

Amateur Astronomers' Contribution to Planetary Science Through Pro-Am Collaboration



IAU100
amateur astronomers day
Brussels, Apr. 13th, 2019

Marc Delcroix

(French Astronomical Society planetary observations section president)



- ❑ Constant increase of co-authored papers and conferences participation
(Mousis et al., Exp. Astr. 2014)
- ❑ Dedicated session @ European Planetary Science Congress since 2008
- ❑ Workshops funded by Europlanet 2020 – NA1 since 2016

Pro-am collaborations
increasing,
even systematic on some
topics



1. Jean-Luc Dauvergne 2. Glenn Orton 3. Peter Rosen 4. Manos Kardasis 5. Clyde Foster 6. Silvia Kowolik 7. Leigh Fletcher 8. Ricardo Hueso 9. Simon Kidd 10. Tirs Abril 11. Christopher Go 12. Joaquin Camarena 13. Agustin Sanchez-Lavega 14. Josep Soldevilla 15. Paulo Casquinha 16. John Rogers 17. Peter Edwards 18. John Sussenbach 19. Martin Lewis 20. Patrick Irwin 21. Candy Hansen 22. Ashwin Braude 23. Constantin Sprianu 24. Kuniaki Horiakawa 25. Michel Jacquesson 26. Anthony Wesley 27. Sean Doran 28. Padma Yanamandra-Fisher 29. Peter Lawrence 30. Emil Kraaikamp 31. Matt Brealey 32. Gerald Eichstaedt 33. Marc Delcroix 34. Arrate Antuñano 35. Padraig Donnelly 36. Alexei Pace 37. Johan Warell 38. Christophe Pellier 39. Mike Foulkes 40. Manuel Scherf 41. Marco Vedovato 42. Miguel Araujo 43. Scott Bolton

Strength of planetary amateur community:

- ❑ Spatial context from hi-res imaging with 25-50cm scopes, lucky imaging with highly sensitive and fast cameras, between 300nm-1 μ m.
- ❑ Time coverage through many connected observers all around the world
- ❑ Availability of images in databases (pro PVOL, ALPO Japan, SAF, ...)

Complementarity with space probes
and ground pro instruments
(1 μ m-5 μ m)

