

# Titan révélé par l'instrument Radar de Cassini-Huygens

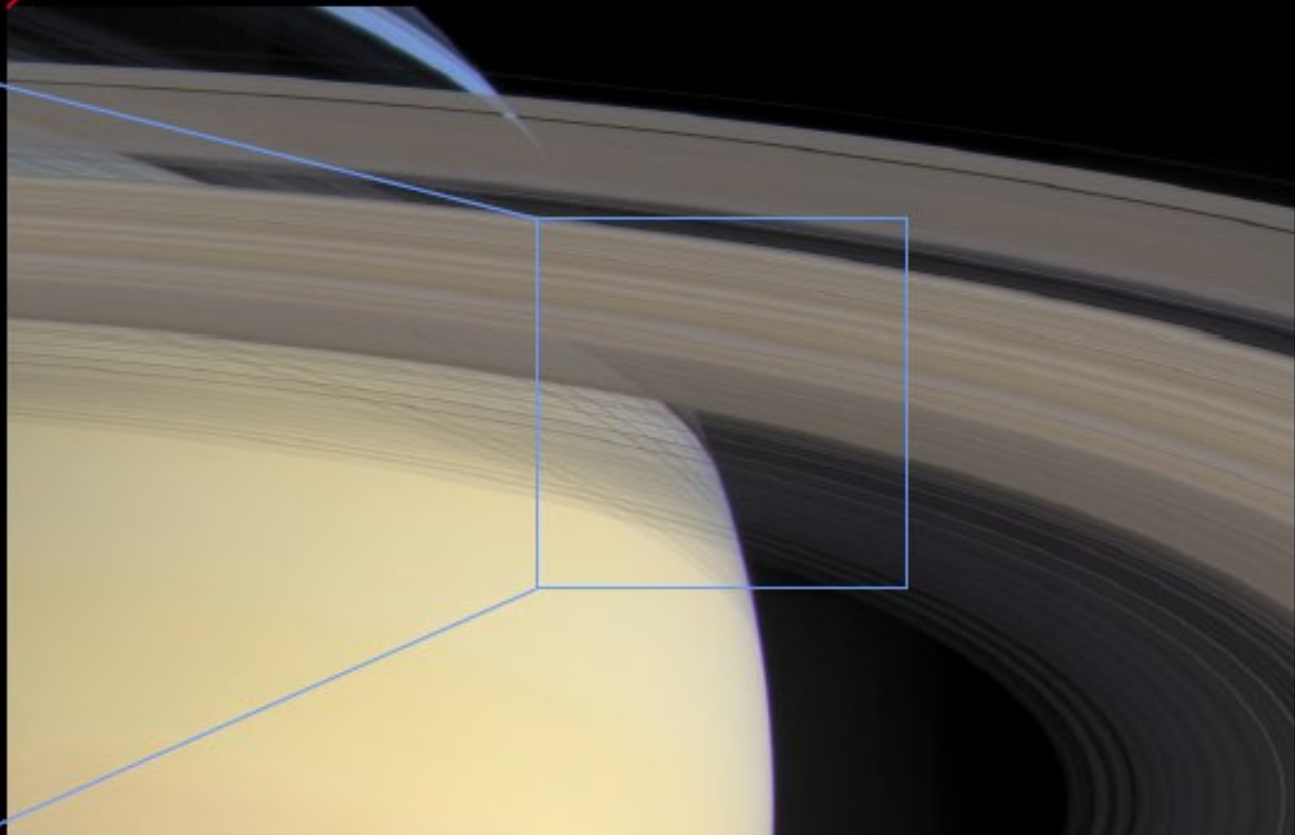
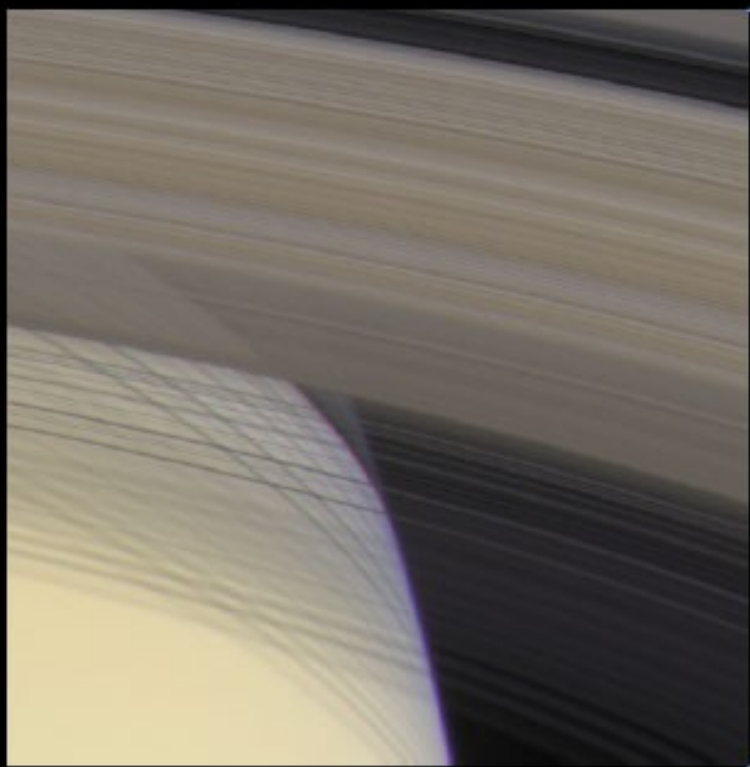


**Philippe PAILLOU**  
**OASU/ LAB**

Observatoire aquitain

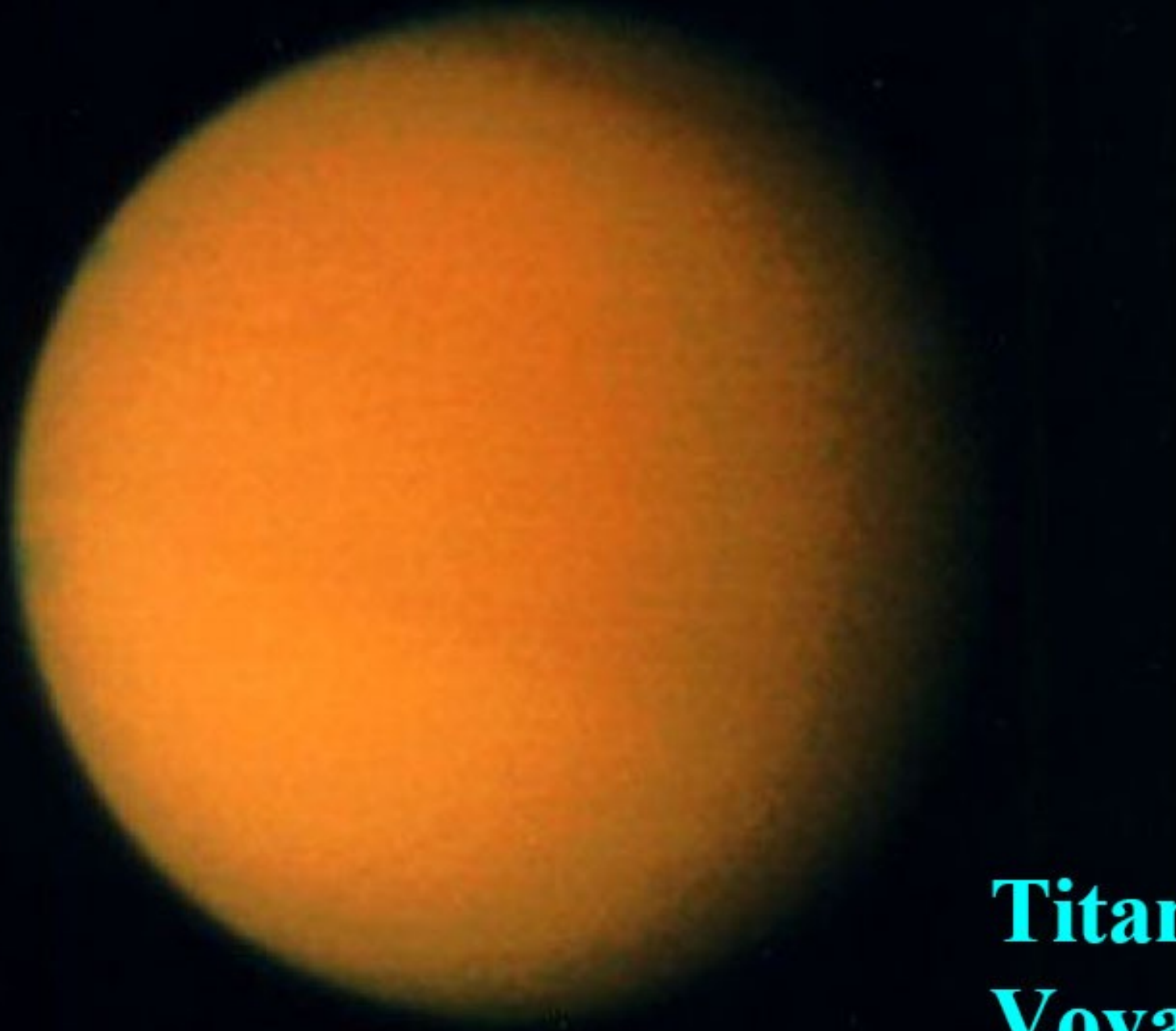


des sciences de l'univers





Survol Encelade (février 2005)

