Bright features in Neptune on 2013-2015 from ground-based observations with small (40 cm) and large telescopes (10 m)

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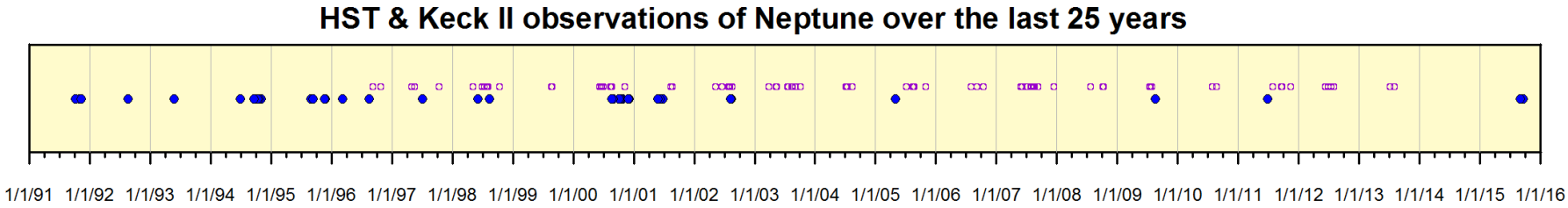
A. Obukhov, D. Peach,
C. Pellier,
A. Antuñano, J.F. Sanz-Requena,
and many others

Neptune: A difficult target for high-res imaging & small telescopes

Small Size (2.31-2.35 ")
Low brightness (Magnitude = 7.85; about 6,000 darker than Jupiter)
Low contrast of atmospheric features in the visible range.
Atmospheric features are contrasted in the near infrarred where the planet is at best 8 times darker.

But Neptune is also a difficult target for atmospheric dynamics: There is always a lack of enough temporal data.

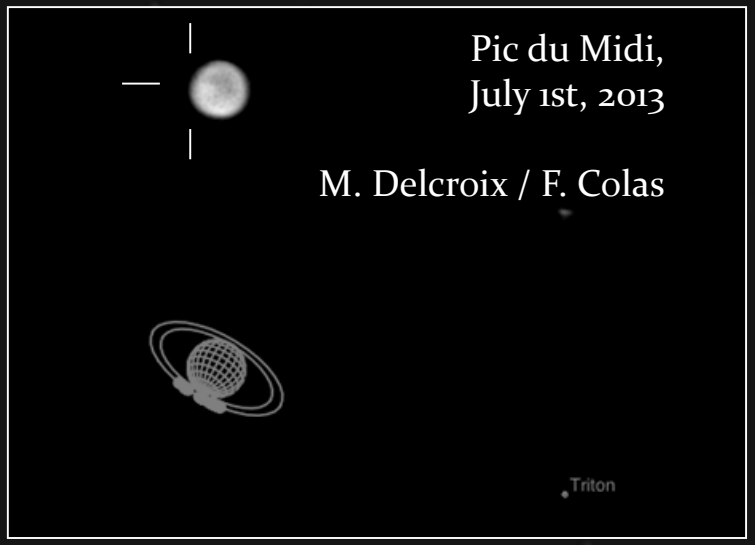


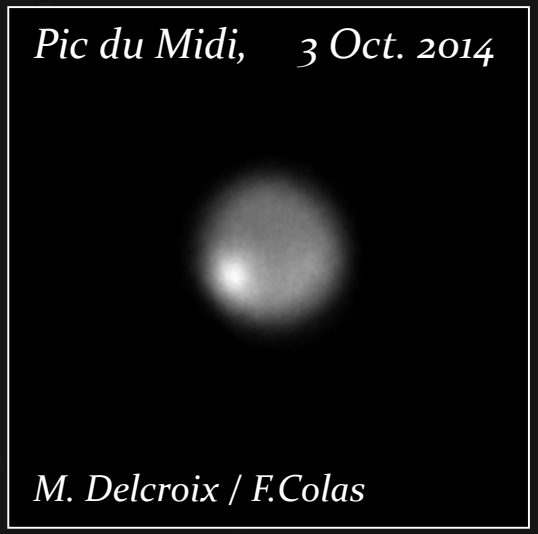
About 200 dates of Keck or HST observations over the last 25 years.
+ Observations by many other telescopes (VLT, IRTF...) with lower image resolution.

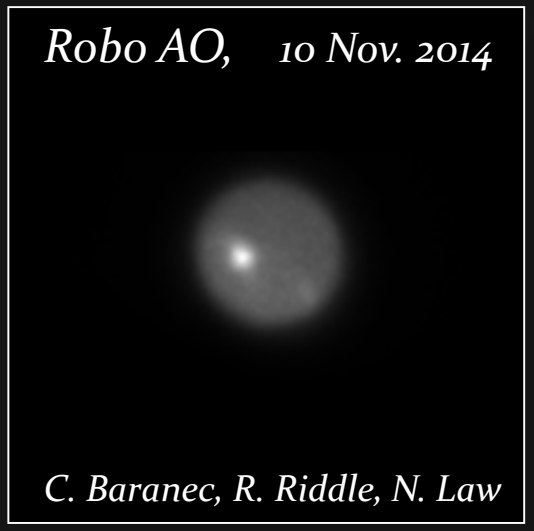
Small telescopes (if they are able to find atmospheric features repeteadly) may have a role in Neptune atmospheric sciences.

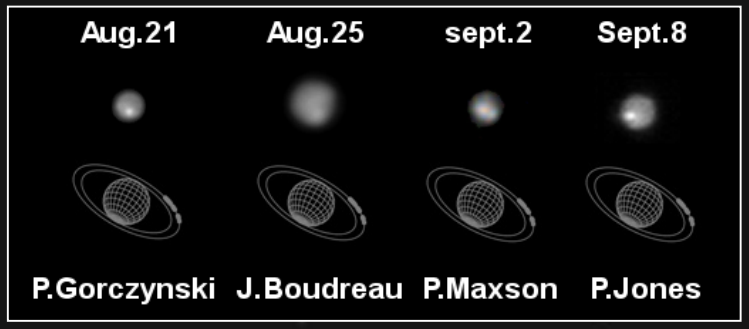
Background image from Michael Phillips

Neptune in 2013-2014:
First unambiguous detections of atmospheric features with small telescopes







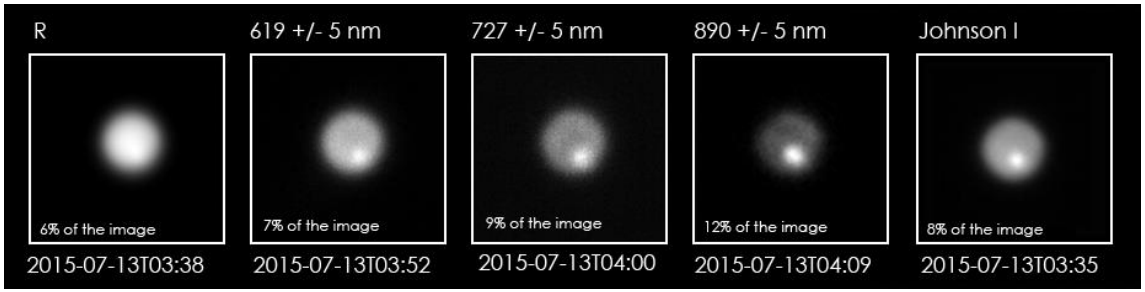


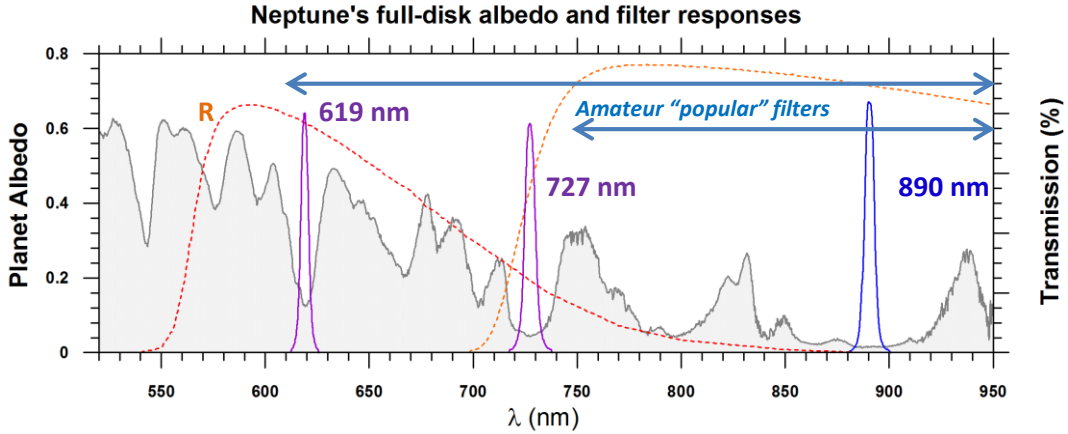
Latitude (Pg) = -47 ± 4°
u=-69 ± 7 m/s
3 months of tracking,
5 amateur detections

