
Titan
*Huygens
Proximal Orbits
Enceladus
Other Icy Satellites (under 10,000 km)
Phoebe
Tethys
Hyperion
Dione
Telesto
Rhea
Rhea
Iapetus
Epimetheus
Mimas
Rhea
Helene
Dione
G arc
Rhea
Helene
Dione
Dione
Tethys
Methone
Telesto
Rhea
Dione
Tethys
Dione
Epimetheus
G arc
EOM Sep 15, 2017
Saturn (seen from Sun)

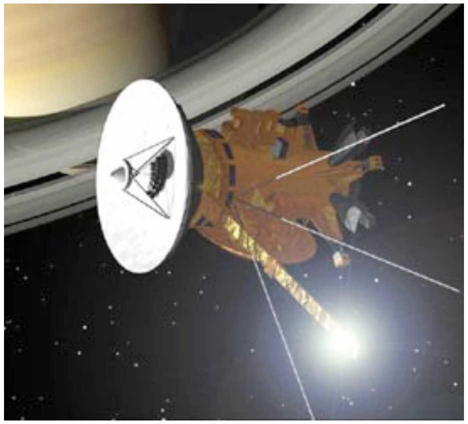
Baseline Allocation



- Cassini will be the only outer planet Flagship mission flying and collecting data through the mid- to late- portion of this decade

- Continued funding of Cassini will:
  - maintain the current scientifically rich tour
  - continue training of next generation of planetary scientists
  - continue healthy international collaboration, and
  - return multidisciplinary, synergistic science data as only a Flagship can do

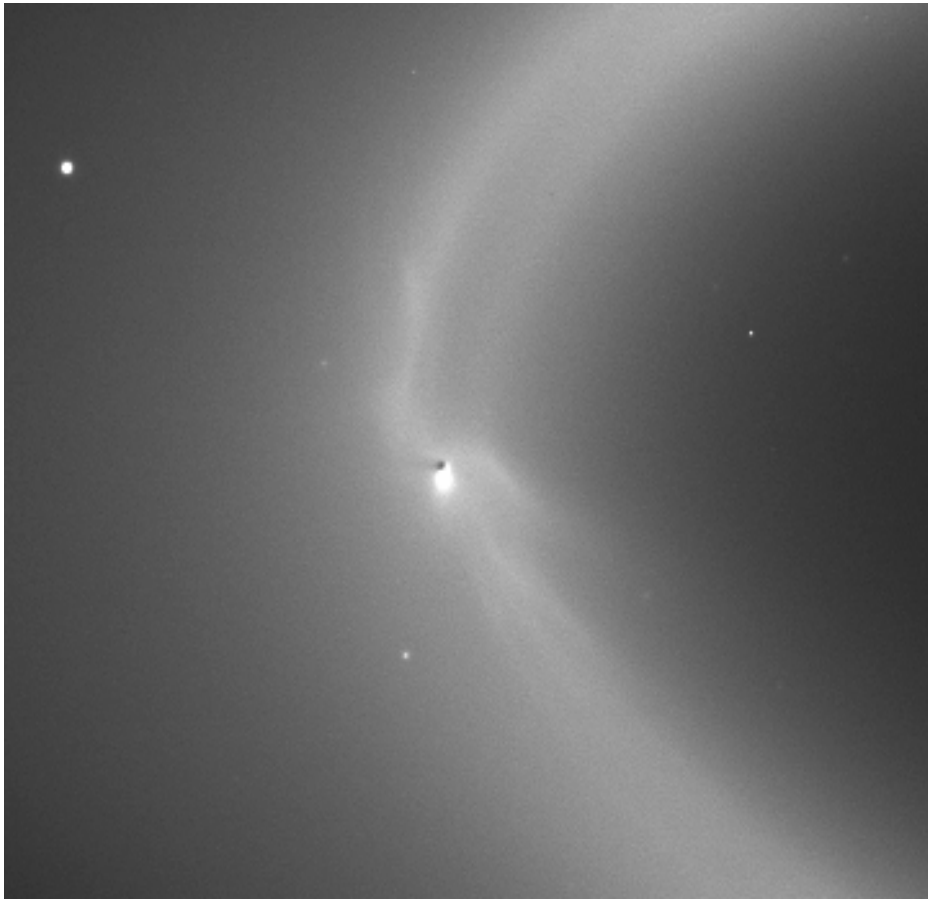
Effects of 85% Allocation



- 85% allocation will result primarily in loss of jobs
  - Cassini spacecraft is built and launched, no major hardware purchases remain
  - Cassini is in orbit at Saturn, 7-year cruise is complete
- Loss of personnel would result in science loss and increased science risk in FY13-14
  - Loss of operationally complex Ka-band science: Would reduce RSS operations and analysis costs
  - Fewer people to implement science observations resulting in fewer and less complex science observations
  - Slower response to instrument anomalies, would be best efforts basis
  - Reduced calibration support, less well validated data to PDS
  - Slower response time to new discoveries, additional opportunities might be missed
  - *Severely impact funding, educating and mentoring of the next generation of planetary scientists (team associates and postdocs)*

