

The latest developments of Jupiter's STB May 2020 outbreak ("Clyde's Spot")

EPSC 2021 virtual meeting
13 September-24 September, 2021

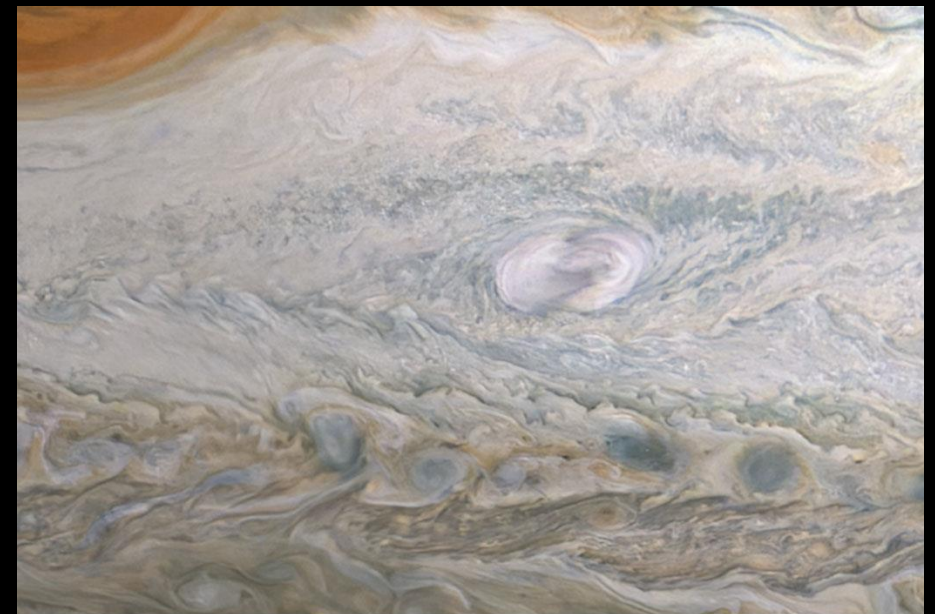
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ALPO-Japan



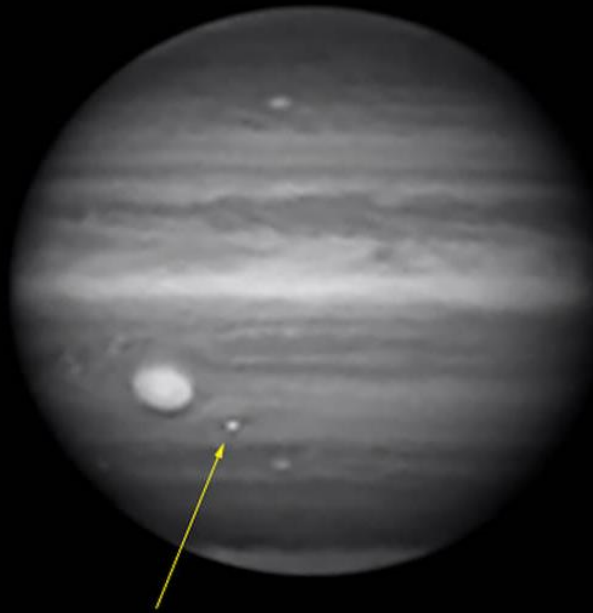
June 2, 2020 Juno PJ27



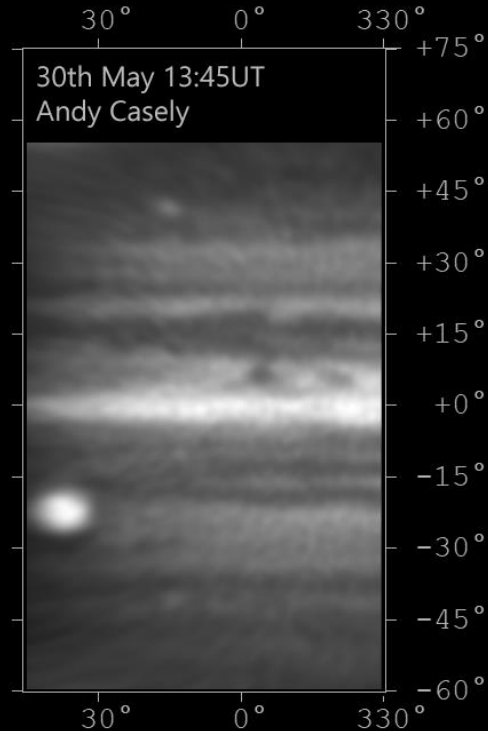
April 15, 2021 Juno PJ33

Recap of initial outbreak

- 31 May, 2020. Methane band imaging showed an unusual bright spot.
- Two days later Juno would capture stunning views on its PJ27.
- This convective outbreak would become known as "Clyde's Spot".

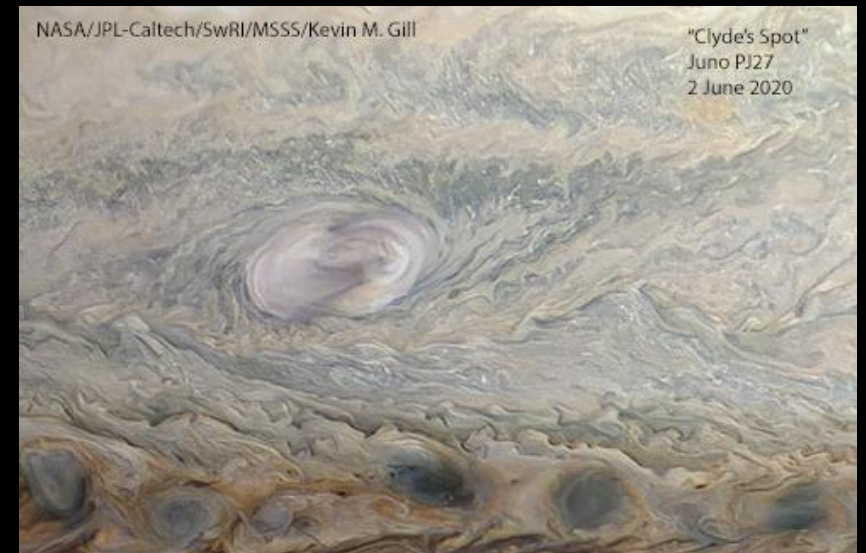
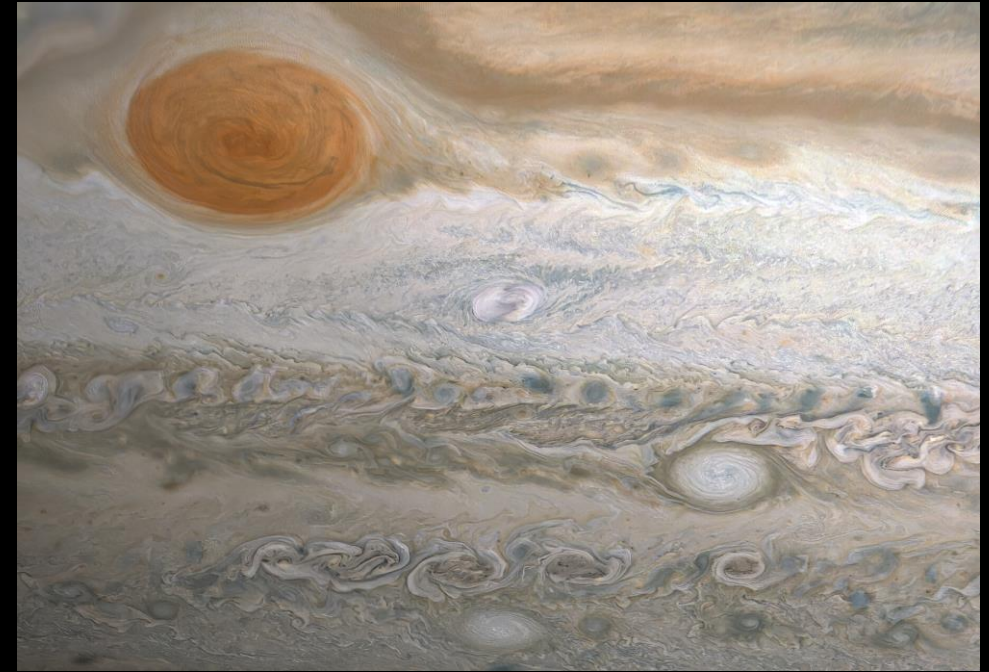


"Clyde's Spot"



Explosive onset of the storm.