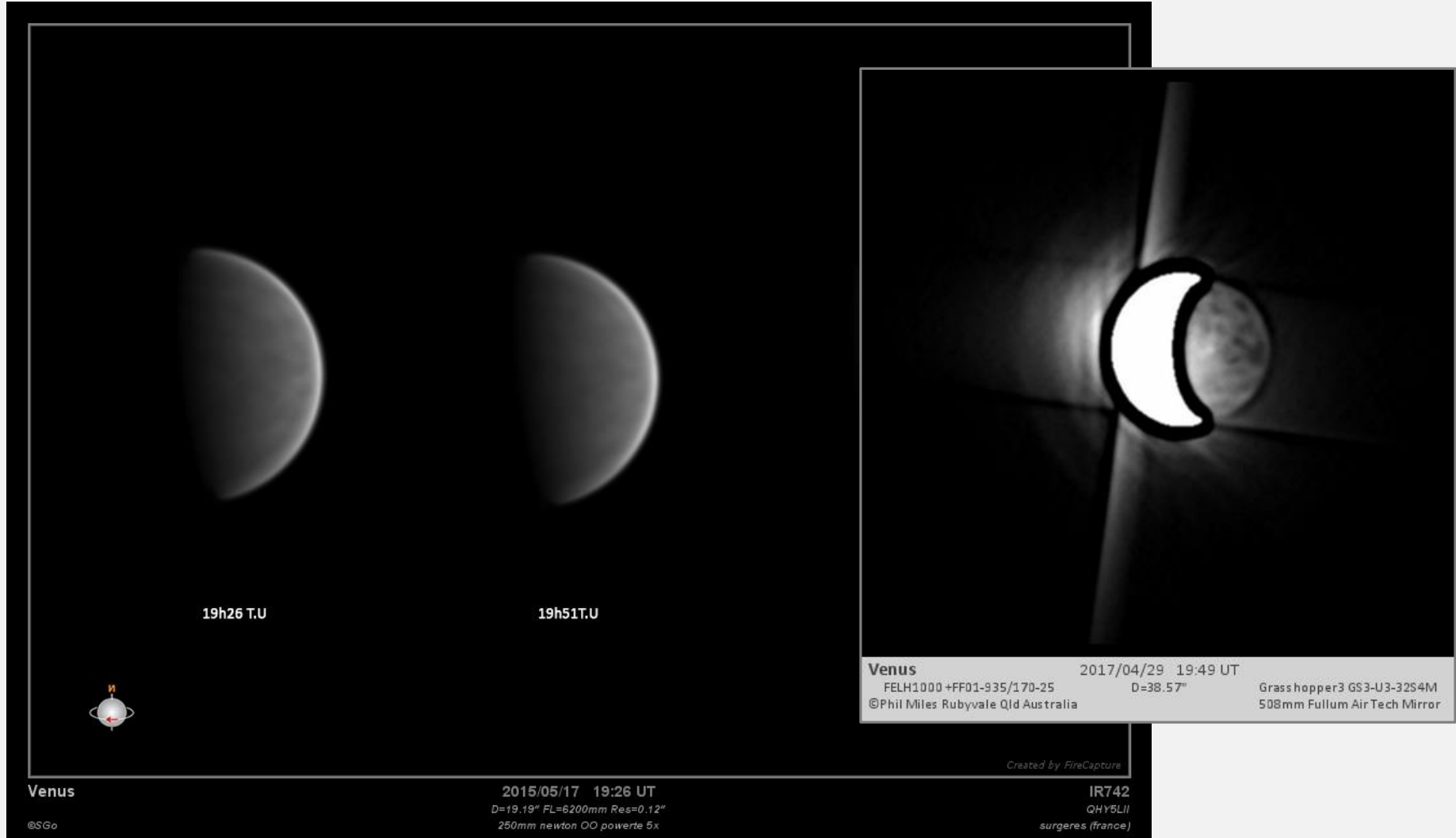
Predictions for observation planning

Context for pro data analysis



A . Wesley (Australia)

- ❑ Venus' clouds in UV and IR (complementary to Akatsuki)
- ❑ Surface thermal emissions @ $1\mu\text{m}$



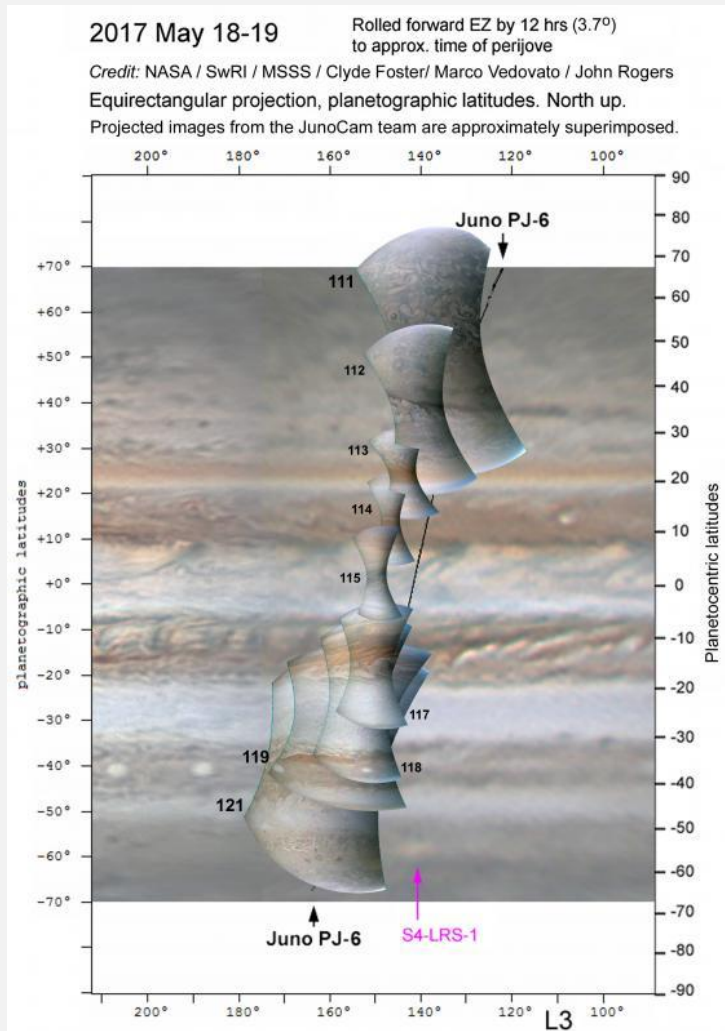
- ☐ Clouds and dust storms (e.g. 2018's) evolution observations
- ☐ High altitude plumes detection (*Sanchez-Lavega et al. Nature 2015*)