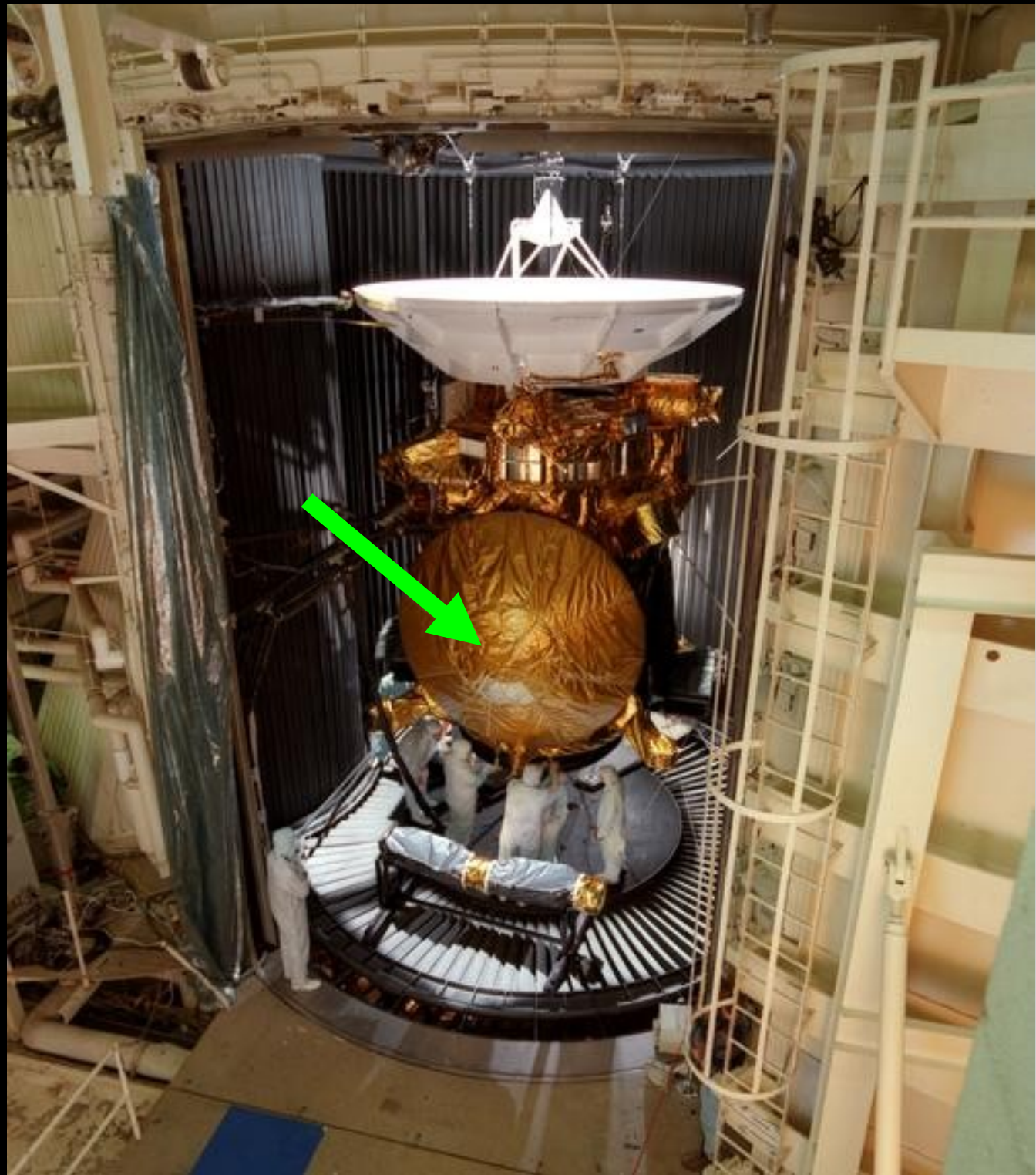


**Titan, vu par  
Voyager  
D = 5150 km**

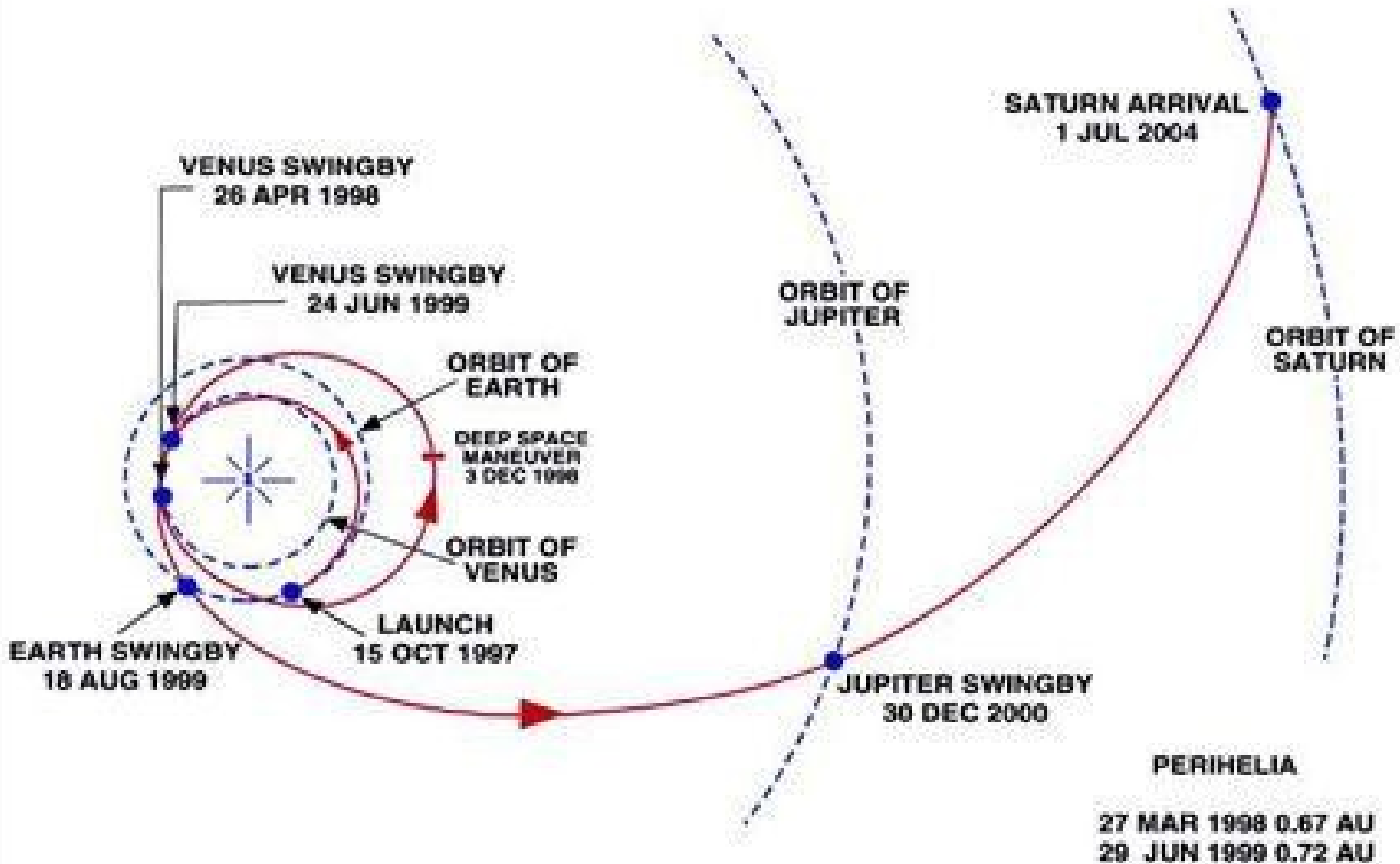
**Mission  
Cassini-Huygens**

**NASA/ESA/ASI**

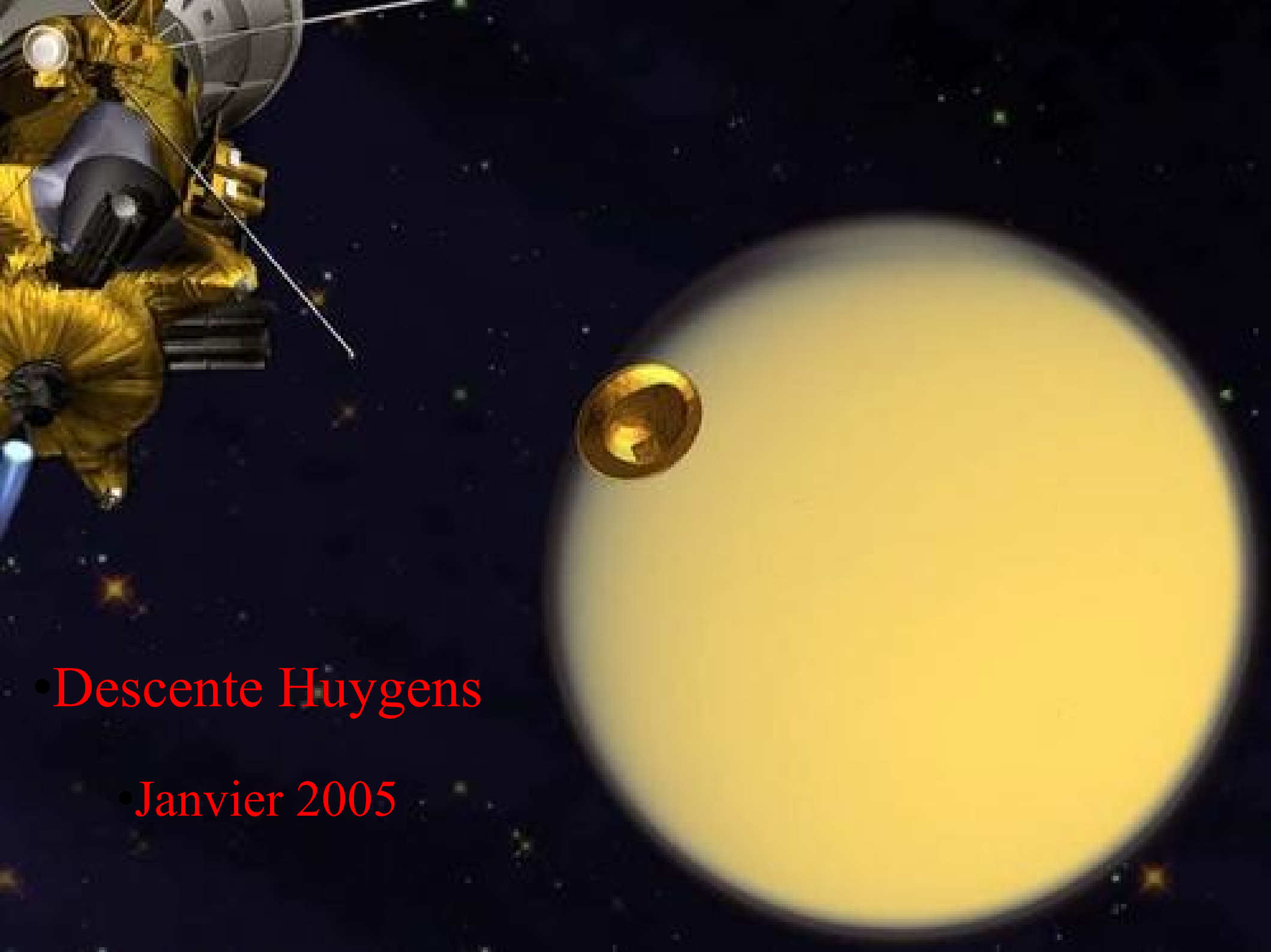
**Lancée Oct. 1997  
Arrivée Juil. 2004**