Latitude (Pg) = -38 ± 2 °
u=-88.8 ± 3.2 m/s

3 months of data,
9 amateur detections

2015: Further bright spots in Neptune

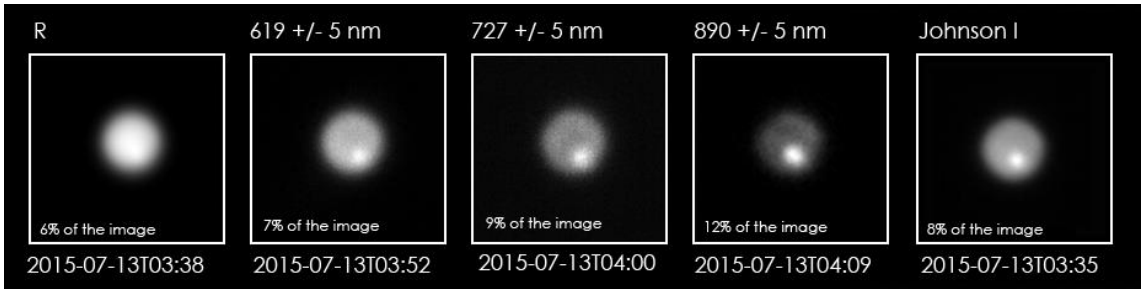


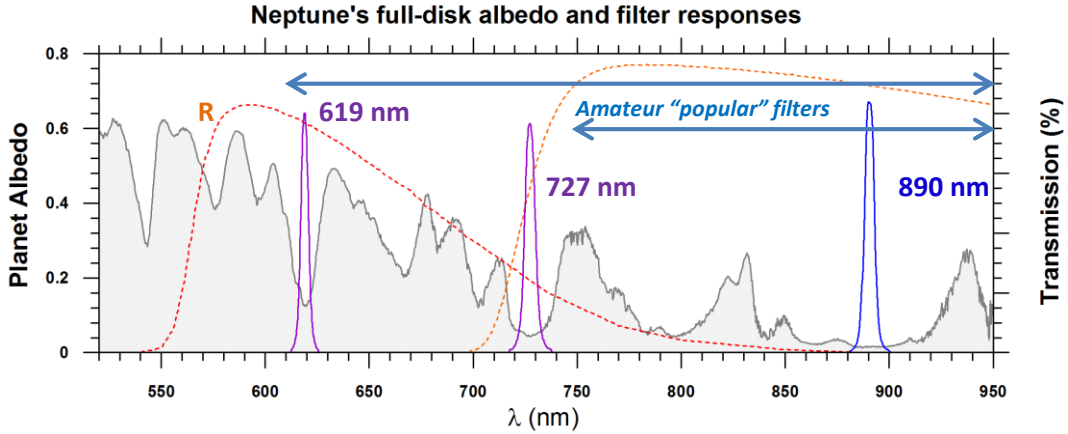


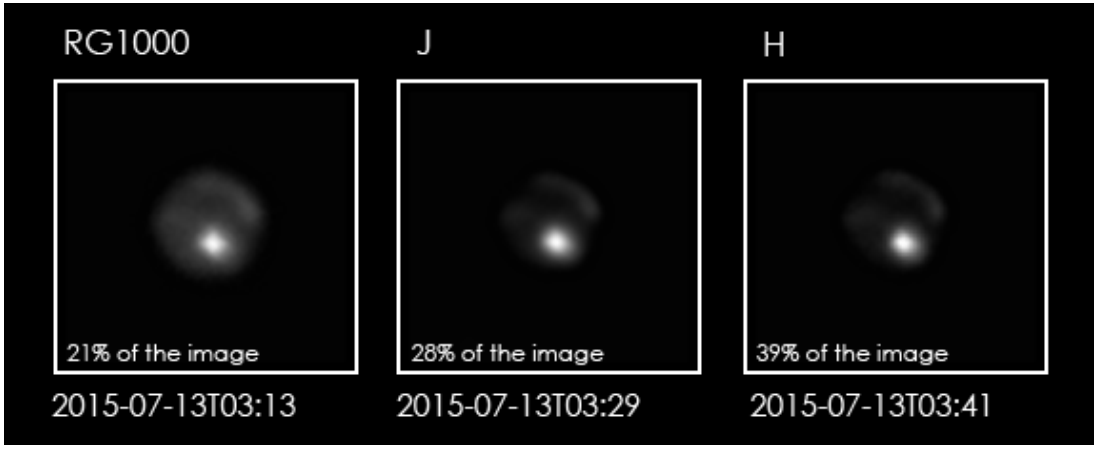
PlanetCam "lucky imaging" instrument in Calar Alto (Spain)
PI: A. Sánchez-Lavega