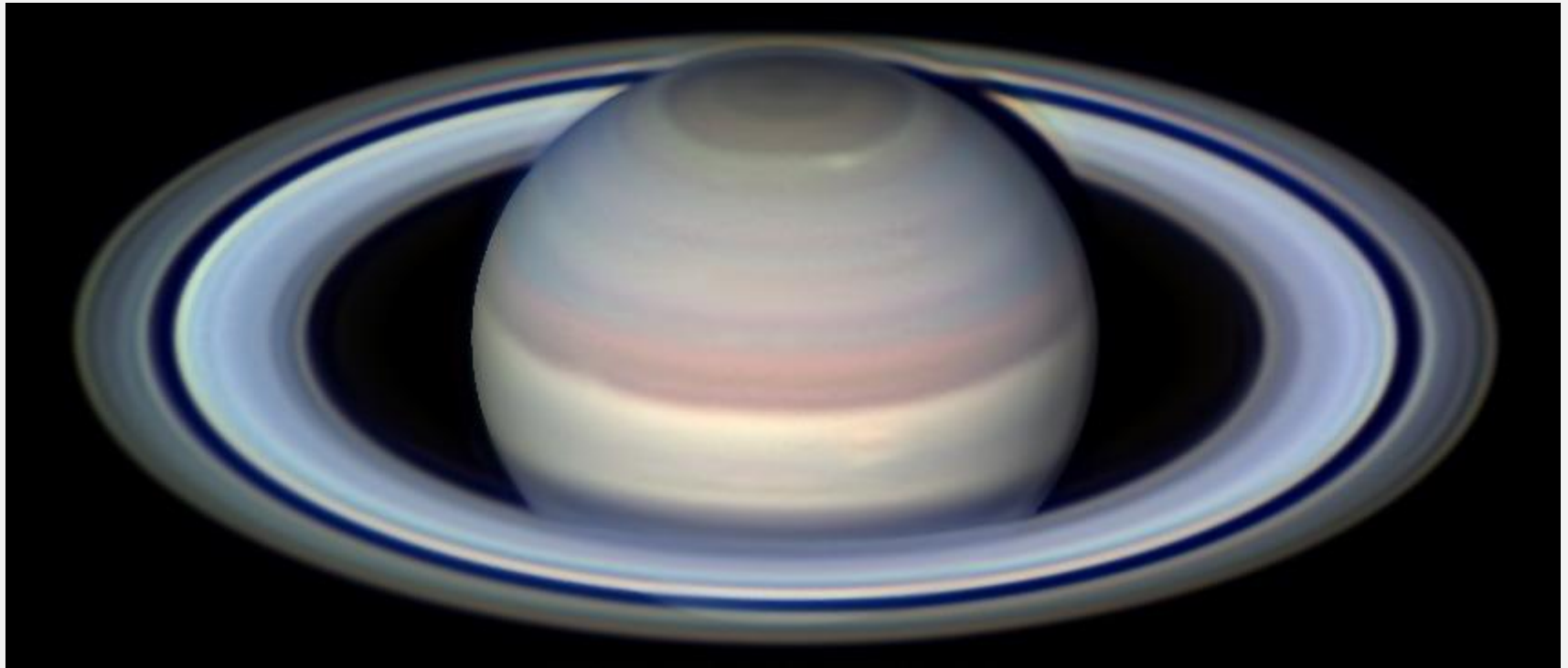
High plume
W. Jaeschke (USA)
2012-03-20

Great Dust Storm 2018
A . Yamazaki (Japan)
2018-06-04

- ❑ Monitoring/discoveries on features evolutions (e.g. BA oval reddening)
- ❑ Complementary observations required for JunoCam