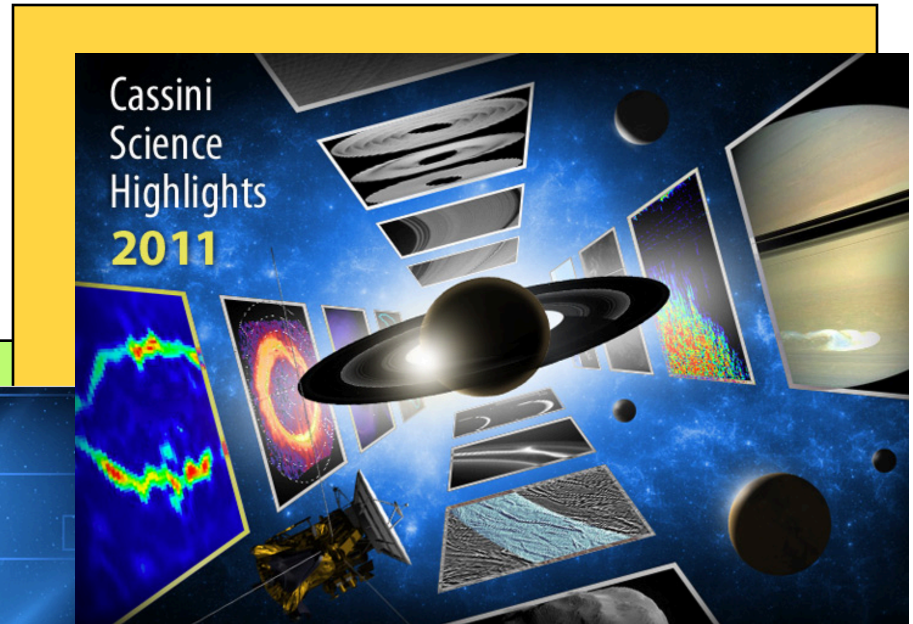
Cassini Solstice Science

- Cassini Solstice Mission enables unprecedented opportunities for unique, groundbreaking science
- Unique, compelling Juno-like end of mission science
- Direct relevance to the Planetary Decadal Survey and NASA's exploration program
- New Participating Scientist program actively involves broader science community



Best of 2011

http://saturn.jpl.nasa.gov/news/cassinifeatures/feature20120110/



Best of …

2011!

http://saturn.jpl.nasa.gov/news/cassinifeatures/feature20111223/

END

Cassini Plasma Spectrometer (CAPS) Status

- CAPS powered off since June 2011 as a result of a high rail to chassis short
- Extensive review conducted by NASA Engineering and Safety Center (NESC) team in conjunction with JPL, Cassini and CAPS teams
  - Growth of tin whiskers most likely scenario for short
  - Condition understood and not expected to cause any problems for spacecraft or CAPS instrument
- Powered back on March 16, 2012 based on unanimous agreement by review board
  - High rail to chassis short not present
- On March 20th, high rail to chassis short in CAPS instrument returned, generating same conditions as previous short
  - Based on NESC review, CAPS instrument left powered on
- CAPS successfully acquired data for 75 kilometer Enceladus flyby on March 27th and for subsequent close Enceladus flyby in early April

2009 Senior Review Comments on Proposed 7-year Solstice Mission

- **The Cassini Solstice mission**
  - **robustly responds to the Decadal Survey and NASA's strategic objectives.**
  - **is essentially a new mission in its own right.**
  - **promises continued unexpected discoveries that will engage the general public.**
  - **will directly benefit preparations for any future mission to the Saturn system.**
  - **presents a unique opportunity to train the next generation of scientists, engineers, and operations personnel.**
  - **presents an opportunity to execute a "follow on" mission to respond to the findings and discoveries of its progenitor mission**.
    - Typically years to decades elapse before such a follow on mission can be executed, but the Solstice mission allows NASA to mount such an effort now in a very cost-effective way.