Observed in the first hours of activity

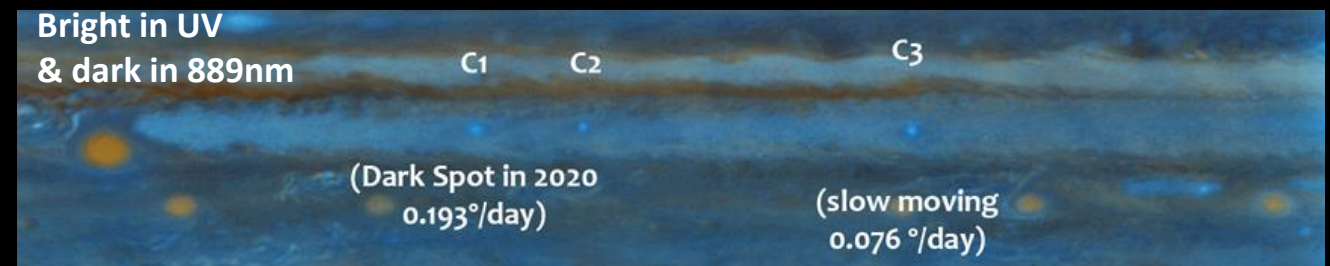
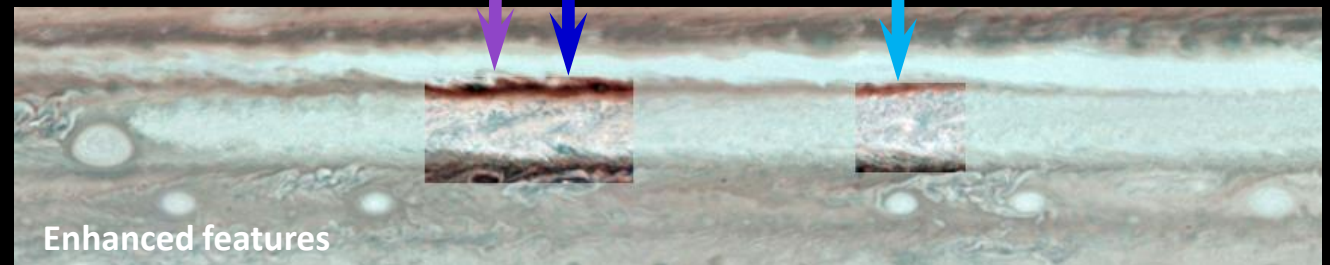
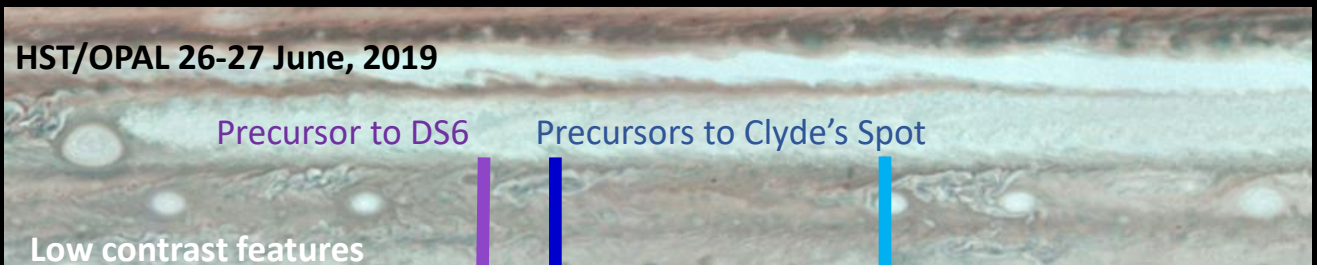


NASA
Juno PJ27
2 June
2020

Prelude to the outbreak- STB cyclones

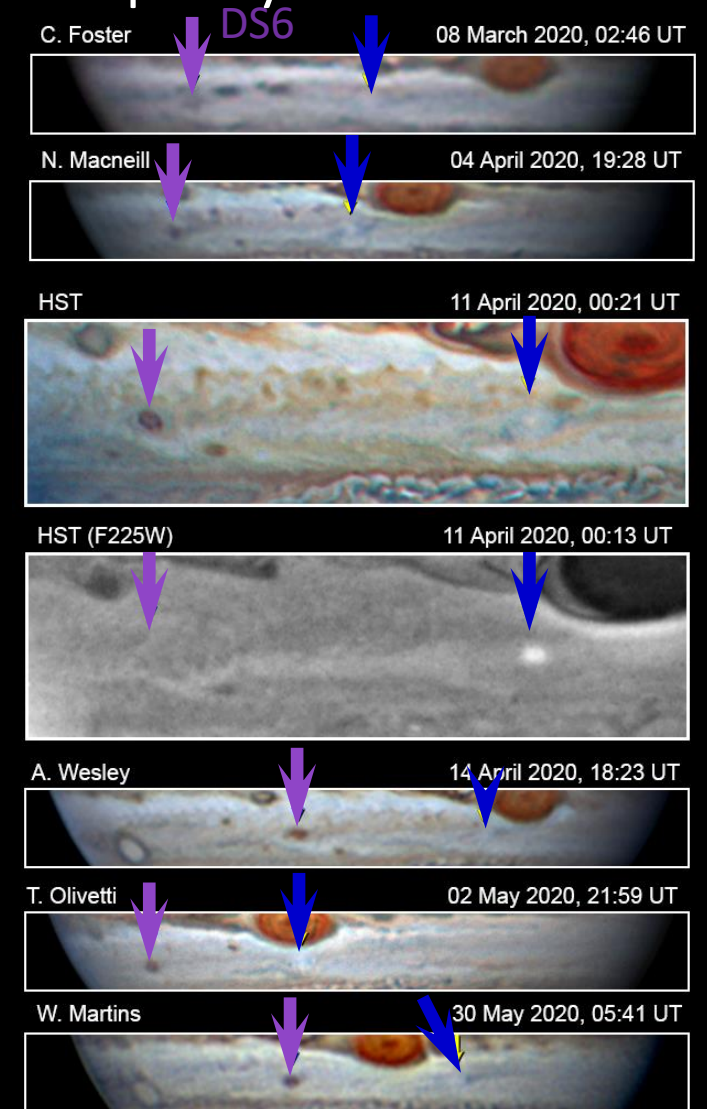
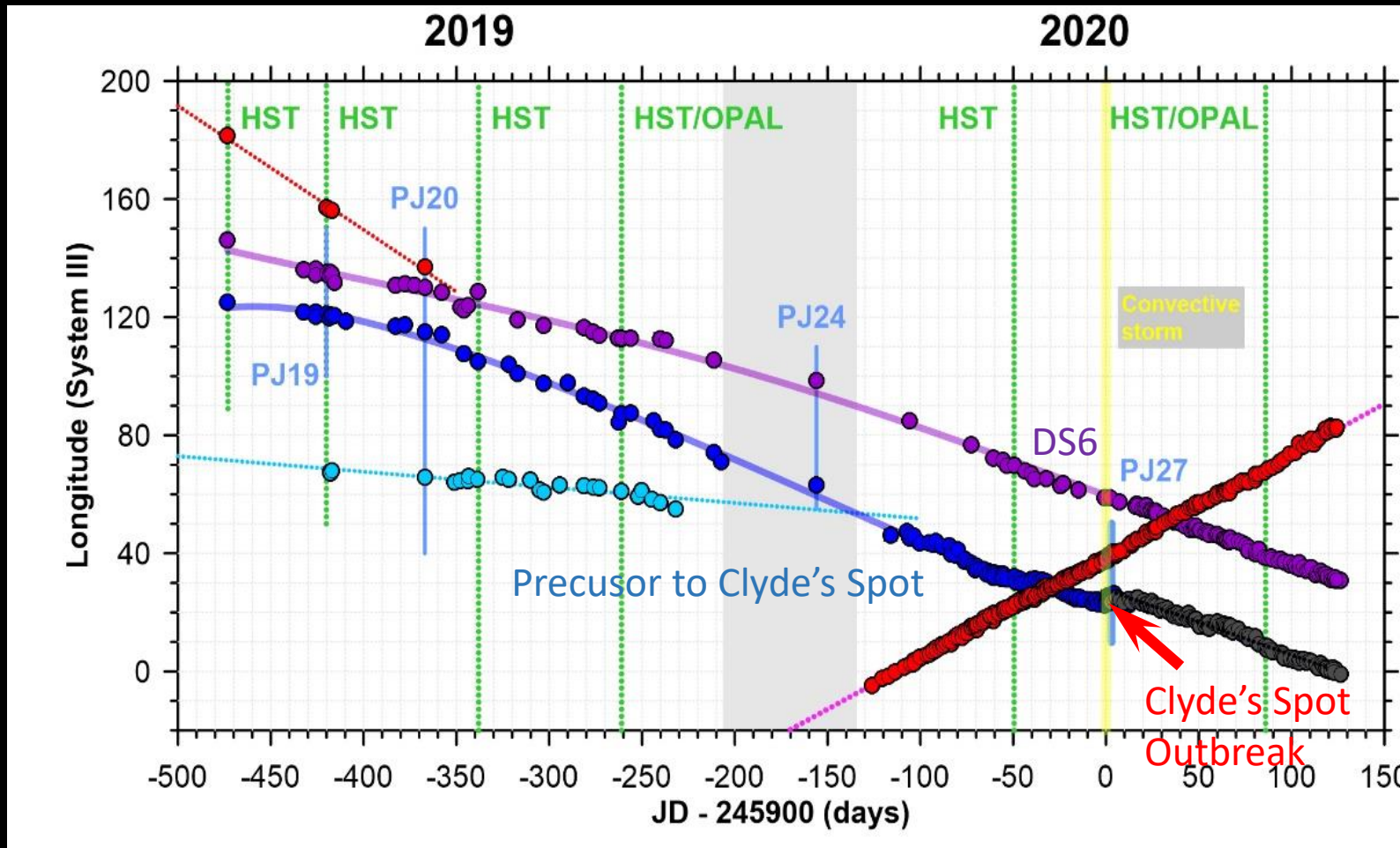
- Research has shown various cyclone systems in the STB dating back to 2019
- Low contrast in amateur images
- Two pairs of these would merge into two resultant cyclonic features
- The Clyde's Spot outbreak would erupt in the leading merged cyclone