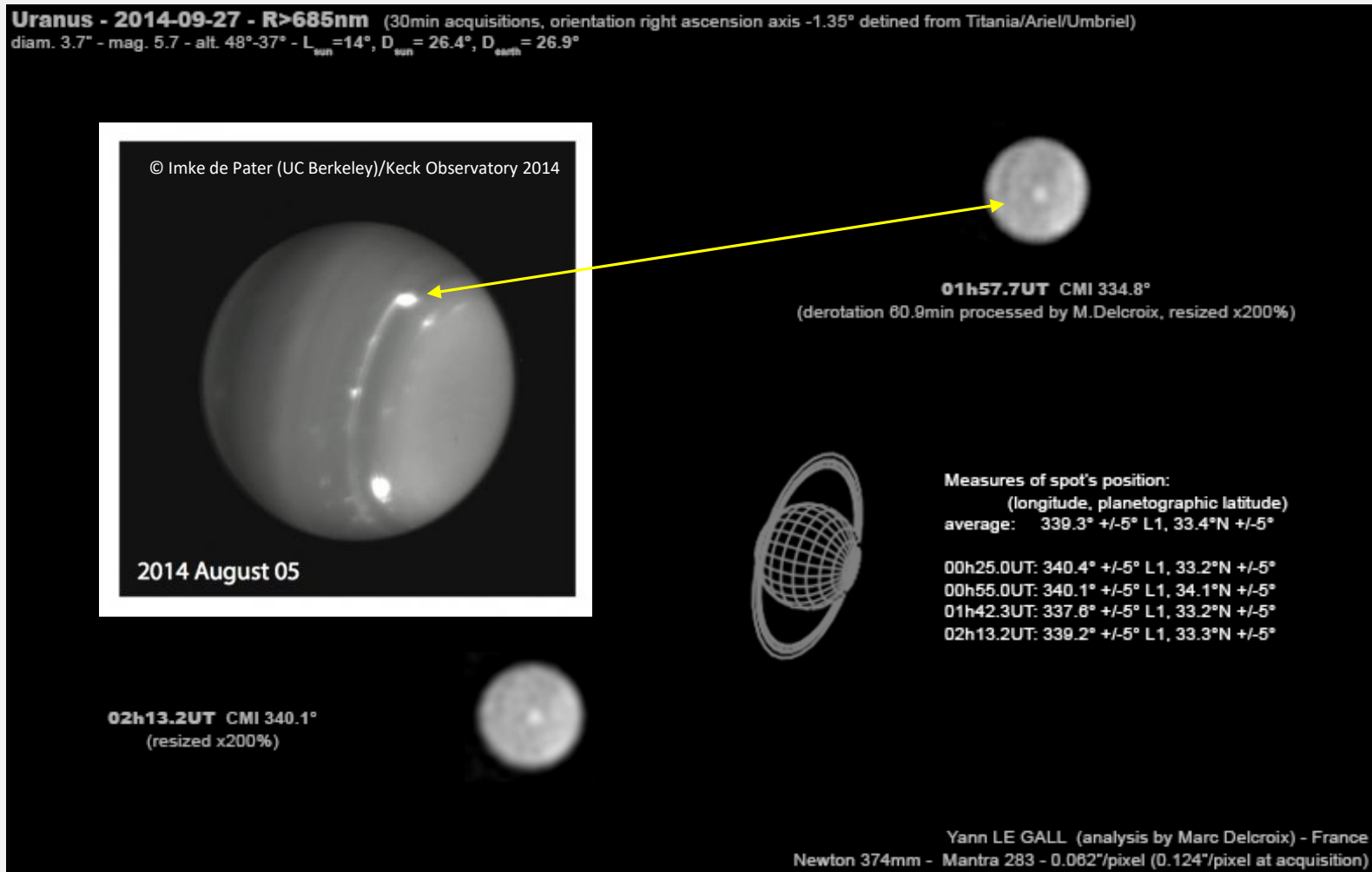
- ❑ Clouds tracking complementary to Cassini radio observations (RPWS)
(Fischer et al. Nature 2011)
- ❑ Continuous monitoring of 2010-2011 GWS *(Sanchez-Lavega et al. Nature 2011)*
- ❑ Spokes *(Delcroix et al., DPS/EPSC 2011)*



