The transformation of Jupiter's North Equatorial Belt in 2021-22

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EPSC, Granada, 2022 Sep.

In 2021-22 we have the chance to observe a phenomenon that used to occur 95-130 years ago.

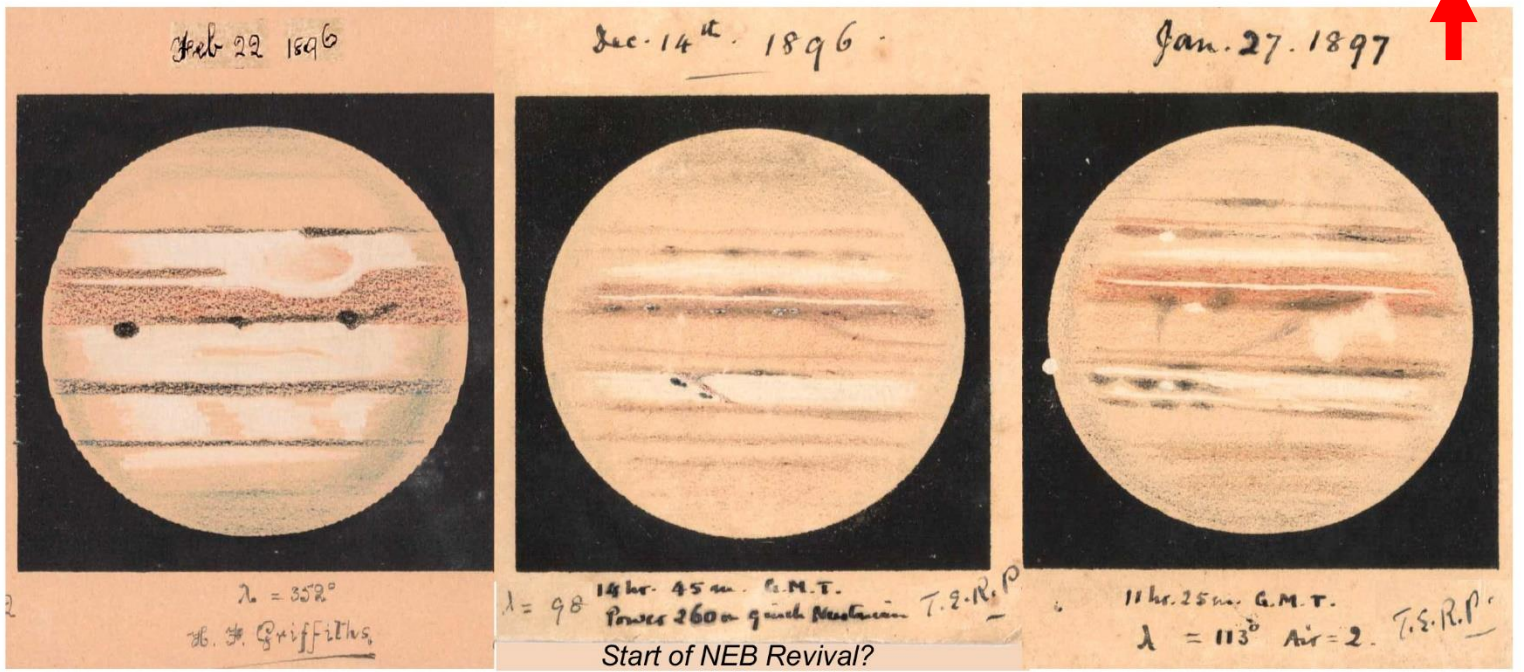
The dark NEB would become very narrow (northern part very faint), then undergo an energetic revival, expanding to its maximum width.

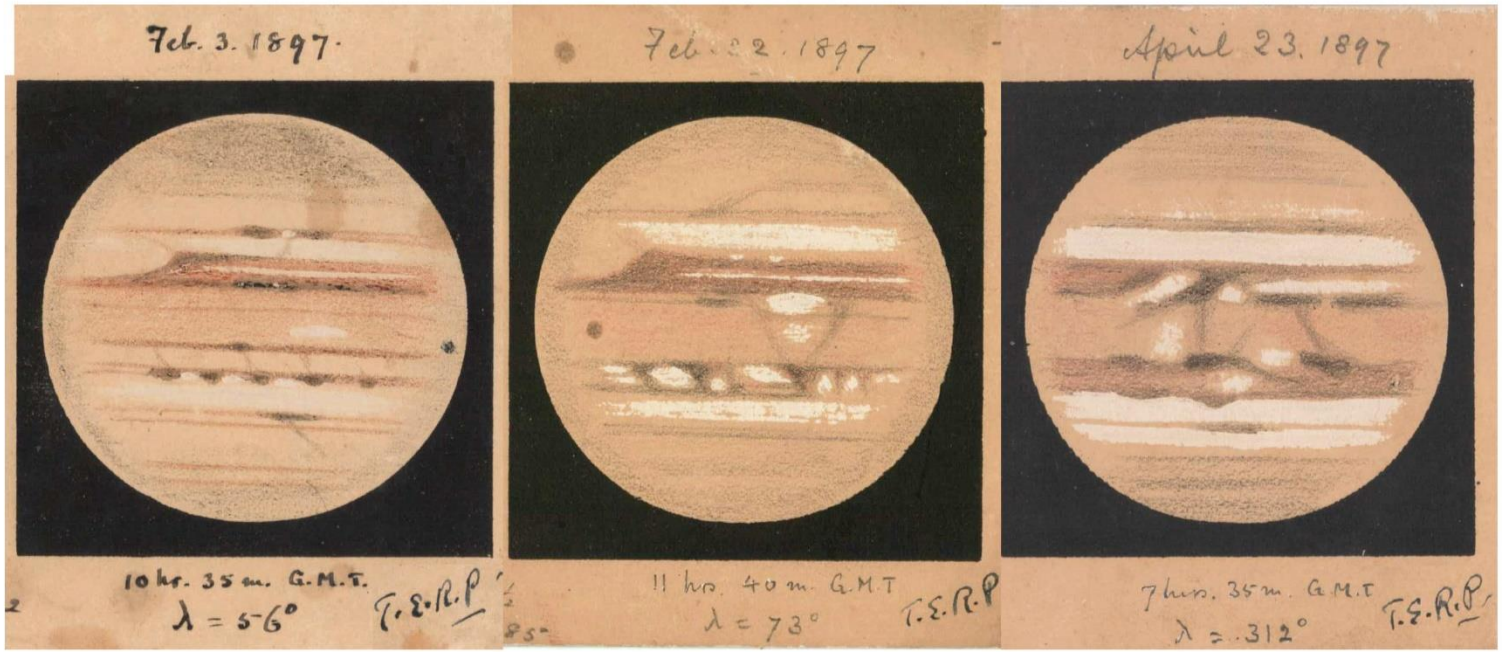
This phenomenon has never been observed in modern times, except in 2011-12 – when the NEB Revival occurred mainly during solar conjunction.

In 2021-22, the NEB has again faded/narrowed, &an unexpected form of revival may be under way.

NEB Revival in 1896-97

All drawings except no.1 by T.E.R. Phillips (BAA archives)





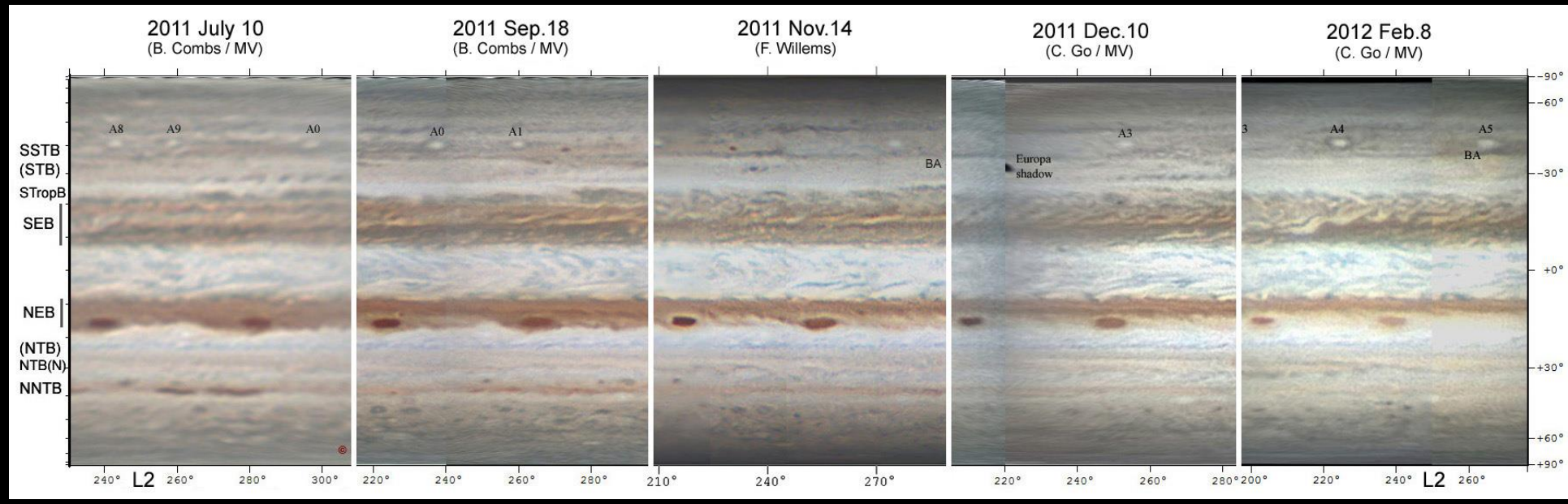
NEB fading in 2011 & revived in 2012

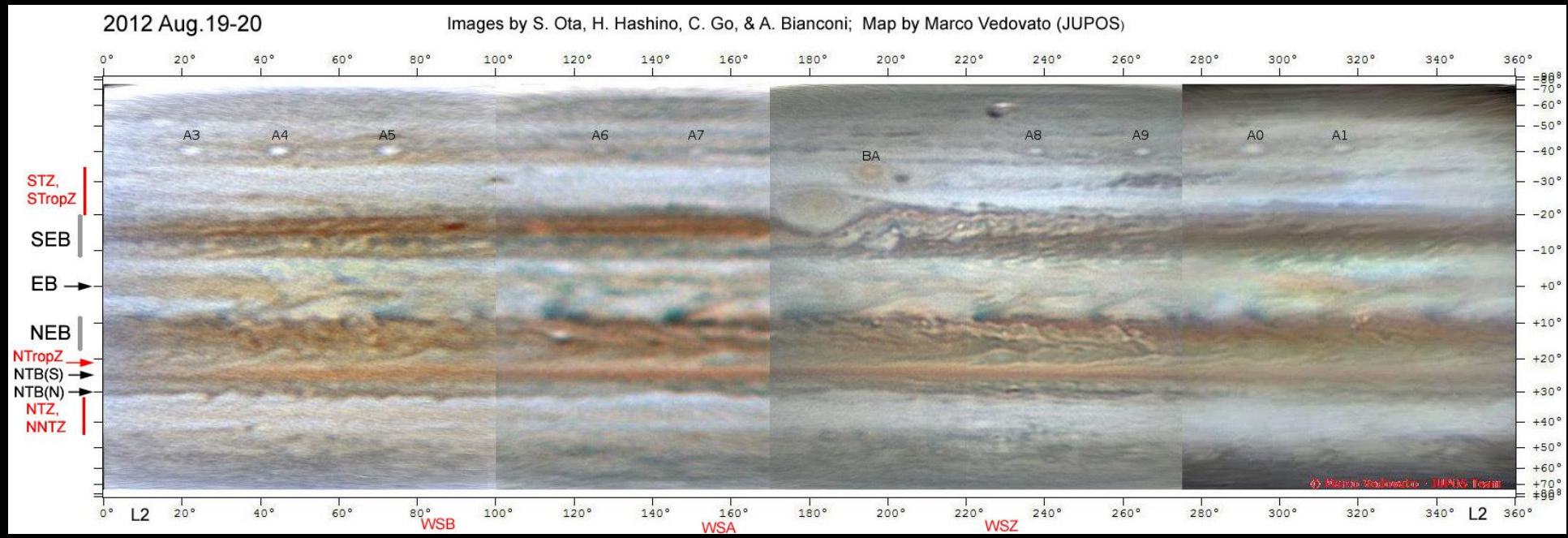
[South up]

This was in 2011-12; but the Revival largely occurred during solar conjunction.

In 2021-22, the NEB has faded/narrowed similarly, and an unexpected form of revival may be under way.

All this is being covered by amateurs and by JunoCam, synergistically.





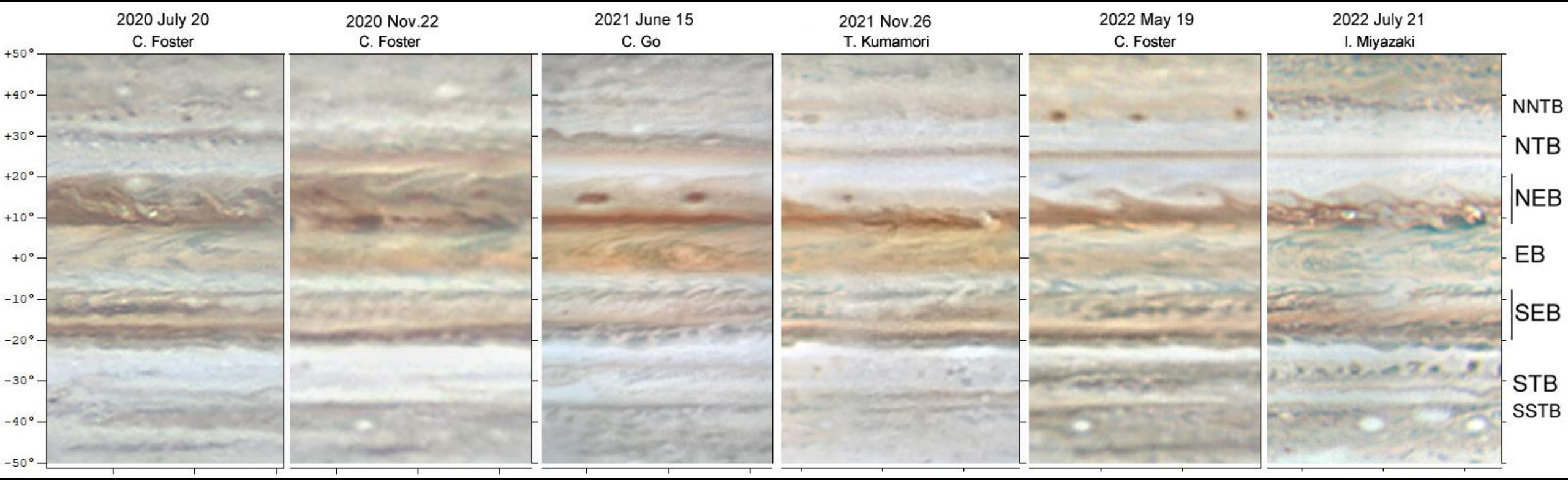
NEB: Quiescence & fading in ground-based images, 2020-2022

(Excerpts from maps by Rob Bullen, JUPOS team)

2020: Typical triennial NEB expansion event

2021: Exceptional fading/ narrowing of the NEB

2022: Small outbreaks in NEB(S), brown streaks spreading north



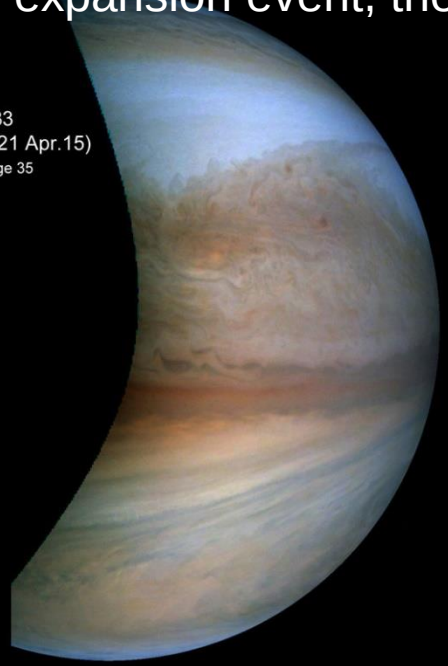
Barges & AWOs develop as usual

Barges become very dark

Barges fade but circulations persist

NEB: Quiescence & fading in JunoCam images, 2020-2022

showing diminishing scale of turbulence from the expansion event, then suppression of the usual zonal gradient