Jupiter's STB cyclone alley during PJ20 (29 May 2019)



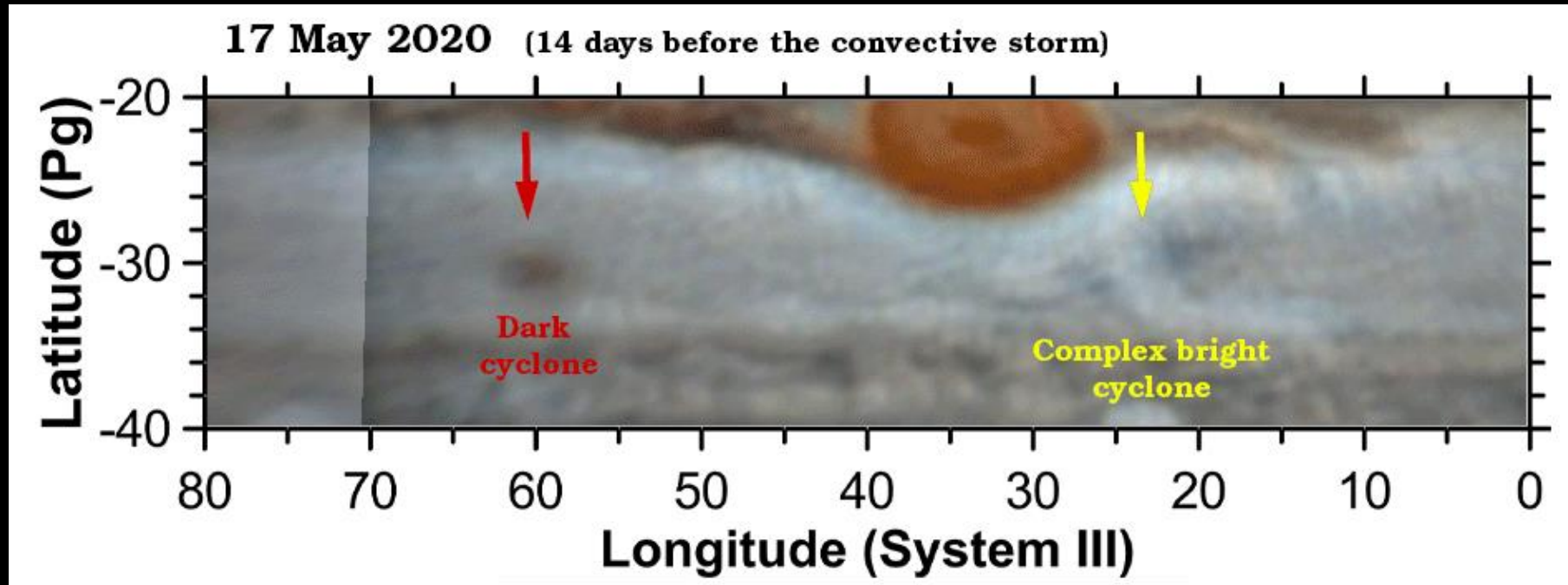
Prelude to the outbreak- likely STB cyclone mergers

- Less intense cyclones likely absorbed by DS6 and the Clyde's Spot cyclonic structure

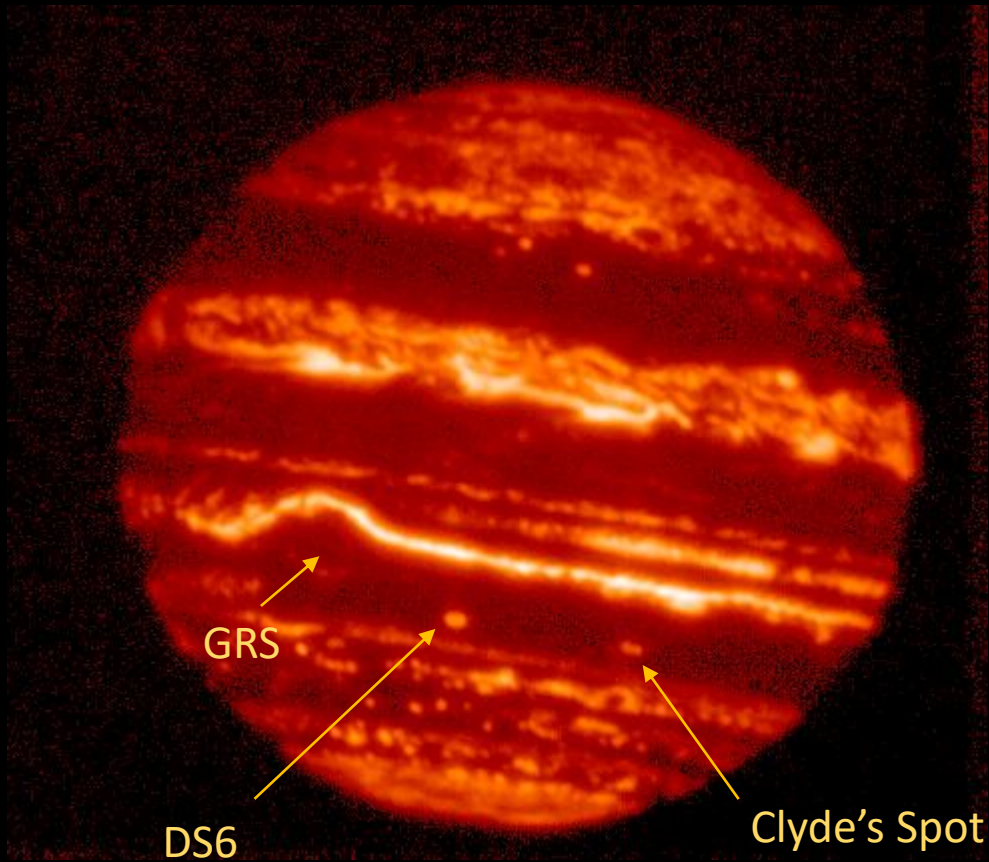


The outbreak (2 months).