Contrast provided by the strong absorptions due to atmospheric methane

2015: Further bright spots in Neptune

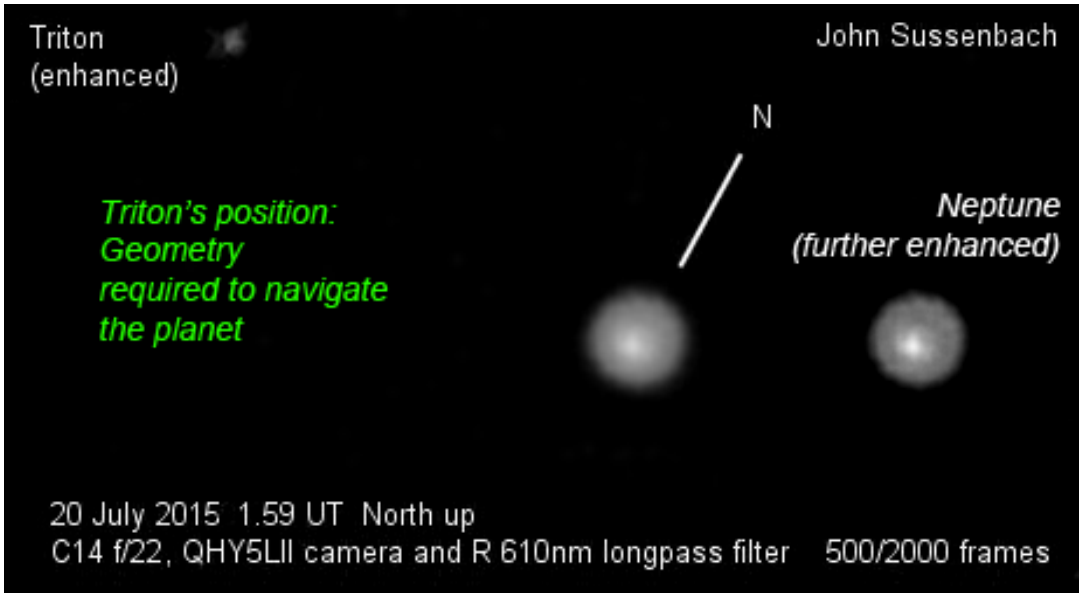


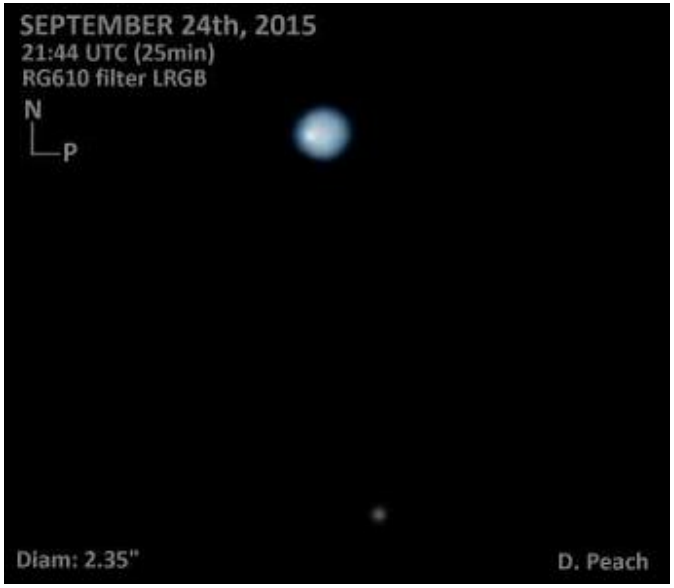


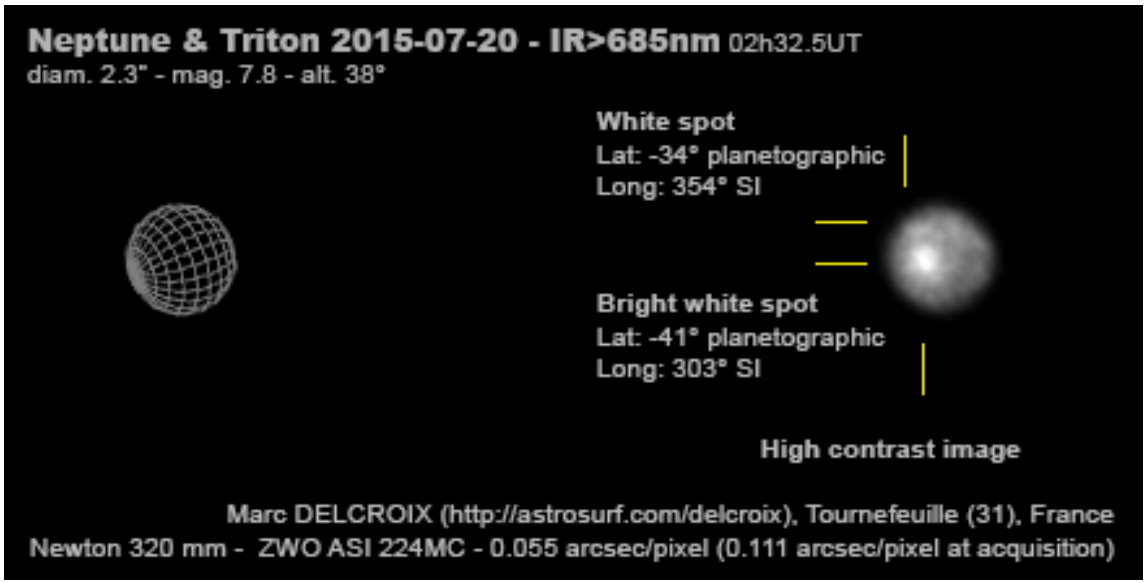


Contrast provided by the strong absorptions due to atmospheric methane

A challenge for amateurs



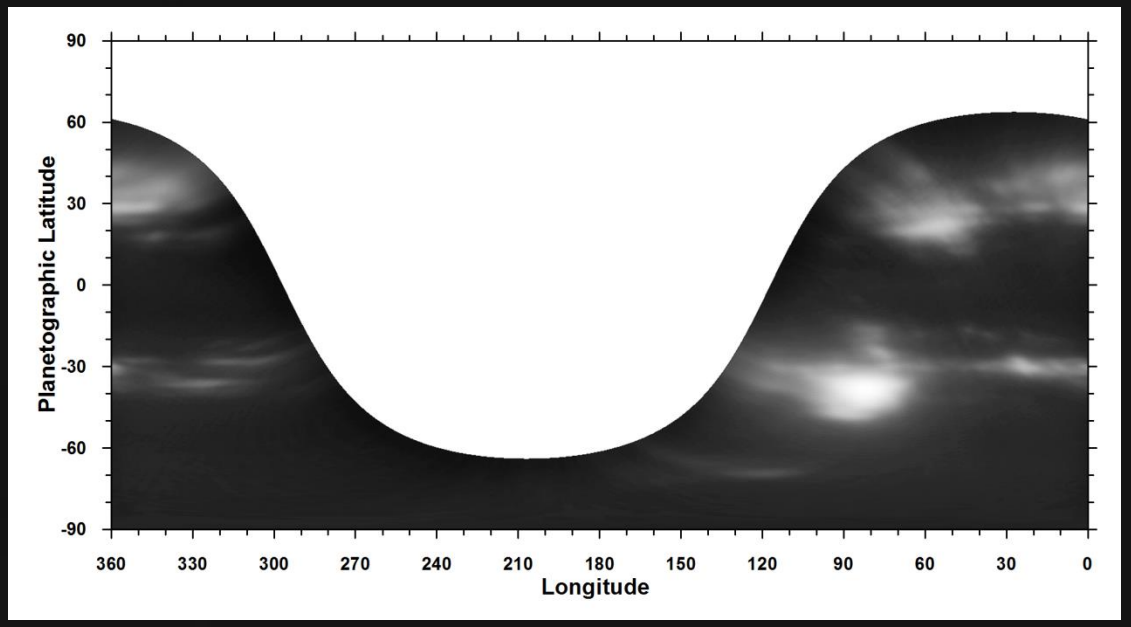


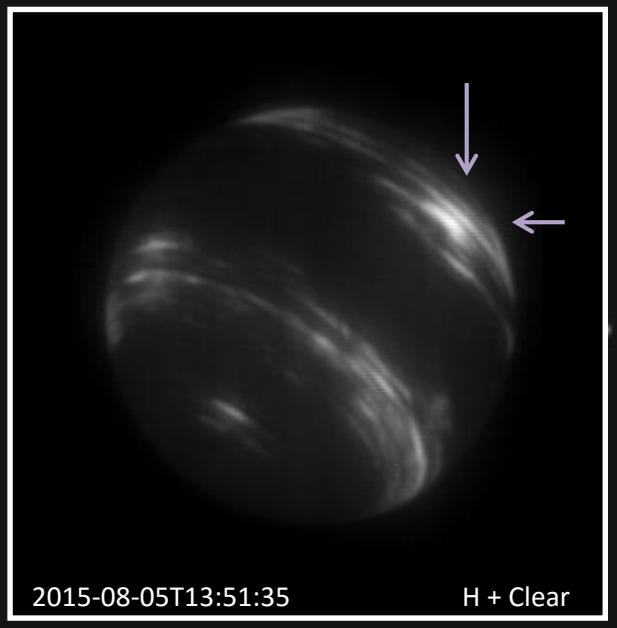


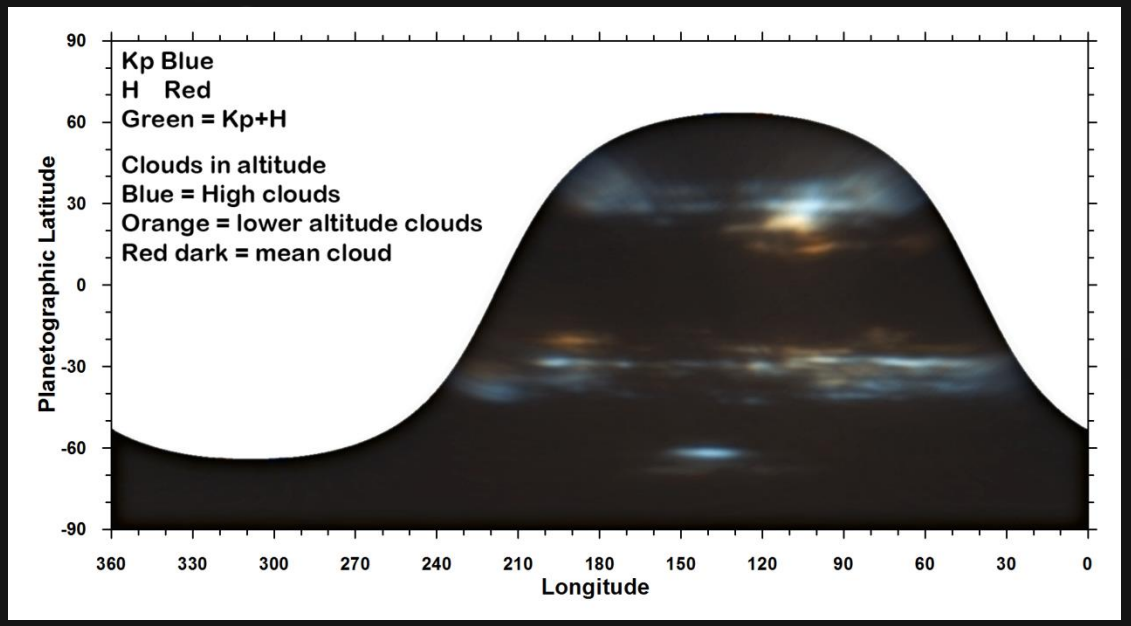
A challenge for amateurs really well solved

- **More than 90 positive detections of the same cloud feature from 18 amateurs.**
- **Several atmospheric features are observable on amateur data (not only the main bright sytem)**
- Observations from 28 cm – 50 cm telescopes. Last detection on 10 November.
- **Improvements in observational techniques specific for Uranus and Neptune widely diseminated now among amateurs.**

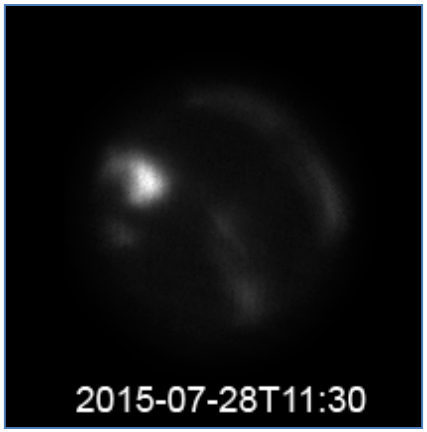
2015-07-25T15:32:08
H + Clear

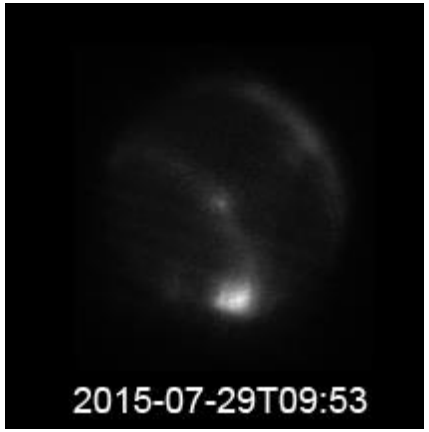

Planetographic Latitude
90
60
30
0
-30
-60
-90
360
330
300
270
240
210
180
150
120
90
60
30
0
Longitude


2015-08-05T13:51:35
H + Clear

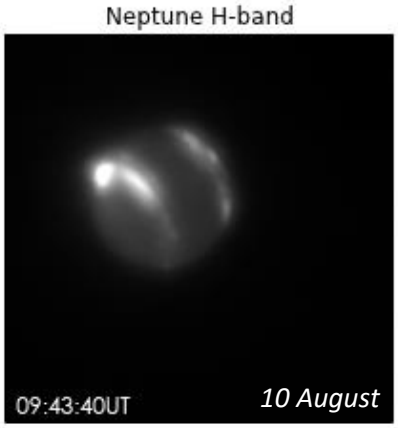

Kp Blue
H Red
Green = Kp+H
Clouds in altitude
Blue = High clouds
Orange = lower altitude clouds
Red dark = mean cloud
Planetographic Latitude
90
60
30
0
-30
-60
-90
360
330
300
270
240
210
180
150
120
90
60
30
0
Longitude

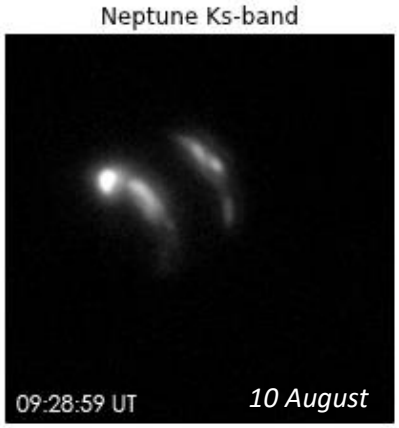
Palomar Hale Telescope (5m) with AO | Statia Luscz-Cook

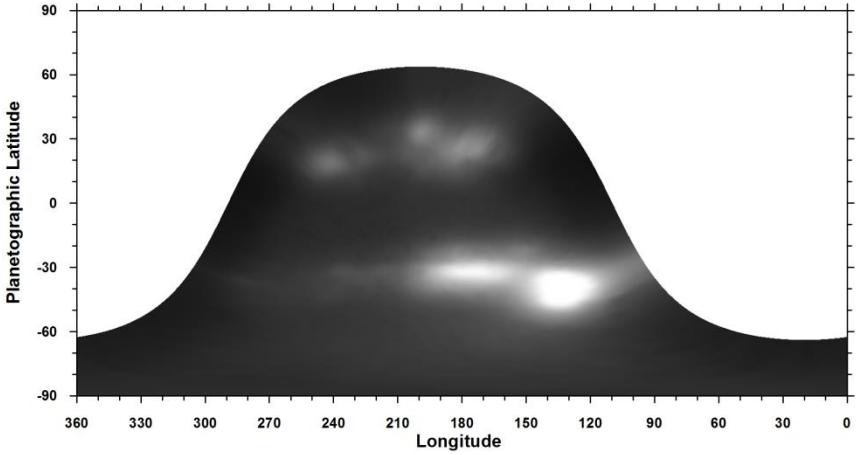




Lick Observatory – Shane 3 m telescope with AO | Katherine de Kleer

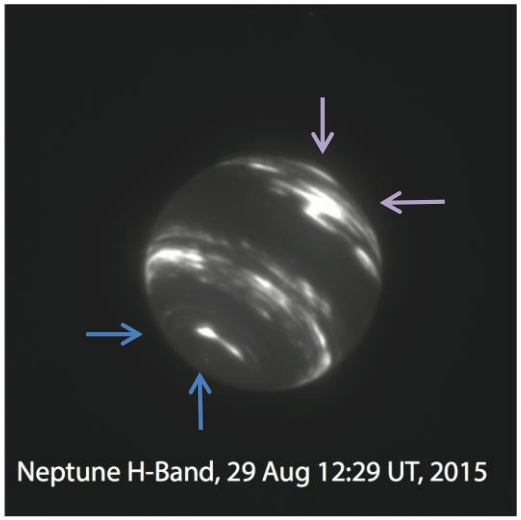


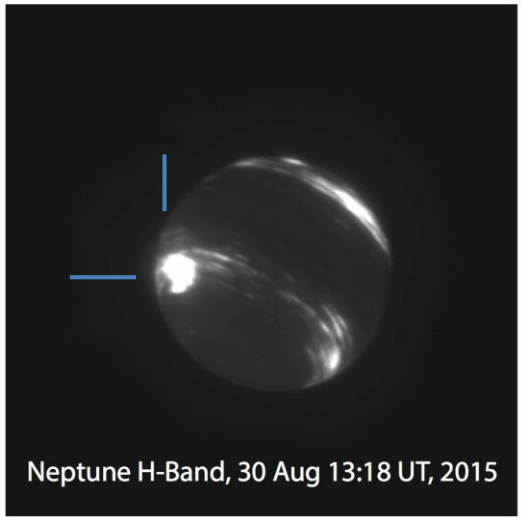




Keck II - NIRC: 29-30 August | PI: Imke de Pater

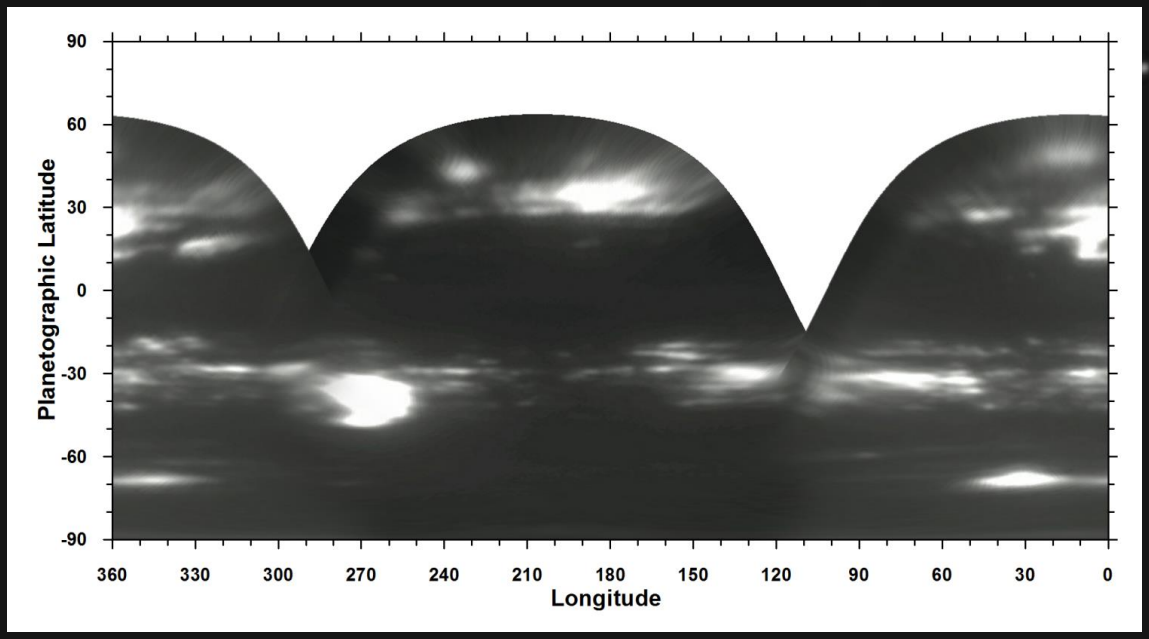
Keck observations, UT 29-30 August 2015. (Observer: Imke de Pater)