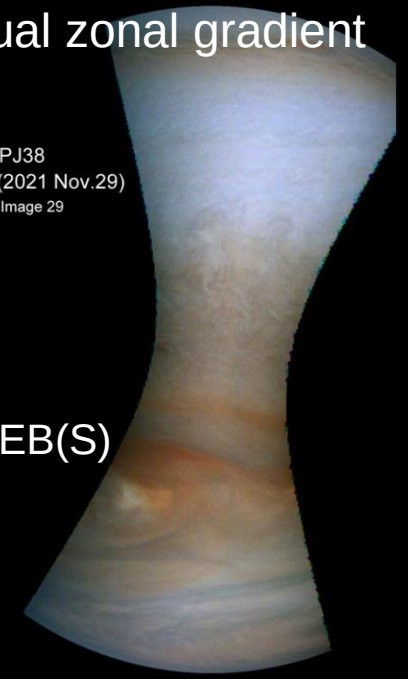
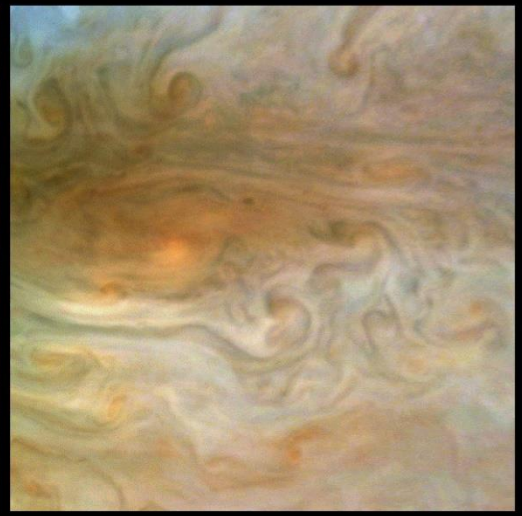


Image maps at 10-15ºN (Gerald Eichstädt):

PJ28 image 26

PJ31 image 27

PJ33 image 35



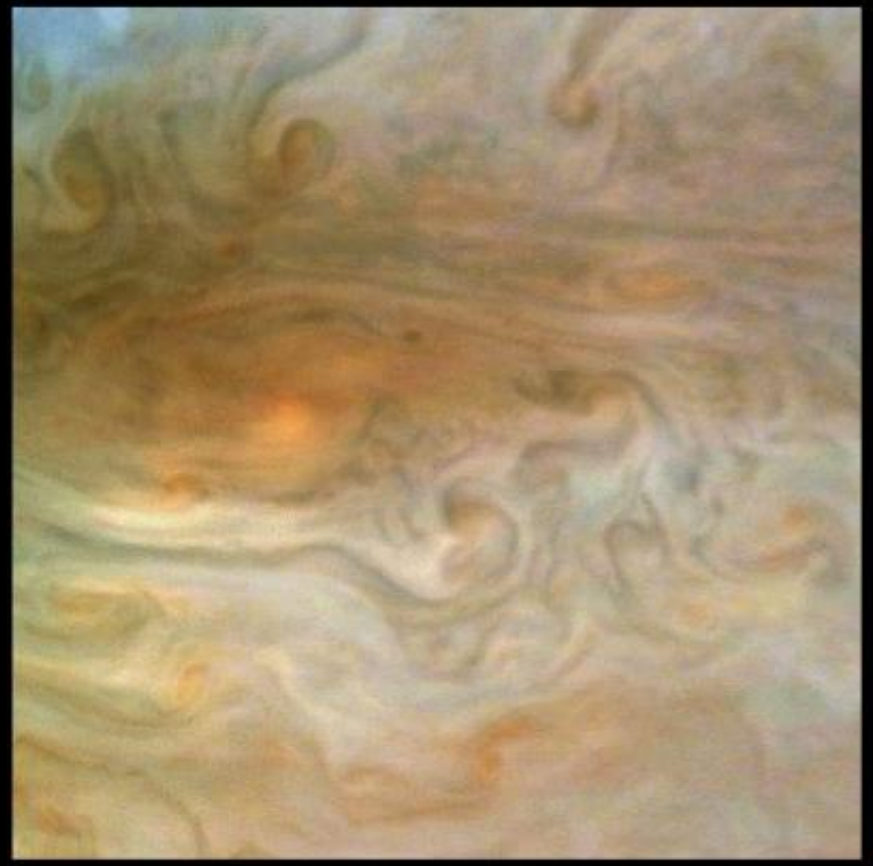
PJ36 image 41 (enhanced)

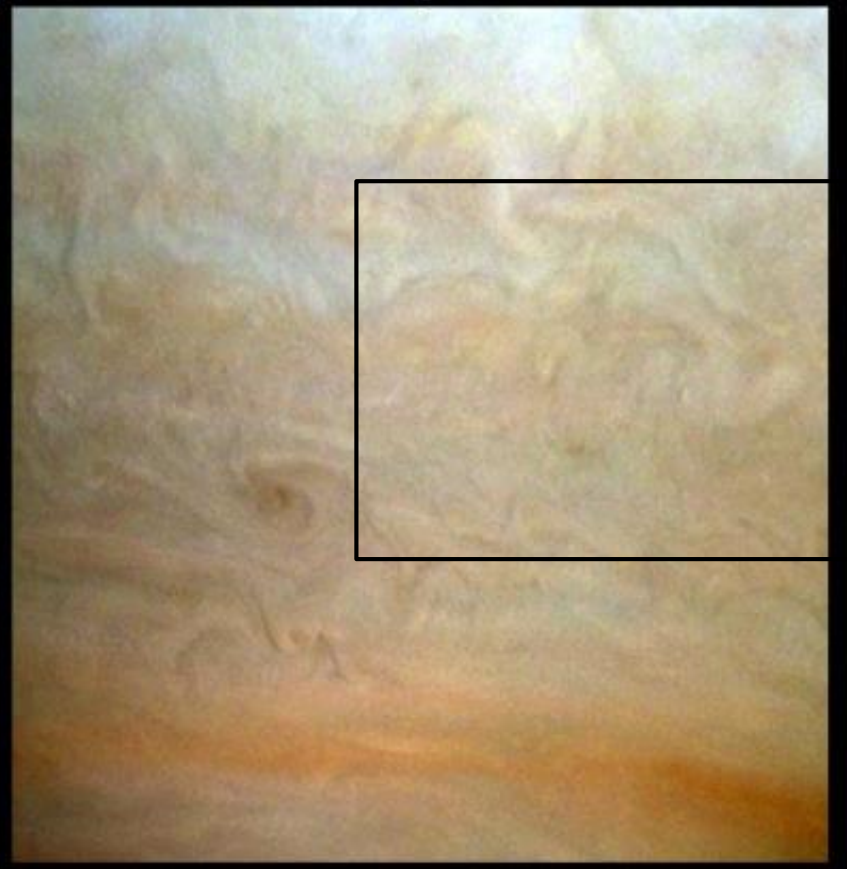
PJ38 image 30

PJ33 image 35

PJ36 image 41 (enhanced)

PJ38 image 30





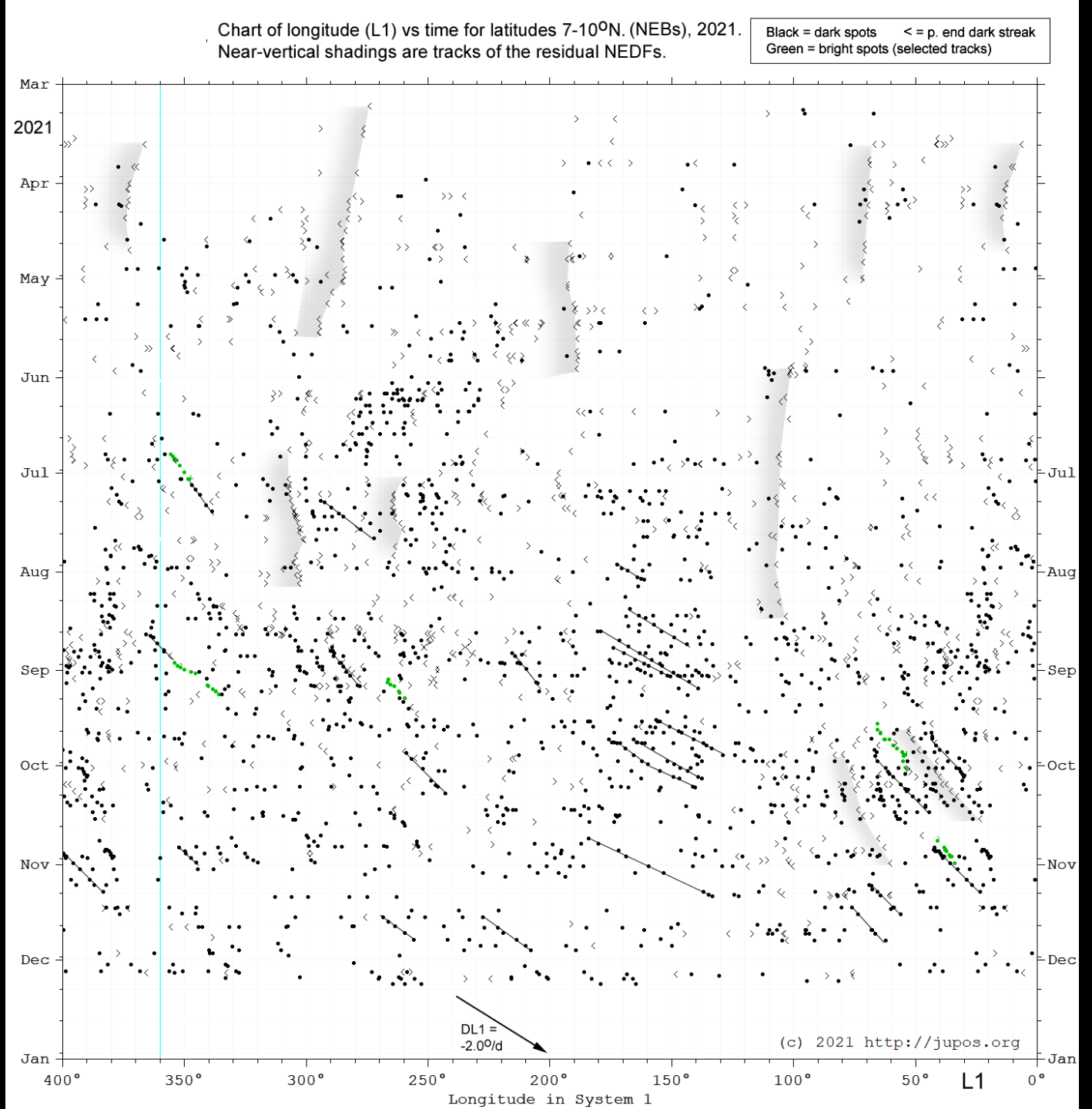
Meanwhile, just as in 2011:

All convective ‘rifts’ disappeared;

The usual NEBs dark formations (‘hot spots’) disappeared;

The usual NEBs drift rates (DL1 ~ 0) were replaced by super-fast drifts of small features (DL1 = -1.3 to -2.6 deg/day; *u* = 130-143 m/s), with evidence for speed gradient down-stream of the last NEDFs.

Thus in the absence of NEDFs, the NEBs jet is similar to the SEBn jet.



Small bright plume outbreaks began to appear in a sector of NEB(S)
(5 from May to Oct; more since then).

Typical behaviour:

Small bright spot appears at 10ºN, DL1>0.

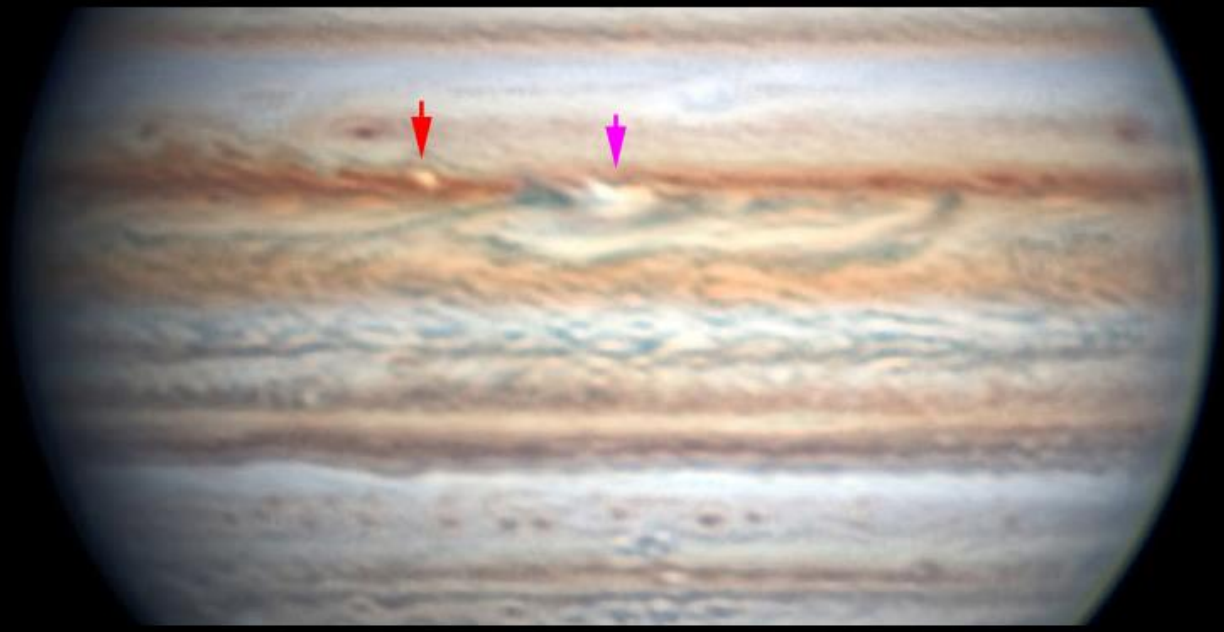
After ~1 week:

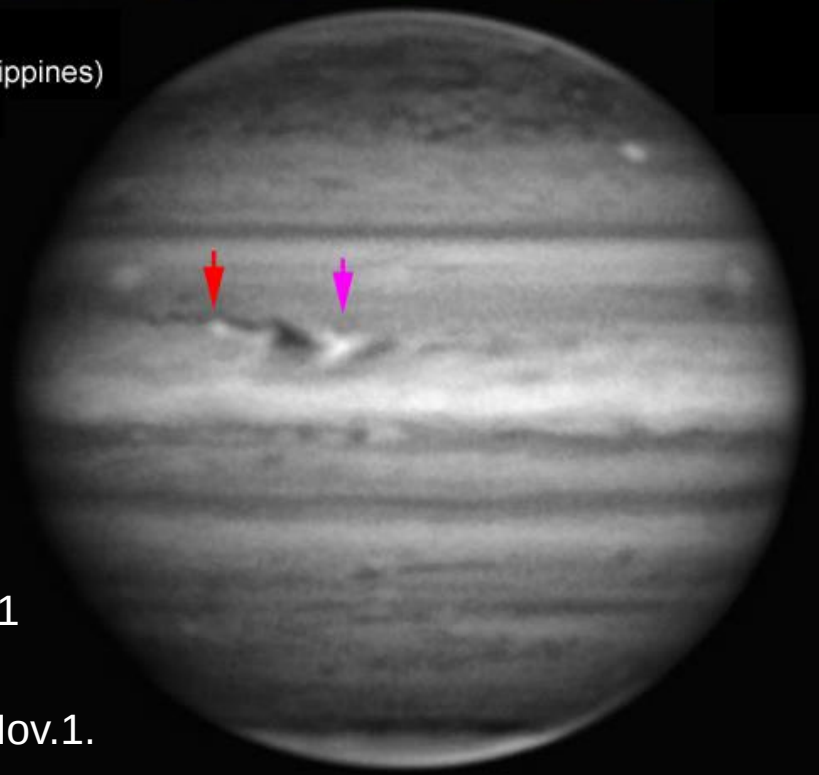
Thin white streaks extend;

Dark blue, methane-dark patch appears;

Plume moves S to NEBs & accelerates from DL1>0 to DL1<0 (-1 to -2 deg/day).

Brown material spreads NW from plume.





(Red) Appeared Nov.21 (today);

(Magenta) Appeared Nov.1.

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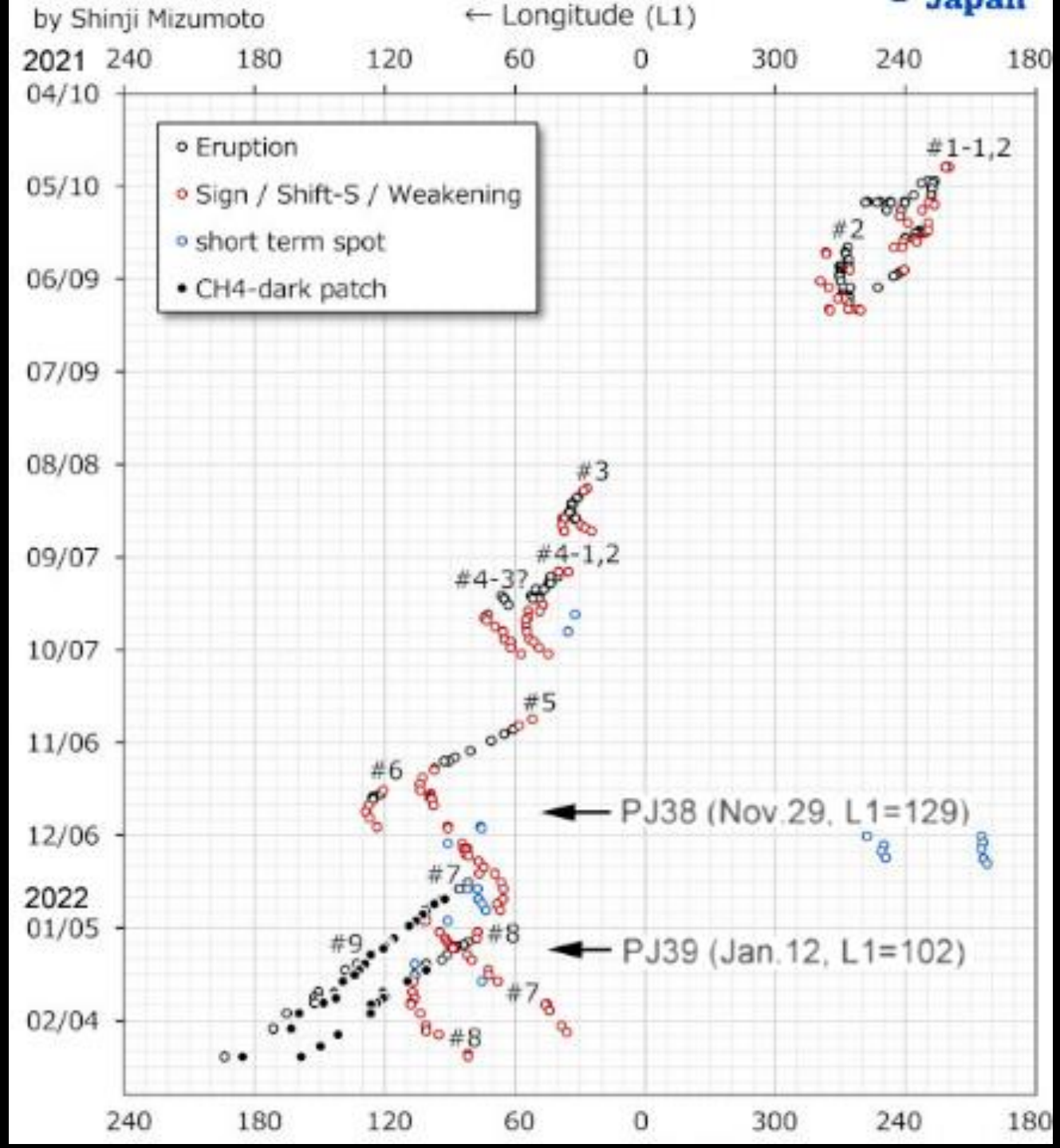

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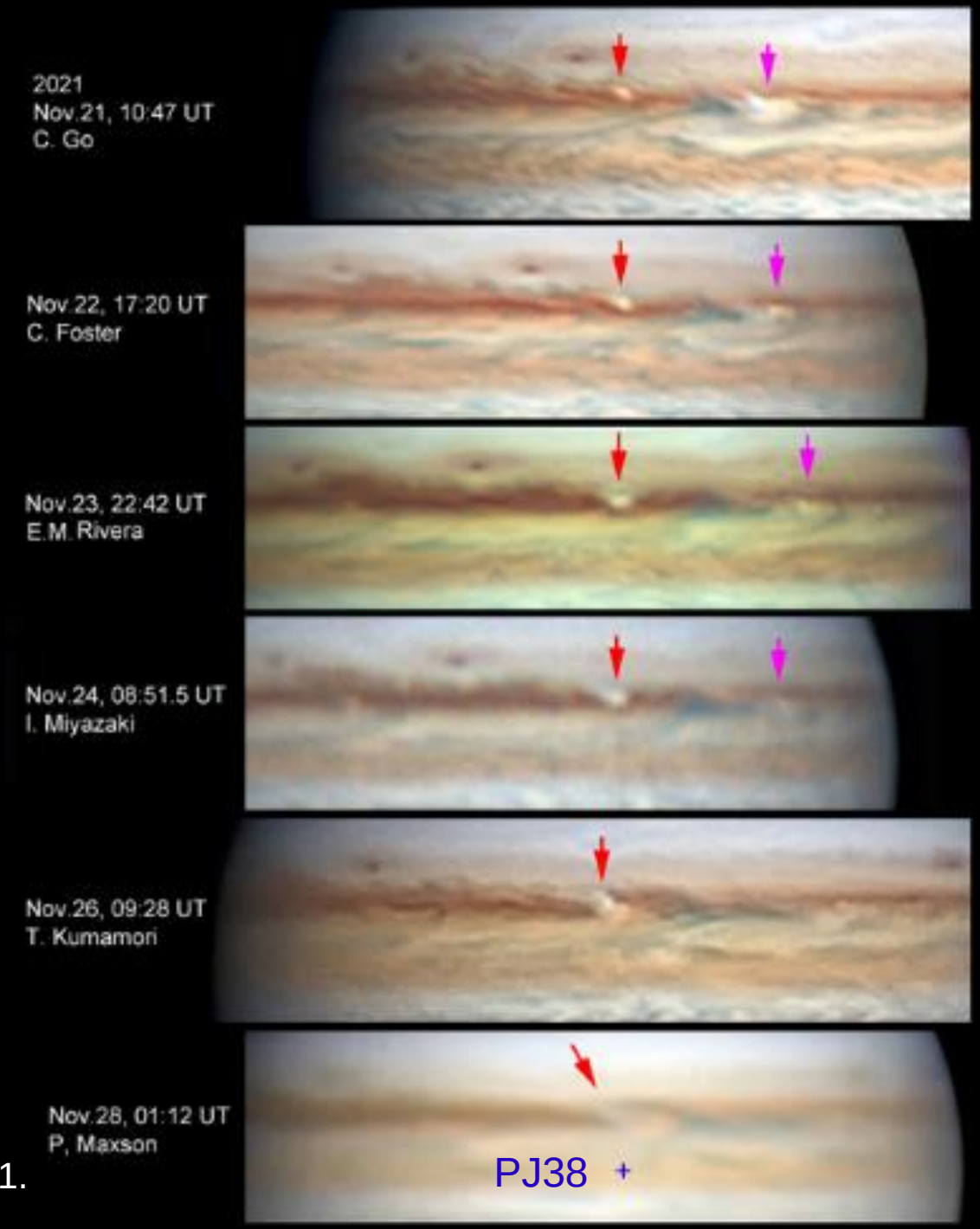
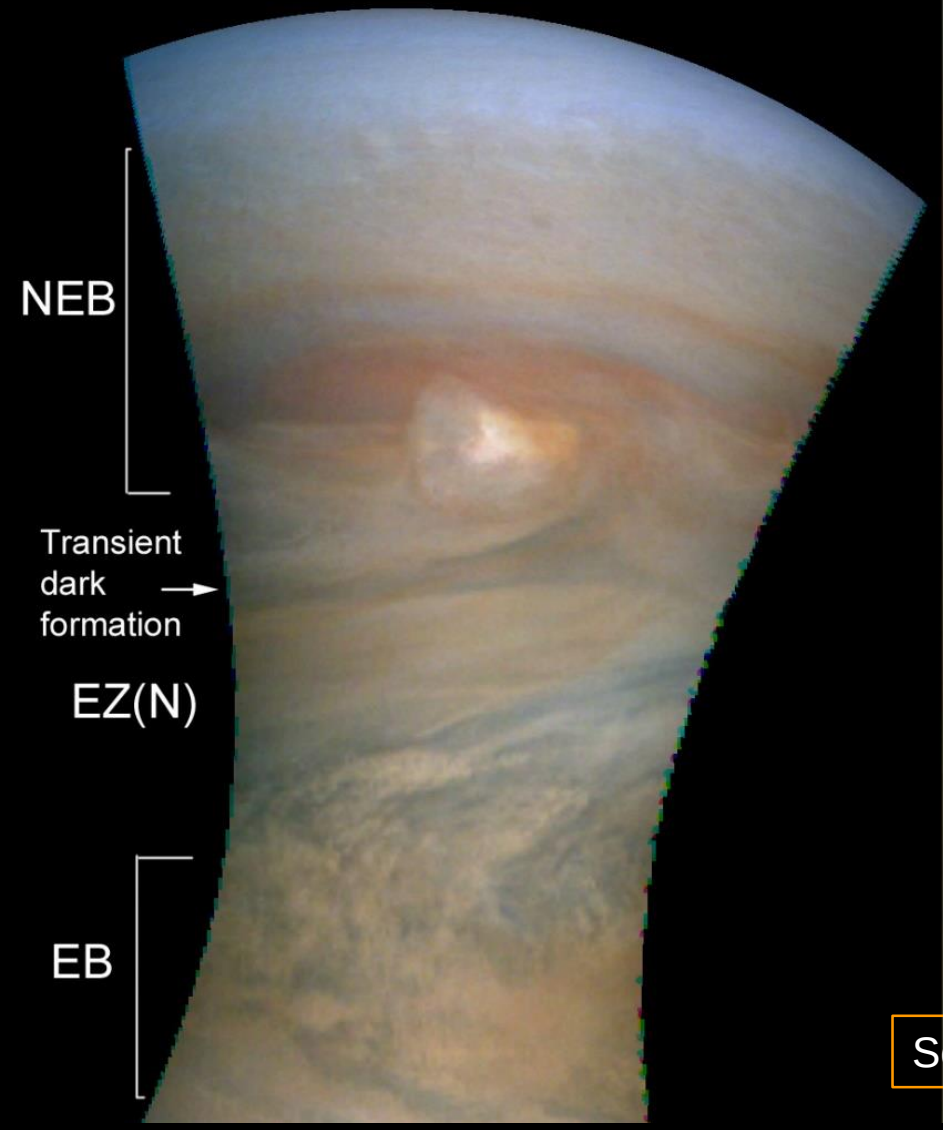