Much dynamic activity, most notably the development of dark structure

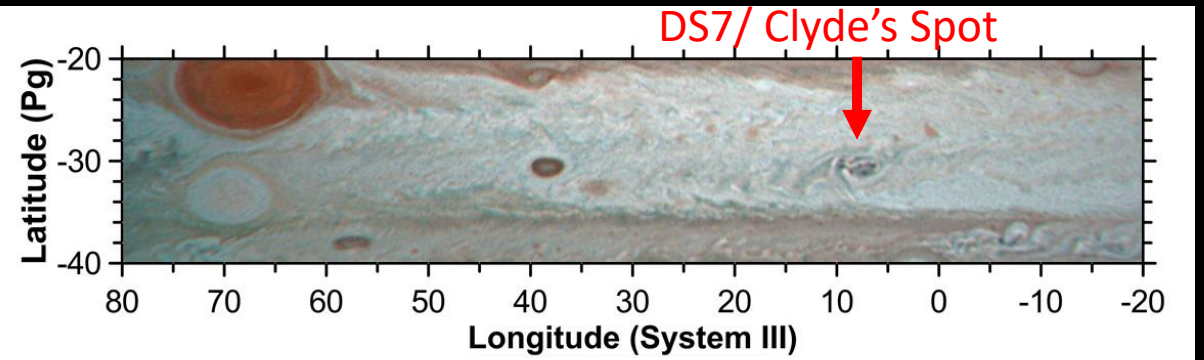


Professional tracking.

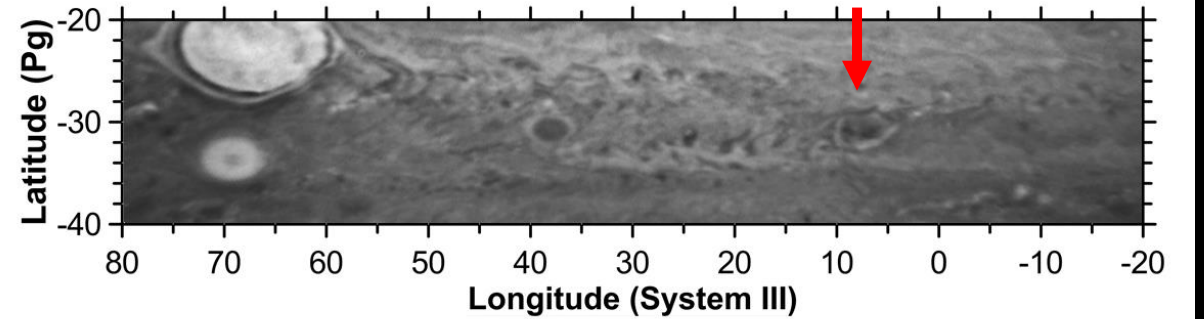


Clyde's Spot from NASA IRTF(5.1 micron)
Mauna Kea, Hawaii
16 August 2020

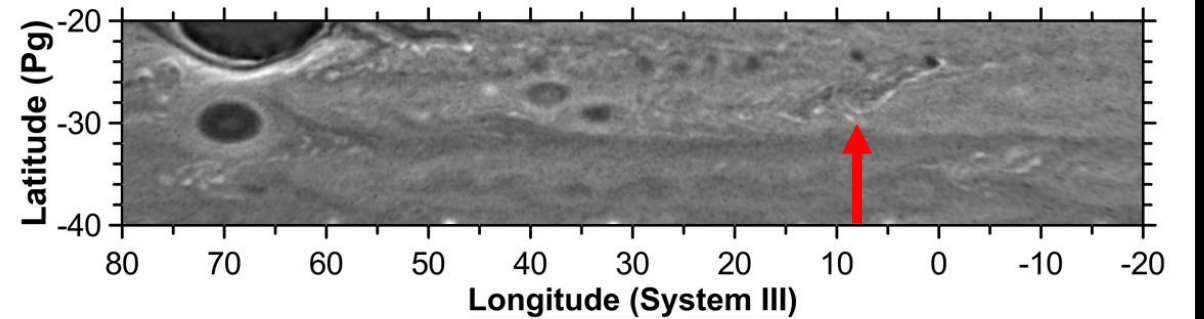
RGB



CH4
F889N



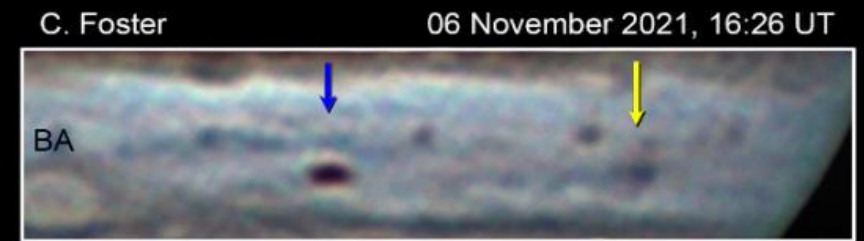
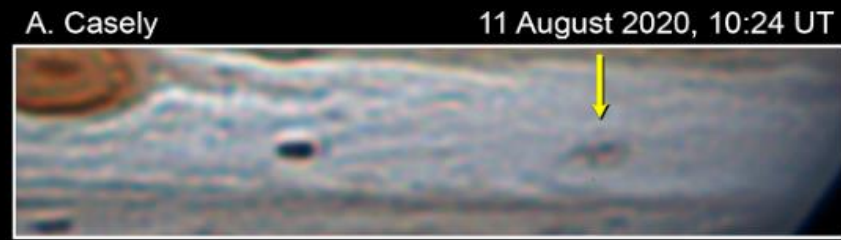
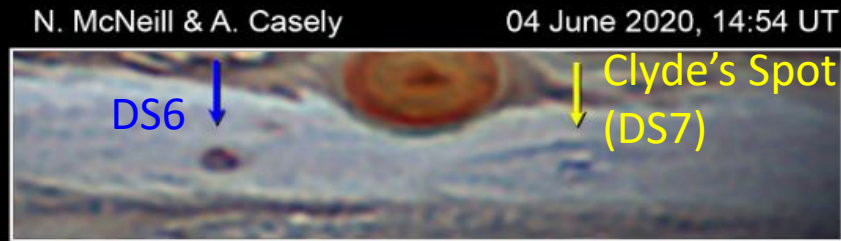
UV
F225W



2020-08-25, HST/OPAL

Development of the outbreak through to solar conjunction.

