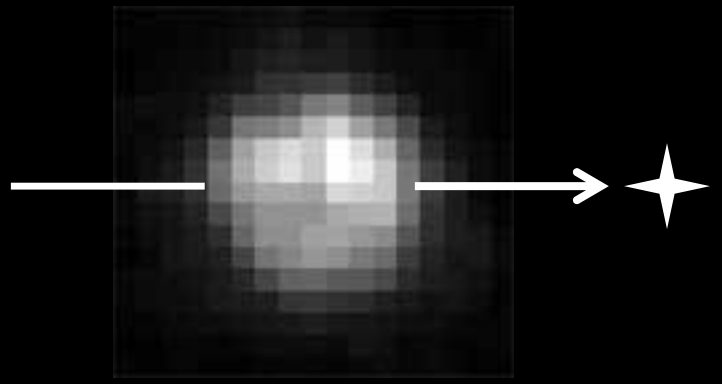
L'exploration du système solaire par occultations dans l'ère Gaia

Bruno Sicardy

LESIA/Observatoire de Paris
& Sorbonne Université
ERC project Lucky Star

3 décembre 2020



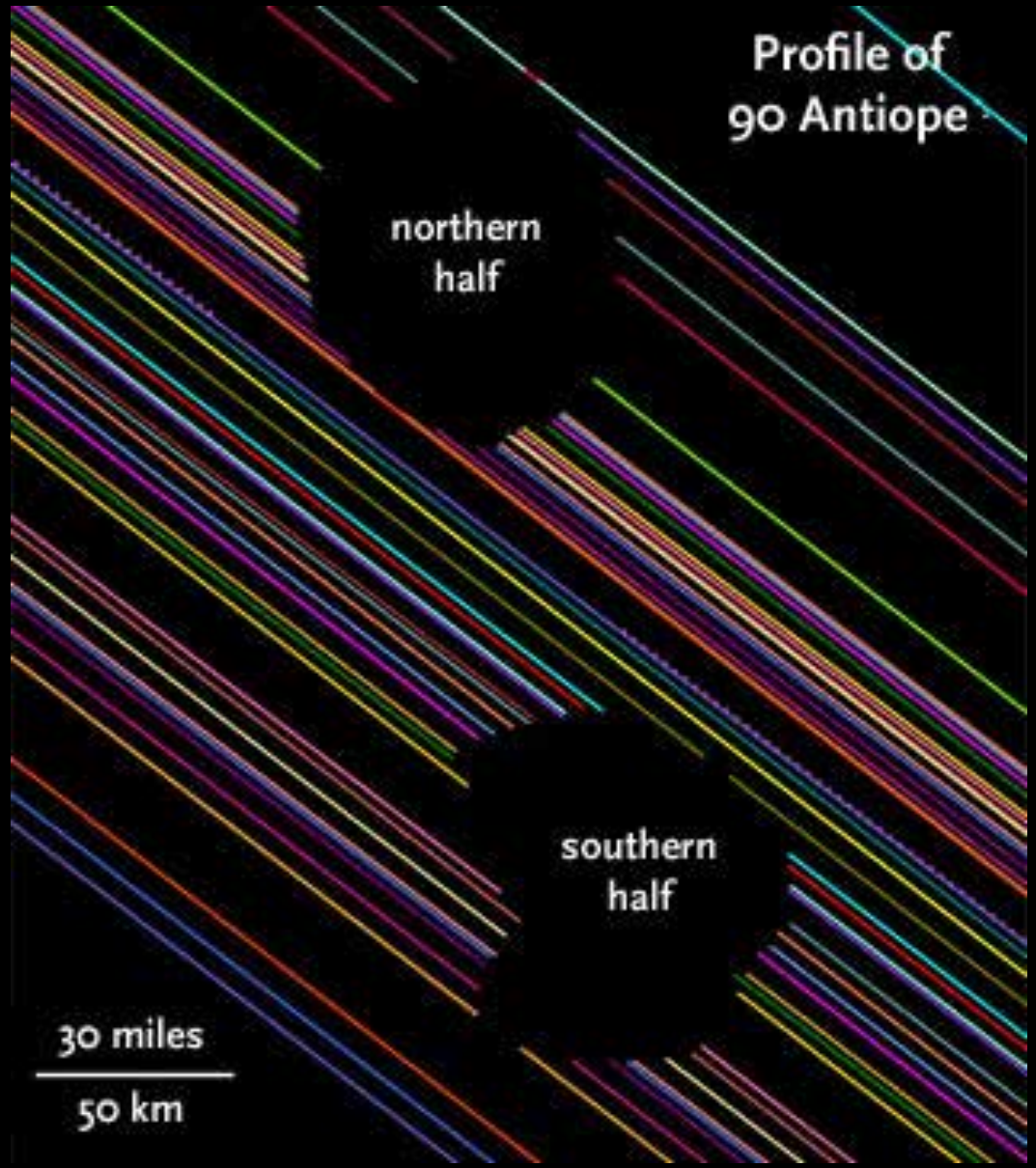
Pluto at best HST resolution
details ~ 500 km at best

Earth's Moon at the same resolution

Occultations: highly efficient method

spatial resolution ~ fraction of km → shape, albedo, density, internal structure, topography
sensitivity to atmosphere ~ a few nanobars → monitoring of Pluto & Triton's atmospheres
sensitivity to rings → discovery of rings around 2 small bodies (Chariklo, Haumea), so far…

http://pluto.jhuapl.edu/Participate/community/What-We-Know.php?link=Making-Maps



Antiope occultation
Kelly Beatty Sky & Telescope
9 Sept. 2011

from F. Colas, F. Marchis with
US and European amateurs

www.skyandtelescope.com/astronomy-news/observing-news/
antiope-occultation-yields-double-bonanza/

Titan

Pluto

Charon

E-ELT angular resolution at 1 µm with AO (~ 6 mas)

quaoar

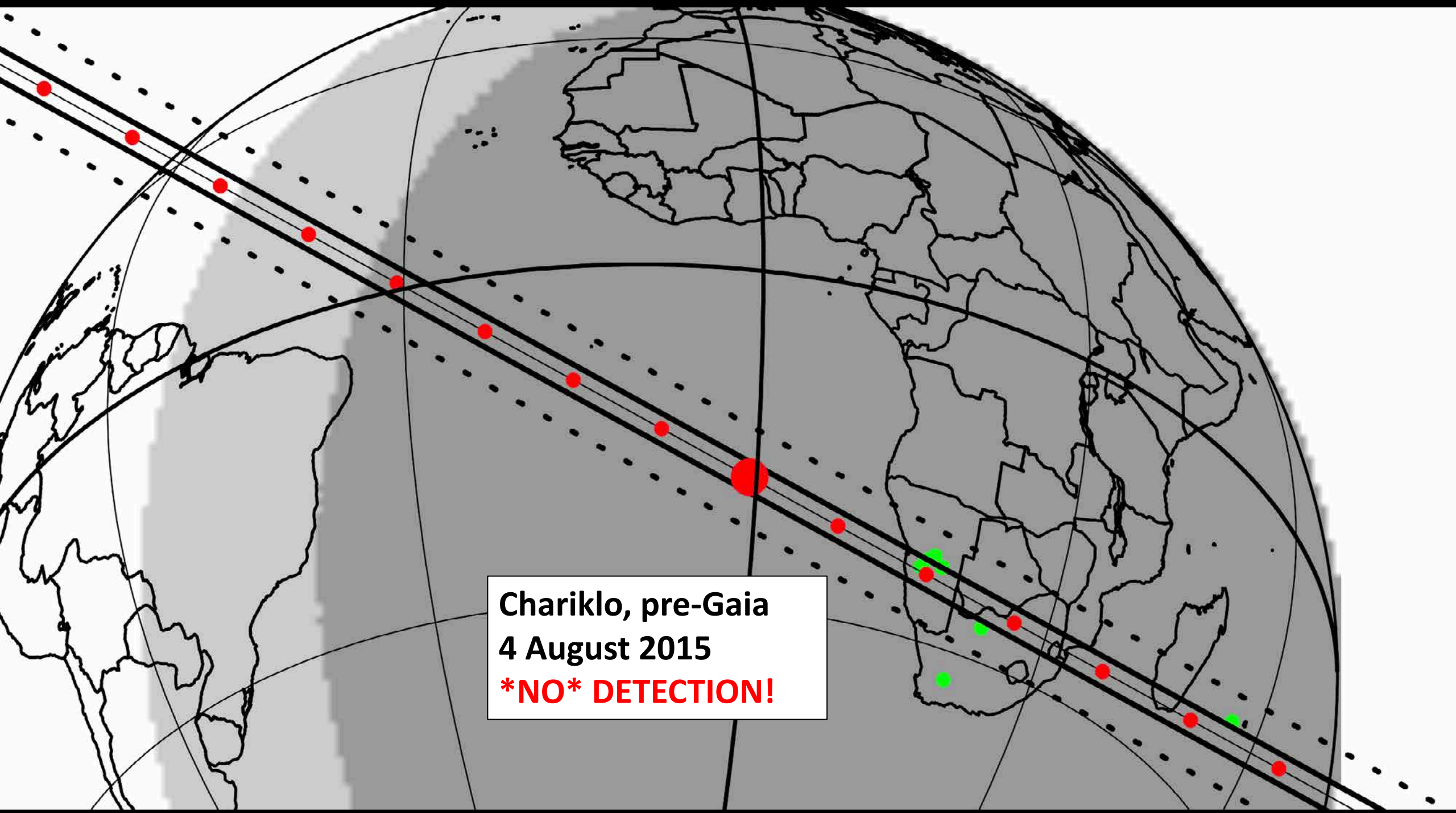
a stamp viewed at 150 km

Eris

indentations
~ 1 mas (Gaia)

10^{-7} radian
~ 20 mas

Makemake


Chariklo, pre-Gaia
4 August 2015
NO DETECTION!


San Pedro 50cm
San Pedro ASH2
05:55:30.0
El Rodeo C14
Salta
Ckoirama T60
Tolar Grande M16
C14 Cachi Adentro
Cono de Arita? M10
Armazones
VLT
Cafayate?
Jean-Luc Dauvergne C11
05:56:00.0
Sylvain Boulay M10 Inca de Oro
Francois Colas M12
Las Campanas
La Silla, 3.6m
La Silla, Danish
Mamalluca, M16
SOAR
Cerro Tololo
Hacienda des Etoiles C14
OAEGG C14
Bosque Alegre T76+C14
Bosque Alegre T154
Combarbala M16
El Leoncito
Villa Gobernador Gálvez
Zavalla
Google Earth
Data SIO, NOAA, U.S. Navy, NGA, GEBCO
Image Landsat / Copernicus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Chariklo 23 July 2017
10 km-accuracy!
(~ 1 mas) DR2 *pre-release*
vive Gaia !
Jean-Luc Dauvergne C11
05:56:00.0
Sylvain Boulay M10 Inca de Oro
Francois Colas M12
Las Campanas
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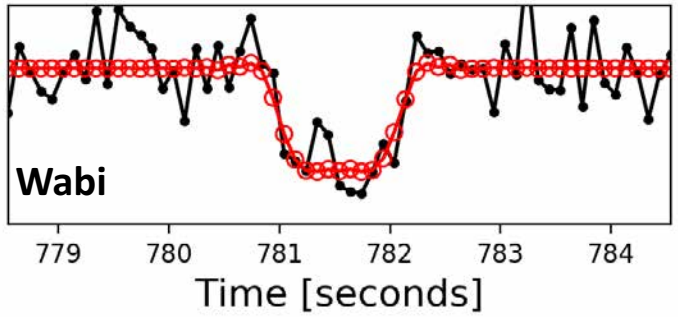
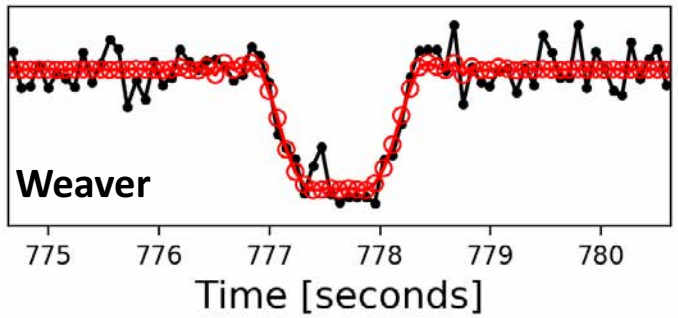
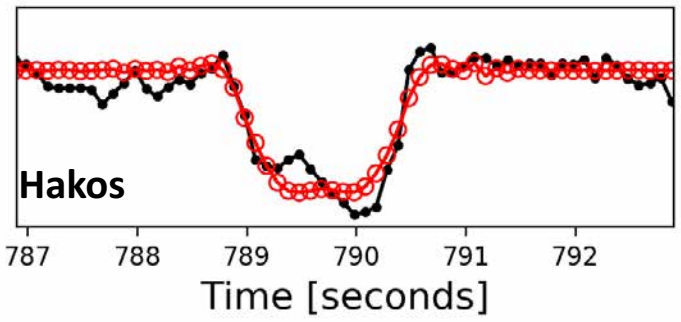
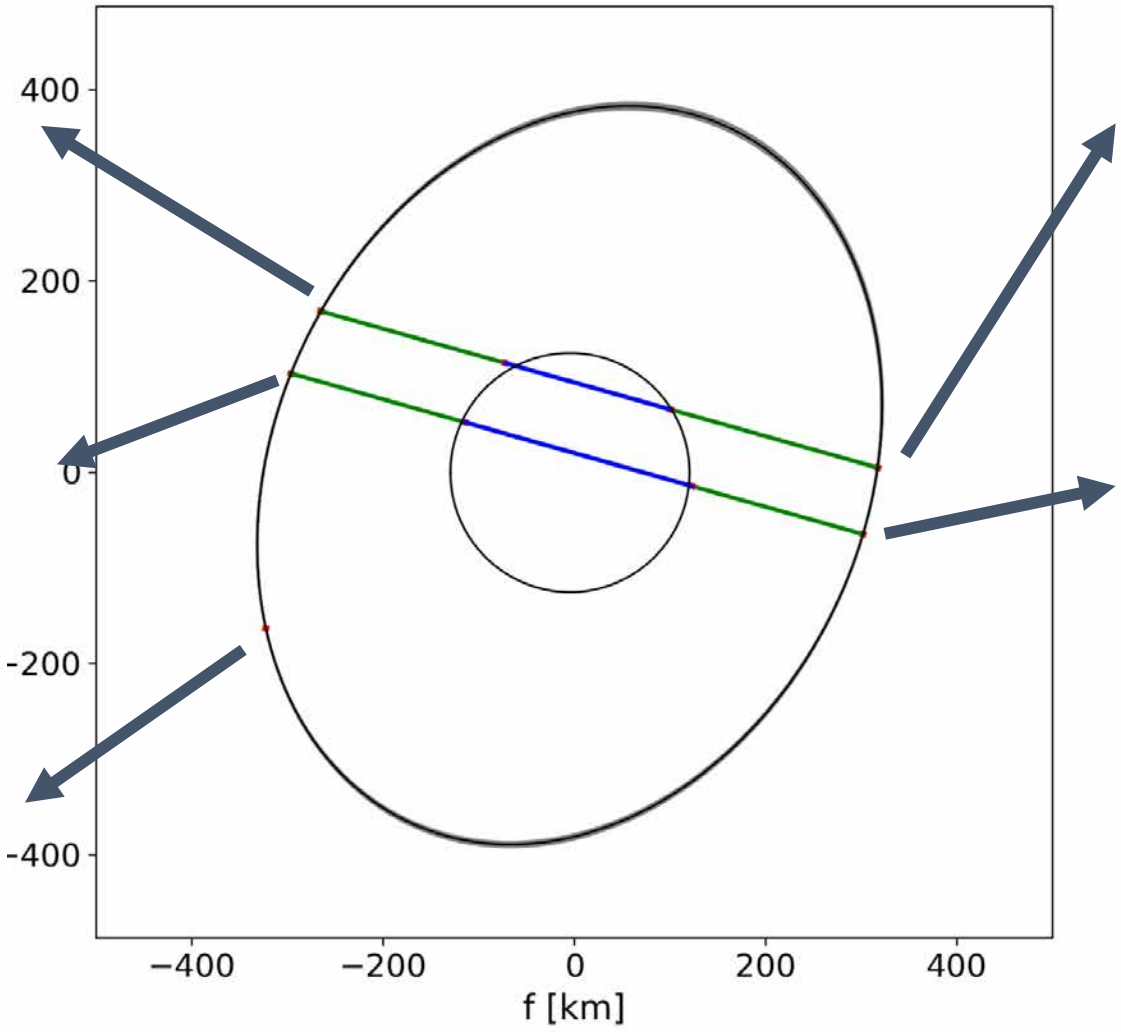
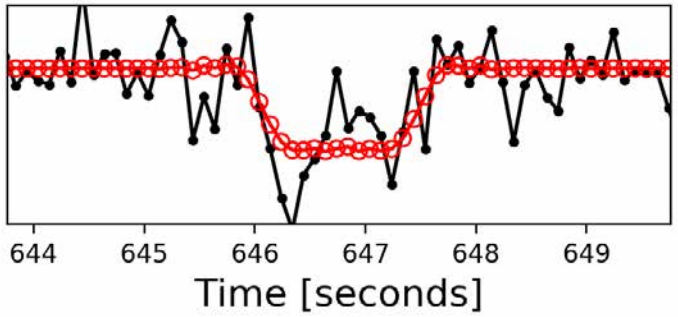
Chariklo's ring detected by amateur stations from Namibia
9 April 2017

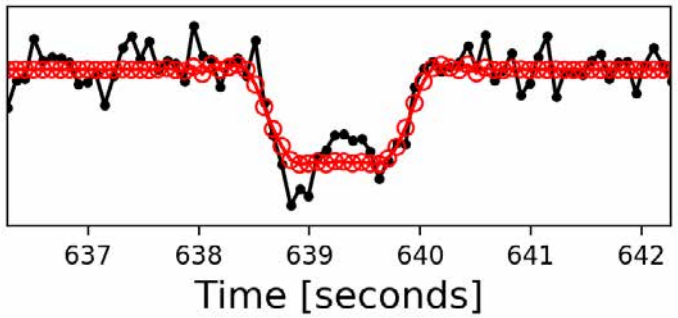


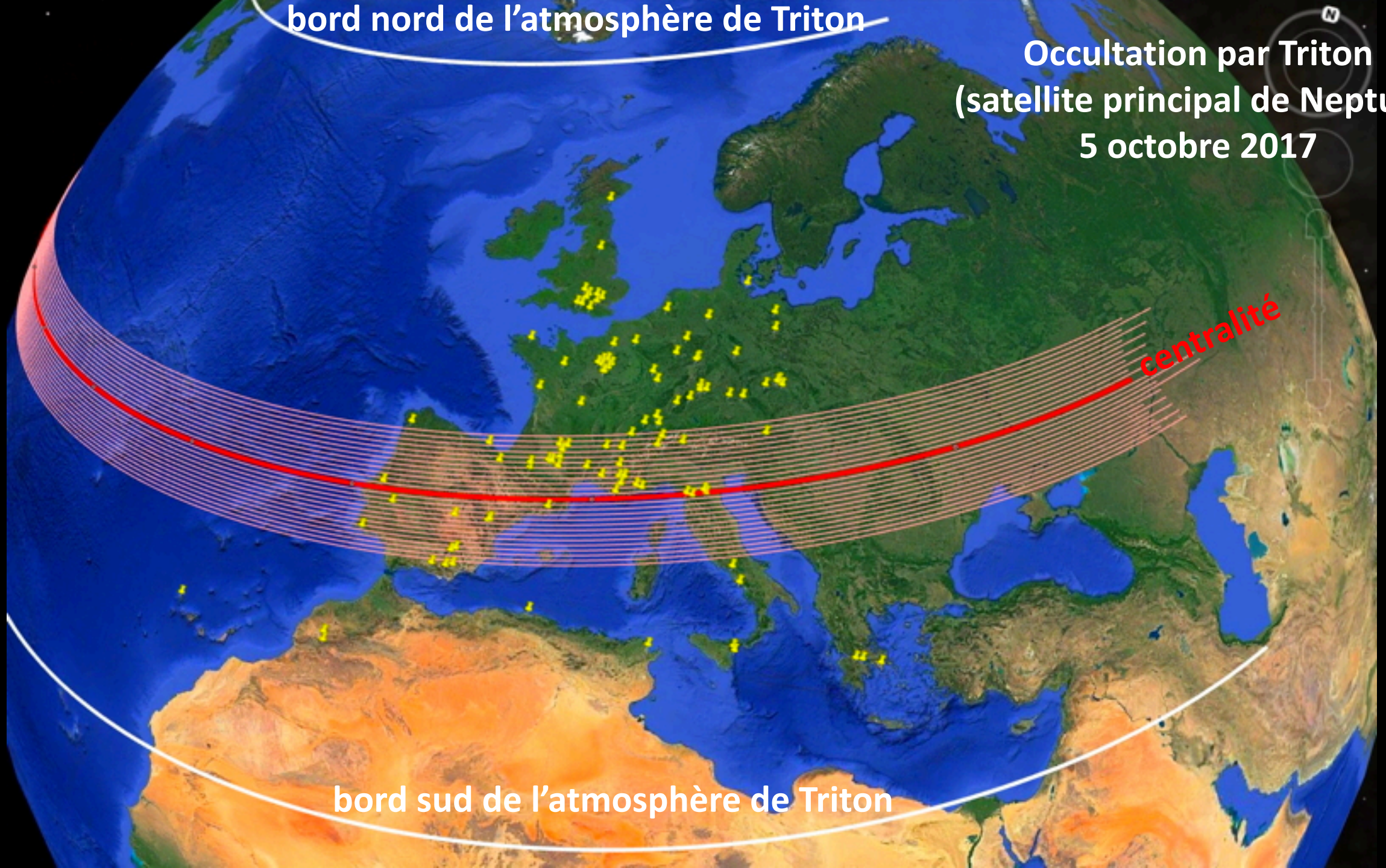


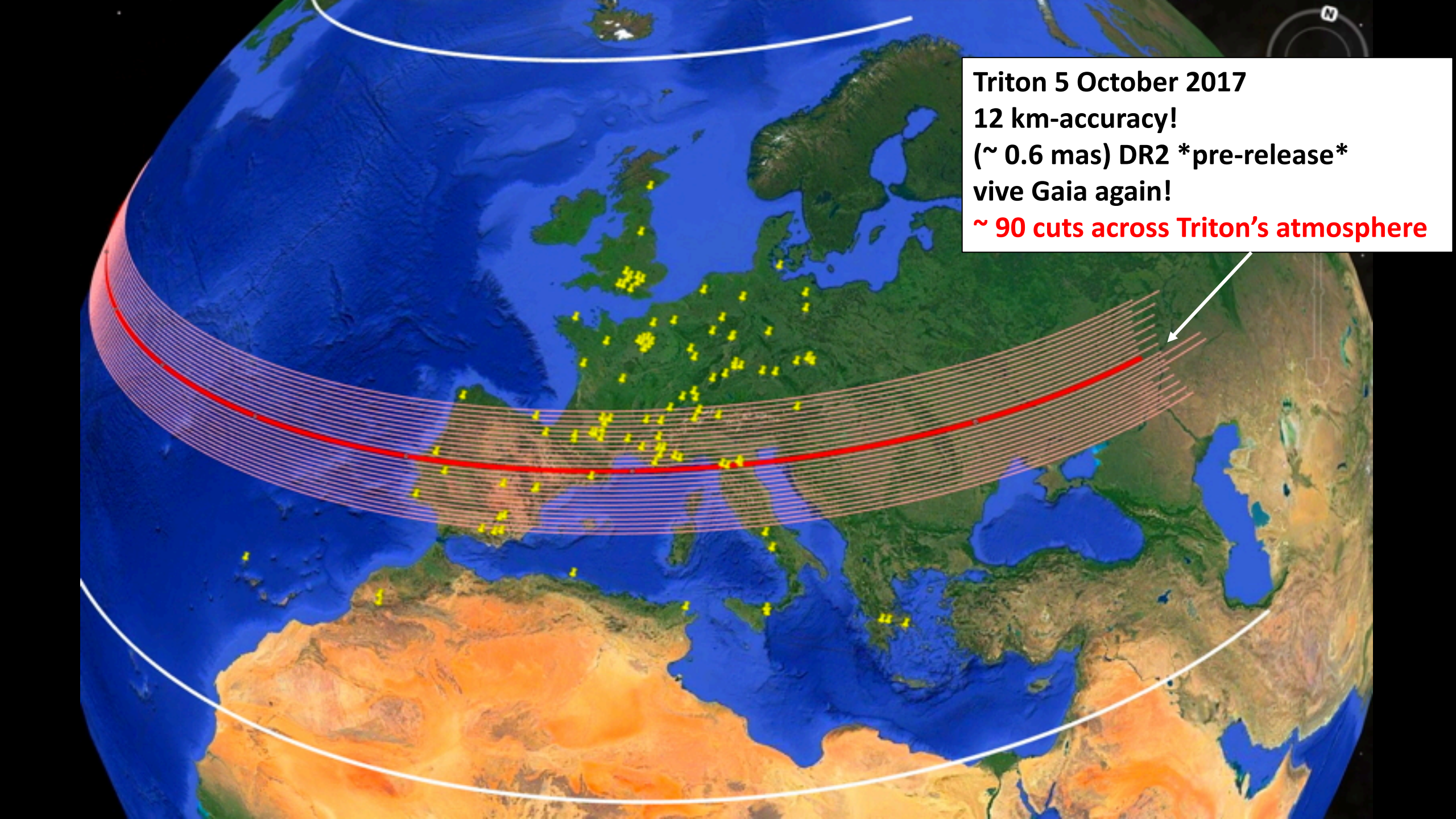




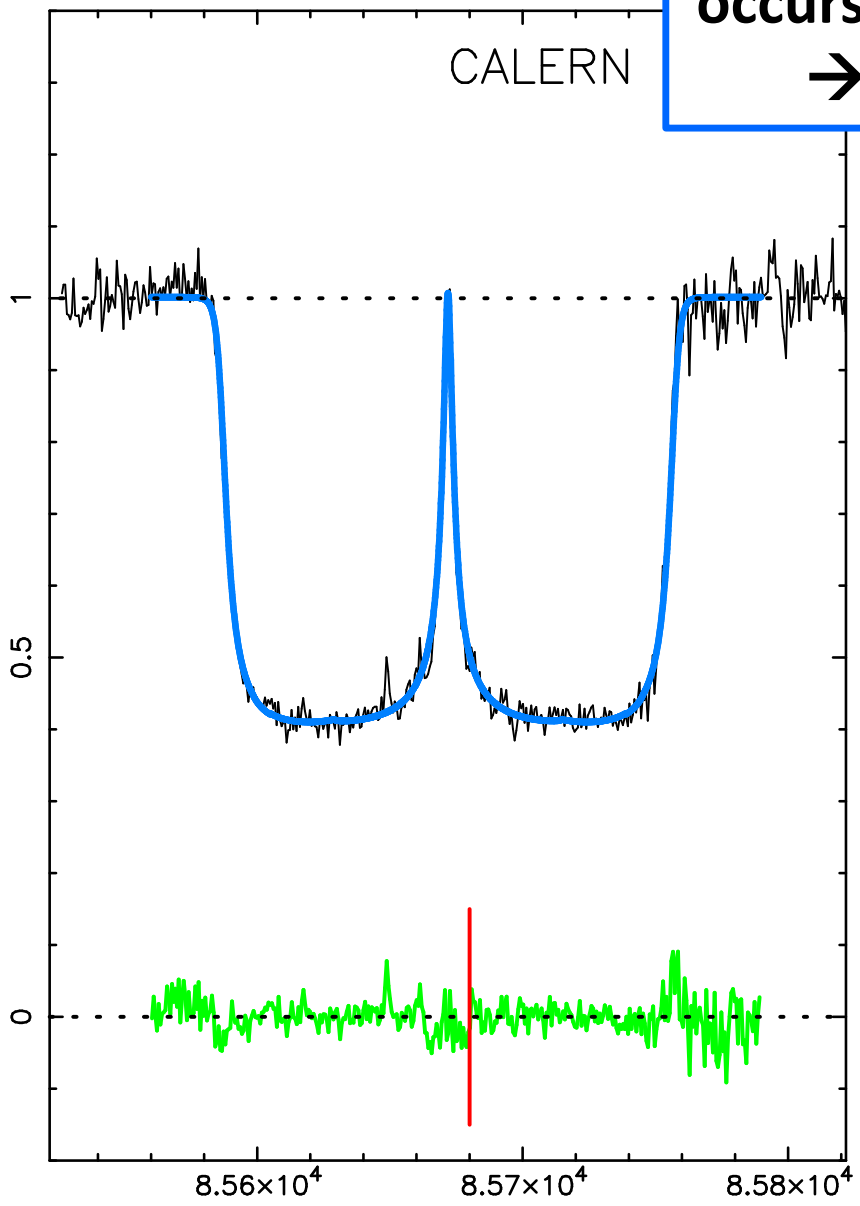


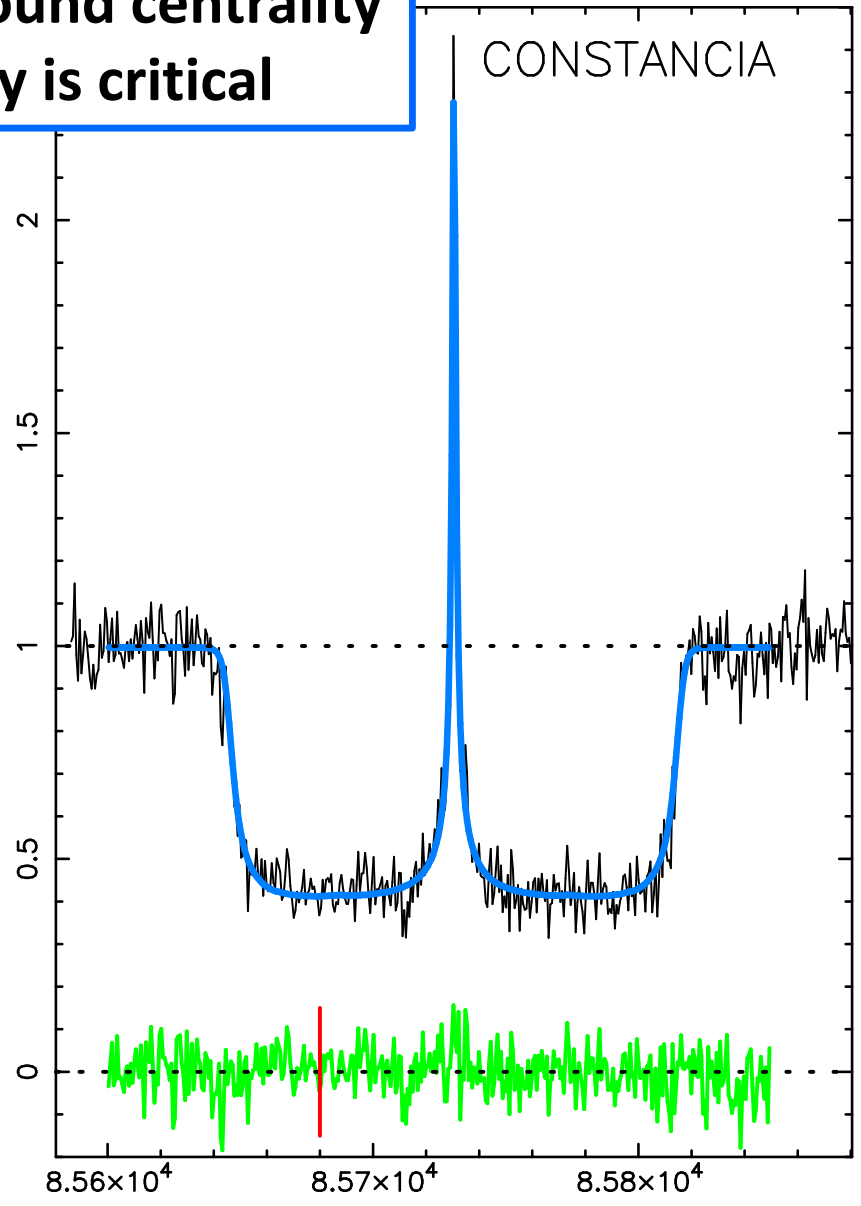



bord nord de l'atmosphère de Triton
Occultation par Triton
(satellite principal de Neptune)
5 octobre 2017
centralité
bord sud de l'atmosphère de Triton

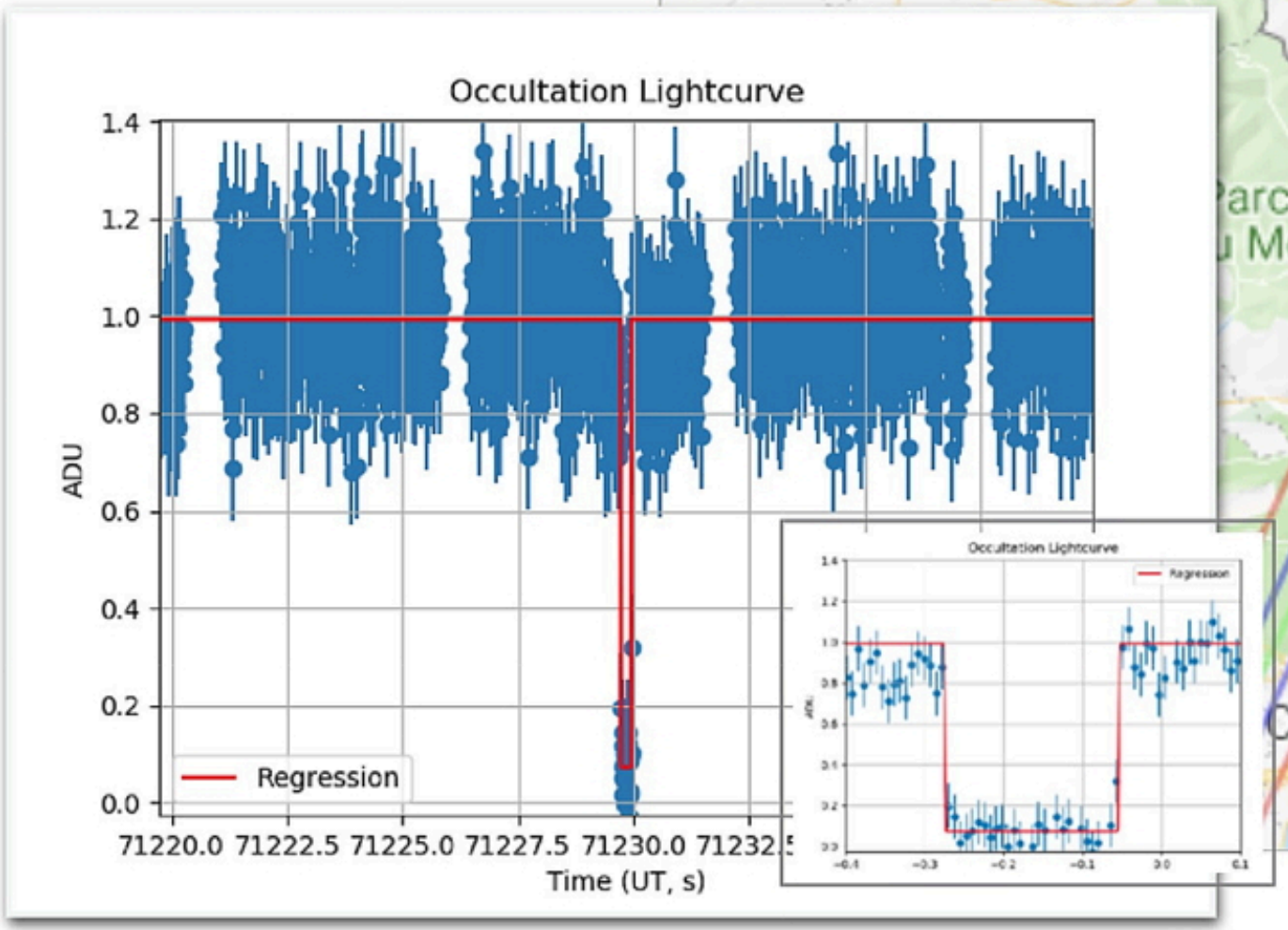

Triton 5 October 2017
12 km-accuracy!
(~ 0.6 mas) DR2 *pre-release*
vive Gaia again!
~ 90 cuts across Triton's atmosphere

Triton central flash 5 October 2017
occurs ~ ± 5 mas around centrality
→ Gaia accuracy is critical

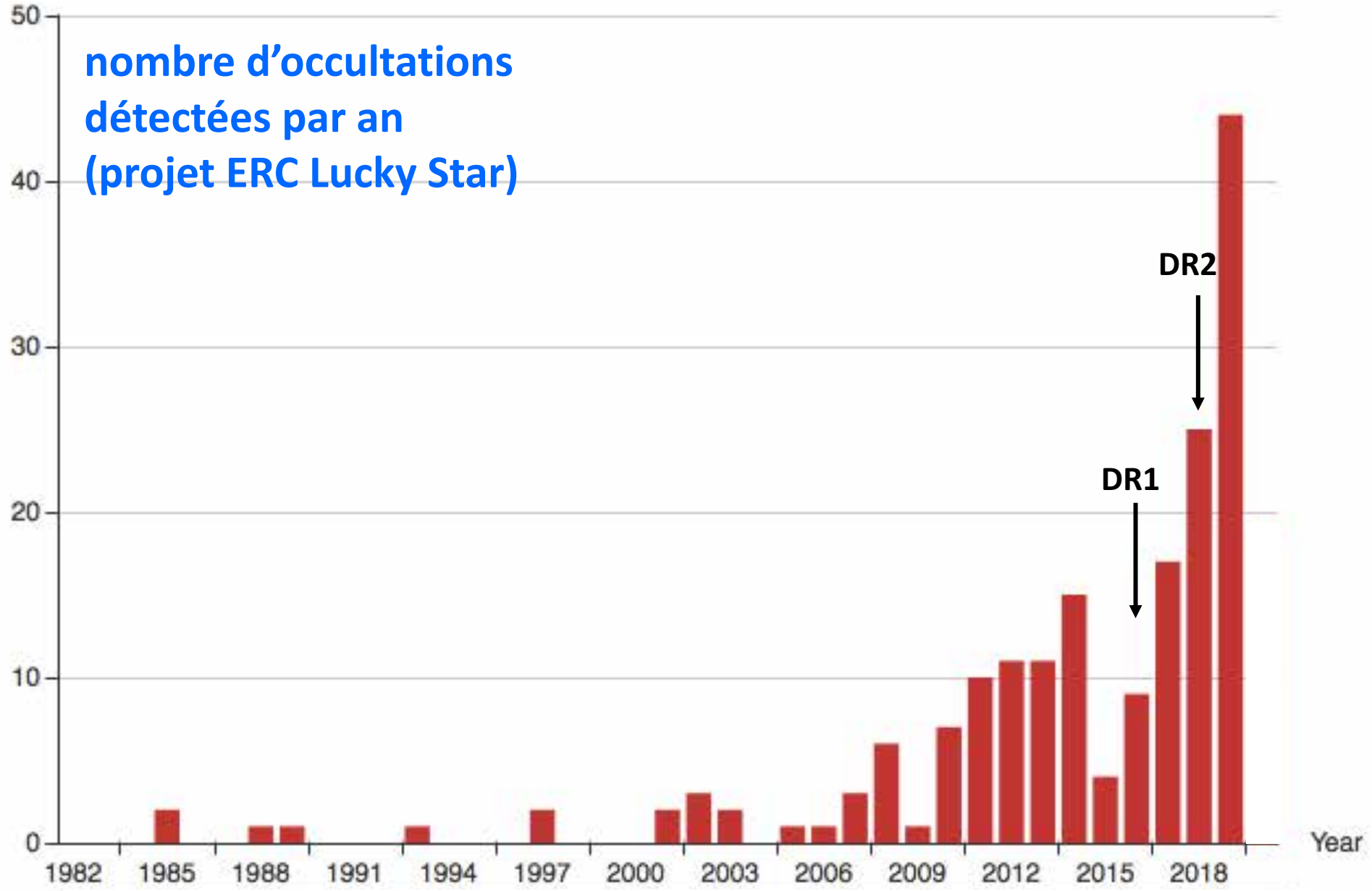




Phaethon event October 15, 2019

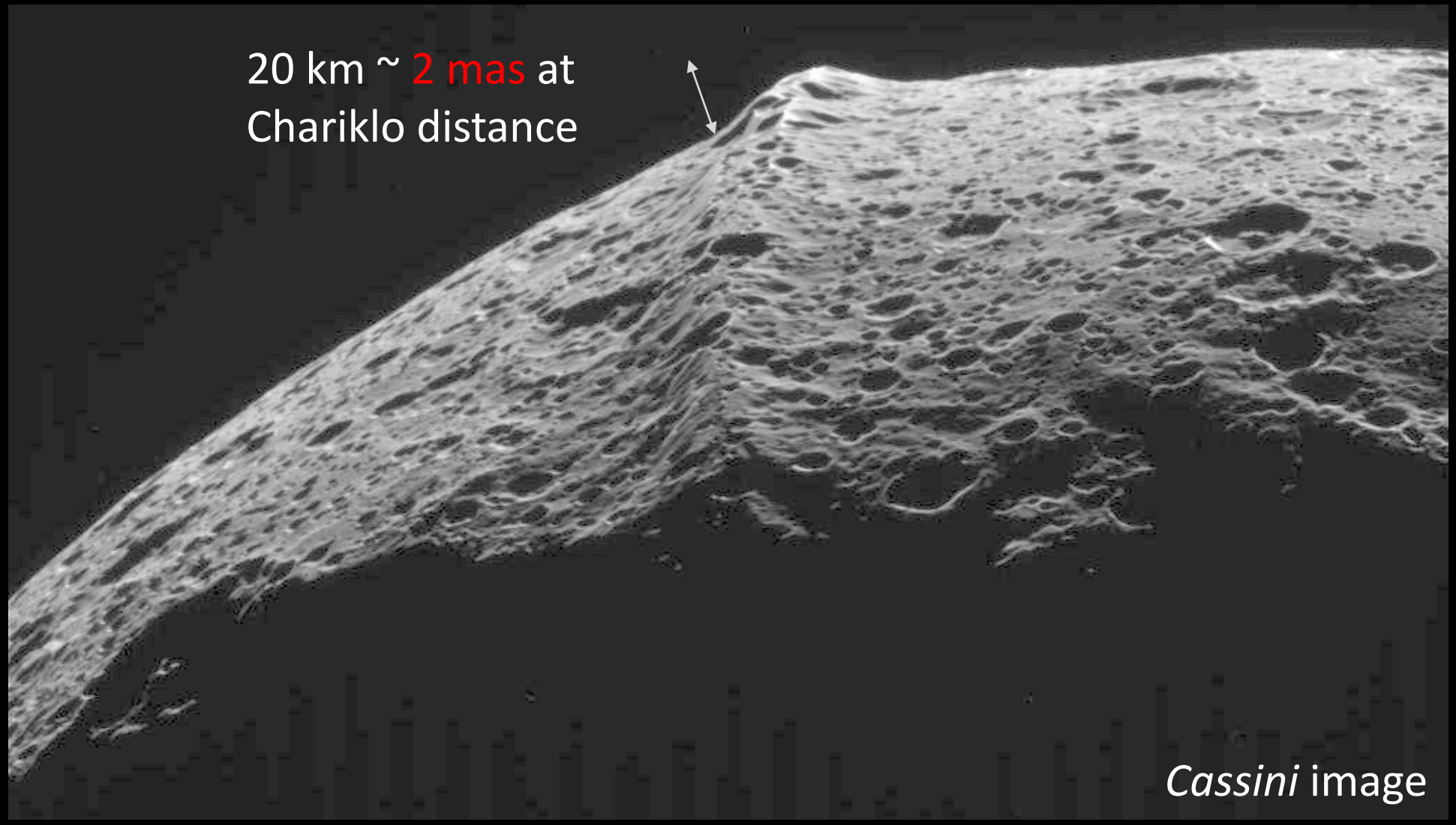


occultation par le géocroiseur Phaéton (diam. 5 km), P. Tanga+

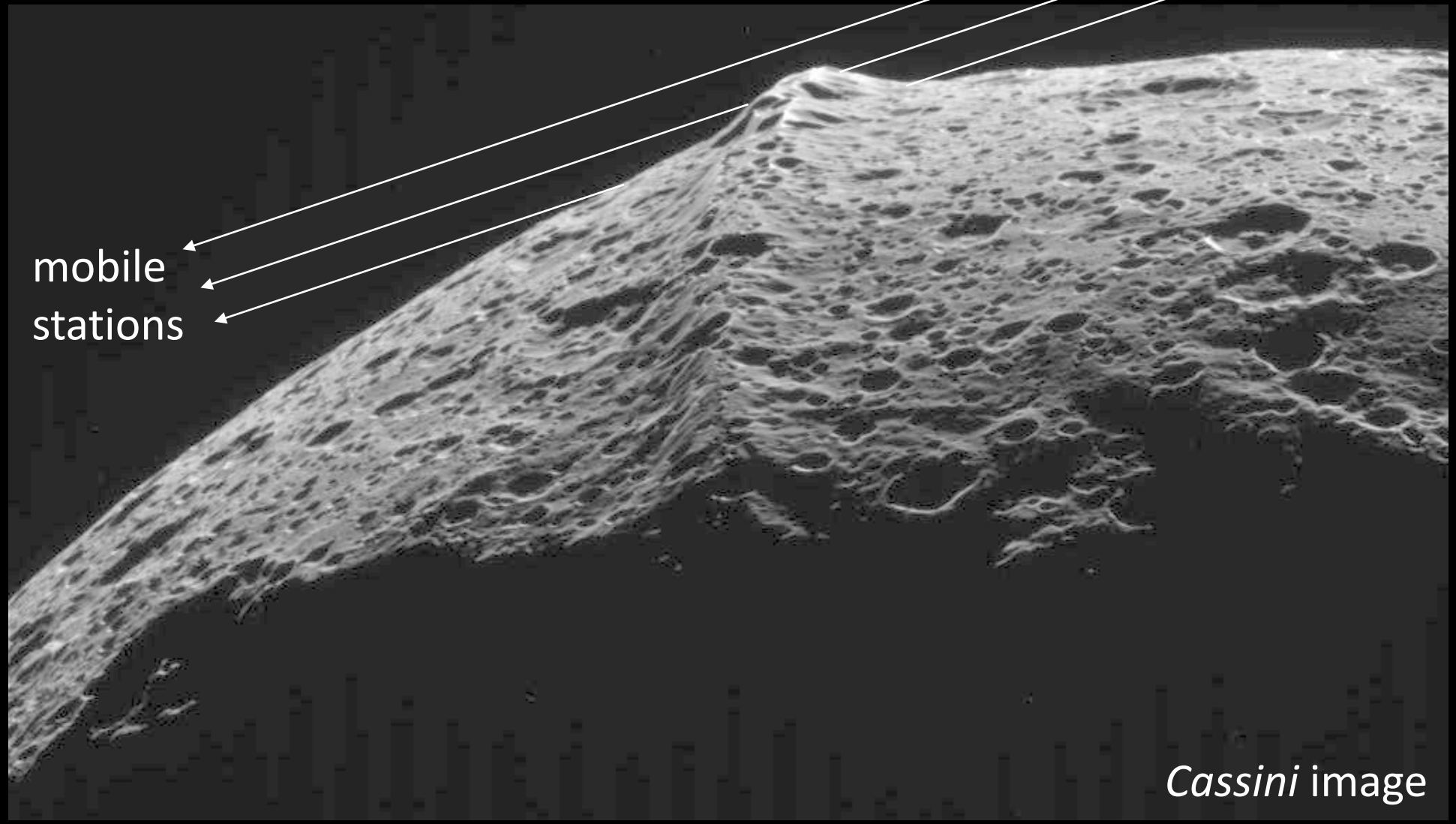


source: http://occultations.ct.utfpr.edu.br/results/

Iapetus equatorial ridge



Iapetus equatorial ridge, etc
an illustration of what can be done
using grazing occultations



Futur (proche…)

de manière générale: accès à un très large échantillon d'objets, en taille et en distance → "Big View" du système solaire

forme et taille de géocroiseurs → évaluation des risques en cas d'impact

détection de l'effet Yarkovsky sur des d'astéroïdes (évolution orbitale due à des effets thermiques) → âge de familles collisionnelles

découverte de nouveaux systèmes d'anneaux autour de petits corps

découverte d'atmosphères autour de corps composés de glaces volatiles

détails topographiques à la surface de petits corps ("géologie")