# CASSINI INTERPLANETARY TRAJECTORY

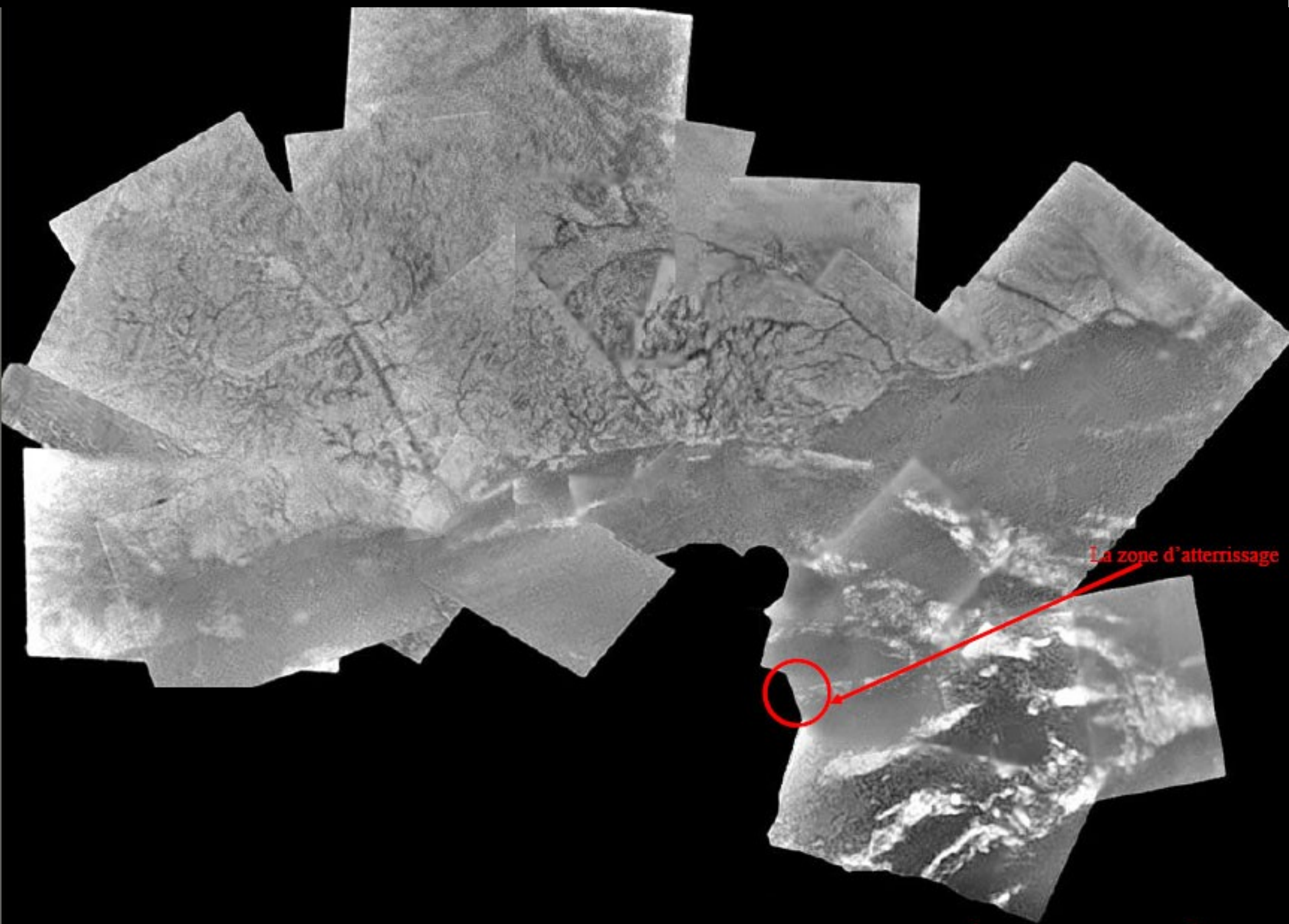


<http://saturn.jpl.nasa.gov/multimedia/videos/video-details.cfm?videoID=19>



- Descente Huygens

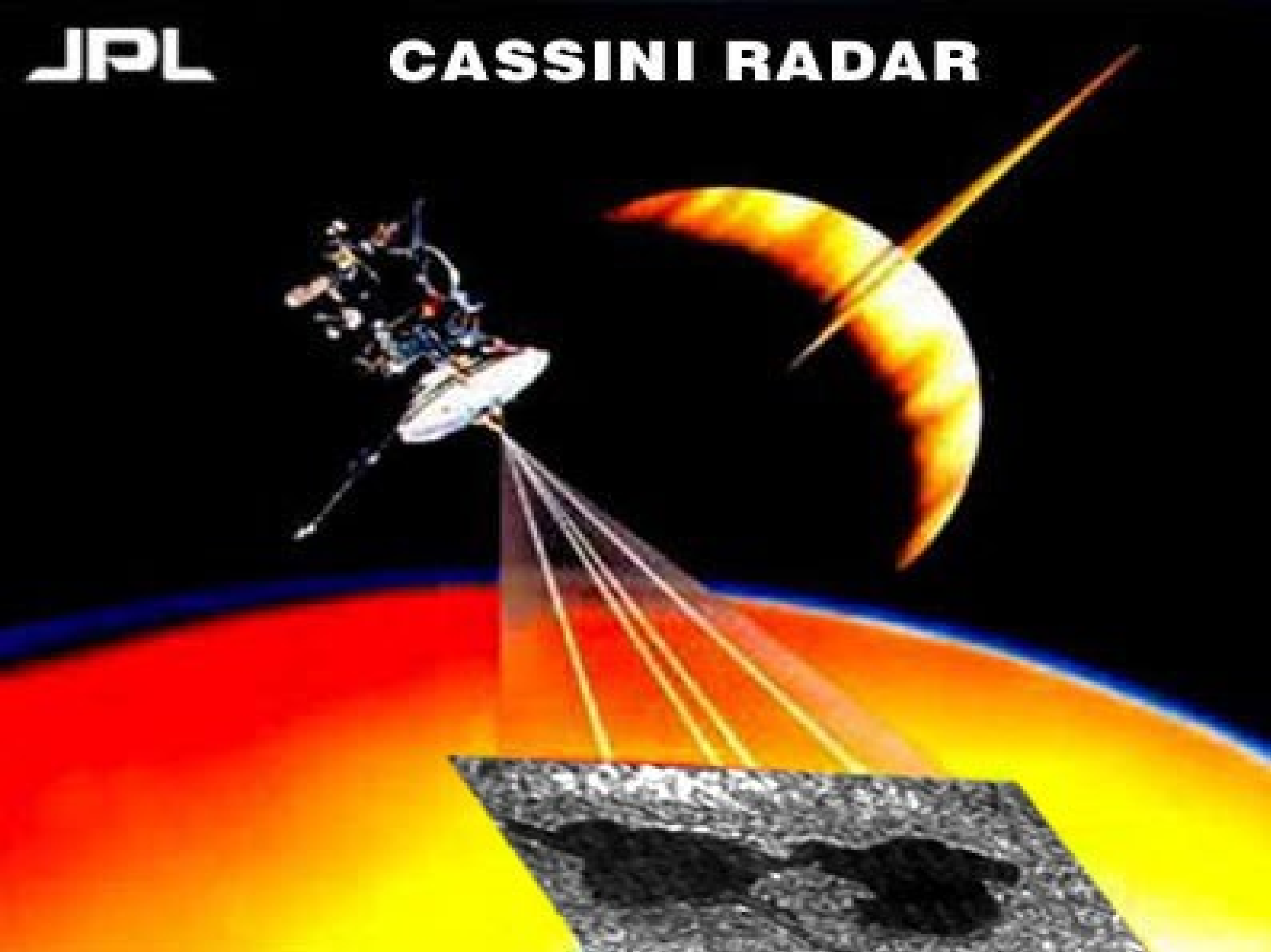
- Janvier 2005



La zone d'atterrissage

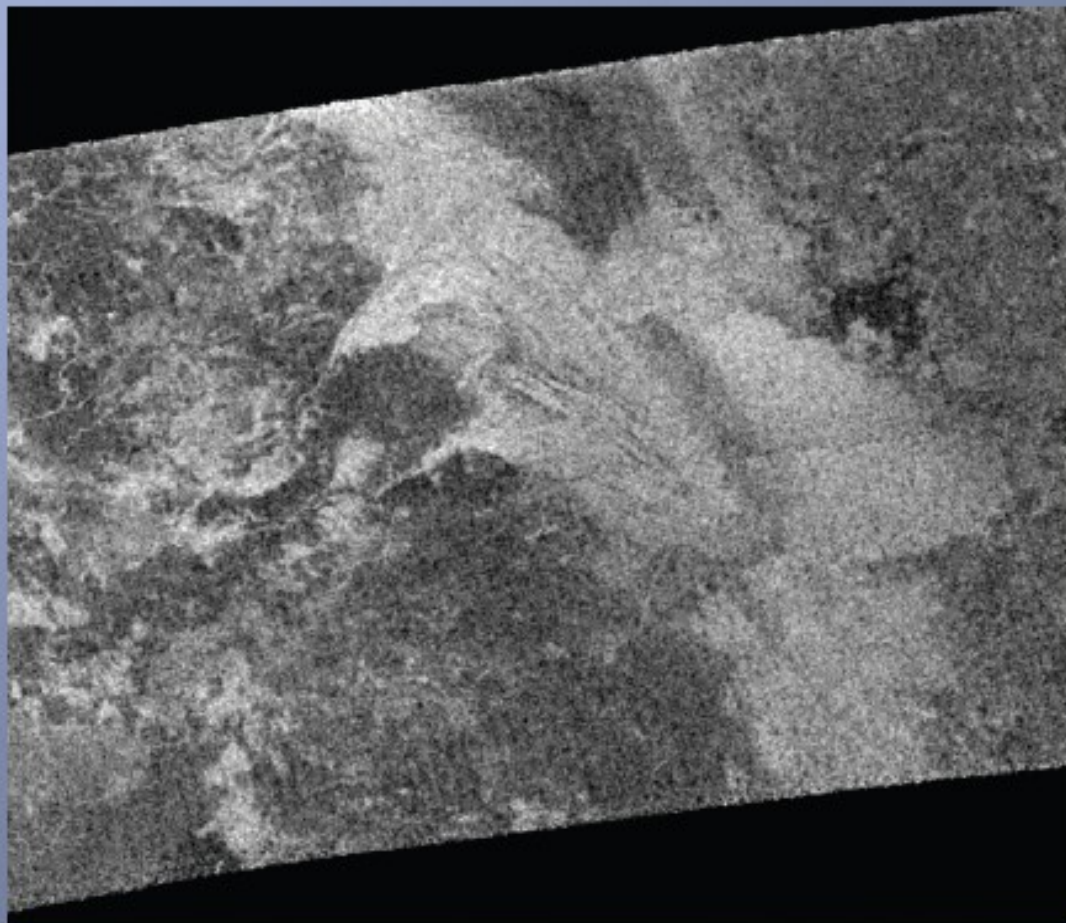
**JPL**

**CASSINI RADAR**



<http://saturn.jpl.nasa.gov/multimedia/videos/video-details.cfm?videoID=21>

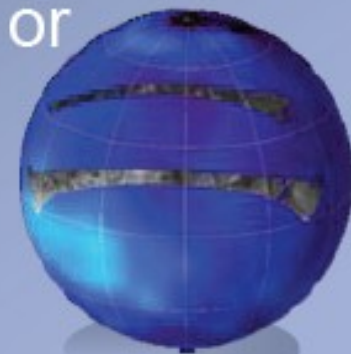
# Fans/deltas (Ta)



Fan-like features seem to open at a possible change in topography  
Image height ~ 200 km