(Red) Appeared Nov.21
(Magenta) Appeared Nov.1.

JunoCam PJ38 images of the NEB(S) outbreak

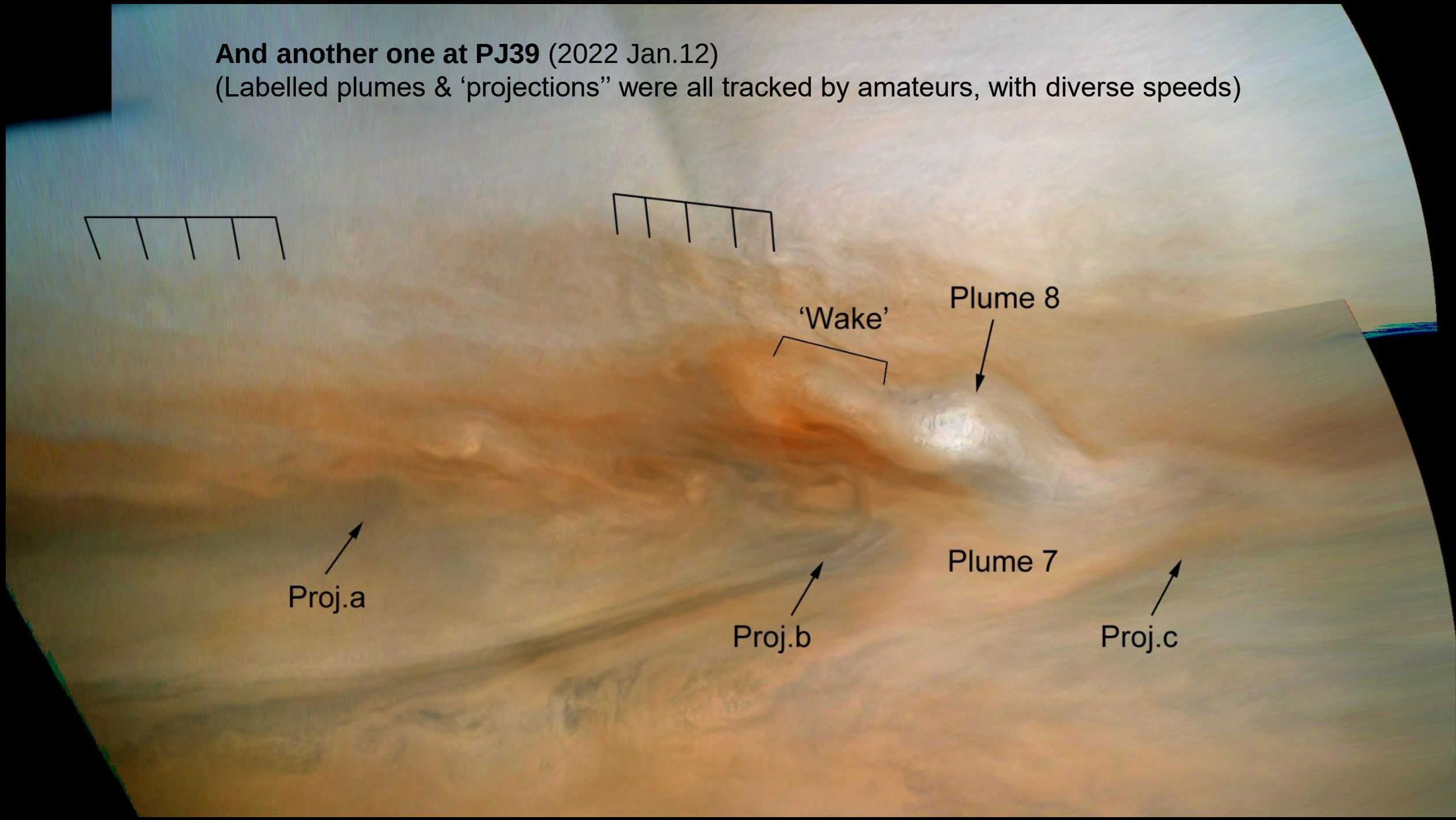
(2021 Nov.29) (NASA / JPL / SwRI / MSSS)

Below: **(A)** Initial version from MSSS team (image 31)
Right: **(B)** Full-resolution enlargement by Kevin Gill (image 30)



See talk 733 by Shawn Brueshaber in OPS4, Thursday pm

And another one at PJ39 (2022 Jan.12)
(Labelled plumes & ‘projections’’ were all tracked by amateurs, with diverse speeds)



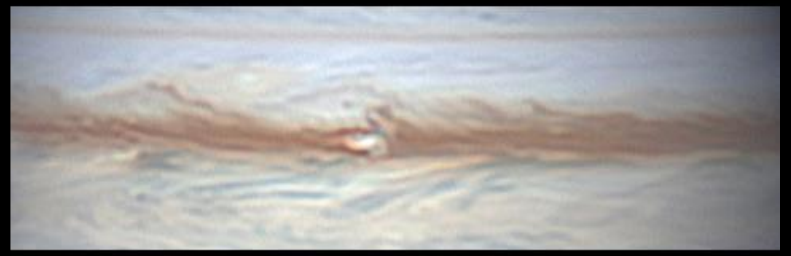

PJ39 (map projection by Björn Jónsson)

And a more energetic one at PJ44 (2022 Aug.17) (Note intense methane-brightness on Aug.16)

Aug.16.97
E. Kardasis
(Greece)

Aug.16.95
E. Kardasis
[CH4]

Aug.17.3
E. Sussenbach
(Curacao)
[just before PJ44]



Aug.19.0
J. Sussenbach
(Netherlands)

Aug.20.25
R. Levesque
(Canada)

Is the NEB Revival occurring in 2022? NEB(S) activity is proliferating…

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(Greece)

Aug.16.95
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[CH4]

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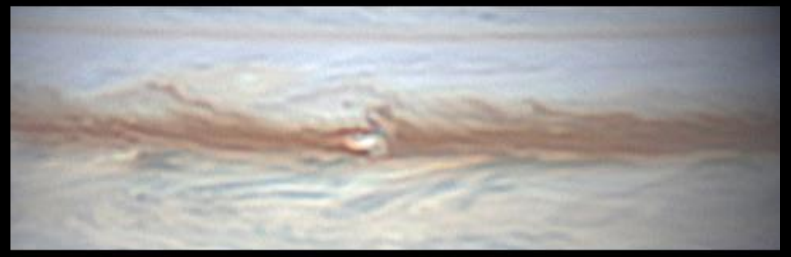

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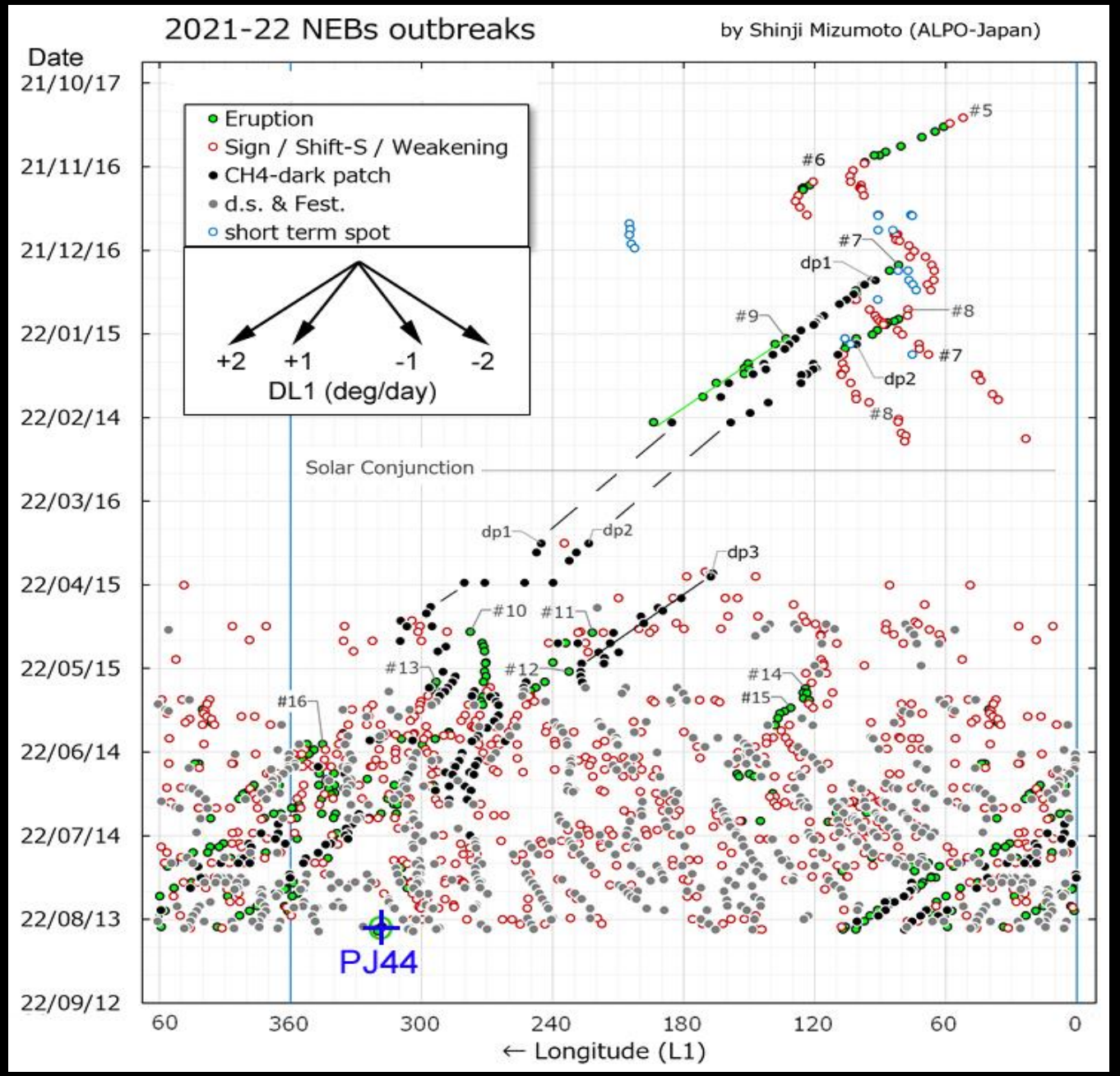
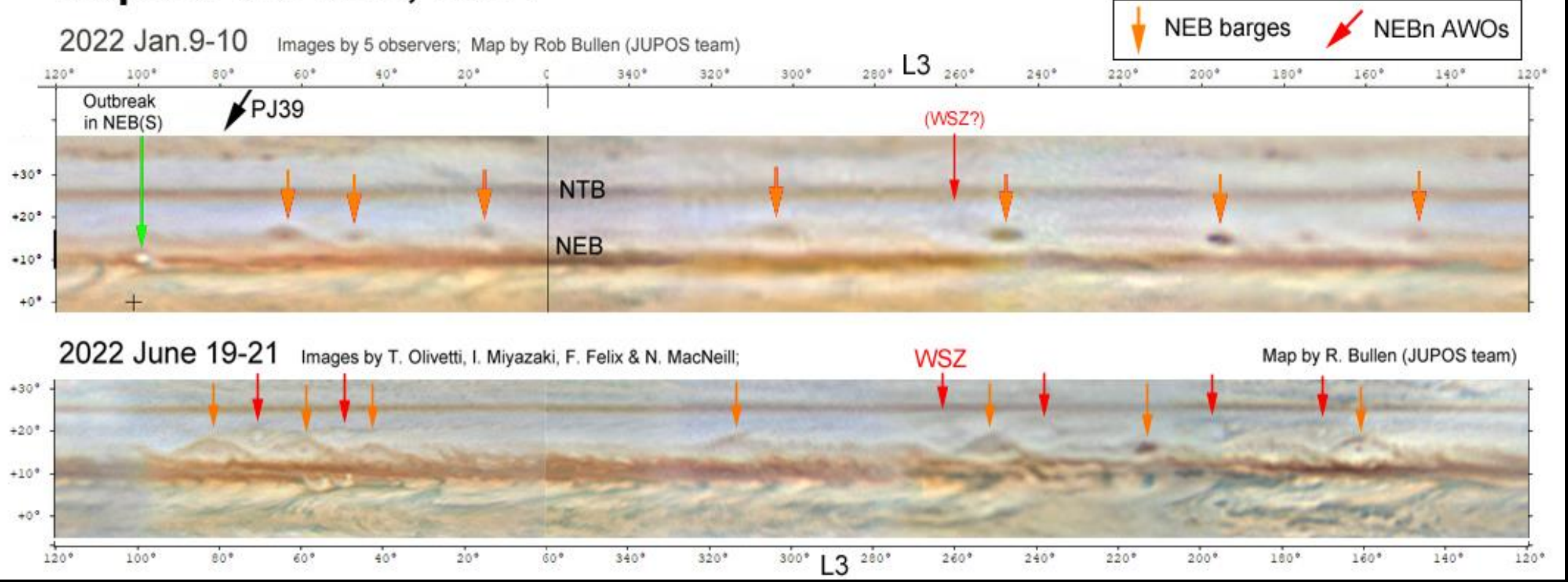
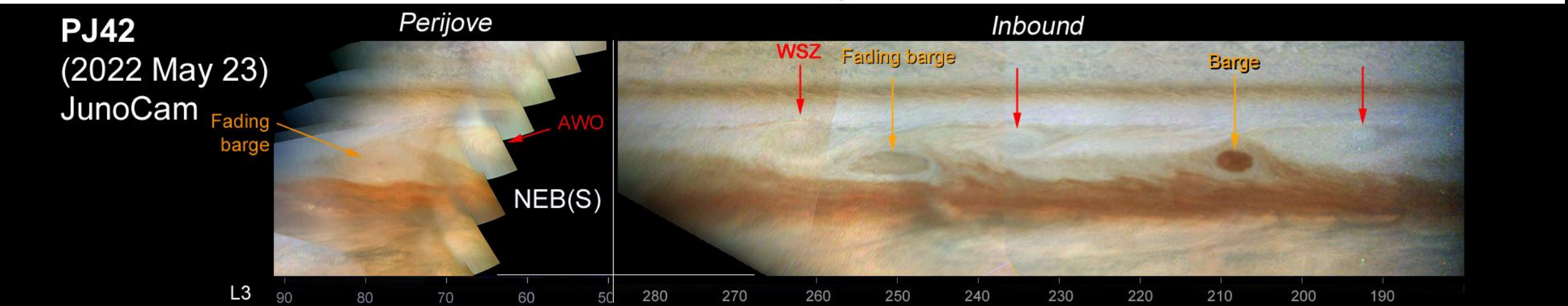
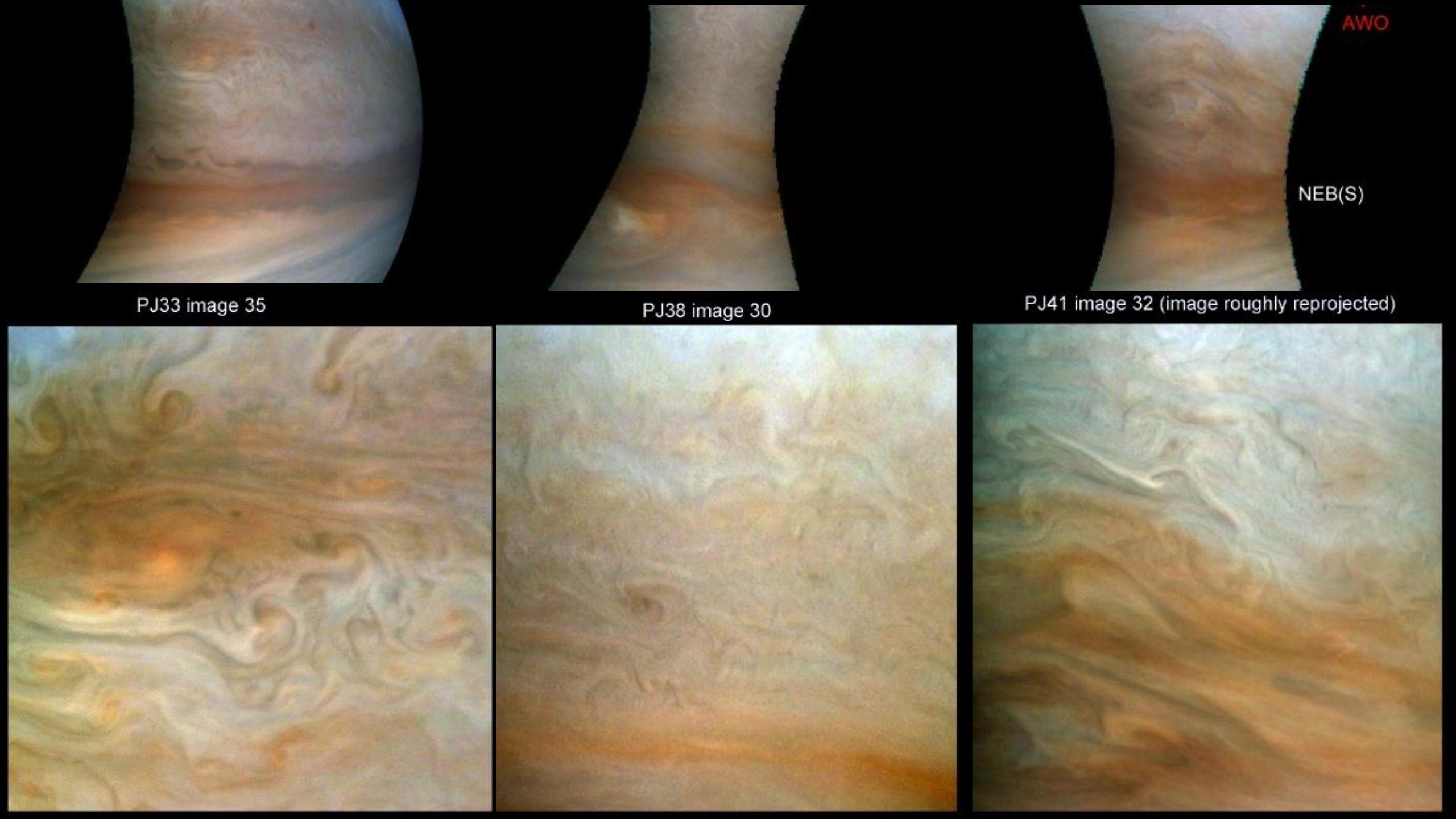