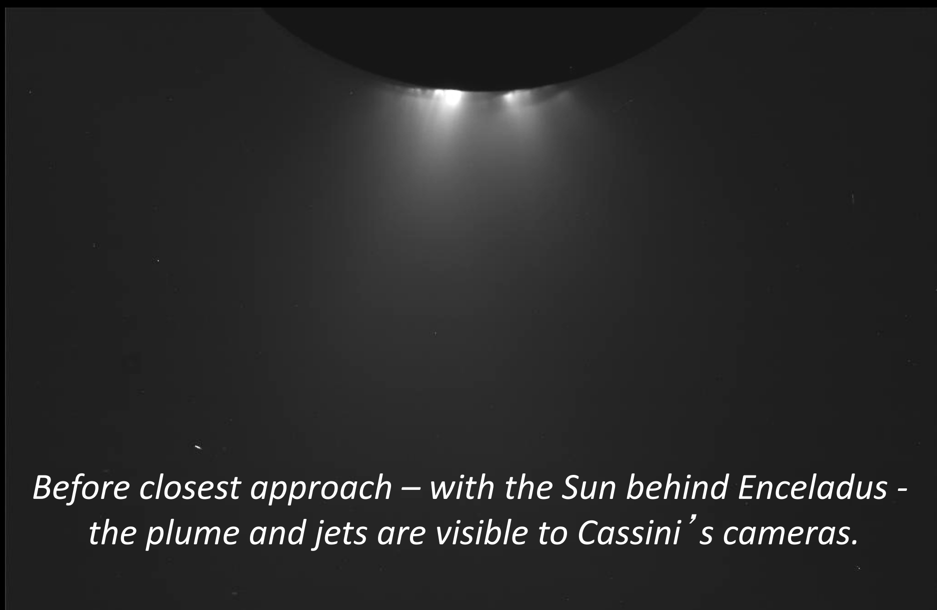
2009 Senior Review Budget Recommendation

- *Recommendation #1: Accept the proposed Solstice Mission at a budget level of 60% for the engineering team and 75% for the science team*
- **This level of funding is considered the minimum to safely operate the spacecraft and a 75% budget for the science portion of operations.**
- **The Cassini team studied a 50% option and found that 50% of the Equinox mission funding was insufficient to support a mission of any significant science value. The review board agreed.**
- Specifically, the funding level for science enables the Cassini team to:
  - **execute an excellent and innovative mission plan that takes sufficient advantage of a productive, unique, and healthy asset to pursue both the discoveries Cassini has already made and those yet to be made**;
  - **fund a more adequate level of timely science analysis necessary to support operations and continue the science productivity of the team** (albeit at a lower level than during the prime and Equinox missions);
  - **retain early career scientists who would be disproportionately lost from the Cassini mission**, precluding using the Solstice mission as a continuing opportunity to train the next generation of scientists;

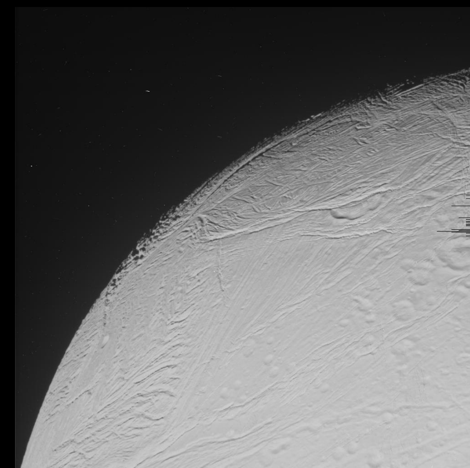
More 2009 Senior Review Board Comments

- **The selected tour is impressive and effectively balances the multitude of requirements, desires, and restrictions for the Solstice mission.**
- **The science value of the Solstice mission is very high.**
    - **Juno-like end of mission scenario is extremely compelling**
    - **All disciplines cited for high science value**
        - One example: **For the Titan discipline, the Solstice Mission can be considered a "stand-alone" mission** because it provides the opportunity to witness hydrological and atmospheric process in action on Titan, as the changing seasons force surficial, fluvial, and atmospheric changes on hemispheric scales.

Diving Deep
through the Enceladus plume



Before closest approach – with the Sun behind Enceladus - the plume and jets are visible to Cassini's cameras.



Outbound, the bright surface of Enceladus is illuminated, and surface features are revealed.