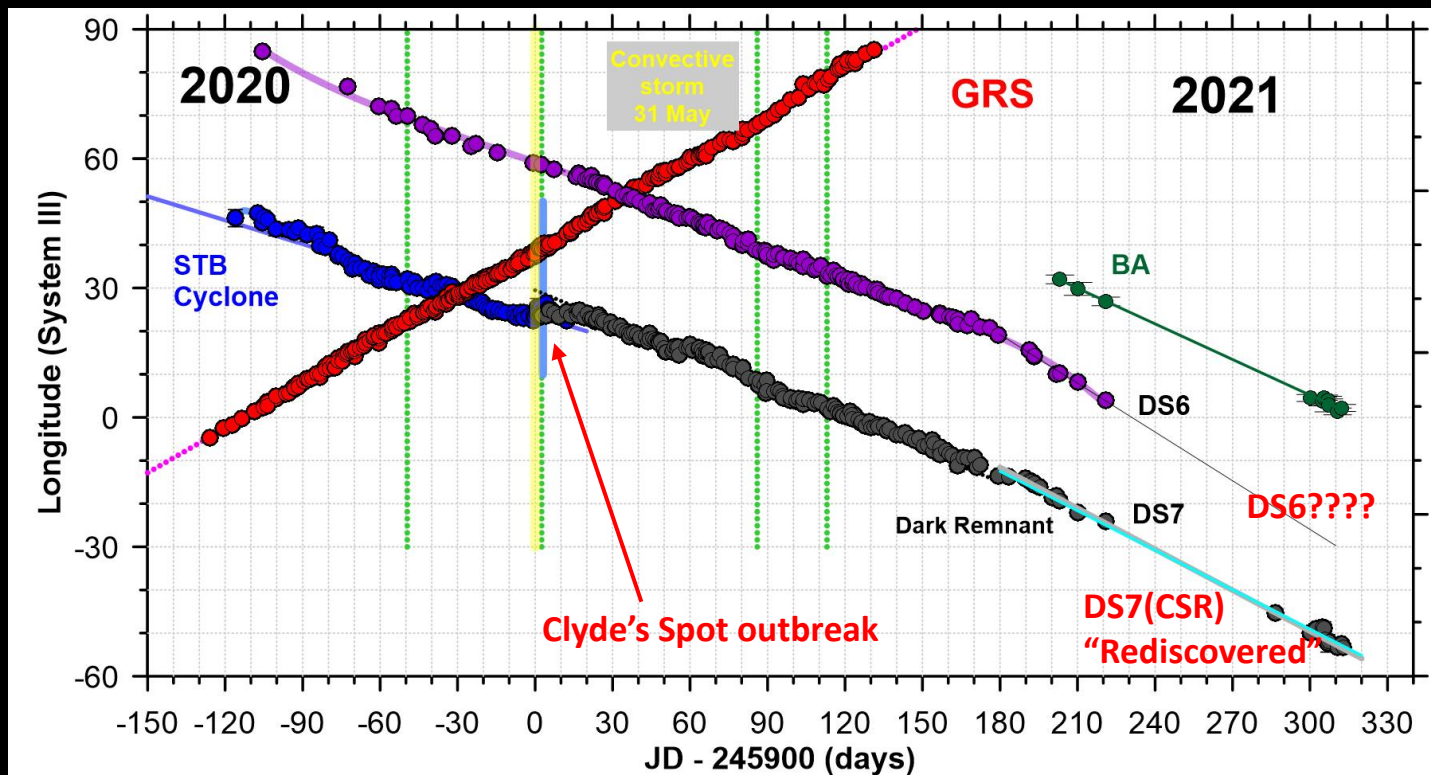
- Clyde's Spot remnant (DS7) tracked extensively by the amateur community
- Ongoing dynamic "dark spot" activity



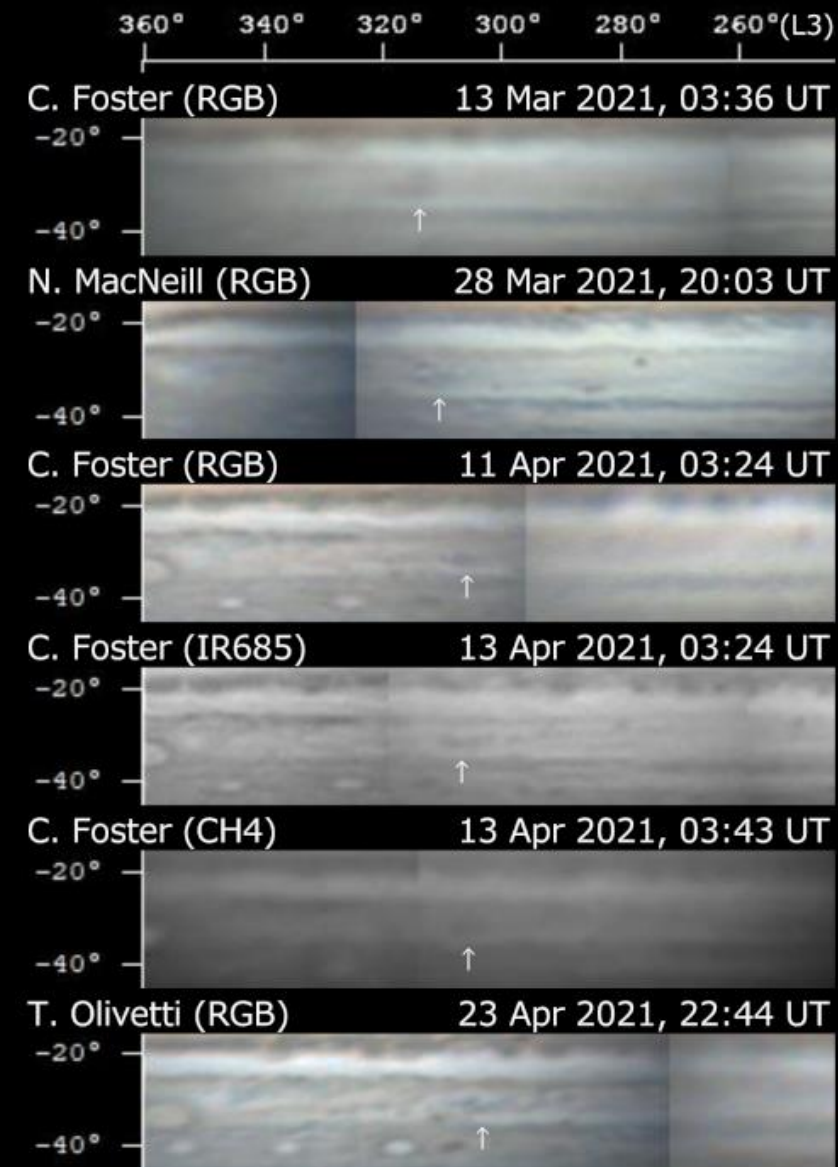
The remnant of Clyde's Spot(DS7)

“Rediscovered” after solar conjunction.

- Charts by R Hueso et al and S Mizumoto/K Horikawa confirmed survival of DS7, but DS6 MIA?

