

JunoCam at PJ41 / 2022/23 report no.1

John Rogers (BAA) (2022 April 29)

Juno's perijove-41 occurred on 2022 April 9. This was just as the planet was beginning to appear in the dawn sky for ground-based observers, who had not been able to get any well-resolved colour images up to that time, so Juno's coverage was very important for assessing what had happened during solar conjunction – particularly in the NEB. Some good amateur images were obtained in the week following. Here we summarise the state of Jupiter's features as revealed by JunoCam and by amateur observers.

Inbound, Juno obtained several distant views of the north polar region of Io ([Figure 1](#)).

Perijove was at 34.0°N ('centric), over the NNTB, and equator crossing was at L1=351, L2=183, L3=68.5 – close to the longitudes covered at PJ37.

North Polar Region

[Figure 2](#) is our north polar map showing the circumpolar cyclones. Their configuration has not changed much -- CPC-7 is still displaced southwards -- but the AWO north of it has reappeared. This AWO was present from PJ4 to PJ28, but absent from PJ32 to PJ39; then a little vortex appeared at PJ40, and has now developed into a substantial AWO.

The inbound images gave good views of extensive rainbow-tinted haze bands.

High northern domains

[Figure 3](#) shows the usual features of the northern domains, with a closeup of the large AWO in the N5 domain which we have tracked for at least 3 years, described in our recent report [ref.1].

There is also a notable anticyclonic oval in the N3 domain – large, pale orange, and methane-bright ([Figures 3&4](#)). We have not previously seen such a 'Little Red Spot', here, but I wonder if it could be the bright AWO that moved from the N3 to the N2 domain in 2021 Sep. and persisted in the NNTZ [ref.1; 'N3-w1' therein] – could it have drifted back again? In Phil Miles' methane image on April 11, it appeared weakly methane-bright; it is not NN-LRS-1 which was at higher longitude and very methane-bright.

Image 29 showed fascinating swirling texture on both sides of the NNTB (shown at full resolution in a version posted by Kevin Gill).

[Figure 4](#) is our global PJ41 map, and [Figure 5](#) compares it with ground-based maps in January and April to identify features that have persisted through solar conjunction.

NEB & EZ

With the evolution of Juno's orbit, JunoCam is again starting to get useful inbound coverage, so strips of the NEB was mapped not only at perijove, but also on the opposite side ([Fig. 4](#)). The results were very informative, showing 3 AWOs, 2 fading barges, an active outbreak region on the NEB(S), and a general tendency of the brown NEB(S) to expand northwards.

--The AWOs were almost invisible in late 2021, having little contrast with the surroundings (Fig. 5), but the views of them near the limb at PJ41 (e.g. Fig.6) confirm that they still exist -- including long-lived White Spot Z (WSZ), which has remained weakly methane-bright in amateur images, and is currently at the same longitude as the GRS.

--The barges were very dark in 2021, but the latest ground-based maps (Fig. 5) show that six of the seven, while still present, have faded considerably. This explains the peculiar structures imaged at PJ41 near the limb, both inbound (a distorted pale barge at L3 = 248) and outbound (a diffuse pale barge at L3 = 73; Fig.6): both are light brown with a white collar surrounded by brown material apparently flowing round from the NEB(S).

--The visibly dark brown NEB(S) has only broadened slightly, but weaker brown darkening has spread from it into the mid-NEB; before conjunction, this was only happening in the wake of NEB(S) outbreaks. So the dark NEB is reviving to some extent. (Image 32 gives a hi-res view of this brown darkening and its relationship to the intricate unaligned whitish clouds of the faded northern NEB.) However, this mid-NEB darkening is not accompanied by any convective 'rift' activity; we have still not seen any convective plumes north of the very dark NEB(S).

--An active region of NEB(S) was very fortunately captured in the first inbound image, and in hi-res ground-based images on April 10 and 19 (Fig.5; green bracket). Moreover, this is the only vigorously active sector (L1 ~ 150-180, L3 ~ 230-260 at PJ41). It includes bright white plumes and a dark blue, methane-dark patch that is retrograding in L1 – just like the outbreaks in Dec.-Jan. Maps and charts recently posted by Shinji Mizumoto show that this is the same longitude sector where those outbreaks were taking place in 2021. Mizumoto's chart (Fig.7) also shows that two other methane-dark patches, produced in this sector in January, have persisted with their even greater retrograding drift in L1, +1.7 to +1.8 deg/day. On the other hand, small NEDFs are now visible all round the NEBs; we don't yet know their drift rate.