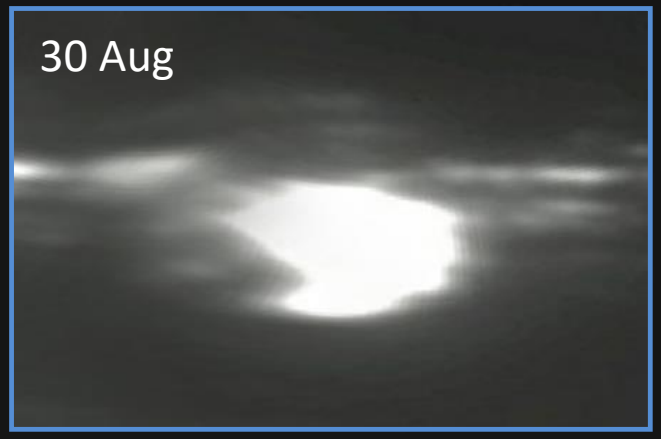


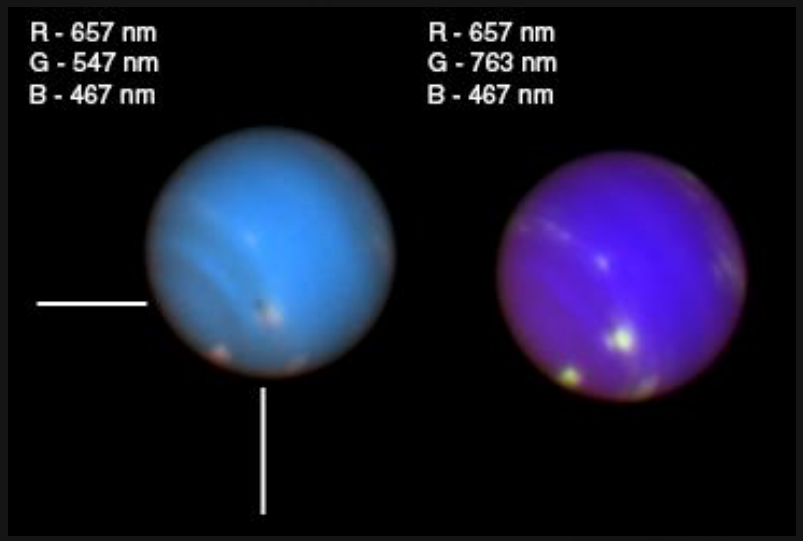


Key dataset to identify and confirm other atmospheric features, in particular in comparison with Lick data.

Shape preserved over 1 month but may be not the size. Small size decrease.



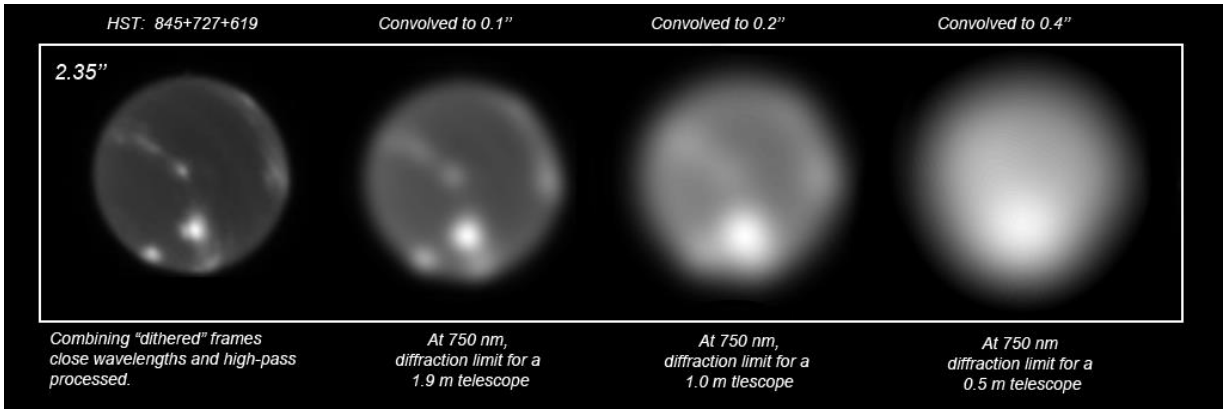


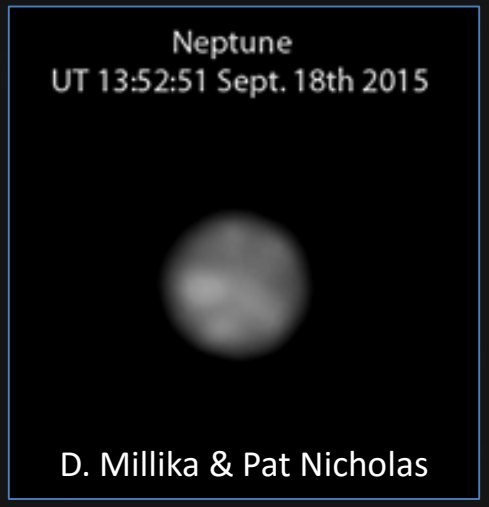


The bright large feature is accompanying a dark feature (possibly a vortex like the Great Dark Spot but much much smaller) .

Possible explanation of the long-lived nature of this feature.

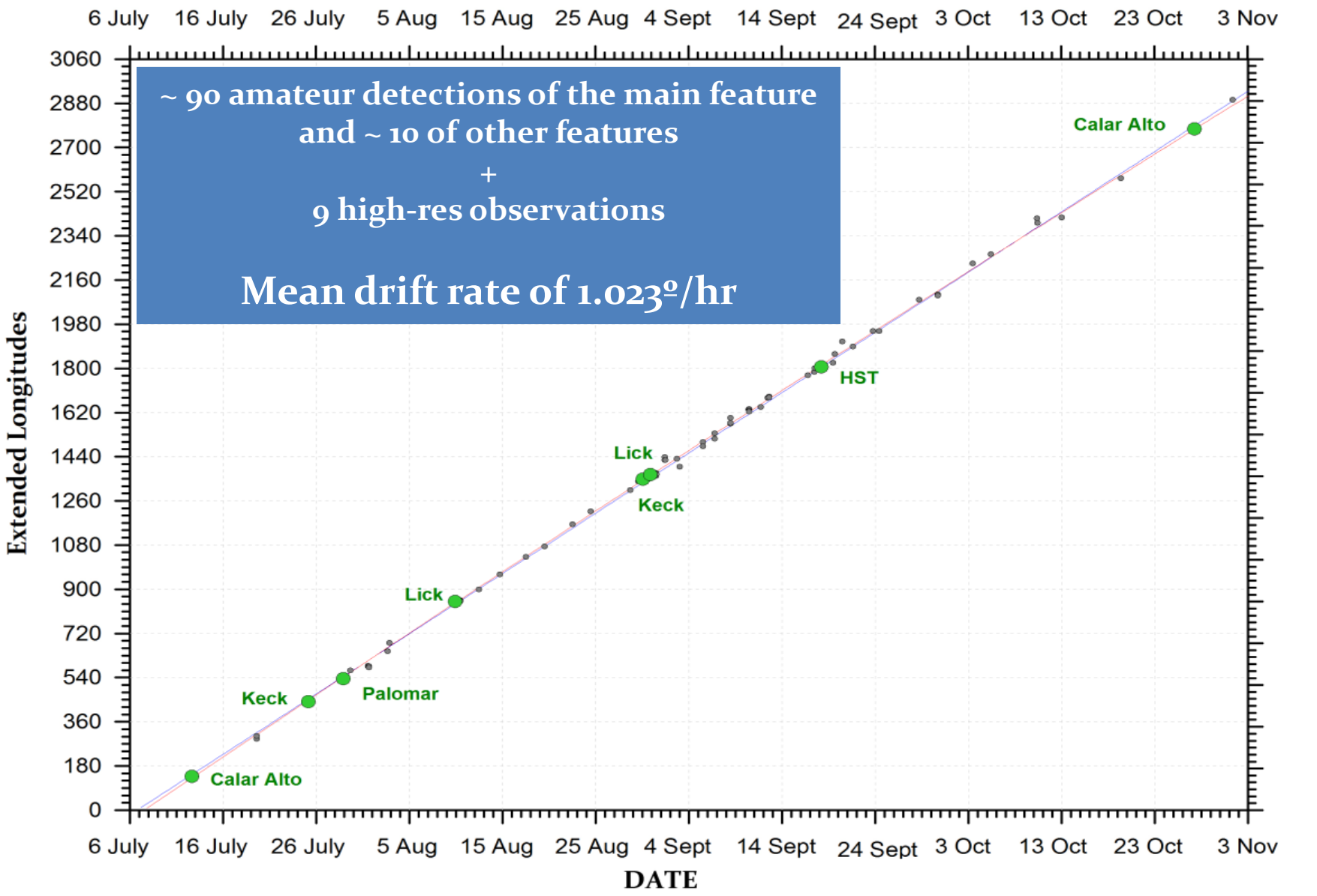
What are amateurs exactly seeing?





Evertyhing is real except for one single small artifact

2015: Amateurs take the challenge to regularly observe Neptune



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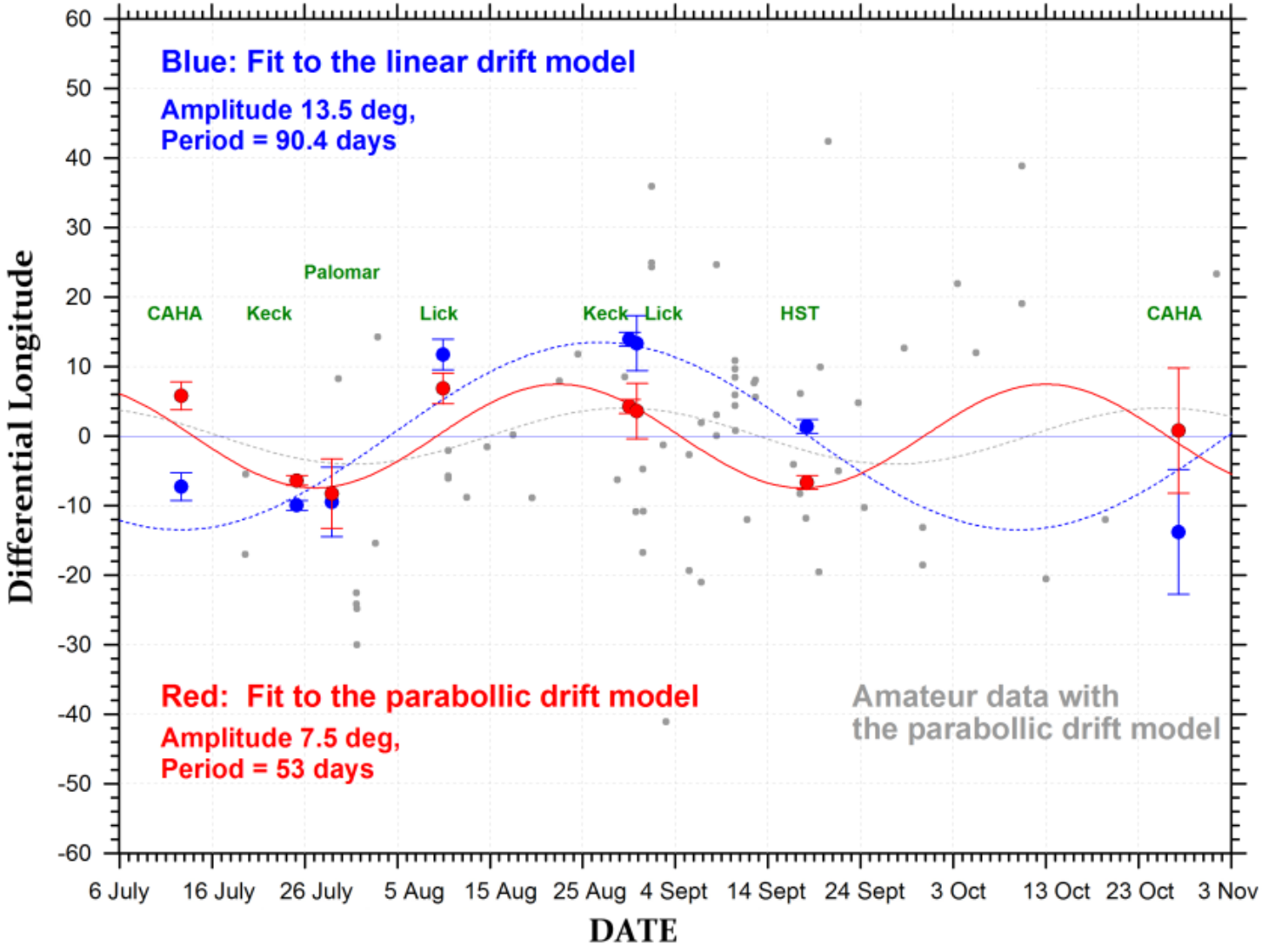
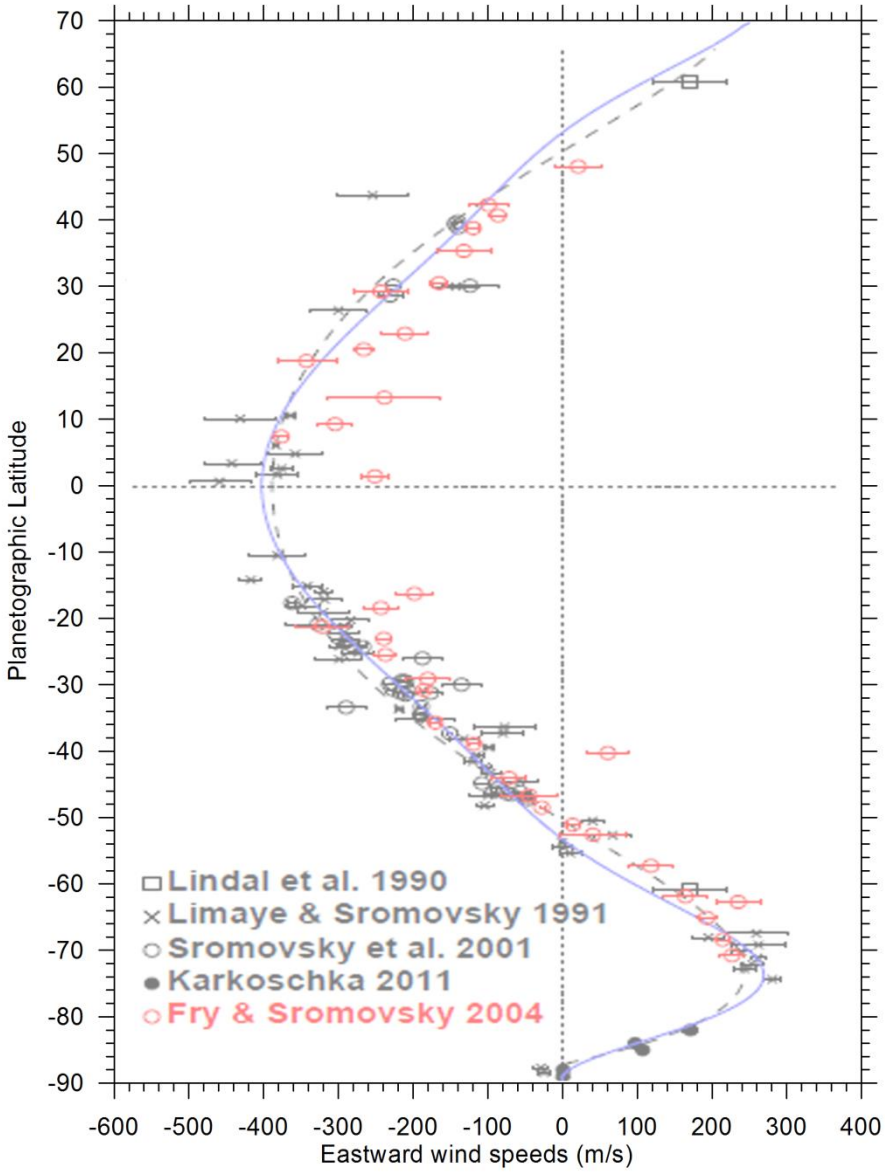


Wind results

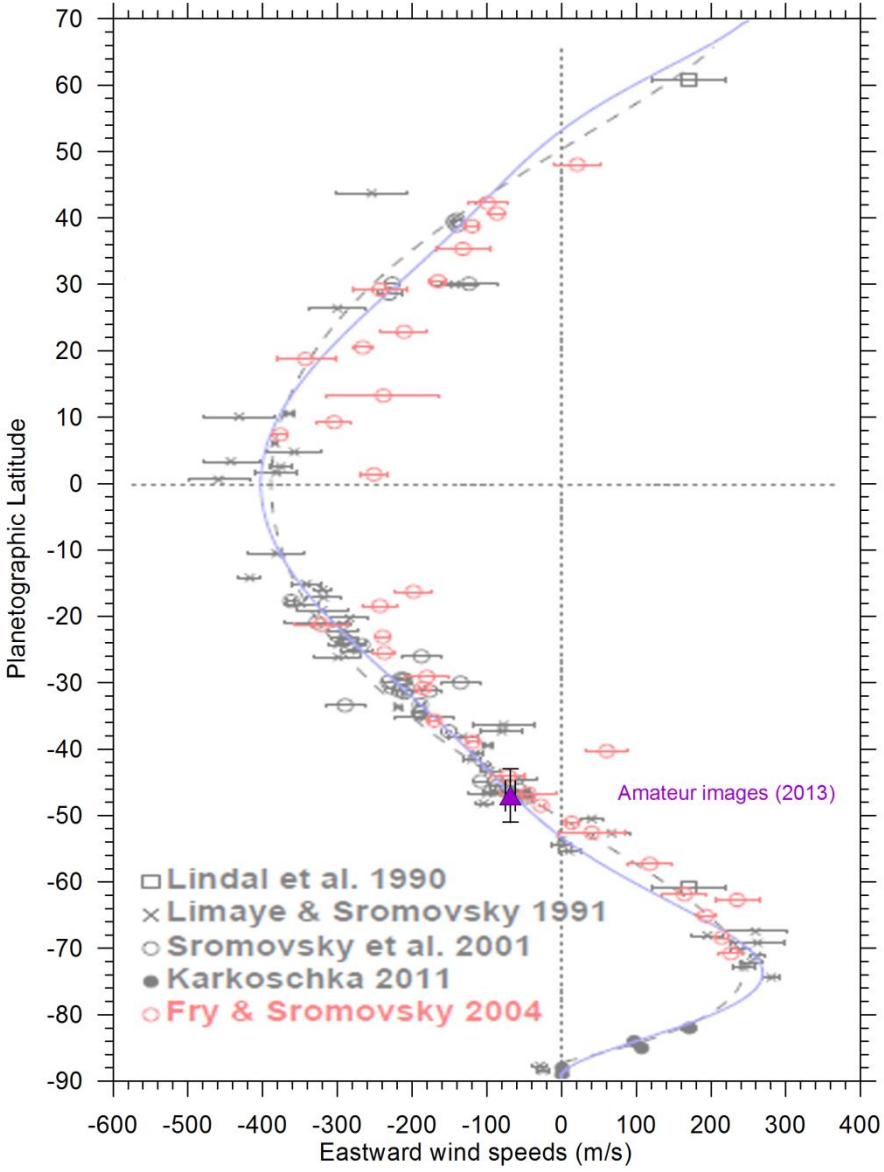


Background figure from:

Zonal Jets and Eddies - Planetary Science and Satellite Oceanography at the Crossroads - ISSI Team, editors: Boris Galperin & Peter Read
Cambridge University Press (submitted, 2015)

Figure compilation by Larry Sromovsky

Wind results



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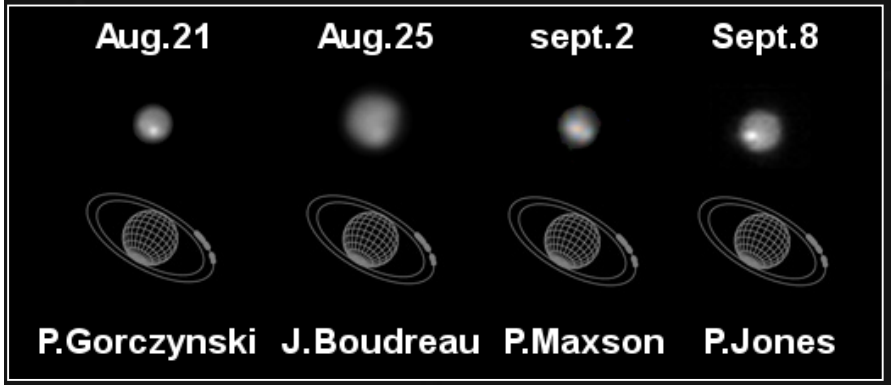

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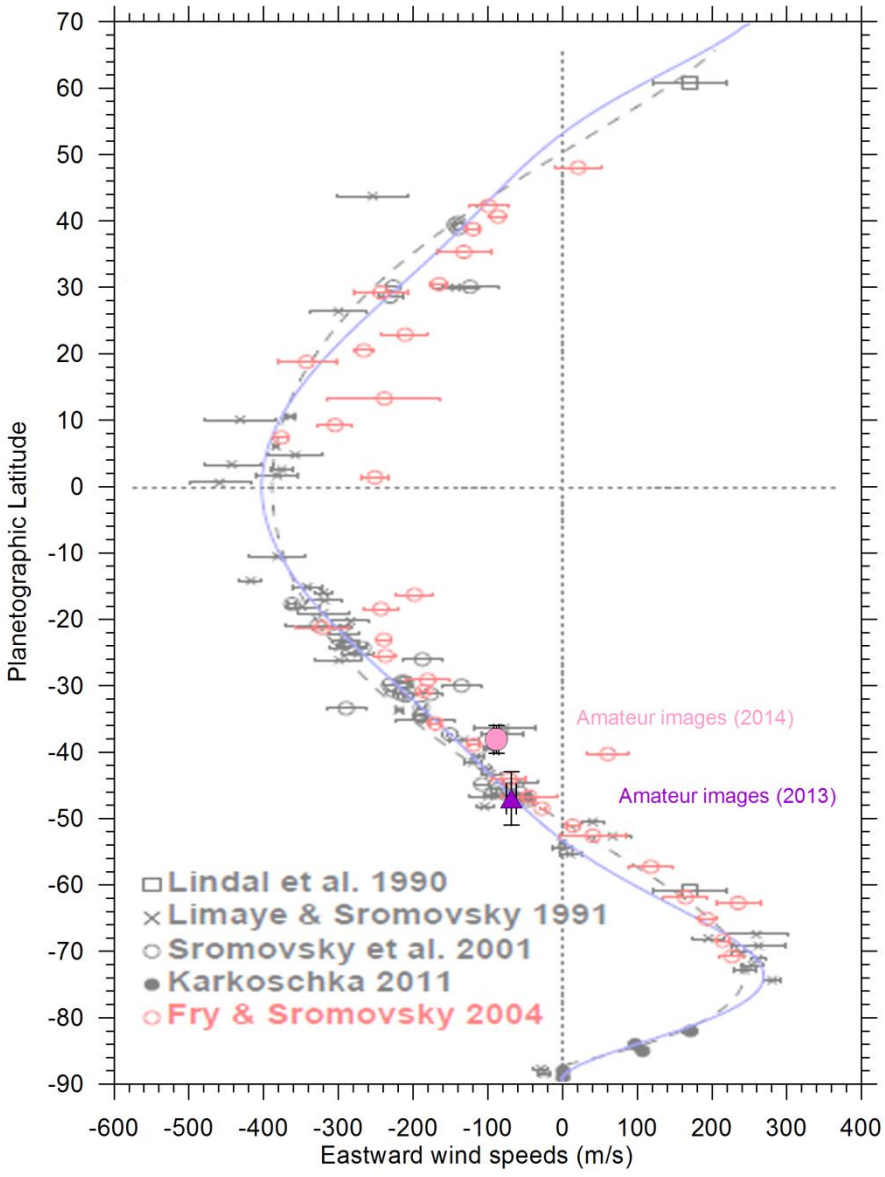