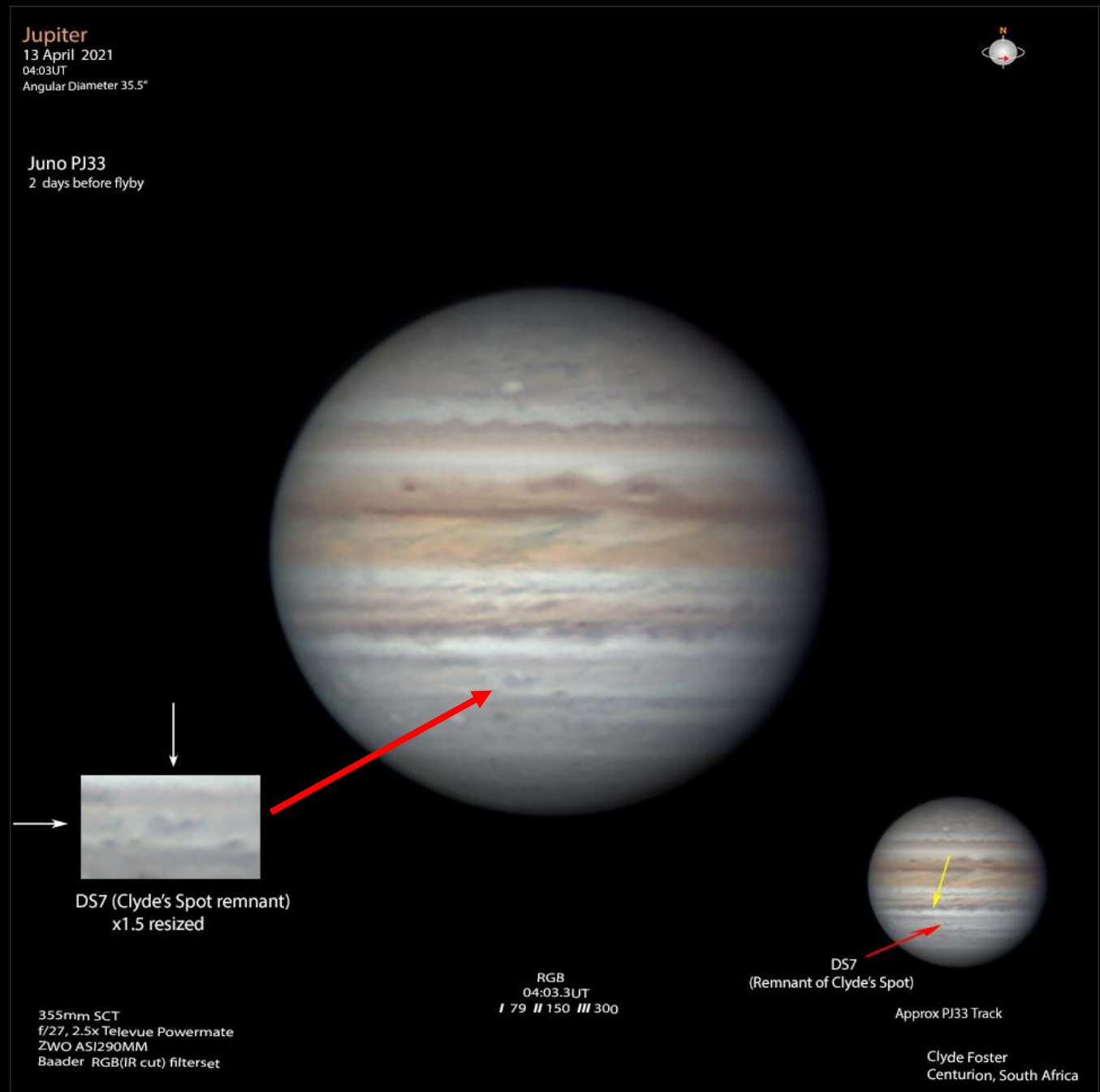


DS7/CSR marked with arrow



Juno PJ 33 15 April 2021

- PJ33: Ten and a half months after initial outbreak
- Much anticipation as the Juno track would sweep over the region



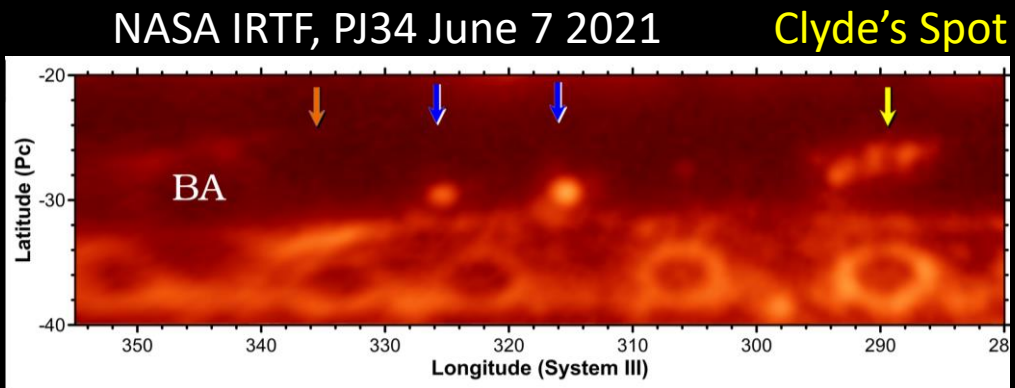
Juno PJ33.



Development of
Folded
Filamentary
Region (FFR)
structure

Juno PJ33 and PJ34.

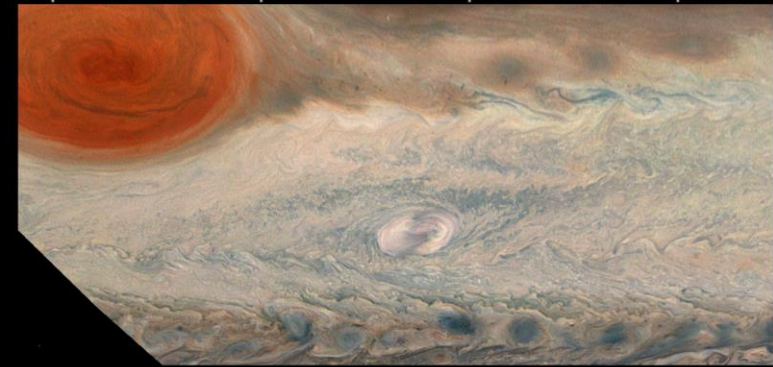
- Juno mission extended
- Orbital adjustment resulted in additional view of Clyde's Spot remnant on PJ34, just under two months after PJ33
- Further expansion was apparent



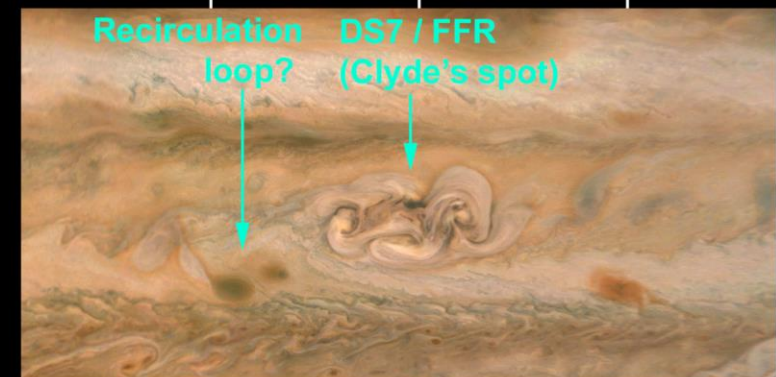
Clyde's spot from JunoCam

Credit: (PJ27): NASA / JPL / SwRI / MSSS / Björn Jónsson
(others): NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers
Longitude marks at 10-deg intervals

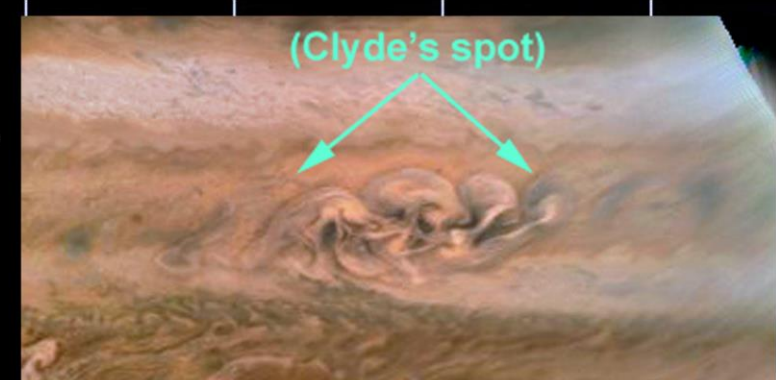
PJ27
(2020
June 2)



PJ33
(2021
April 15)



PJ34
(2021
June 7)



Juno PJ 27/33/34

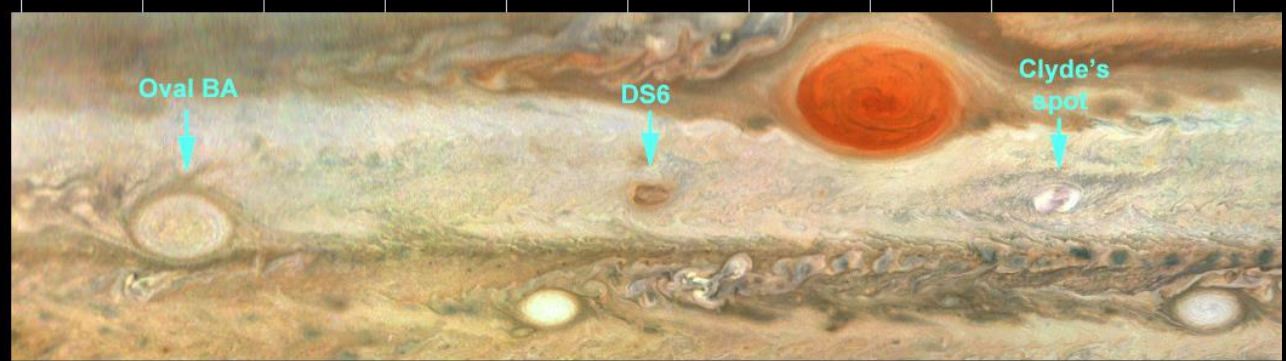
Solving the mystery of DS6!

- “Captured” by Oval BA
- Retained its compact cyclonic structure, but with lighter colouration
- Name change to WS6 (White Spot 6)

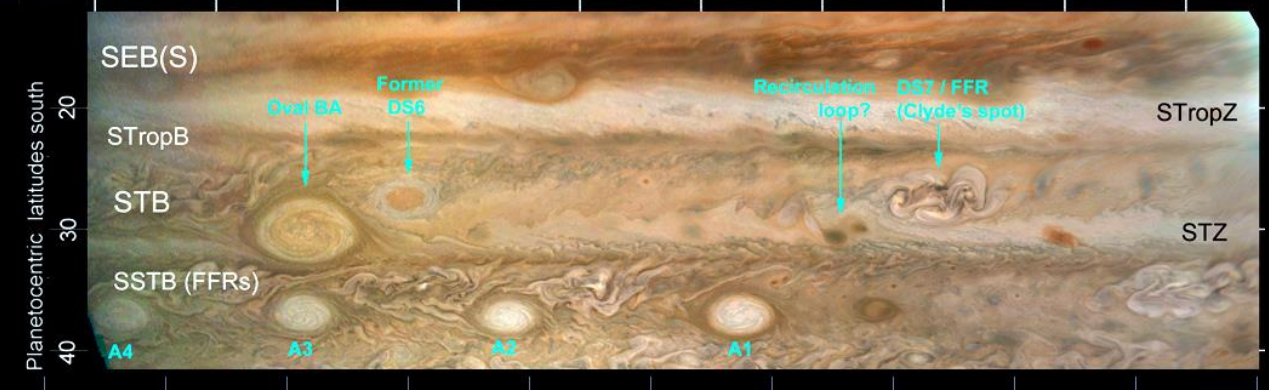
S. Temperate domain preceding oval BA

Cylindrical map from JunoCam images Longitude marks at 10-deg intervals Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers

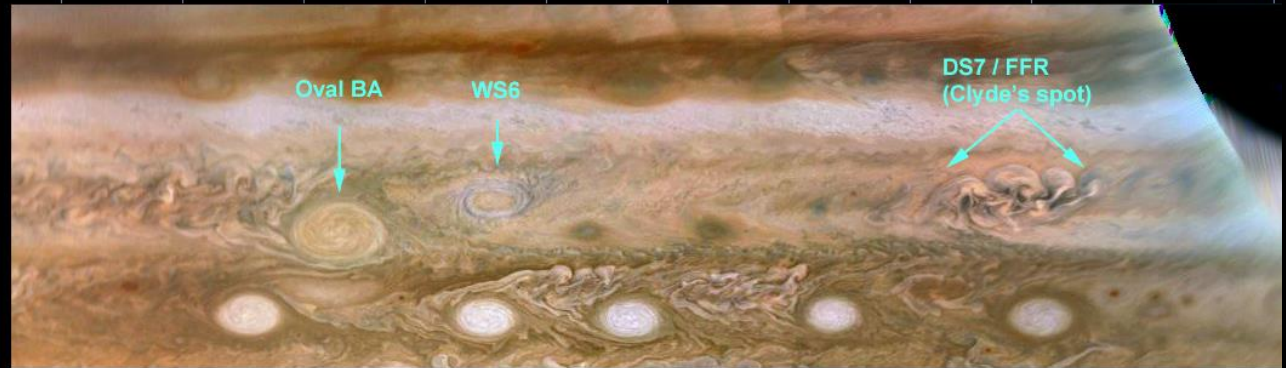
PJ27
(2020
June 2)



PJ33
(2021
April 15)

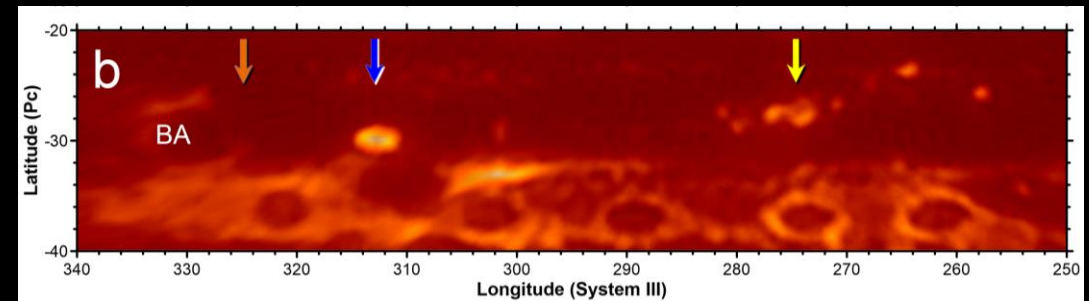
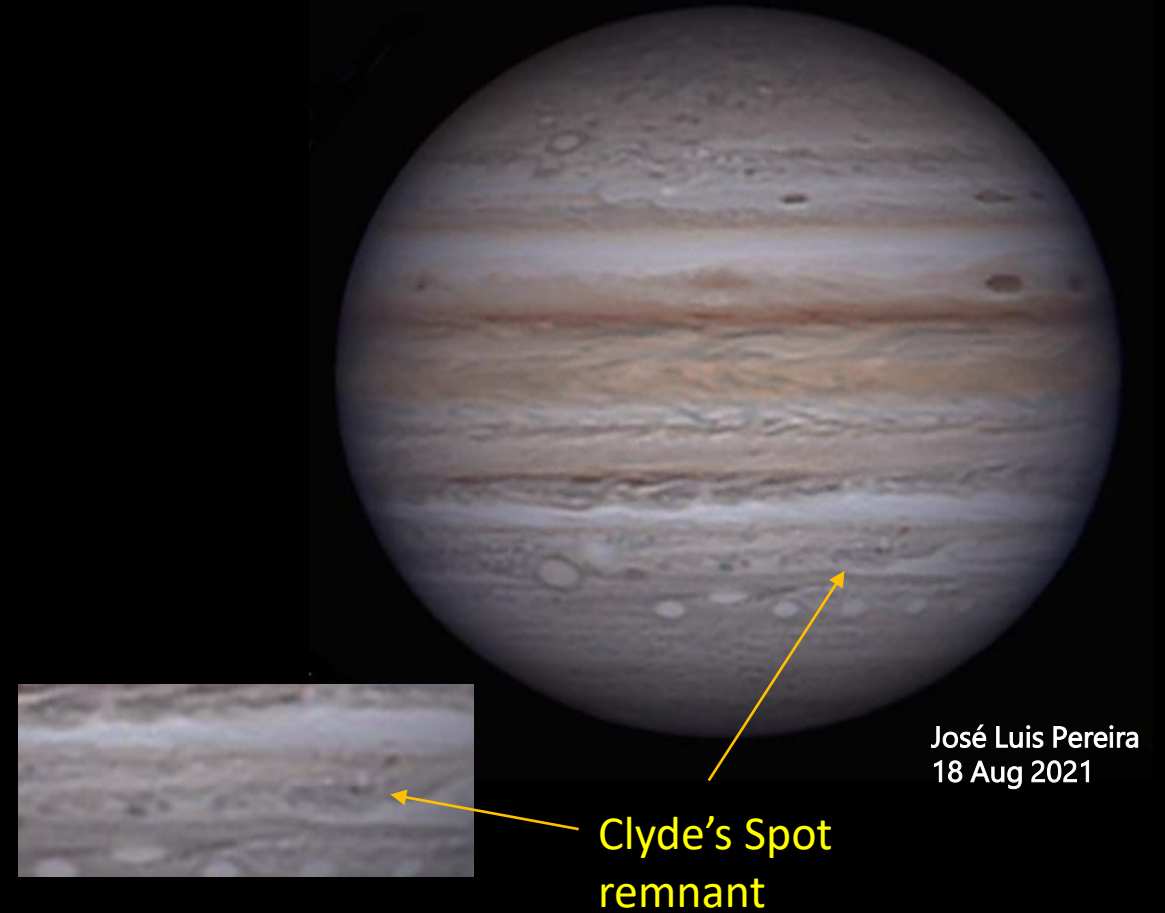
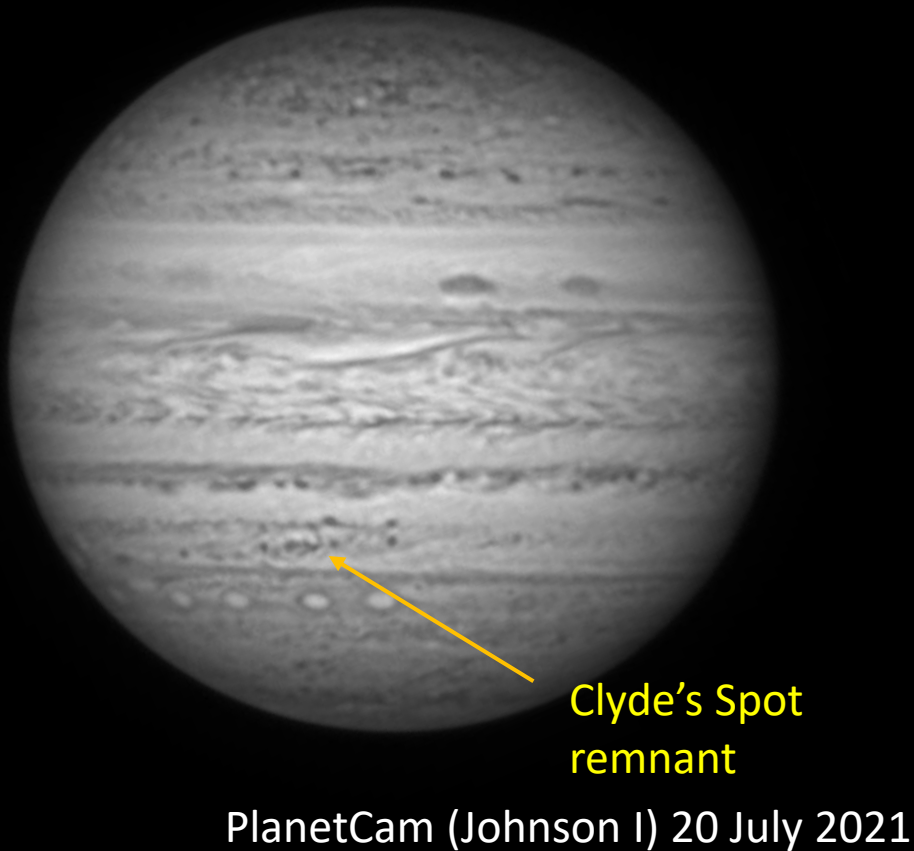


PJ34
(2021
June 7)



Latest developments- July 2021.

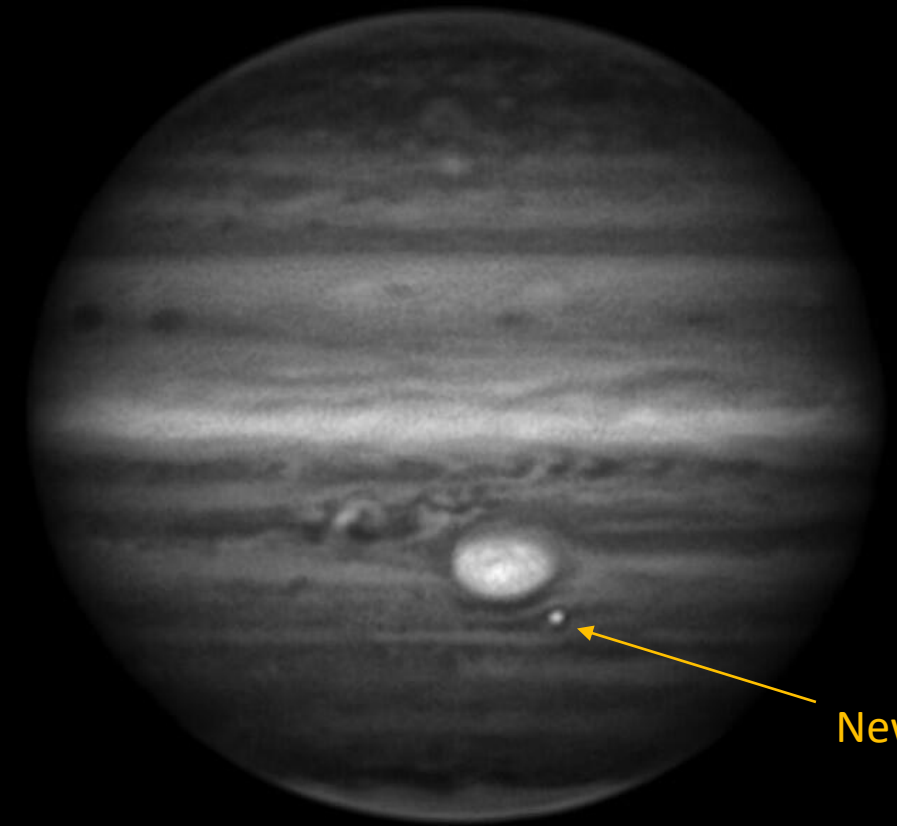
- Ongoing activity and expansion
- Complex and dynamic structure, with dark and light spots



IRTF
21 July
2021

VERY Latest developments- Repeat of Clyde's Spot outbreak?!

- Alert by Chris Go on 7 August 2021
- Initial indication : possible repeat
- Could provide a very interesting comparison in terms of development and timeline



New STB outbreak

15:40UT CH4 I: 104 II: 6 III: 187 (10 min)

Credit: Chris Go

Jupiter: GRS and STB Outbreak

2021.08.07 S: 8/10 T: 3-4/5

© Christopher Go (Cebu, Philippines)

Conclusions.

- The Clyde's Spot outbreak has provided interesting additional perspective on STB convective storms in comparison to those at other latitudes (eg SEB,NTB etc).
- The outbreak erupted in a cyclone that had experienced a vortex merger, with possible intensification, in the previous 120-140 days. We speculate that the resultant vortex may have extended to deeper layers where water is more abundant.
- We are able to track the evolution better than ever before thanks to the wonderful Pro-Am collaboration taking place, including the professional HST OPAL, NASA IRTF, Planetcam programmes, the NASA Juno mission, and comprehensive amateur imaging.
- Nearly a year after the initial outbreak, Juno images showed a beautiful miniature FFR structure .
- Amateur and professional observations indicate ongoing complex activity.
- The FFR structure raises expectations that DS7/Clyde's Spot remnant may develop into a longer term STB segment

My thanks to all those in the Pro-Am planetary community for their support and interest in tracking and researching the initial Clyde's Spot outbreak and its resulting remnant. In particular my co-authors of this presentation.