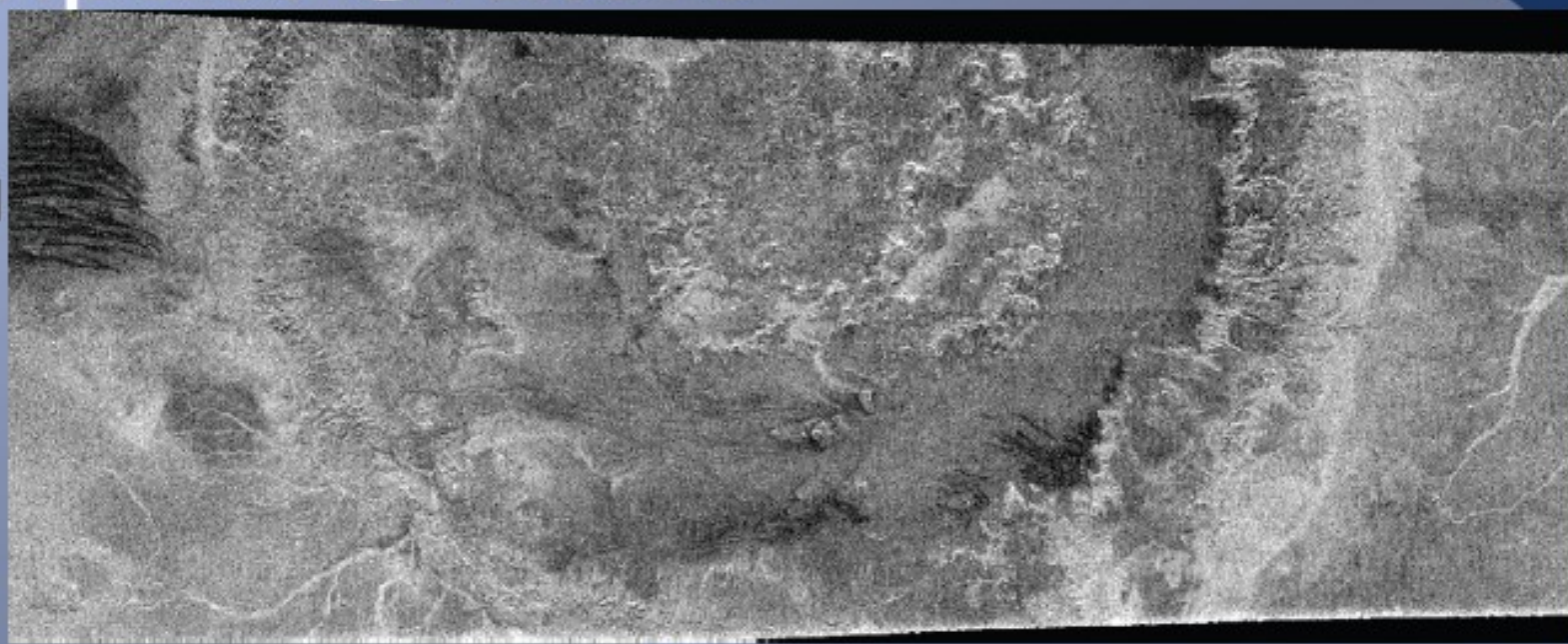
## Fan-shaped units with sinuous features

- Most larger in scale than Huygens 'channels'
- 500m – 1km across and extend for tens of km
- Indicative of transport and deposition of materials, and topography
- Possible transport mechanisms include slope-related processes, cryovolcanism, or hydrocarbon fluid flow



# T3 Impact Craters

450 km  
87°W 20°N

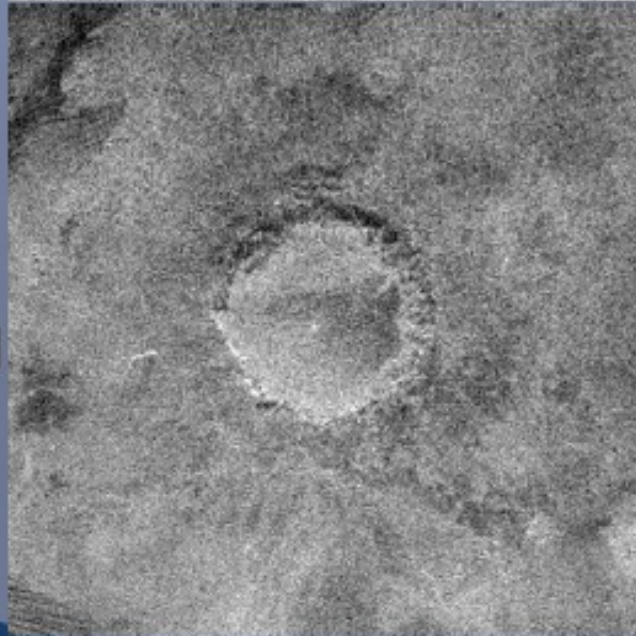


100 km

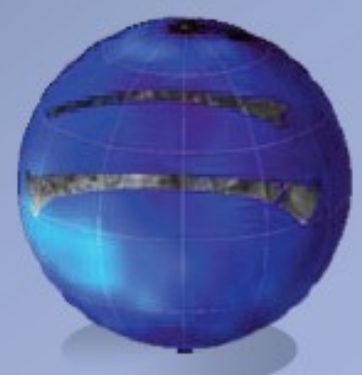
Mernva

Atmospheric shielding  
means impactors need be >  
2 km, ~ 20 km diam crater

80 km  
16°W 11°N



Sinlap





# T7: "Coastline"

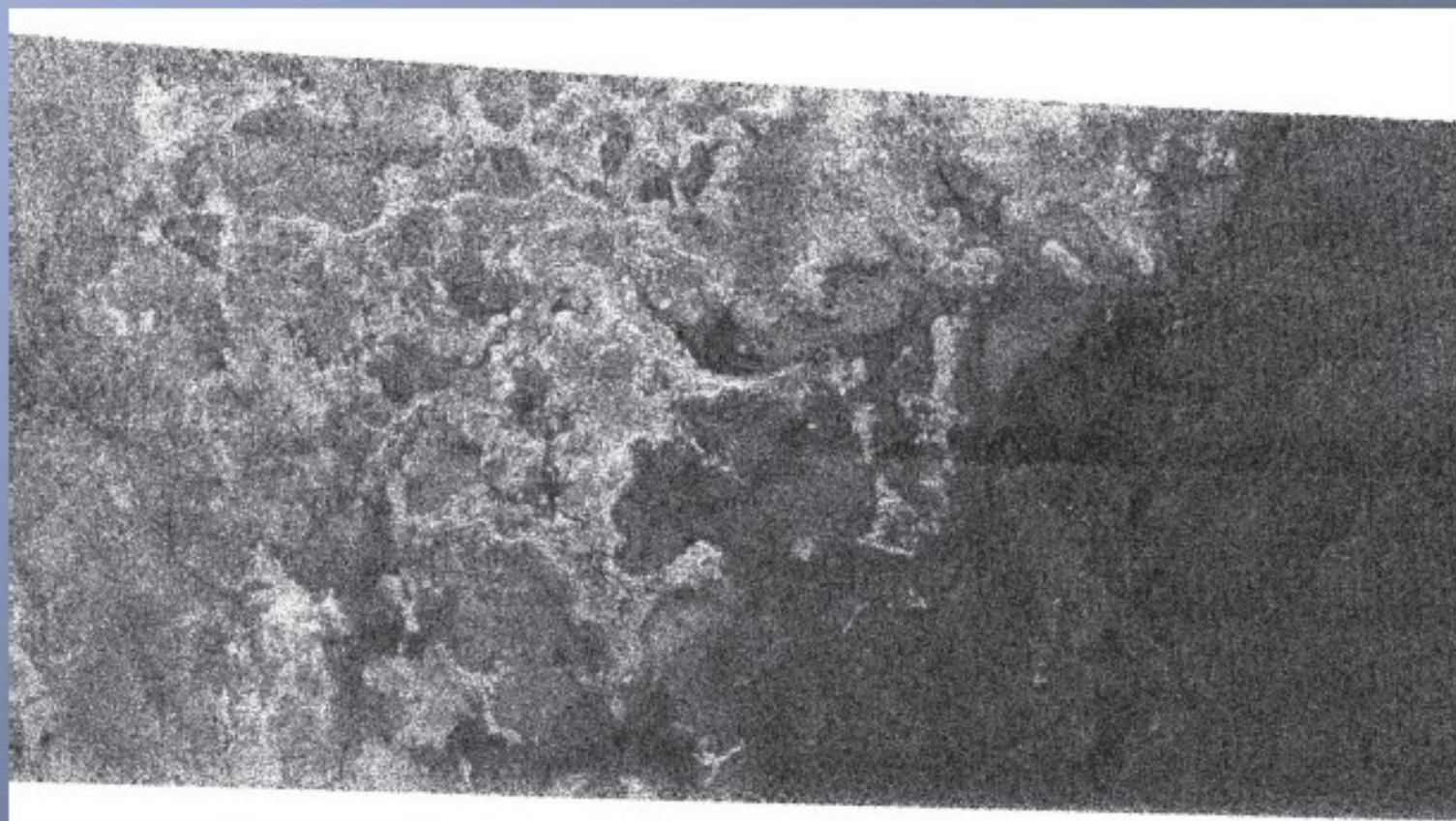
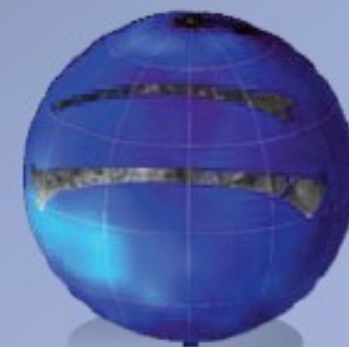