• On 27 March 2012, the Cassini spacecraft made its closest-ever passage through the south-polar plume of Saturn's moon Enceladus
• Cassini passed just 74 km above the south pole on this "E17" flyby
• During the flyby, the composition and density of the plume gases and icy particles were measured by Cassini's suite of instruments
• The trajectory was carefully designed in coordination with the E14 (1 Oct 2011, 99 km alt) and E18 (14 April 2012, 74 km alt) trajectories, to allow for extensive mapping of the plume by the fields and particles instruments

Relative Mission Costs: Value of Solstice Mission

- Cassini Solstice Mission baseline cost approved by 2009 Senior review board
  - **FY13 – FY17 baseline cost from previous Senior Review: ~$320 M**

- **Remaining Cassini Solstice mission at $320 M is a worthwhile investment!**
  - Provides a Saturn orbiter mission with novel seasonal configuration
  - Provides a Juno-like mission with multiple highly inclined orbits at very close range to Saturn

- Challenges of returning to the Saturn system with a new spacecraft
  - Distant destination with long flight times
  - Saturn has a long "year"—northern spring-to-summer progression will not repeat for another 30 years!
  - Solstice Goals:
    - Observe seasonal and temporal change in the Saturn system to understand (1) hemispherically asymmetric behavior on Titan, (2) Role of sunlight in Enceladus plume activity, (3) Origin of surprising asymmetry in Saturnian polar circulation
    - Complete the goal of long-baseline observations revealing phenomena not discernable with short baselines/limited data sets.

Decadal Survey Statements

- **Fund currently flying missions**
  - **Ensure a level of funding that is adequate for successful operation, analysis of data, and publication of the results of these missions, and for extended missions that afford rich new science return.** (p. S-4)

- **Cassini is a superb example of international collaboration**
  - The joint NASA-ESA Cassini-Huygens mission to explore the saturnian system is a superb example of international cooperation of this scale (Flagship missions). (p. 2-12)

Cassini Achievements mapped to Decadal Survey

- **Cassini discoveries make up ¼ (3 of 12) of those highlighted**.
  - An active meteorological cycle involving liquid methane on Titan.
  - Geothermal and plume activity at the south pole of Enceladus.
  - Dramatic changes in the atmospheres and rings of the giant planets and the discovery of rapid changes in their ring systems. (p. 1-9. RECENT ACHIEVEMENTS IN PLANETARY SCIENCE)

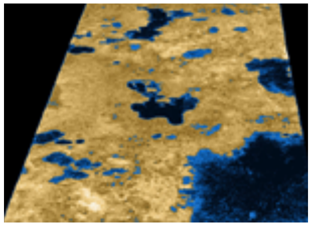
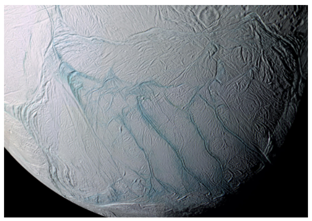
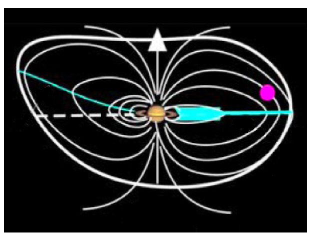
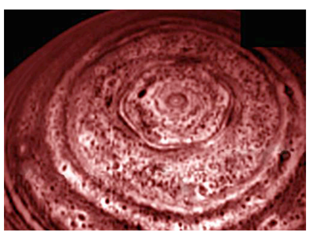
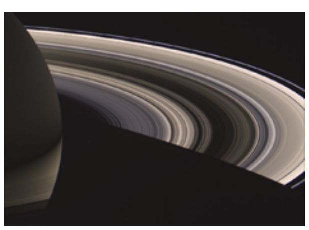
- **The science return from the Cassini mission has been phenomenal**. (p. 8-10)

Decadal Survey: Important Science Return from Cassini

- **Continuation of Cassini is cost-effective**
  - The planned continuation of the Cassini mission through 2017 is the **most cost-effective and highest priority way to advance our understanding of planetary satellites in the near-term**. (p. 8-37 (top bullet of Summary of SATELLITES chapter)