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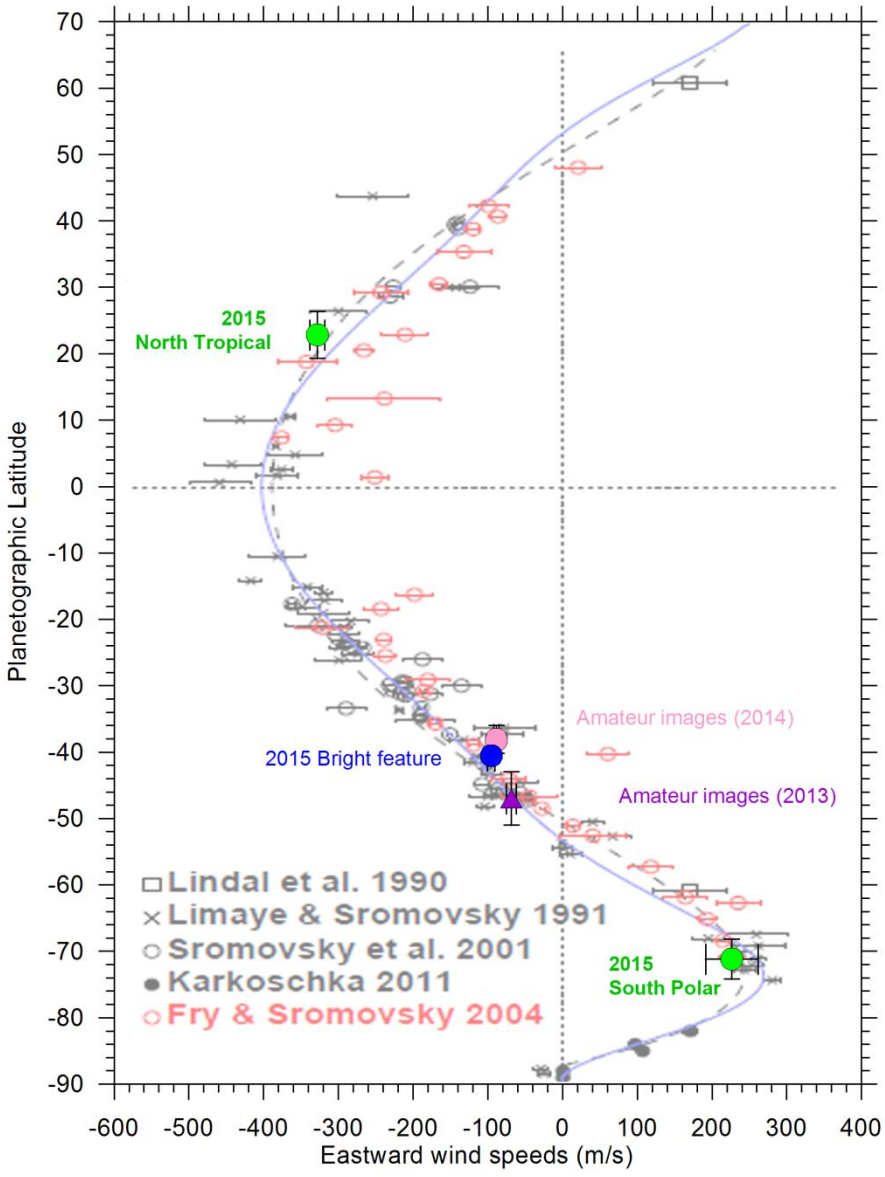

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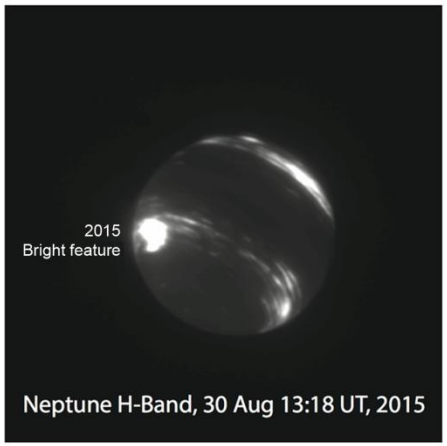

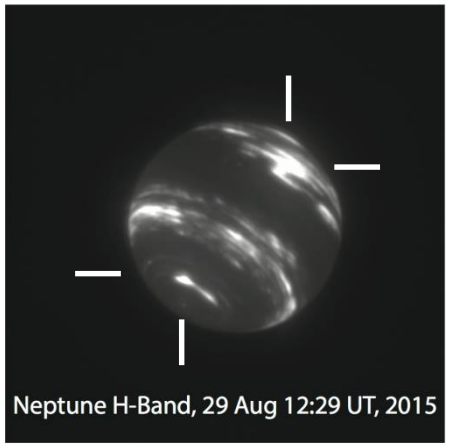

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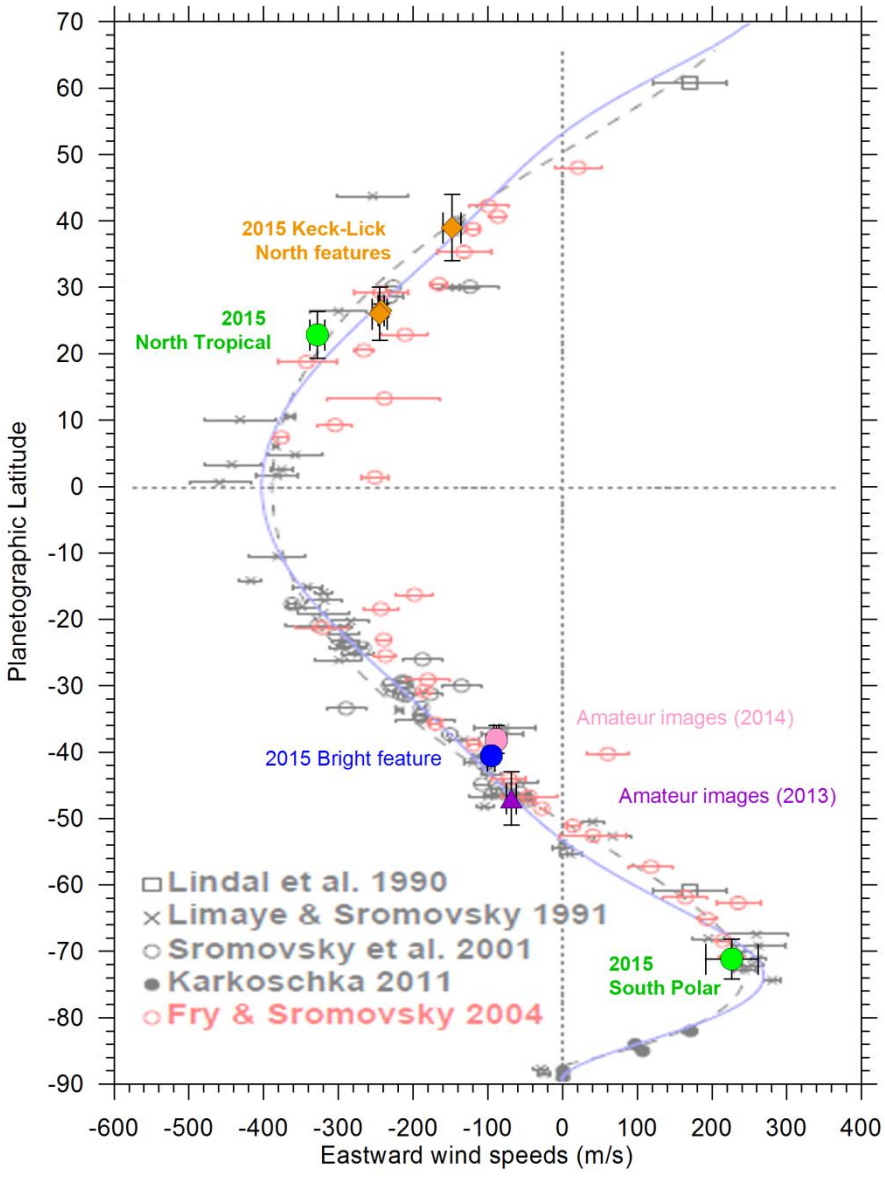

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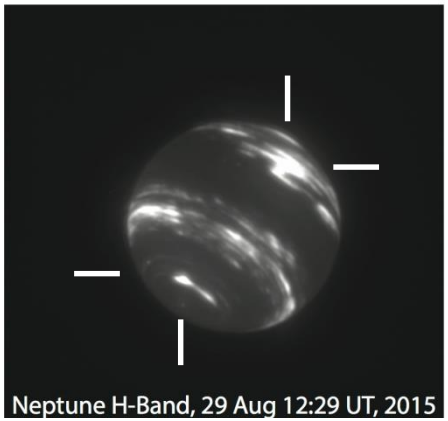
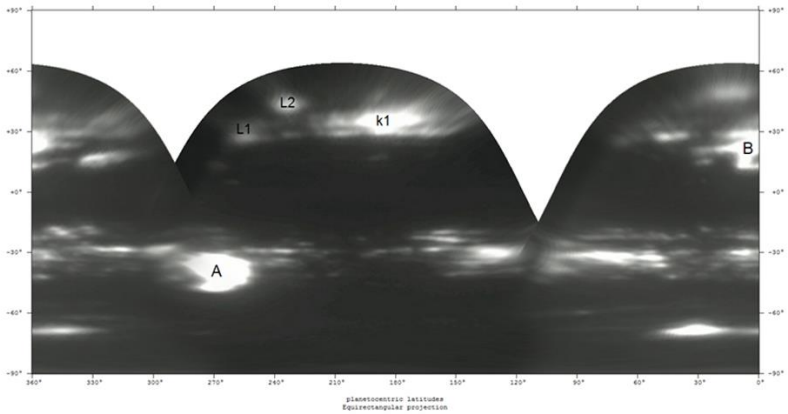