Polar and equatorial Storm 2018
C. Go (Philippines)
2018-04-19

❖ Since sept. 2017, amateurs alerts on potential storms
for ground observing

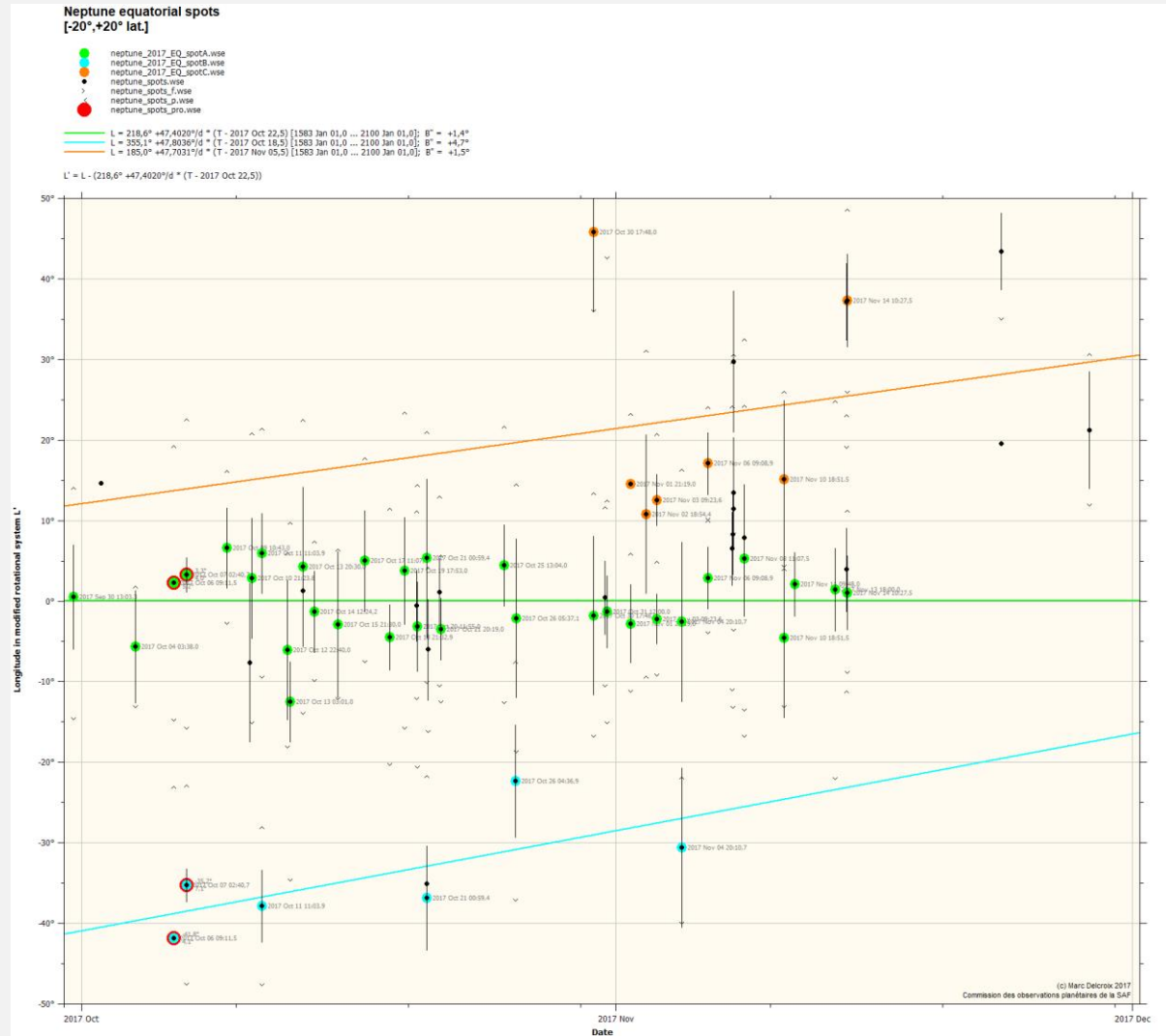
- ❑ Bands and clouds observations in NIR (justifying pro observations)
- ❑ 2014 storm tracking