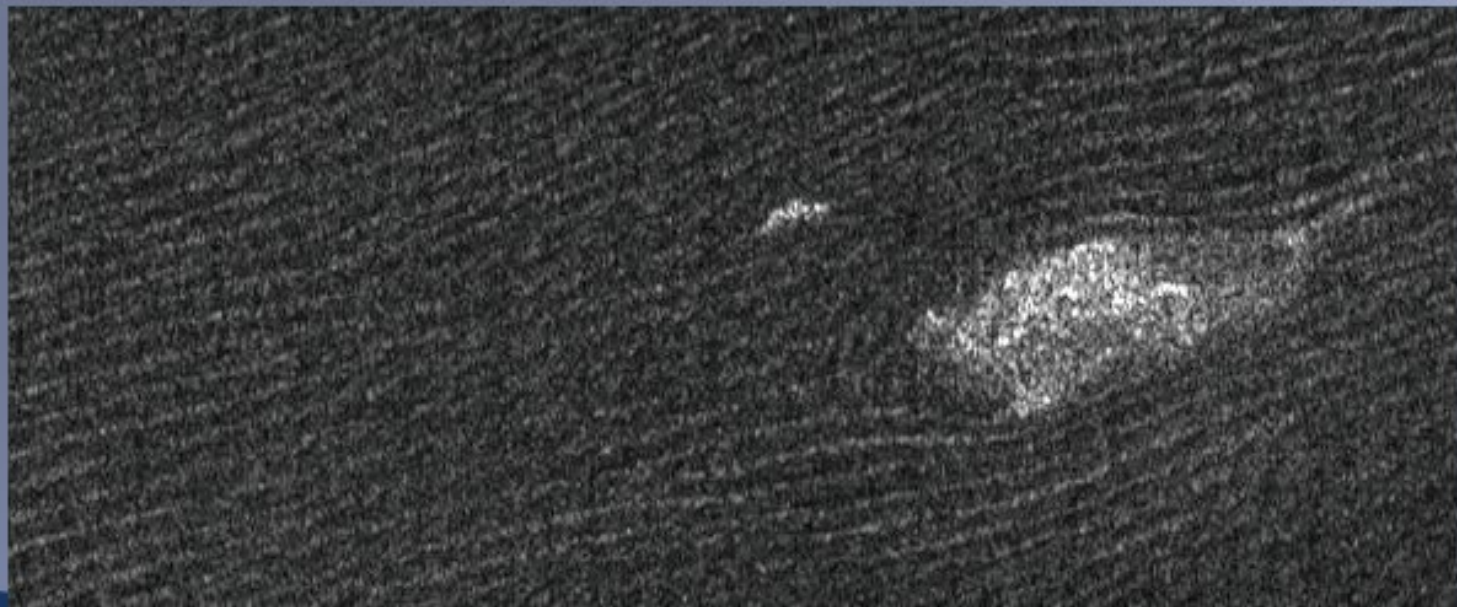
Image height  
~ 200km

Bright, rough region appears to be topographically high terrain, cut by channels and bays.

Is boundary a shoreline? Patterns in the dark (smooth) region indicate that once it may have been flooded.

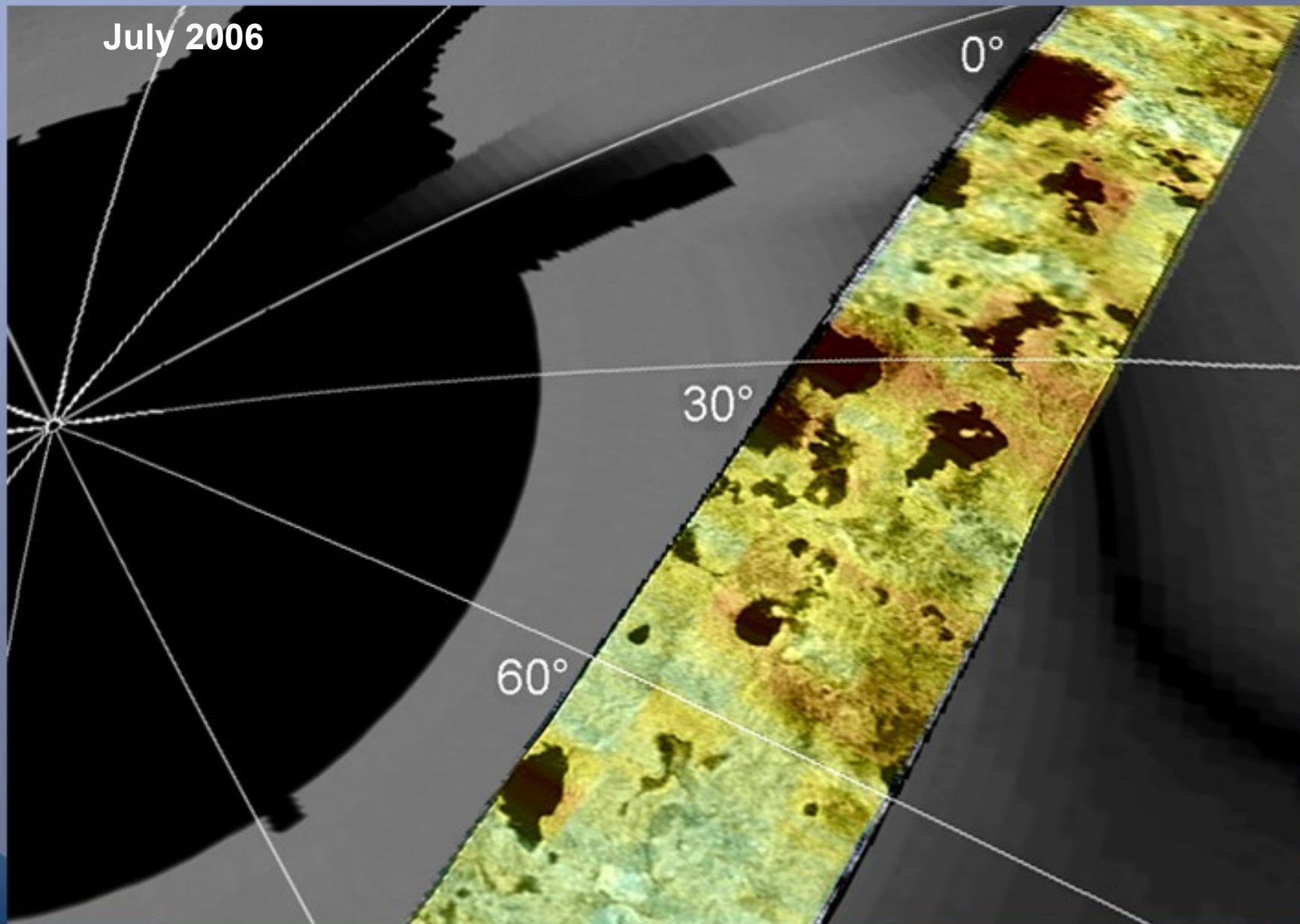


# T8: Dunes



# T16: Lakes !

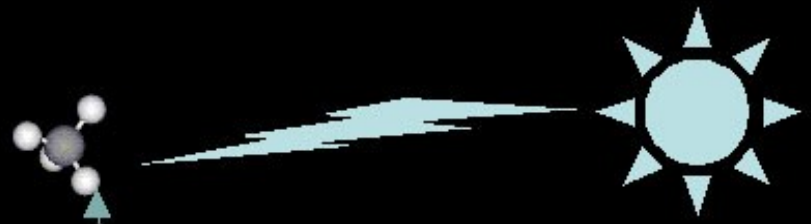
Nature, Jan. 2007



<http://saturn.jpl.nasa.gov/multimedia/videos/video-details.cfm?videoID=149>

Stratosphère

$\sim 10^7 - 10^8$  yrs



$\sim 10 - 100$  yrs

Troposphère

$\sim 100 - 1000$  yrs

Surface

Pôle

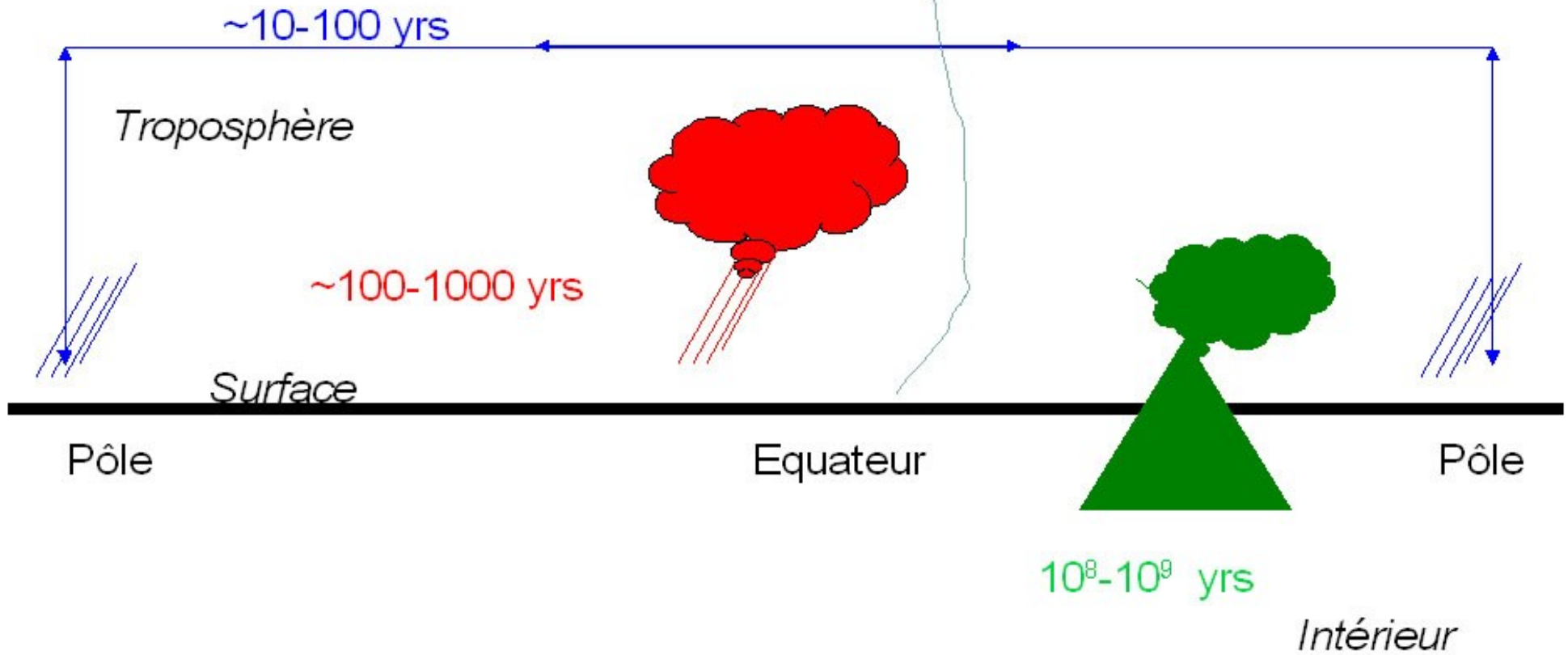
Equateur

Pôle

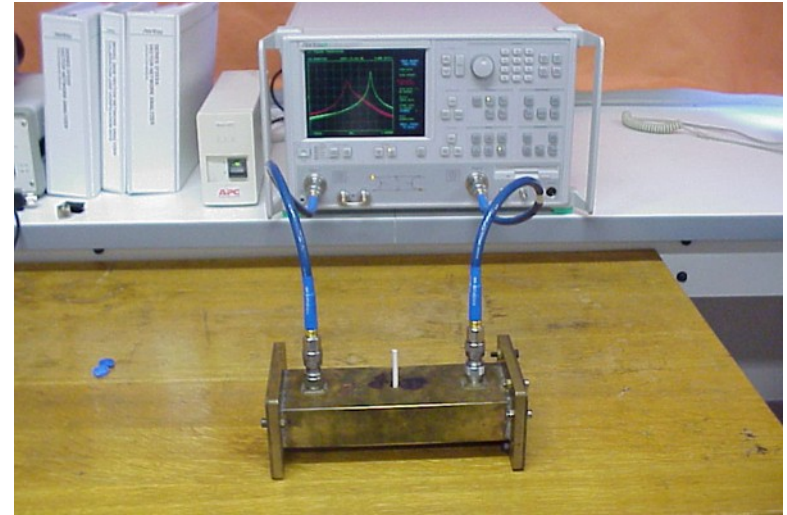
$10^8 - 10^9$  yrs

Intérieur

**Cycle du méthane ?**



# Mesures en laboratoire (IMS)



**Methane (liquid):**

$$\epsilon = 1.8 - 0.001 / 0.00001j$$

**Butane (solid):**

$$\epsilon = 1.88 - 0.003j$$

**Heptane (solid):**

$$\epsilon = 1.97 - 0.003j$$

**CO2 (solid):**

$$\epsilon = 1.55 - 0.0003j$$

**N2 (liquid):**

$$\epsilon = 1.42 - 0.00015j$$

**Water ice (solid):**

$$\epsilon = 3.1 - 0.000006j$$

**Tholins #1 (solid):**

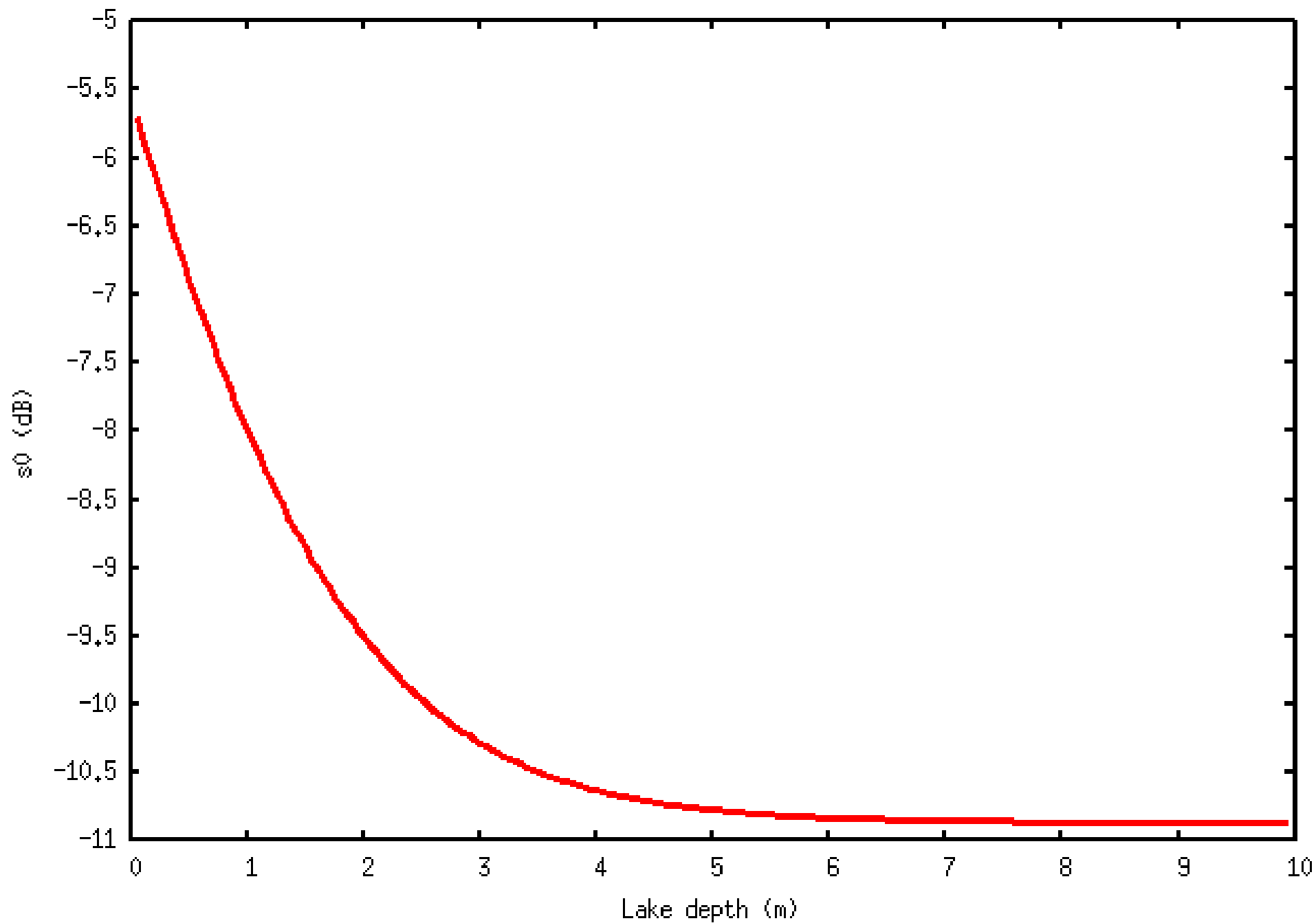
$$\epsilon = 2.2 - 0.01j$$

**Tholins #2 (solid):**

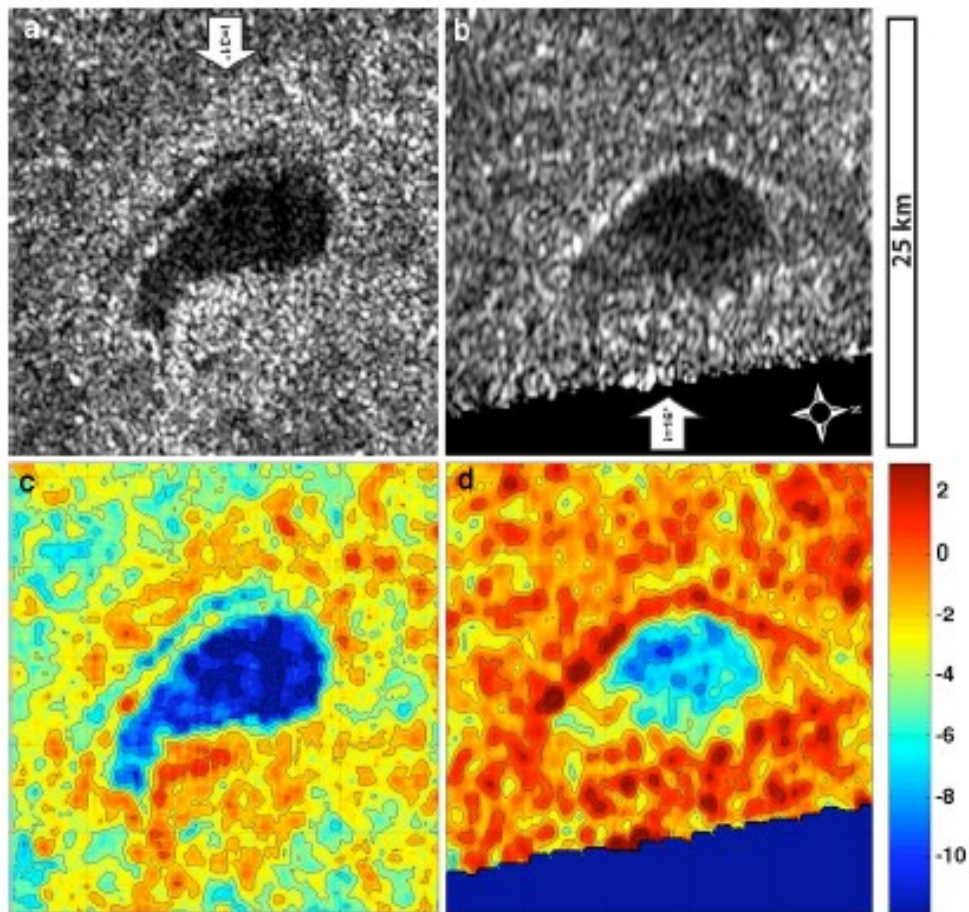
$$\epsilon = 1.15 - 0.035j$$



Lake #20 T19 LT = 1.2 10<sup>-3</sup>

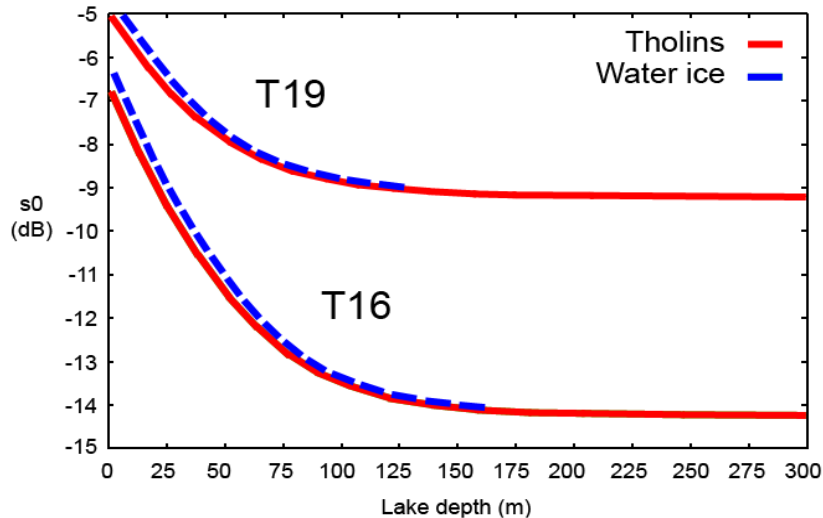


## T16/T19 Lake #20

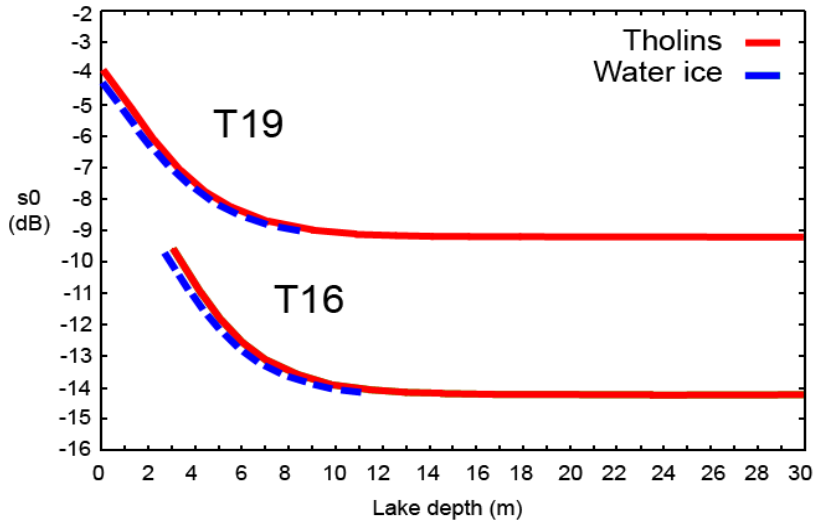


Lake #20 vu à 31° dans T16 et à 16° dans T19  
-> **changement lié à la variation d'incidence ?**

# Détection d'une variation temporelle ?



Modèle à deux couches avec un remplissage de méthane à *faibles pertes* ( $\epsilon = 1.8 - 0.00007j$ ) : changement expliqué par un effet d'incidence.



Modèle à deux couches avec un remplissage de méthane à *fortes pertes* ( $\epsilon = 1.8 - 0.001j$ ) : changement expliqué par une **variation de niveau de 2 mètres !**

# TITAN FLYBYS

## CASSINI MISSION

Ta	10/26/04