In summary, the mid-NEB has somewhat darkened and the NEBs carries small features at all longitudes, but it is not yet clear whether this is the full NEB Revival. The activity seems to be still limited to the same active sector of NEB(S) as in late 2021. Possibly the source(s) in the NEB(S) latitude are only driving rather superficial changes further north, not the kind of vigorous spreading convection that would accompany a NEB broadening event. So this might all settle down again, deferring the full NEB revival to 2023, as originally predicted. On the other hand, it could all continue to develop this year – we'll just have to wait and see.

The ochre colour in the EZ seems to be weaker than it was last year.
The PJ41 images show some mesoscale waves in it.

Southern domains

SEB: JunoCam had a good view of a barge (Fig.8). Along its south edge there is an exceptionally large array of mesoscale waves (bracketed in the enlargement in Fig.8). At PJ15, JunoCam viewed a similar barge with a similar train of waves [ref.2], which lie transversely along the SEBs jet where it is channeled past this circulation.

STB: Little has changed since late 2021; all the features tracked then are still recognisable. There is an ongoing outbreak of dark spots in the STBn jet, coming from the STB complex around DS7 (Figs.4 & 5), and well imaged at PJ41 (Fig.8). STB spot 8 was well imaged (Fig.8, lower right), and is still a dark oval, as at PJ39.

The outbound images enabled us to make a map (Fig.9) of the complex sector encompassing oval BA and DS7 (formerly Clyde's Spot). Cyclonic white oval WS6 has drifted well away from oval BA. DS7 can be recognised as a disturbed patch, but its limits are ill-defined. Preceding it there is a white spot that may be a small AWO formerly adjacent to the

‘F-Spectre’ recirculation, but the structure of this region will need higher-resolution imaging to unravel.

SSTB: The seven AWOs are still present (Figs.4 & 5 & 9), and there are now two cyclonic white oblongs: between AWOs A4-A5 and between AWOs A1-A2. The latter is new but not surprising as this sector had been rapidly lengthening, and the white oblong will probably also grow longer.

References:

1. Rogers J & Adamoli G (2022) Jupiter in 2021-22, Report no.9: N3 to N6 domains. https://britastro.org/section_information_/jupiter-section-overview/jupiter-in-2021-22/jupiter-in-2021-22-report-no-9-n3-to-n6-domains
2. Orton G et al.(2019) ‘Survey of Small-Scale Waves and Wave-Like Phenomena in Jupiter's Atmosphere Detected by JunoCam.’ JGR-Planets 2019JER006369 [Fig.5].

Figures (small copies):

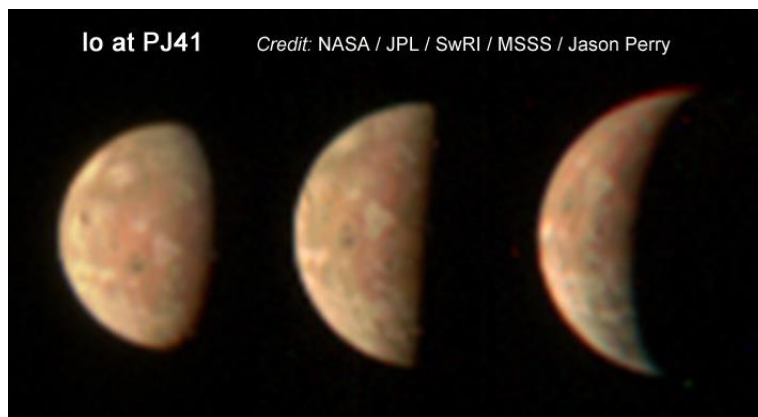


Figure 1:

[Figure 2 is on the next page]

Figure 3:

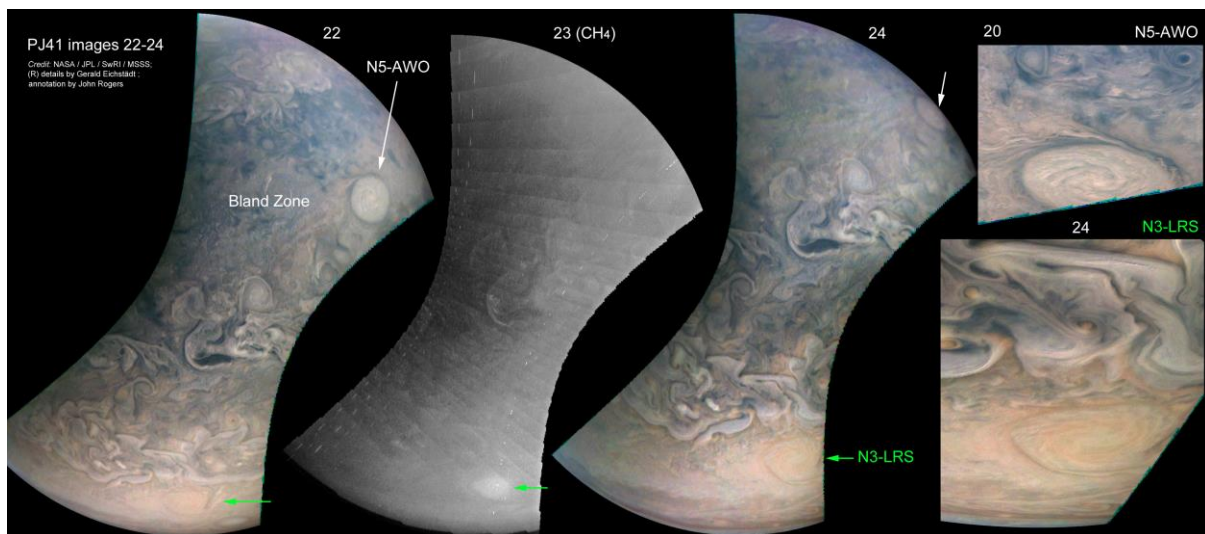


Figure 2:

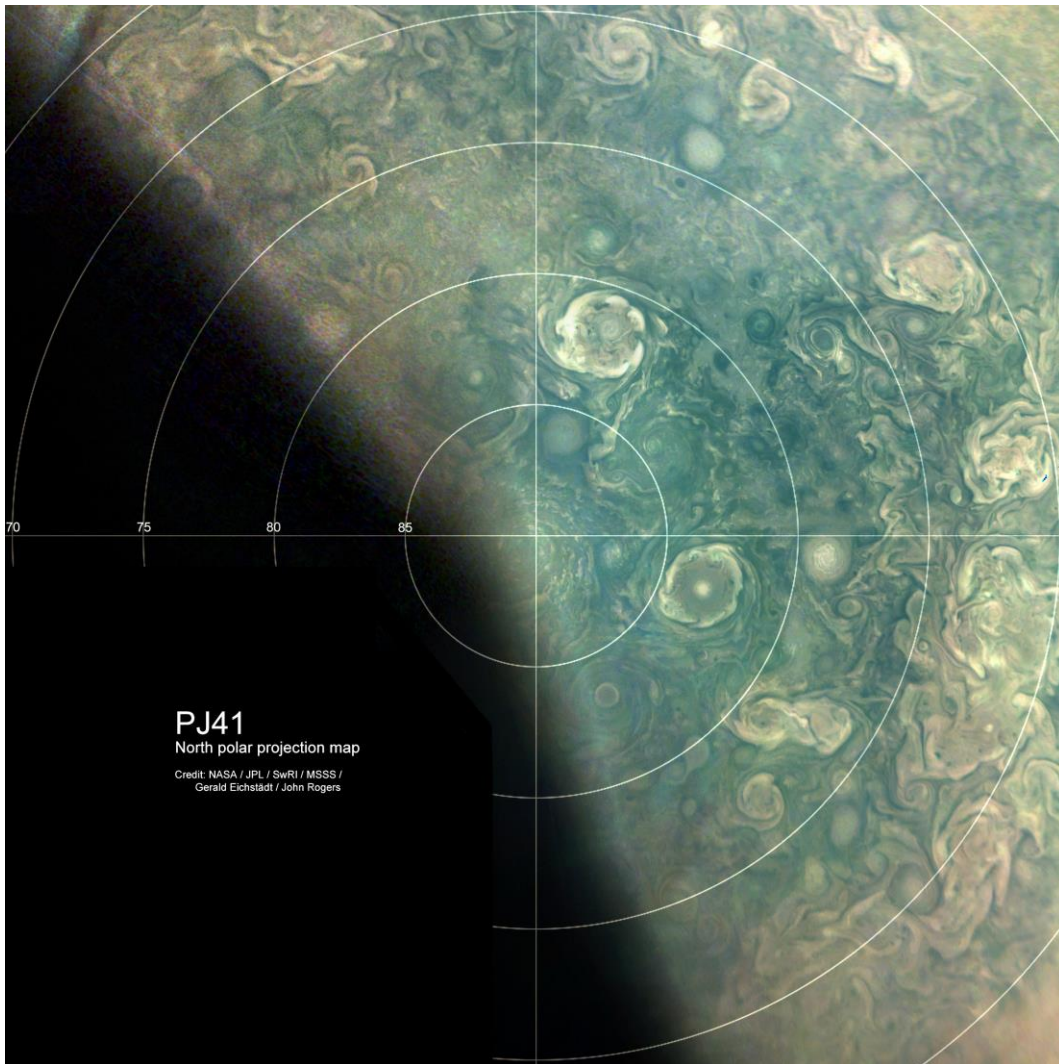


Figure 4:

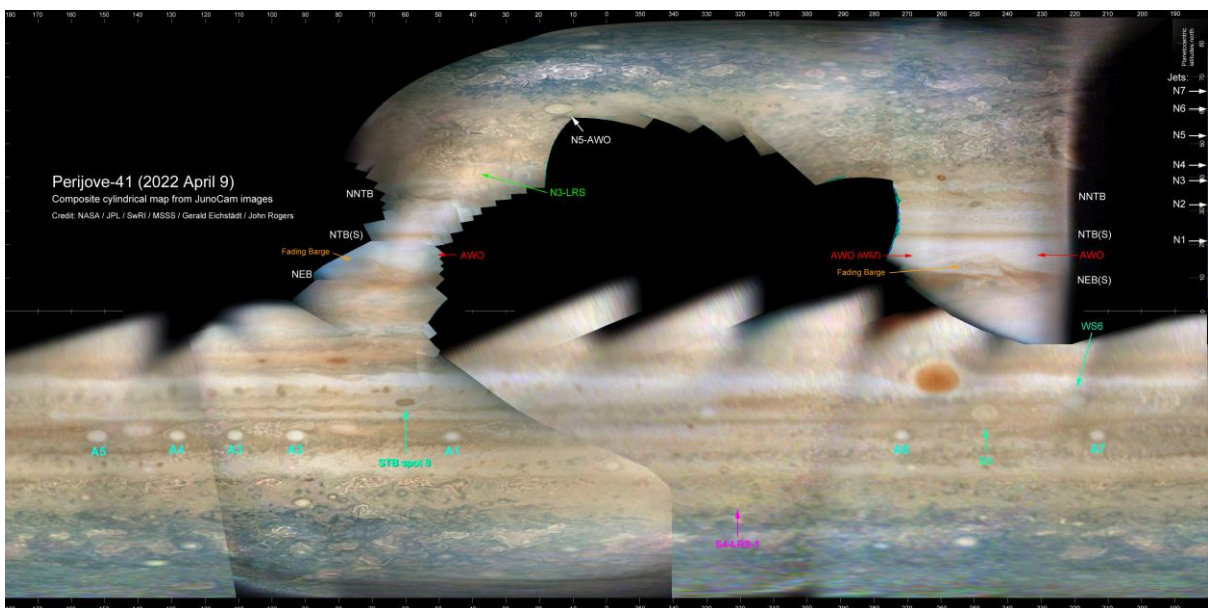


Figure 5:

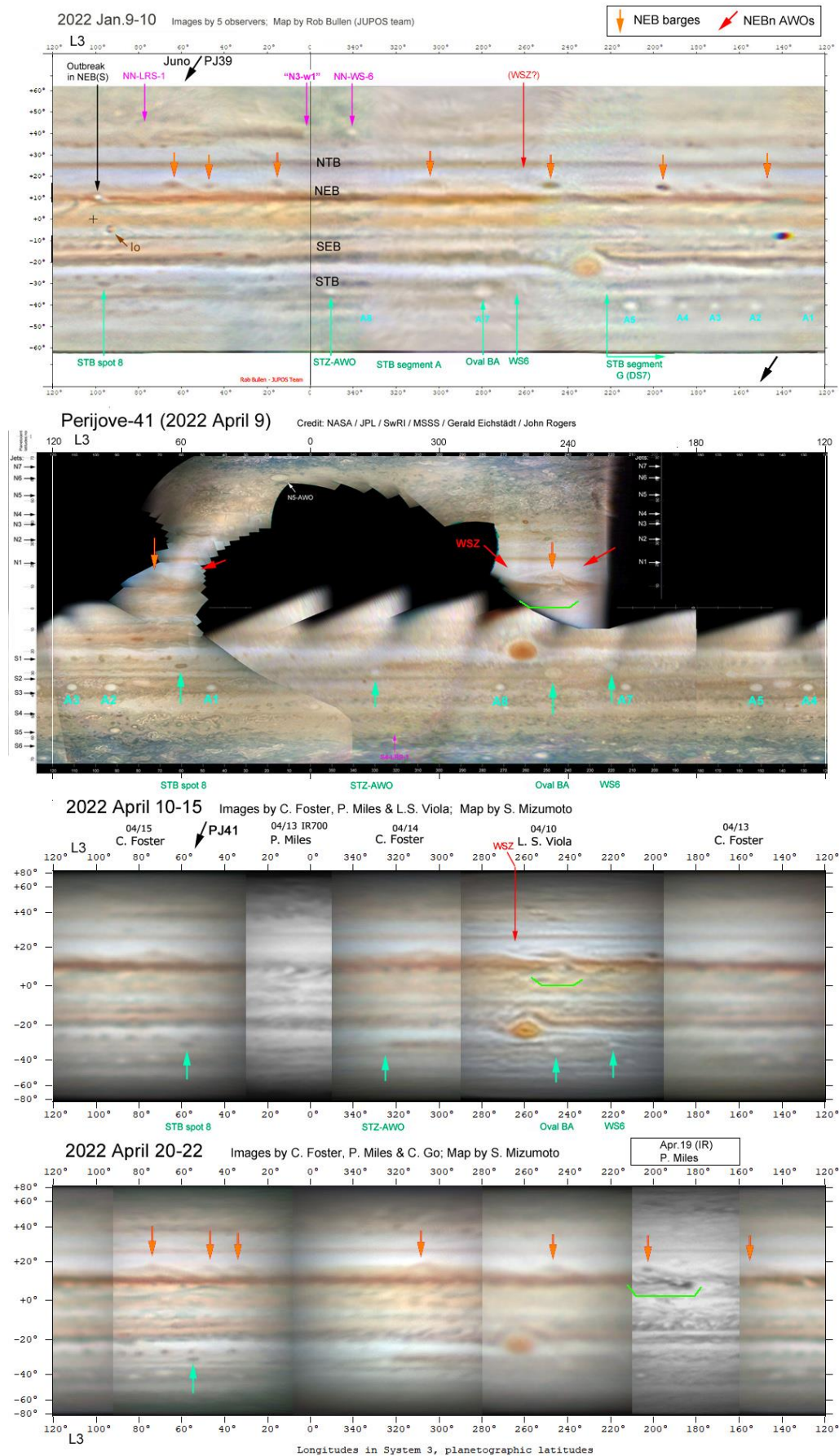


Figure 6:

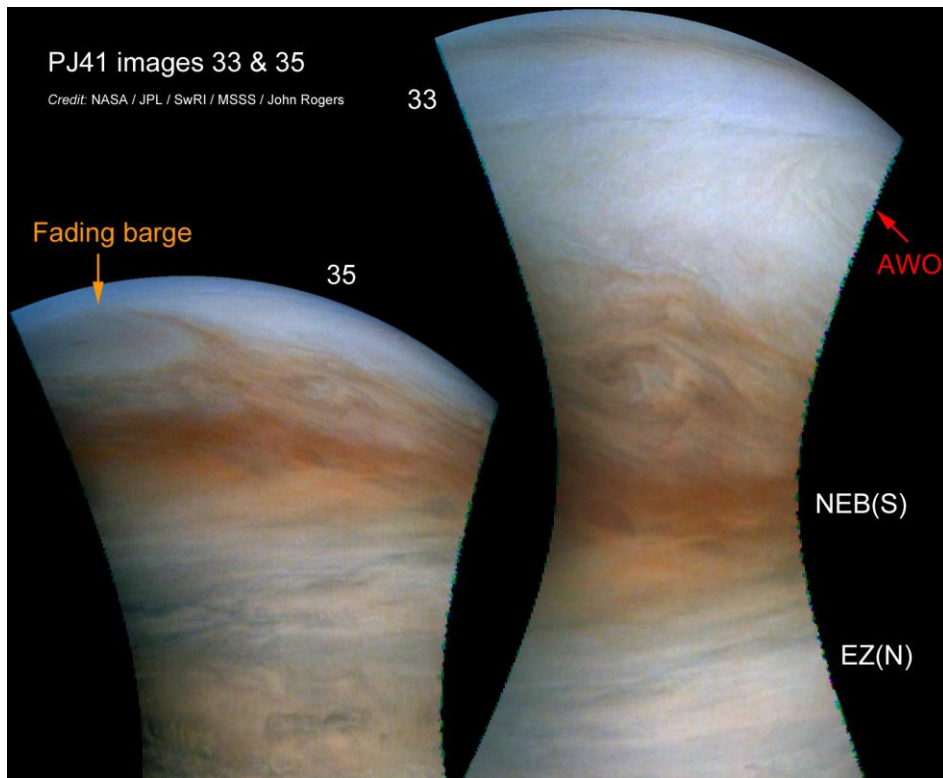


Figure 7:

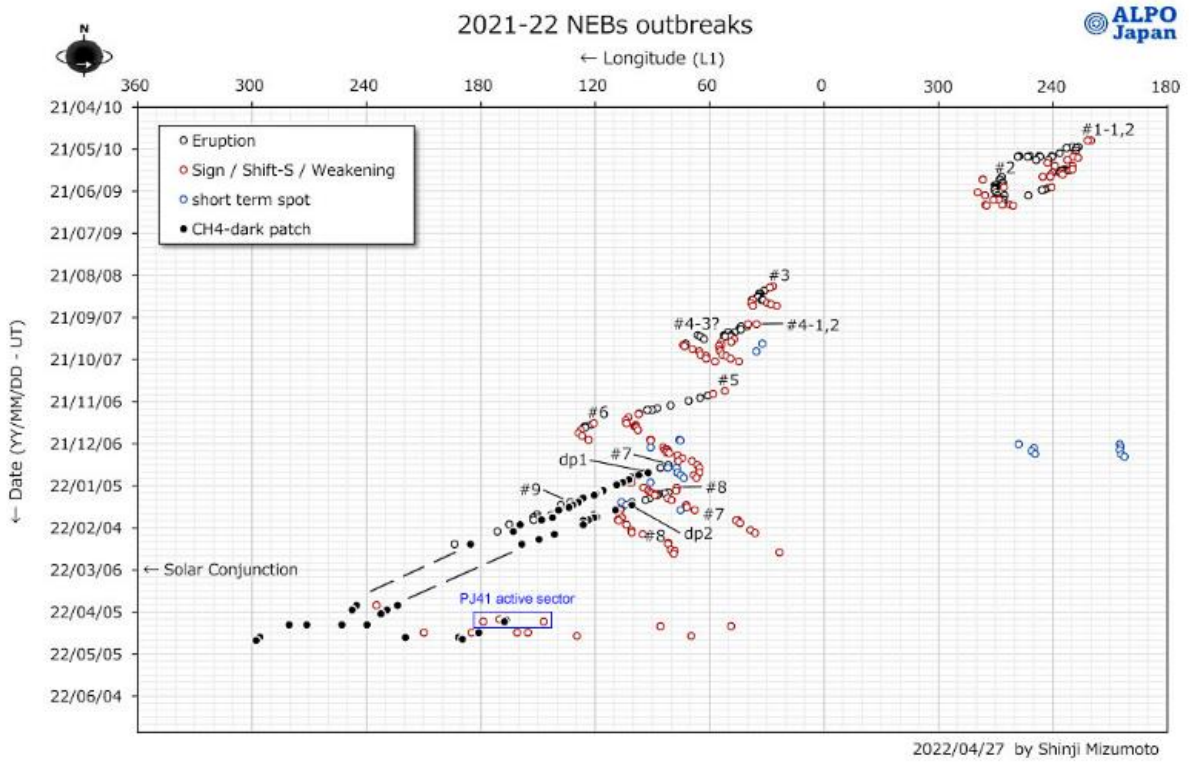


Figure 8:

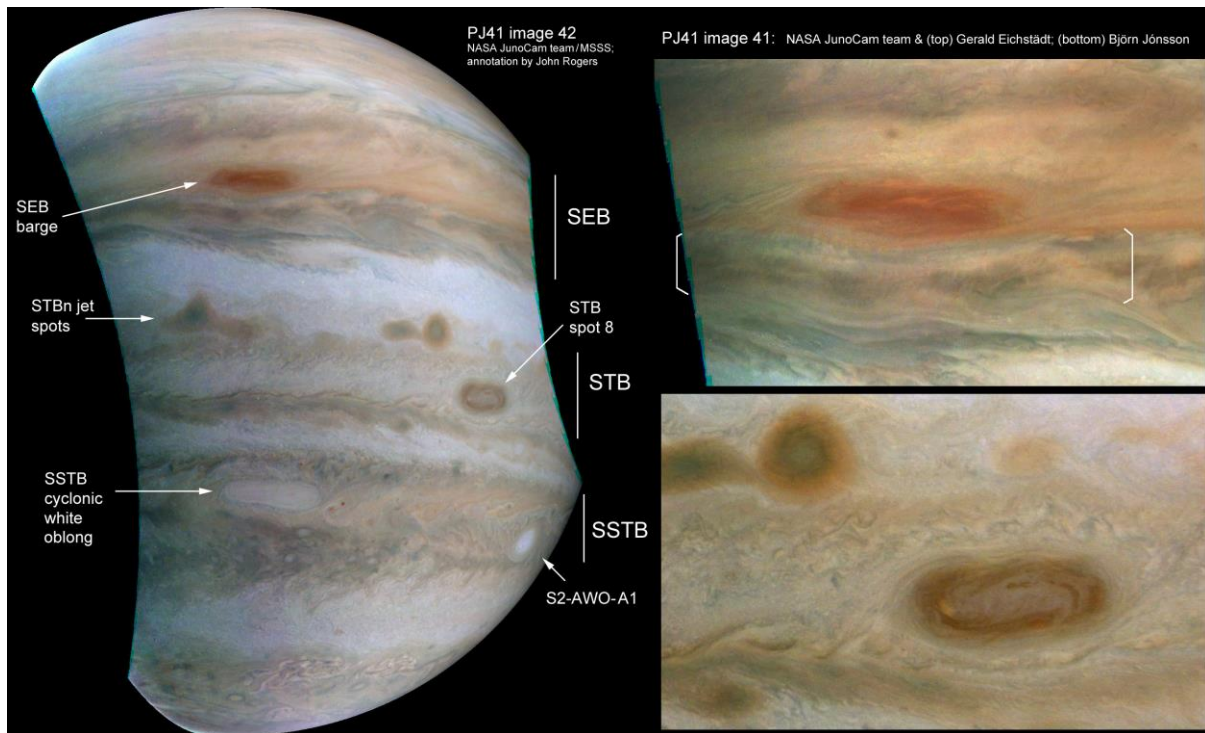


Figure 9:

