2014 Uranus storm activity observations by amateur astronomers

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Context

1986: faint activity (Voyager)

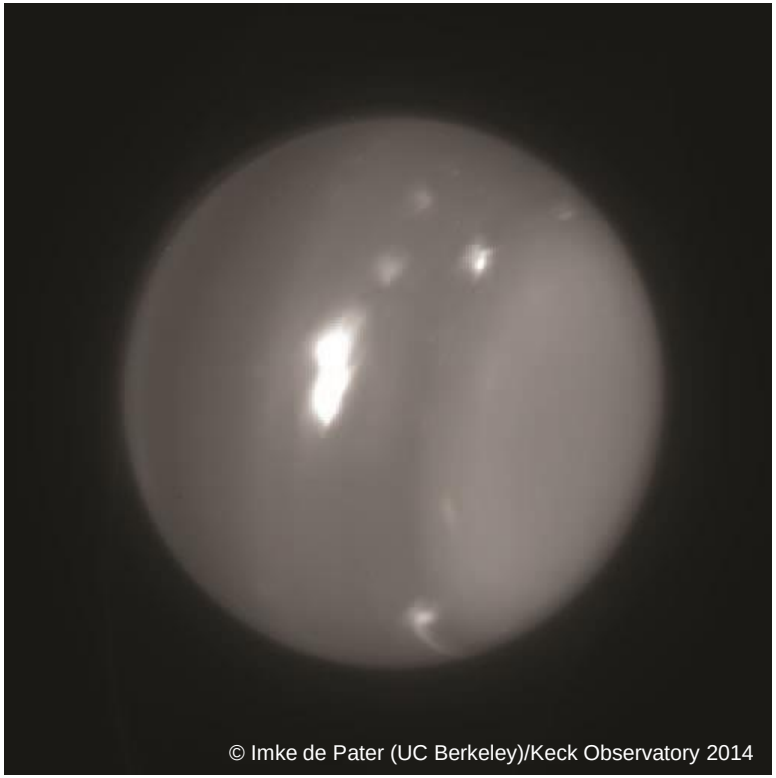
1994: discrete clouds (HST)

1997+: growing # of clouds (HST, IRTF)
2000+: regular Keck detections
2004-2009: major long-lived storm “Berg” in Southern hemisphere

2007: spring equinox

2011: activity observed in 2011

2014: Major outbreak detected with Keck on Aug. 5th/6th



Hammel H. et al. 2005-New Cloud Activity on Uranus in 2004-First Detection of a Southern Feature at 2 .2 microns - Icarus jan. 2005
Sromovsky L. et al. 2012: Episodic bright and dark spots on Uranus, Icarus vol.220 issue 1 pp 6-22, 2012
de Pater I. et al. 2015 - Record-breaking storm activity on Uranus in 2014 - Icarus vol.252 pp121-128 2015

Story

- After **Keck** observations of several spots, **call for amateur** observations of **brightest "Feature Br"** (K0) from Larry Sromowsky

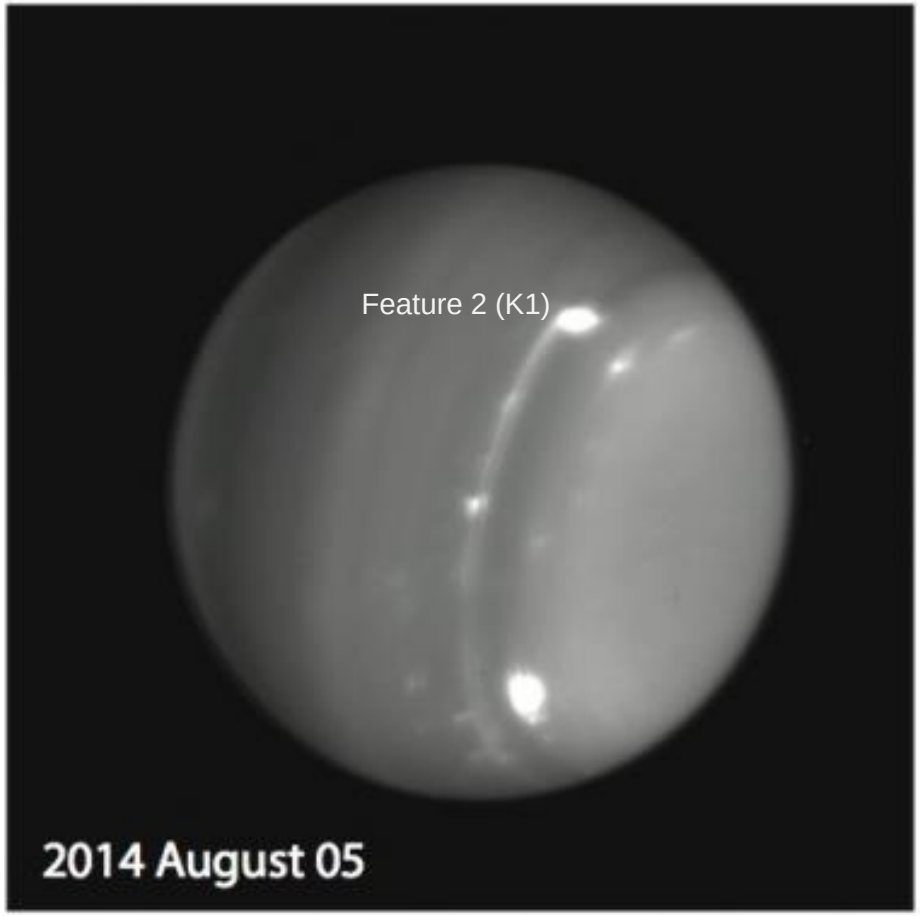
- **2nd observation of Br at Keck** on August 20th

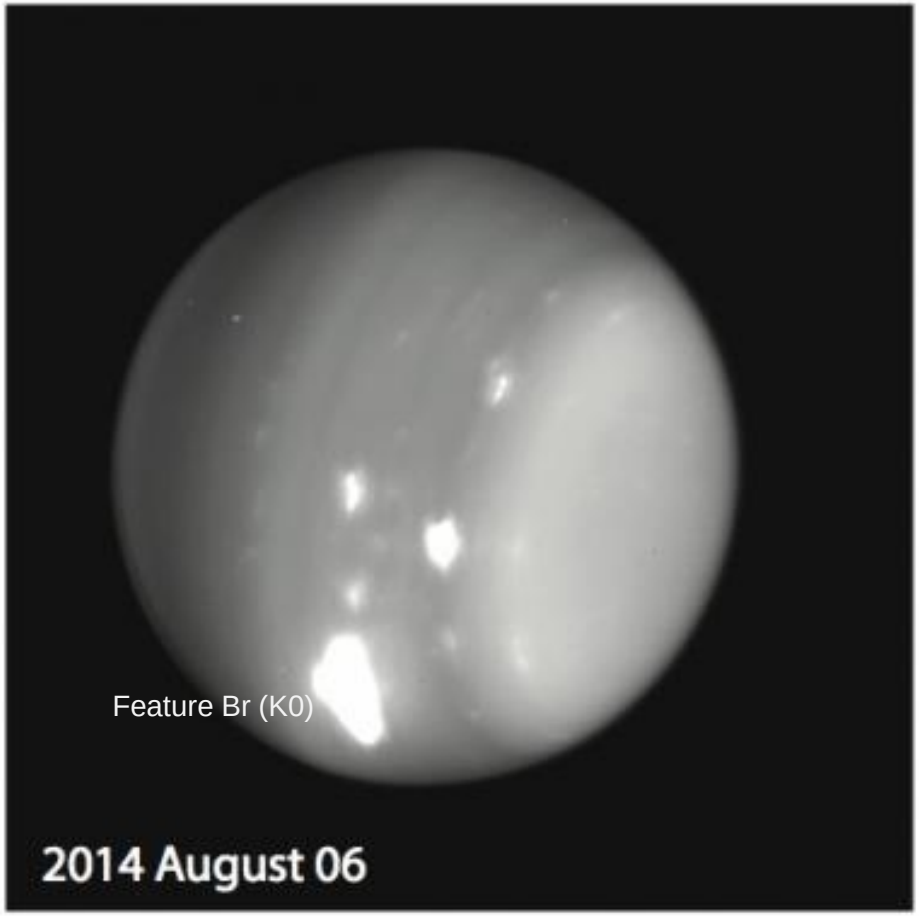
- **1st amateur observation** and confirmation of **bright spot "Feature 2** (K1)" by French amateurs Régis De-Bénedictis, Yann Le-Gall and Pascal Bayle (analyzed by Marc Delcroix)
  Leads to accurate drift rate calculation and **prediction** for Feature 2 allowing **usage of HST (ToO)** and **other professional telescopes** (Pic du Midi, WHT, GTC, VLT, Keck) targeting the storm

- finally **19 observations of Feature 2 from 10 amateurs** most of which planned their observation according to the prediction

2014 Uranus storm activity observations by amateurs

Marc Delcroix





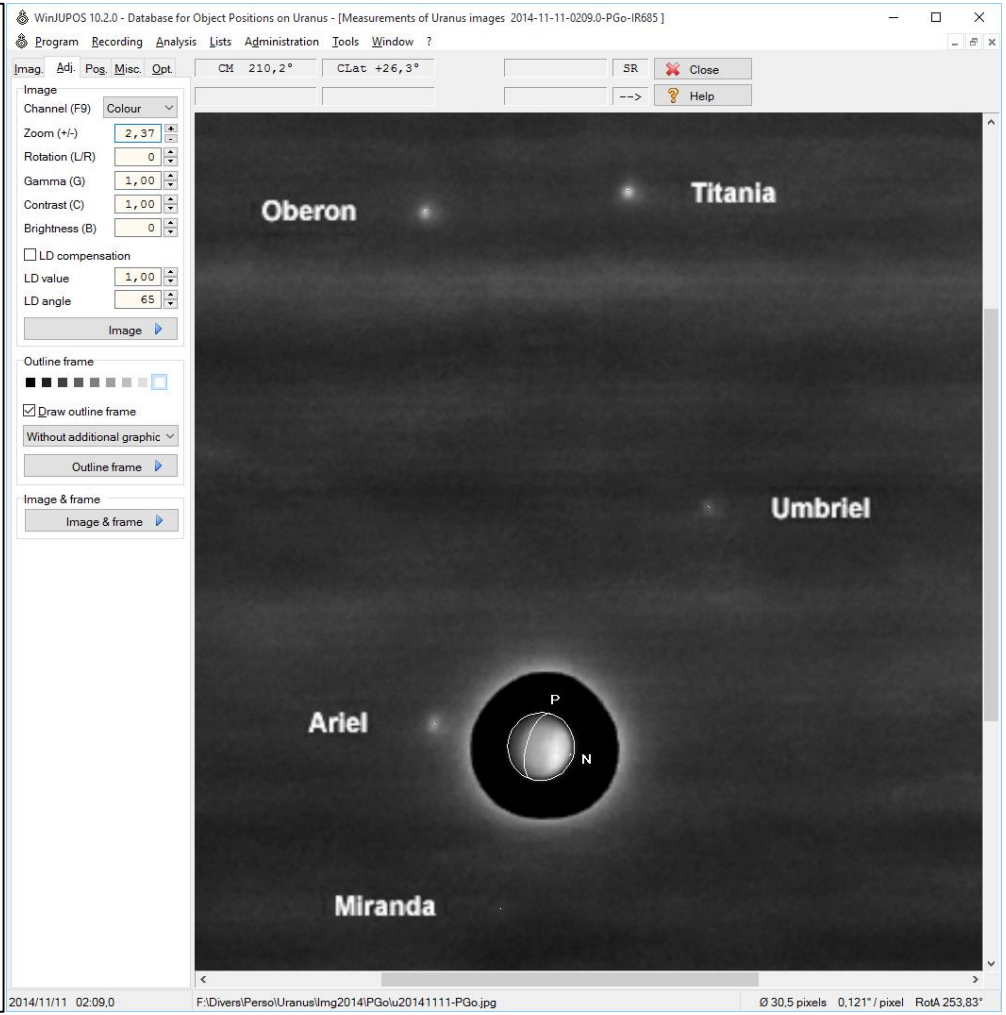
Data

- **Observations from amateurs** :
  - From Sep. 11th 2014 to Nov. 19th 2014 (2 months)
  - From 19 amateurs astronomers from all around the world (France, USA, Australia, Russia, Romania, Greece)
  - in **infrared wavelengths** (longpass filters>610nm, 685nm, …)
  - 73 potential white spots measurements
- **Analysis** with WinJUPOS software by Grischa Hahn) identifying one persistent bright white spot
- Longitudinal drift rate measurement after selection of measures

Data measurement

Prerequisites required for **best measurements**

- **acquisitions** duration **limit** (~15min ?) to avoid elongation of feature
- **Mid-time** acquisition information (7.5min difference implies 2.6° CM difference)
- **Satellite(s) visible** for calibrating contour orientation (not enough features visible on the planet) and size (turbulence and processing makes it very variable)



First amateur confirmation Sept. 11th

Uranus - 2014-09-11 - R>685nm (30min acquisition of 300ms exposures, gain 95%, orientation detfined from Ariel/Umbriel/Oberon)
diam. 3.7" - mag. 5.7 - alt. 48° - L_{sun}=14°, D_{sun}= 26.2°, D_{earth}= 27.5°

02h51UT CMI 254.6°
(unsharp mask, resized x200%, 30min acquisition, 2500 frames)

Measures of spot's position:
(longitude, planetographic latitude)
02h51.0 UT: 271.8° +/-5° L1, 35.1°N +/-5°

02h43.5UT: 273.5° +/-5° L1, 34.8°N +/-5°
02h58.5UT: 271.0° +/-5° L1, 35.1°N +/-5°

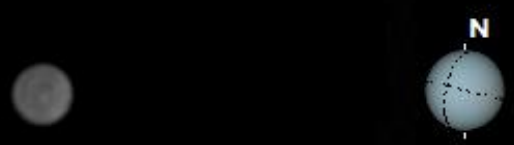
02h43.5UT CMI 252.0°
(slight unsharp mask, resized x200%, first 15min)

02h58.5UT CMI 257.2°
(slight unsharp mask, resized x200%, last 15min)

Régis DE-BENEDICTIS (analysis by Marc Delcroix) - France
Schmidt-Cassegrain 356mm - PLA-Mx - 0.067"/pixel (0.115"/pixel at acquisition)

Sept. 27th

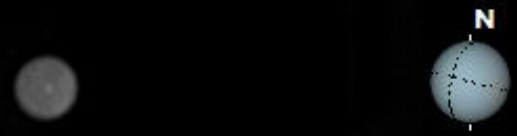
brightness increase at CM, deep cloud ?



Uranus 2014/09/27 01h43 ut
CM 329,6°

Redim 200%

LE GALL YANN
NEWTON 374mm F/D 23
MANTA 283
FILTRE IR 685 BAADER
ADC



Uranus 2014/09/27 02h13 ut
CM 340,1°

Redim 200%

LE GALL YANN
NEWTON 374mm F/D 23
MANTA 283
FILTRE IR 685 BAADER
ADC

Oct. 1st

brightness increase at CM, deep cloud ?

Oct. 2nd


A bright storm on Uranus
Filter: 650 - 850nm
Capture time: 15 minutes @ 6.6fps
Uranus 2 Oct 2014 15:18.8 Z CM:240.0
Anthony Wesley, Murrumbateman Australia

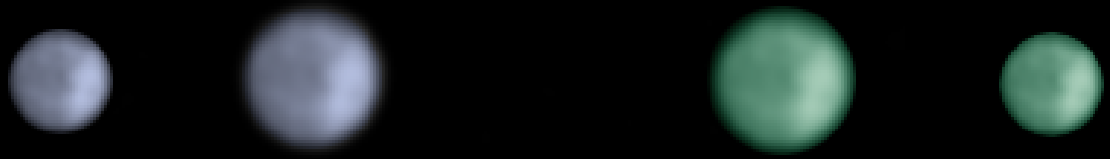
Oct. 4th

Amateur using 1 meter Pic du Midi telescope

Oct. 9th

iR610nM

False Colour



1.5X 2X 2X 1.5X

Contrast Filter
applied version

Uranus UT 14:36:00 October 9th 2014
C14 & ASI120MM-S
Exposure = 80mS FPS = 11 Duration 1600 seconds
Contrast filter applied
© Milika & Nicholas

Oct. 18th
(false color)

Storm on Uranus
Winjupos combined data between 1247UTC and 1435UTC
Filter 650nm longpass
False colour

Uranus 18 Oct 2014 13:48.0 Z CM:307.0
Anthony Wesley, Murrumbateman Australia

Results for Feature 2

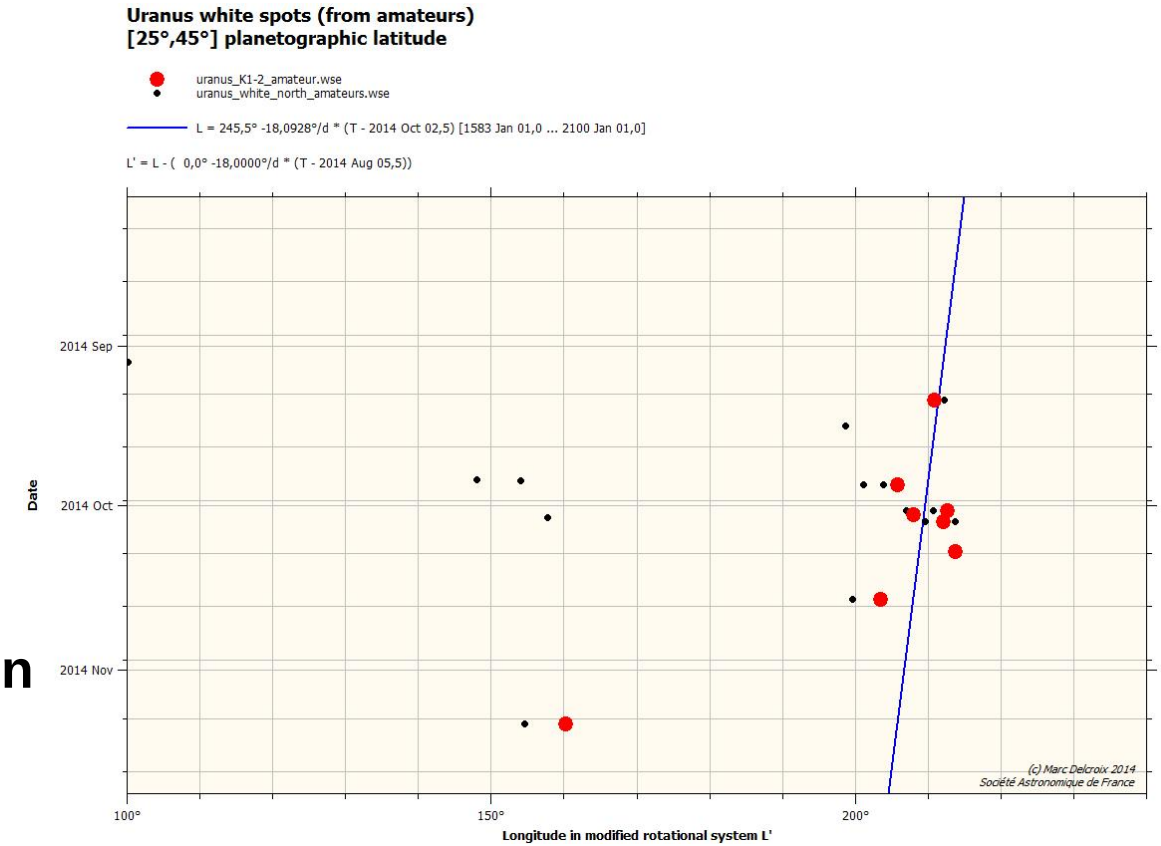
From amateur observations, after selection of the best observations for each rotation with Feature 2:

- observations for **7 different rotations** Sept.10th – Oct.18th

- average latitude
  34,4°N +/-0,8°

- drift rate estimation
  -18,09°/d +/- 0,14°/d

- longitude **standard deviation**
  +/-1,5°



Comparison with professional observations

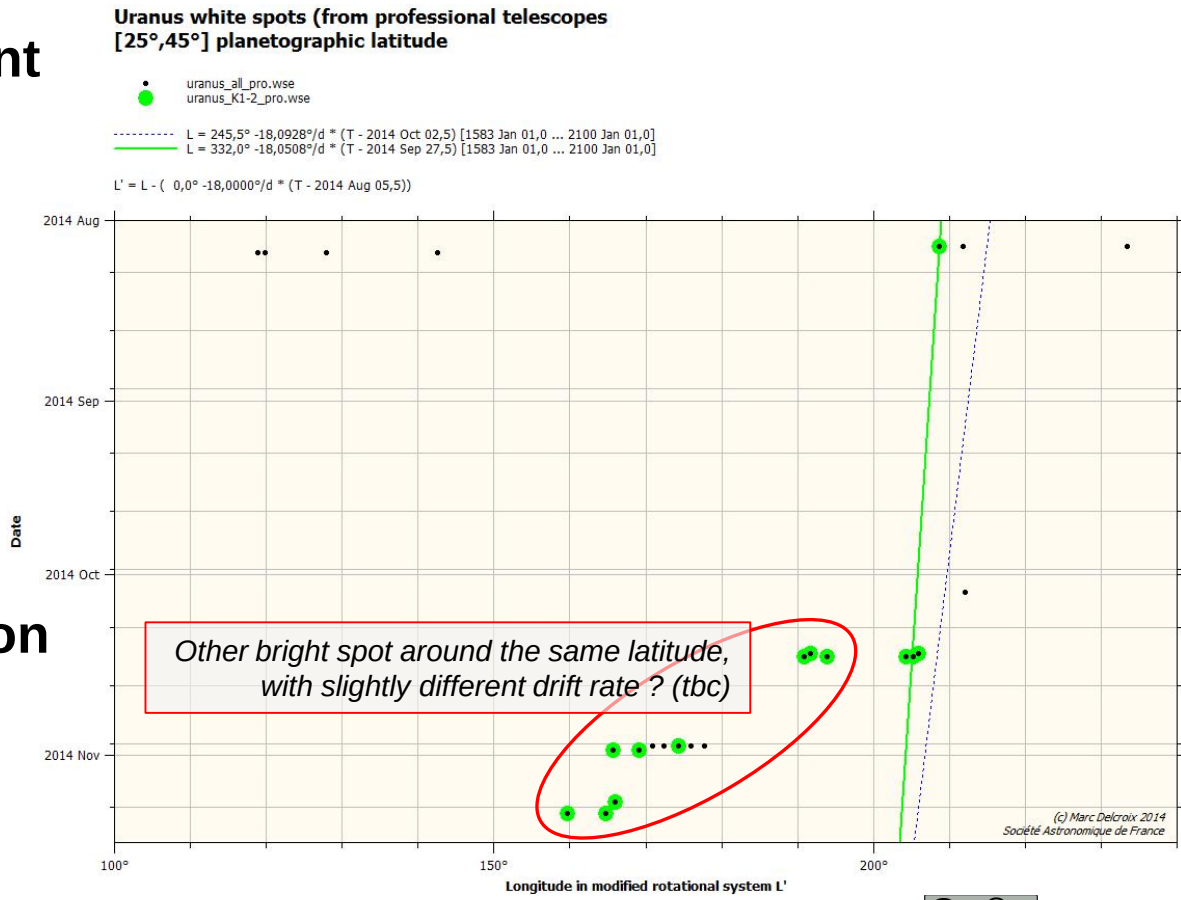
From professional observations, after selection of the best observations for each rotation with Feature 2:

- **4** observations for **2 different rotations** Aug.5th – Oct.15th

- average latitude
  33,3°N +/-0,4°

- drift rate estimation
  -18,05°/d +/- 0,01°/d

- longitude **standard deviation**
  +/-0,4°



Nov. 11th

(possible other spot)

Take away

- **Uranus, new frontier for amateurs**, deeper features accessible in broadband near-IR (<1µm)