T3	2/15/05 and 2/16/05
T4	3/31/05
T7	9/7/05
T8	10/28/05
T12	3/18/06
T13	Sunday 4/30/06
T15	7/2/06
T16	Saturday 7/22/06
T17	9/7/06
T18	9/23/06
T19	Monday 10/9/06
T20	25/10/2006
T21	Tuesday 12/12/06
T23	Saturday 1/13/07
T25	Thursday 2/22/07
T28	Tuesday 4/10/07
T29	Thursday 4/26/07
T30	Saturday 5/12/07
T36	Tuesday 10/2/07
T39	Thursday 12/20/07
T41	Friday 2/22/08
T43	Monday 5/12/08
T44	Wednesday 5/28/08



## EXTENDED MISSION

T45	JUL 31, 2008
T46	NOV 3, 2008
T47	NOV 19, 2008
T48	DEC 5, 2008
T49	DEC 21, 2008
T50	FEB 7, 2009
T51	MAR 27, 2009
T52	APR 4, 2009
T53	APR 20, 2009
T54	MAY 5, 2009
T55	MAY 21, 2009
T56	JUN 6, 2009
T57	JUN 22, 2009
T58	JUL 8, 2009
T59	JUL 24, 2009
T60	AUG 9, 2009
T61	AUG 25, 2009
T62	OCT 12, 2009
T63	DEC 12, 2009
T64	DEC 28, 2009
T65	JAN 12, 2010
T66	JAN 28, 2010
T67	APR 5, 2010
T68	MAY 20, 2010
T69	JUN 5, 2010
T70	JUN 21, 2010