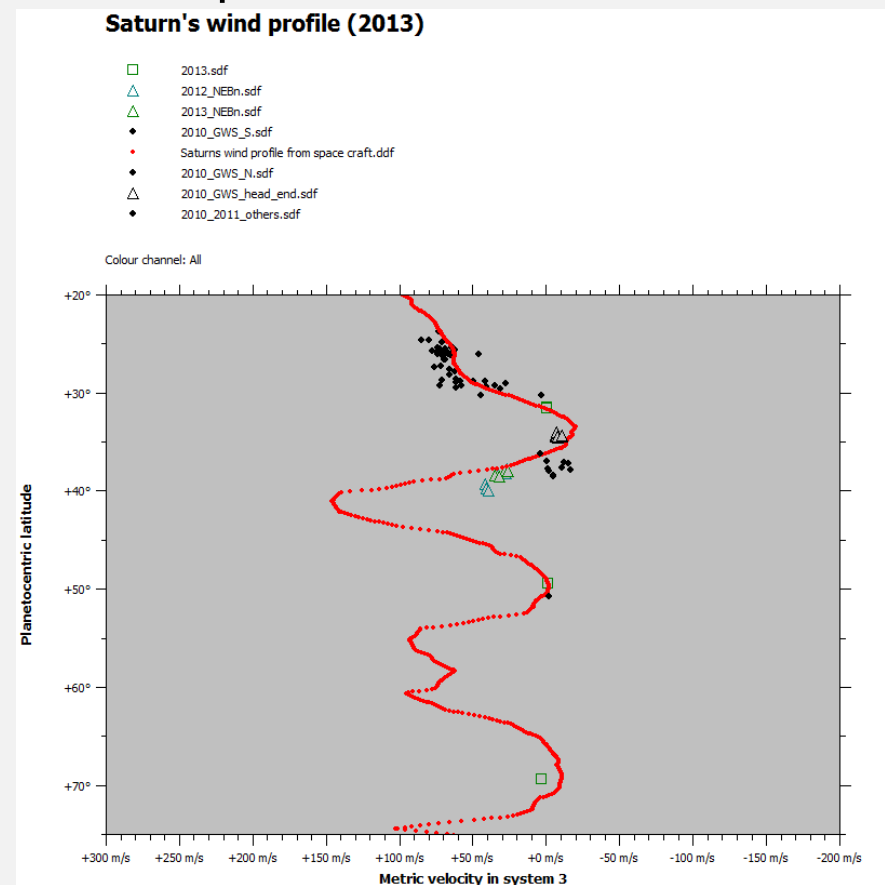
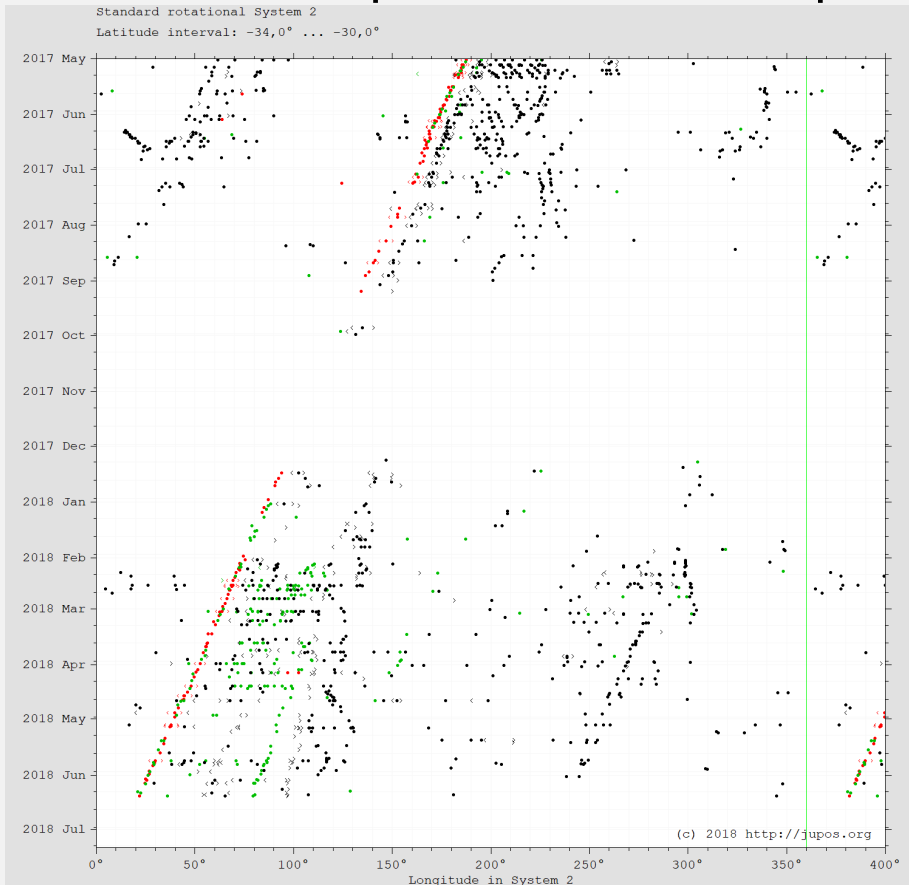
□ Bright zones observed in NIR since 2013 (triggering complementary pro observations) *(Wong et al. Astr. Journal 2018)*



2010-10-10 © Marc Delcroix



- ❑ Amateurs' processing softwares
(lucky imaging w/ Autostakkert, derotation, measures, analysis w/ WinJupos)
- ❑ Measures, analysis, ephemeris performed by amateurs themselves
(J. Rogers/JUPOS for Jupiter, M. Delcroix for Saturne, Uranus et Neptune)
- ❑ Zonal wind profile evolution in planets' atmospheres



**Impact flashes detection with DeTeCt software project/
Projet de détection de flash d'impacts avec le logiciel DeTeCt**
by/par [Marc Delcroix](#)

 [Presentation of the project](#) (EPSC2013, BAA workshop)





























17/03/2018: NEW SOFTWARE VERSION 2.0.6 / NOUVELLE VERSION 2.0.6 DU LOGICIEL

 [Software download and tutorial](#) for participating to the project
 [Téléchargement du logiciel et tutoriel](#) pour participer au projet

NEW 26/03/2017 : Join the [impact detection Yahoo group](#) for exchanges and support !

