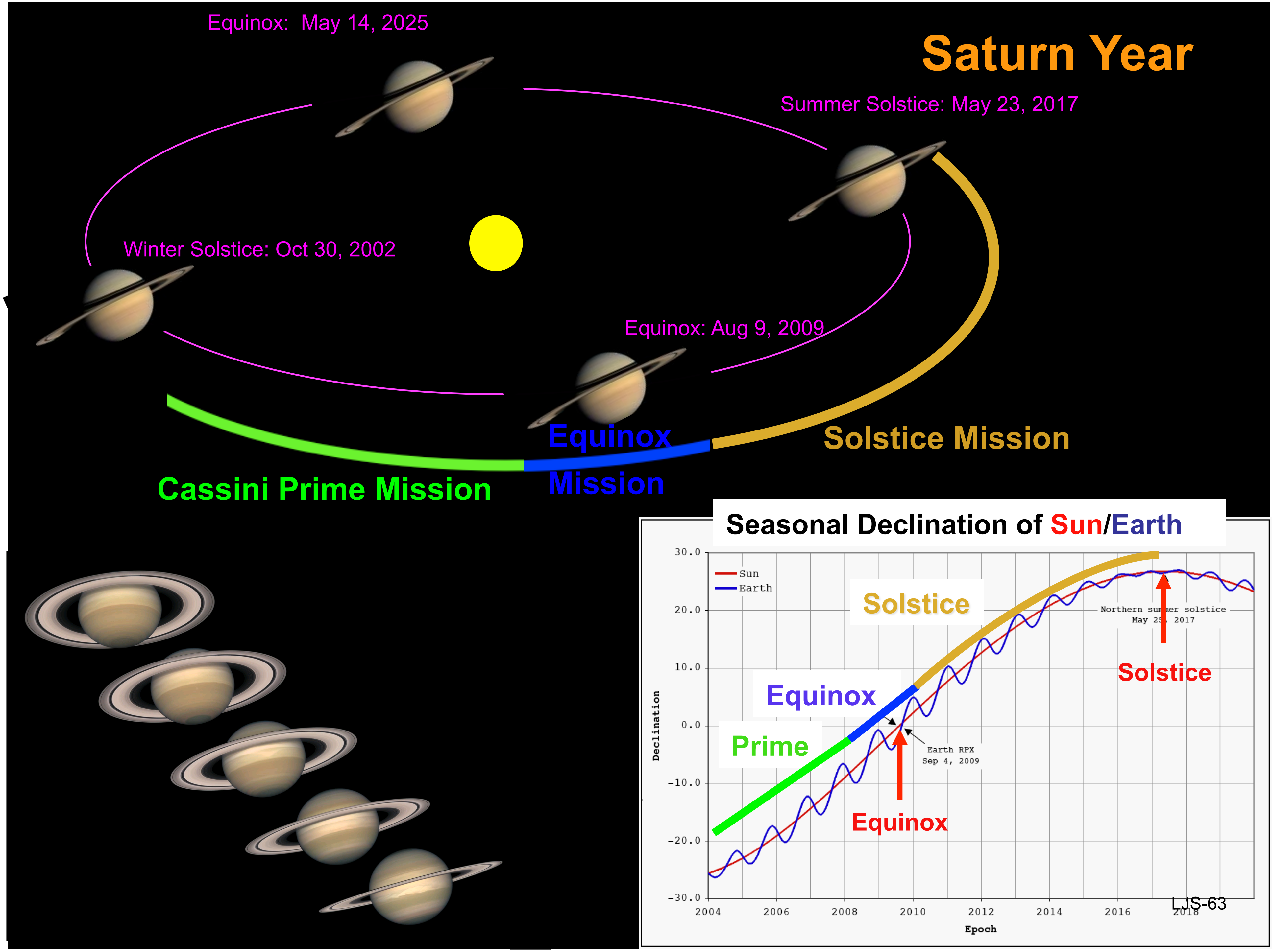
- **Titan, one of the most important objectives for planetary science**
  - Continued exploration of this fascinating Earth-like atmosphere, both from orbit and in situ, **remains one of the most important objectives for planetary science**. (p. 3-14 (chapter entitled PRIORITY QUESTIONS IN PLANETARY SCIENCE FOR THE NEXT DECADE))

Cassini's Science Structure: 5 Science Disciplines

- Cassini's science structure
  - 12 Instrument Teams (2 European PIs)
  - 9 Interdisciplinary Scientists (3 Europeans)
  - 5 Disciplines (Saturn, Rings, Titan, Icy Satellites, Magnetospheres and Plasma Science)
  - 270 Scientists (associates and postdocs not included)
  - ~Half are European scientists
- ~2100 science publications in peer-reviewed journals as of October 2011

Each discipline is like a mission in its own right!


Saturn Year
Equinox: May 14, 2025
Summer Solstice: May 23, 2017
Winter Solstice: Oct 30, 2002
Equinox: Aug 9, 2009
Equinox Mission
Solstice Mission
Cassini Prime Mission
Seasonal Declination of Sun/Earth
Sun
Earth
Solstice
Equinox
Prime
Earth RPX
Sep 4, 2009
Equinox
Solstice
Declination
Epoch
30.0
20.0
10.0
0.0
-10.0
-20.0
-30.0
2004
2006
2008
2010
2012
2014
2016
2018
LJS-63