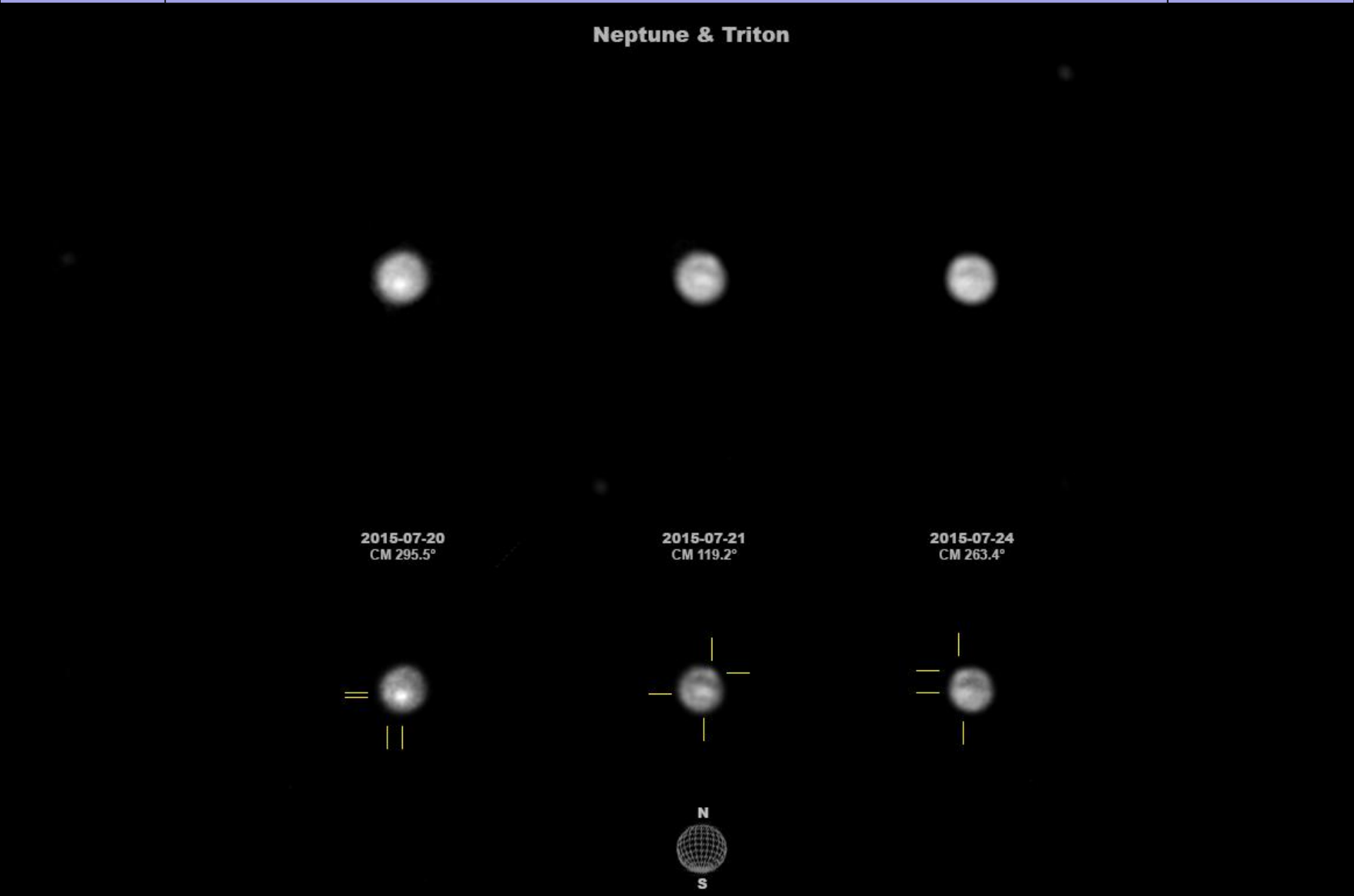
- Collaboration for **predictions targeting pro observations**

- Position **measures/drift** calculations **coherent with professional** observations

Next steps

- **Further analysis of Feature 2** data in broadband near-IR

- Next step …. also **Neptune in 2015** !



Neptune, July 2015 - Marc Delcroix