Jupiter

estimation of 4 impacts per year (0,3 per month)
total excludes 4,527 days of simultaneous observations

Observer	Duration	Number of videos	Date range
Total : 78 observers	90.586 days	79217 videos	2004/02/29 - 2018/06/26
 Zac Pujic (Australia)	15.557 days	6372	2005/02/22 - 2018/06/05
 Paul Rolet (France)	10.983 days	8848	2012/09/07 - 2018/06/02
 Michel Jacquesson (France)	9.152 days	6620	2014/03/12 - 2017/01/23
 Manos Kardasis (Greece)	6.993 days	5668	2004/02/29 - 2017/09/12
 Thomas Ashcraft (USA)	4.969 days	5886	2013/10/09 - 2016/11/30
 Bernd Gahrken (Germany)	4.021 days	5645	2016/03/06 - 2018/06/03
 Benito Loyola (USA)	3.790 days	1416	2018/02/17 - 2018/06/22
 Alan Coffelt (USA)	3.593 days	2605	2013/10/04 - 2018/05/14
 Marc Delcroix (France)	2.782 days	2178	2006/04/13 - 2018/06/26
 Xavier Dupont (France)	2.062 days	1867	2012/09/16 - 2015/04/25
 Grant Blair (USA)	1.988 day	1874	2013/09/20 - 2016/04/21
 Agapios Elia (Cyprus)	1.734 day	1922	2009/07/06 - 2012/12/30
 Trevor Barry (Australia)	1.612 day	2421	2009/07/06 - 2012/12/30
 Christophe Pellier (France)	1.530 day	739	2013/09/20 - 2016/04/21
 Hampton University Sayanagi Group (USA)	1.509 day	1099	2013/09/20 - 2016/04/21
 David Domine (France)	1.450 day	907	2013/09/20 - 2016/04/21
 Pascal Bayle (France)	1.390 day	1697	2013/09/20 - 2016/04/21
 Torsten Mellenthin (Germany)	1.218 day	1416	2013/09/20 - 2016/04/21
 Lammertus de Vries (Spain)	1.171 day	635	2013/09/20 - 2016/04/21
 Stephane Gonzales (France)	1.131 day	1243	2013/12/20 - 2018/06/03
 Jocelyn Serot (France)	1.121 day	845	2014/01/10 - 2018/06/12
 Arnaud Claisse (France)	0.941 day	842	2014/01/19 - 2016/05/03
 Matic Srekar (Slovenia)	0.932 day	1631	2013/09/20 - 2016/04/21
 Pic du Midi (Delcroix/Dauvergne) (France)	0.840 day	1636	2013/09/20 - 2016/04/21
 Paul Jones (USA)	0.819 day	723	2011/08/29 - 2015/04/05
 Jean-Luc Dauvergne (France)	0.778 day	439	2013/09/20 - 2016/04/21
 Pascal Lemaire (France)	0.753 day	828	2013/09/20 - 2016/04/21
 Jean-Jacques Poupeau (France)	0.751 day	1135	2013/02/03 - 2016/03/23

Saturn

estimation of less than 31,8 impacts per year (2,6 per month)
no simultaneous observations

Observer	Duration	Number of videos	Total
Total : 17 observers	11.487 days	5080 videos	200
 Zac Pujic (Australia)	5.155 days	2103	20
 Marc Delcroix (France)	2.085 days	908	20
 Paul Rolet (France)	1.059 day	279	20
 Manos Kardasis (Greece)	0.791 day	398	20
 Grant Blair (USA)	0.445 day	255	20
 Oleg Zaharciuc (Moldova)	0.399 day	191	20
 Pic du Midi (Delcroix/Dauvergne) (France)	0.297 day	338	20
 Arnaud Claisse (France)	0.260 day	62	20
 Societe Astronomique de Touraine (France)	0.223 day	92	20
 Stephane Gonzales (France)	0.195 day	90	20
 David Domine (France)	0.171 day	35	20
 Matic Srekar (Slovenia)	0.169 day	85	20
 Hampton University Sayanagi Group (USA)	0.171 day	81	20
 Hampton University Sayanagi Group (USA)	0.165 day	79	20
 Adrien Marezac (France)	0.022 day	18	20
 Arnaud Claisse (France)	0.006 day	11	20

« **DeTeCt** » project evaluating impacts frequency on Jupiter (and Saturn) since 2012, led by an amateur
(Delcroix et al. EPSC 2013, Hueso, Delcroix et al. A&A 2018)

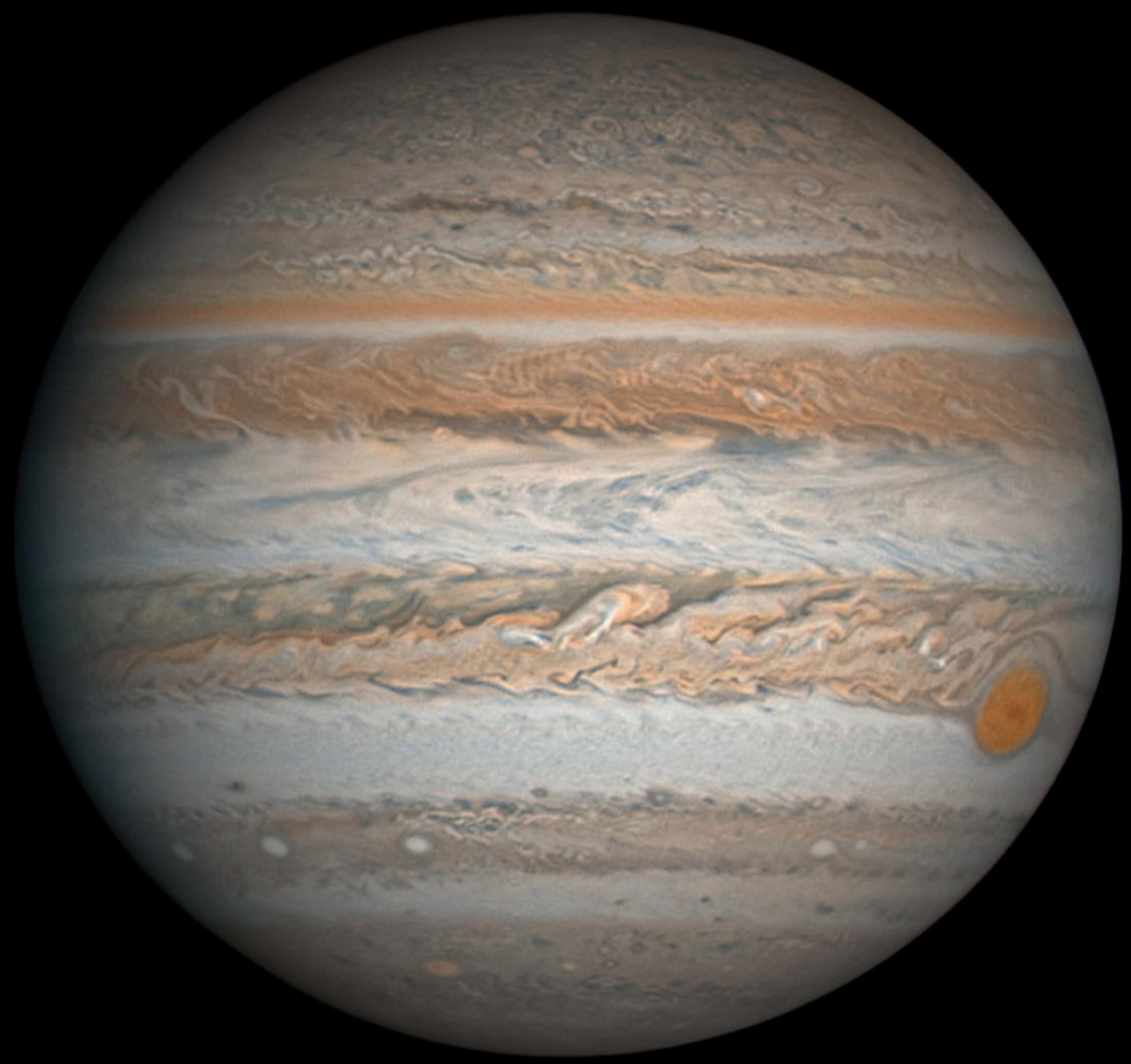
>100d observations, 87 000 videos,
no discovery with software yet

- ❑ Used by a few advanced amateurs (JL. Dauvergne, M. Delcroix).
- ❑ Best images from the ground with strong public and pro impacts.

Saturn - 2017-06-11 - 01h03.0UT



- ❖ Usage of more pro instruments
- ❖ Planets' polarimetry
- ❖ Planets' spectroscopy



- ❑ Amateurs' observations essential complementary to pro observations, or for new discoveries on planetary atmospheres
- ❑ Strong amateur experience in image processing
- ❑ Advanced amateurs analysing community images tracking atmospheric features, zonal winds, and leading specific projects
- ❑ Capability to operate professional resources
- ❑ Funding stimulates involvement and cooperation

Marc Delcroix
(delcroix.marc@free.fr)
<http://astrosurf.com/delcroix>
Commission des observations
planétaires, Société
Astronomique de France