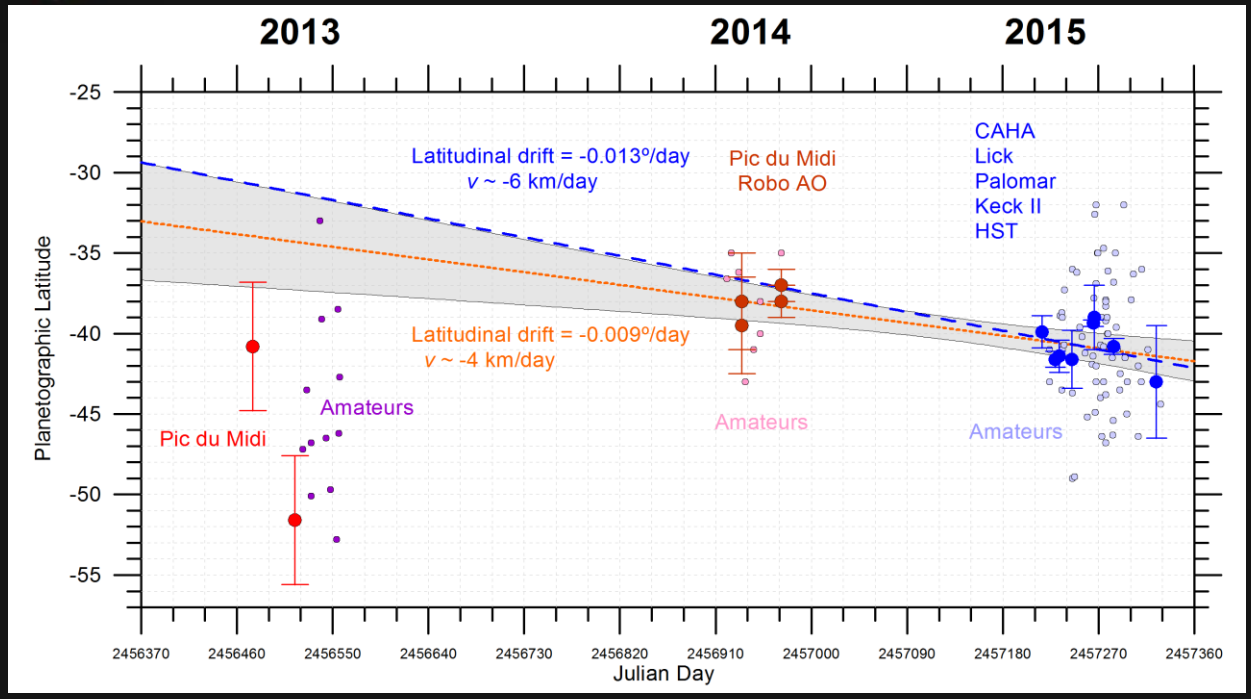


Conclusions

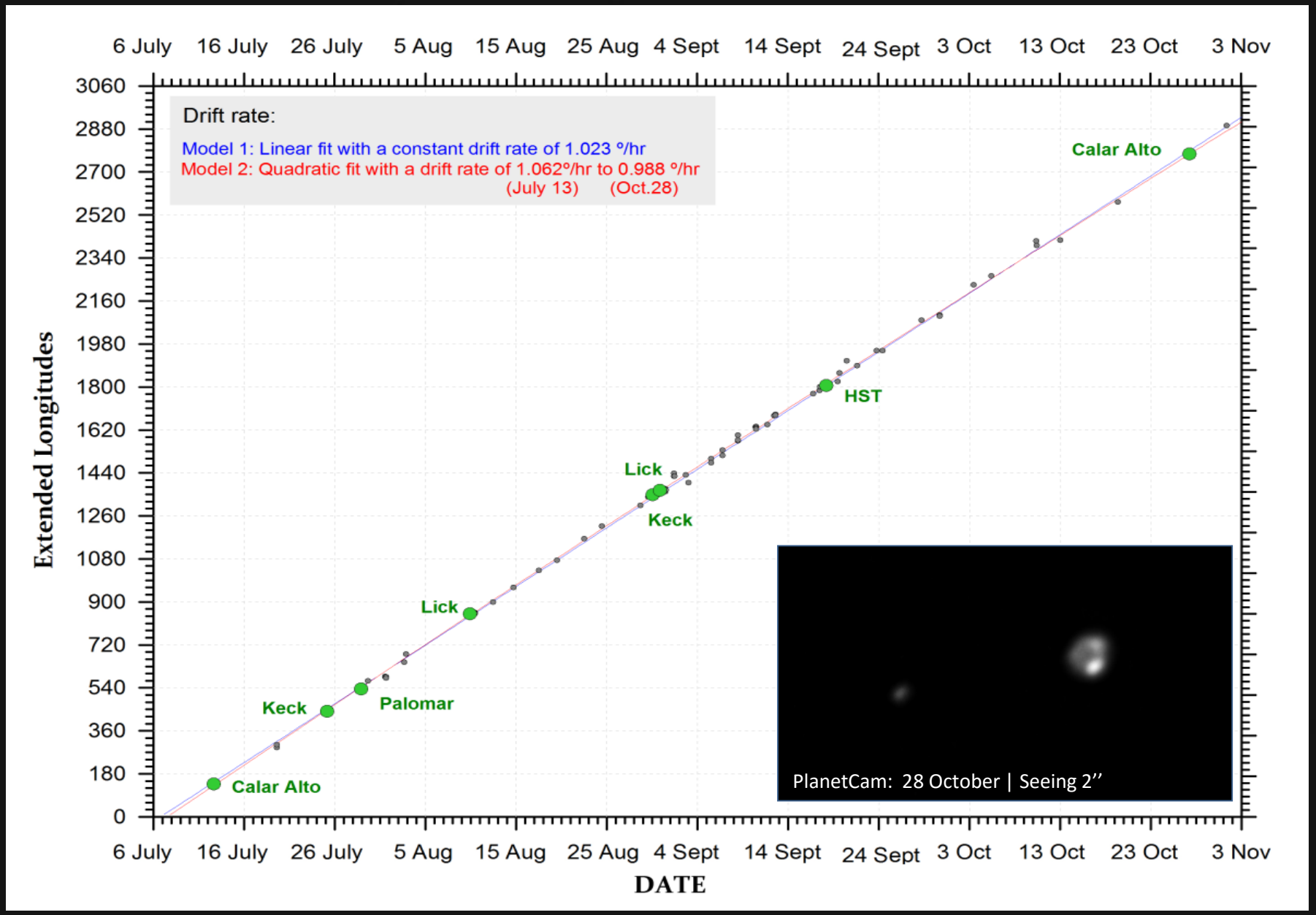
- Amateur observations are now good enough to play a role in the understanding of time-variable phenomena in Neptune (not only for triggering observing programs).

- Neptune in 2013-2015 shows consistently a belt of clouds with **large long-lived features** that can be tracked in time and follow the main winds each year with small differences from previous profiles.

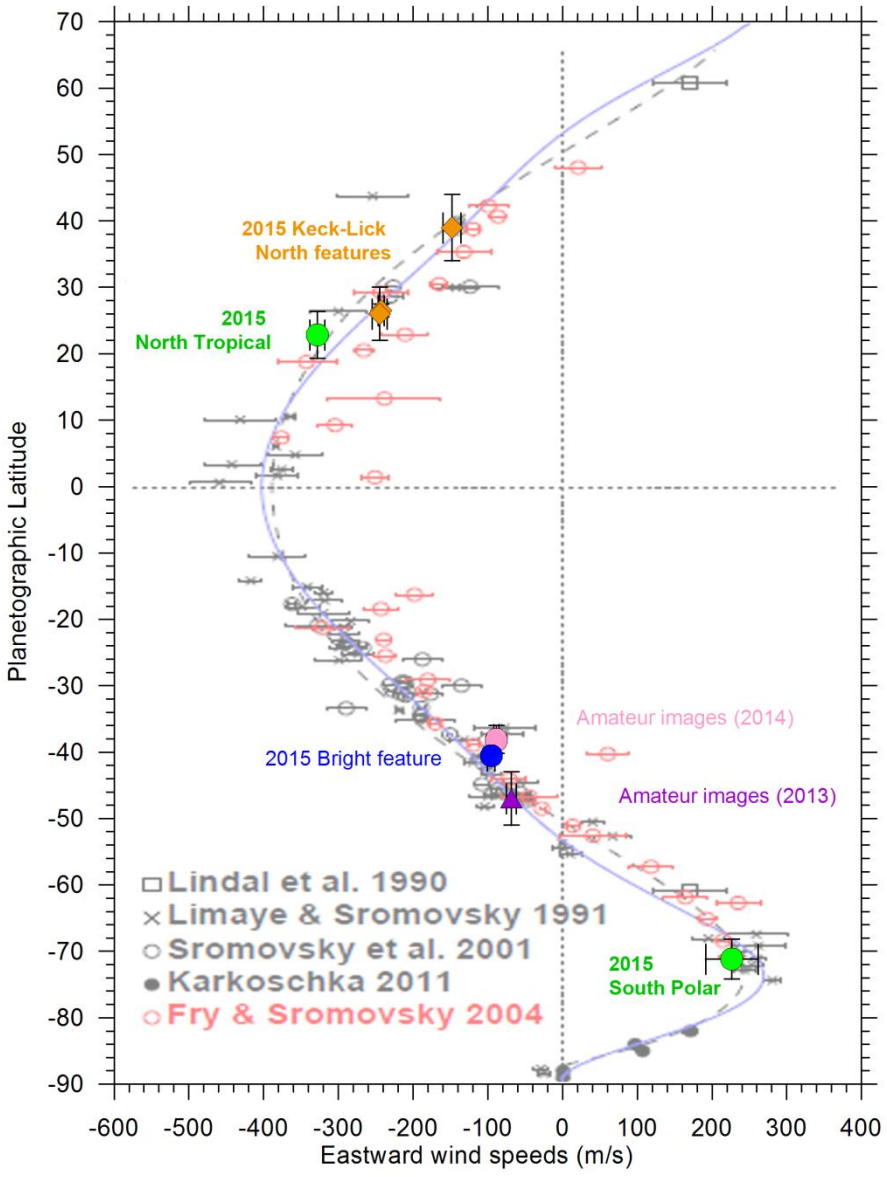
- The main bright features in 2014 and 2015 seems to be the same cloud system drifting southwards. This bright clouds is linked to a Small Dark Spot deeper in the atmosphere.

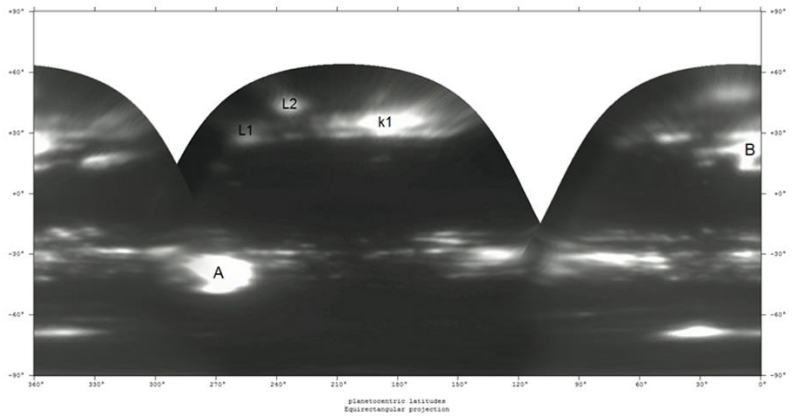


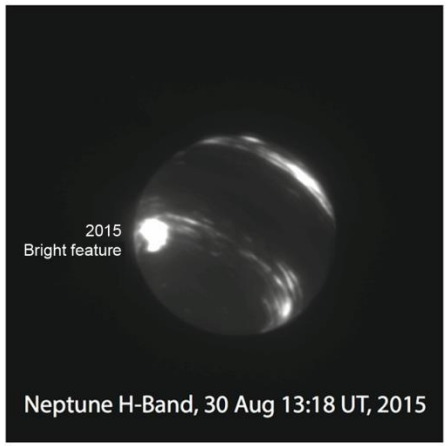
2015: Amateurs take the challenge to regularly observe Neptune

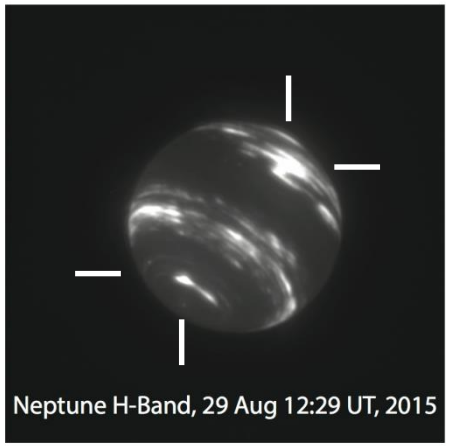


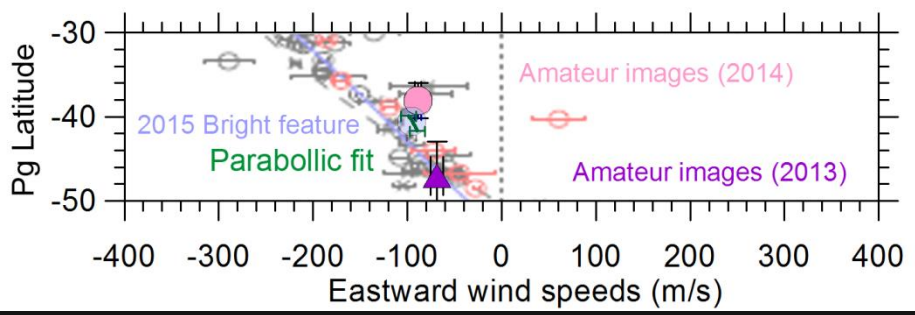
Wind results



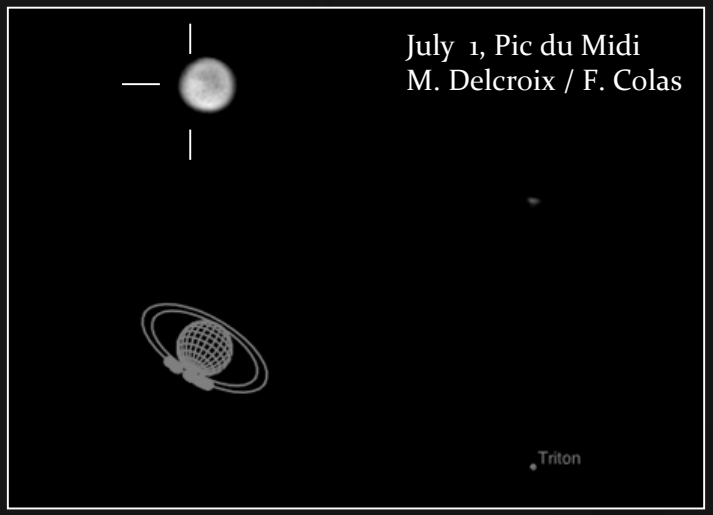


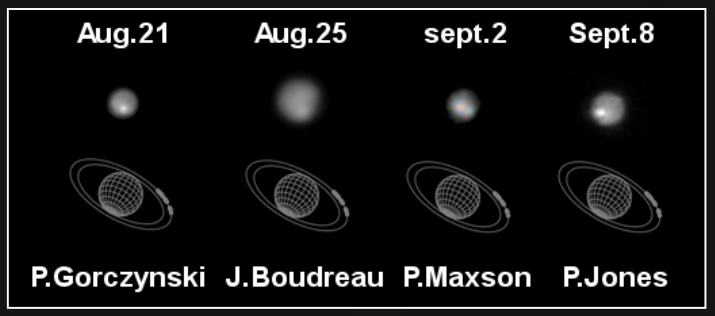


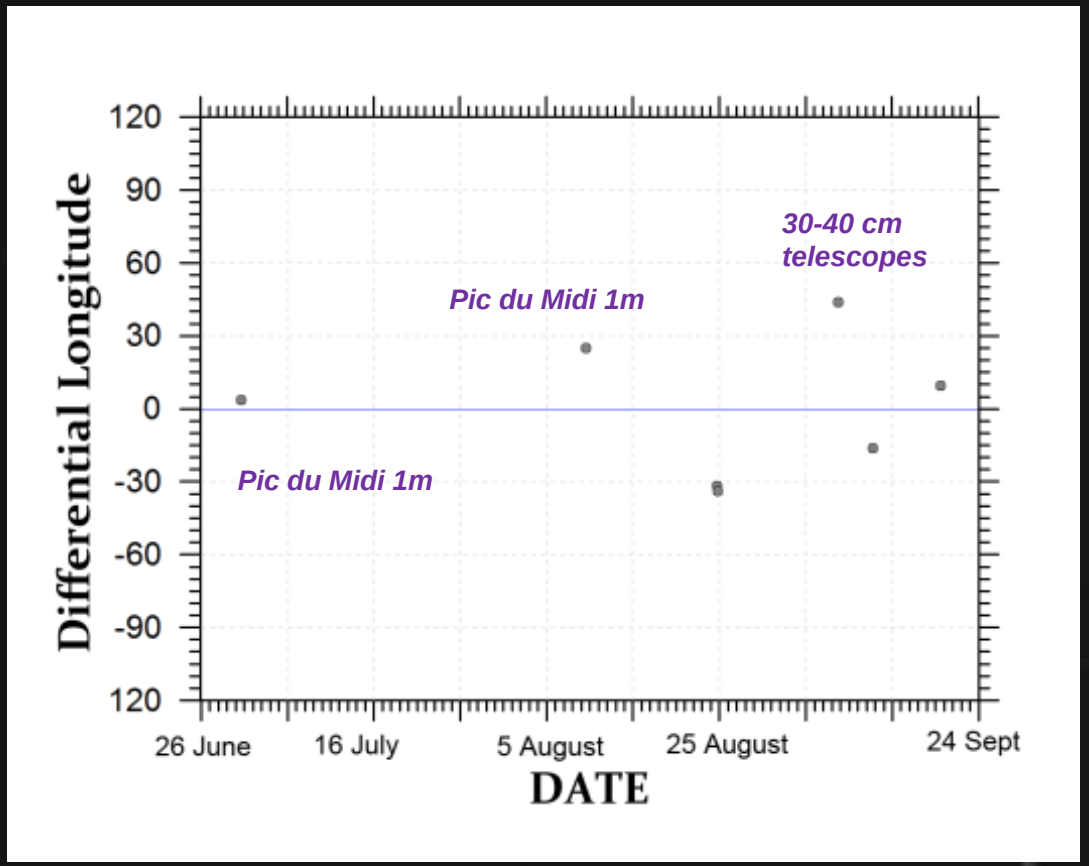




Neptune in 2013: First unambiguous detection of atmospheric features with small telescopes





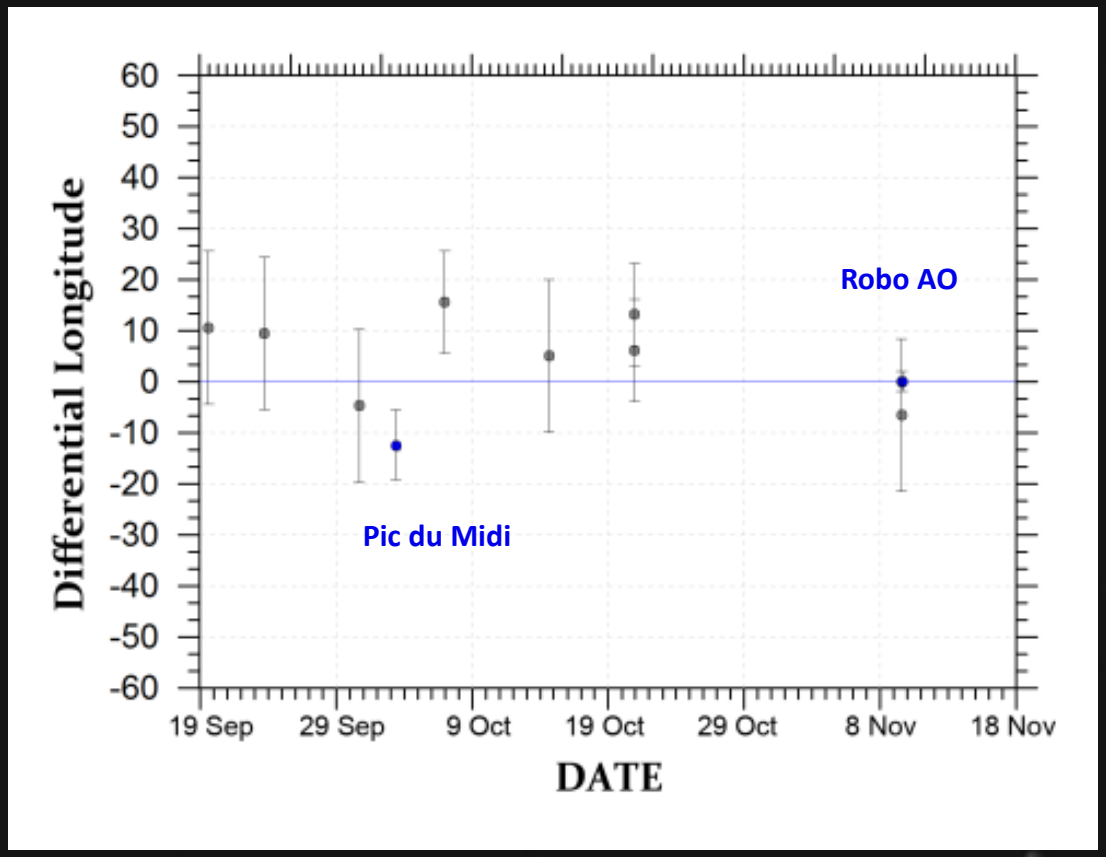


First wind measurement in Neptune with small telescopes: Latitude (Pg) = -47 ± 4°
u=-69 ± 7 m/s

Neptune in 2014: A brighter feature and larger interest from the side of amateur astronomers

Pic du Midi, 3 October

M. Delcroix / F.Colas



Robo AO, 10 November

Robo AO

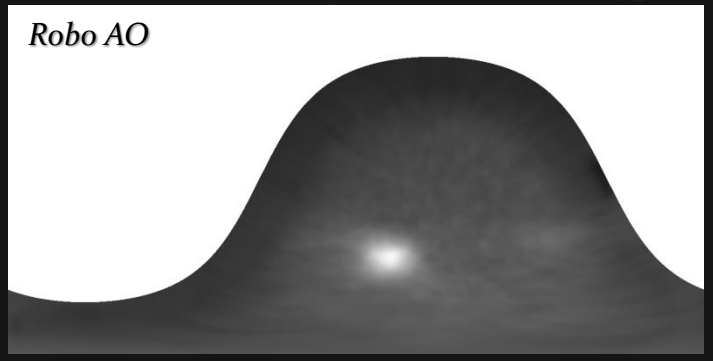


Image courtesy of C. Baranec, R. Riddle, N. Law

Latitude (Pg) = -38 ± 2 °
u=-88.8 ± 3.2 m/s