NEB barges
NEBn AWOs
2022 Jan.9-10
Images by 5 observers; Map by Rob Bullen (JUPOS team)
L3
Outbreak in NEB(S)
PJ39
(WSZ?)
NTB
NEB
2022 June 19-21
Images by T. Olivetti, I. Miyazaki, F. Felix & N. MacNeill;
WSZ
Map by R. Bullen (JUPOS team)
L3


PJ42
(2022 May 23)
JunoCam
Perijove
Inbound
Fading barge
AWO
NEB(S)
WSZ
Fading barge
Barge
L3

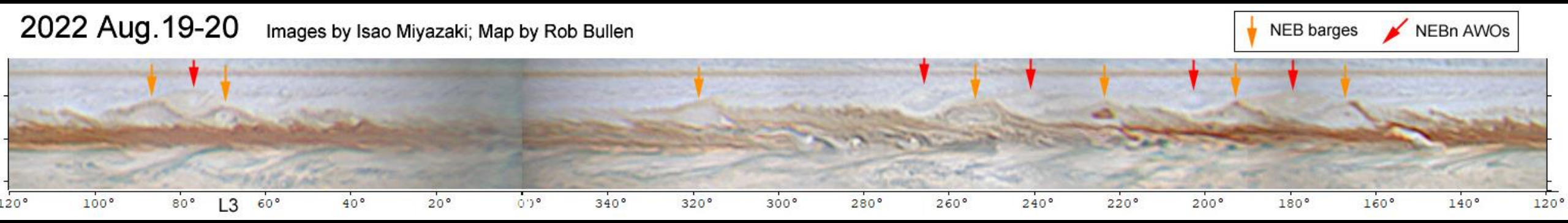


PJ33 image 35

PJ38 image 30

PJ41 image 32 (image roughly reprojected)

Is the NEB Revival occurring in 2022?



Northern NEB: still faint, including the barges which have also faded.

Southern NEB: very disturbed by these convective outbreaks.

Mid-NEB: partly darkened from the NEB(S), but still no convective outbreaks here.

This peaceful, partial revival is occurring slowly, and may have stalled.

In contrast, triennial NEB expansion events, & SEB Revivals, & NTB Revivals, are all triggered or accompanied by large-scale convective activity & turbulence.

So will this lead to peaceful, complete revival of NEB?

Or will it pause until an energetic expansion event begins on schedule in 2023 or later?

Further details in the Juno/Jupiter Splinter Workshop, 17:30 this evening.