

JunoCam at PJ53: What the pictures show

John Rogers (BAA) (2023 August 24)

Juno passed through Perijove no.53 on Monday July 31. The trajectory and the imaging programme were similar to those of PJ52, with the major addition of Juno's closest-so-far flyby of Io. Perijove was at 44.5°N at L3=123, with altitude of 3500 km, and equator crossing was at L3=129 – all on the dark side. The images taken were as follows:

Image no:	1-50	Inbound rotation 1
	52-112	Inbound rotation 2
	114-127	Io
	128-146	Inbound rotation 2 (cont.)
	148-168	NPR & terminator (hi-res)
	170-174	Lightning search (dark side)
	176-219	Outbound (SPR)

Flyby of Io

Juno currently passes over Io during its approach phase for every odd-numbered perijove. It gets closer to the moon every time, until at PJ57 on Dec.30 it will do a very close flyby. At PJ53, JunoCam got its best series of images yet (e.g. [Figures 1-3](#)), including image 121 taken at closest approach, a range of 22,243 km ([Figure 2](#)). (The north pole is very near the centre of image 123.) The images include the best views ever of some north polar features, which are confirmed to be tall mountains, surrounded by white haloes that are believed to be SO₂ frost (west of Dazhbog in [Figure 3](#)). As with previous, lower-resolution views, we see only small changes since the Voyager and Galileo flybys in the regions imaged, with no evidence for large recent eruptions (in contrast to the New Horizons images in 2007, from a similar viewpoint, which showed the spectacular eruption of Tvashtar on the dark limb). Loki has changed its appearance somewhat, but as viewed on the sunlit limb, there is no visible plume over it. However, the first six images do show a volcanic plume, faintly catching the sunlight on the dark side (yellow arrows in [Figures 2 & 3](#)) – the first plume that JunoCam has seen in these recent flybys. This is the Prometheus plume, which has been erupting continuously since the first observations by Voyager 1. It is visible up to 15° beyond the terminator, indicating an altitude of at least 64 km, which is within the previously observed range.

Inbound global maps

Once again, maps covering all longitudes and most latitudes were obtained on two jovian rotations before north pole crossing. A map from amateur images on the same day is in [Figure 4](#). [Figure 5](#) shows JunoCam's second inbound map, supplemented with the outbound map south of 48°S, in RGB. [Figure 6](#) is the same in CH₄.

The NEB: The slow progress of the NEB revival since late 2022 was illustrated by maps in our PJ52 report (Fig.3 therein). The maps at PJ53 show that the belt is now fairly normal in width and darkness, and the faded barges (of which only three are recognisable) have gradually darkened, now having less contrast with the surrounding NEB. These barges could be on the way to dissolving into the NEB (and one new dark barge had already formed at PJ52). Likewise, only 4 the former 6 AWOs remain; the other two are represented by nothing more than a small dark blue spot (at L3=244).

The STB is unchanged since PJ52. Segment A is still $\sim 100^\circ$ long, and Segment G 53° long; Spot 8 is confirmed as a white spot.

North polar region

The final approach sequence gave excellent views of the large long-lived AWO in the N5 domain, and surrounding features (Figure 7). In the hope of visualising the little-known dynamics of this region, and particularly how the AWO interacts with the N6 jet, Gerald Eichstädt made hi-res polar maps of images 148-160, which span ~ 20 minutes. Animating these maps reveals the circulations in the big AWO and in some FFRs, but it seems that the time-span of the images is too short to measure the N6 and N7 jets.

In these final-approach images as a whole (Figure 7A), both RGB and CH4 images show almost no sign of the usual haze features – the North Polar Hood (NPH) and linear bands in the Bland Zone -- except near the bright limb. Moreover, the large N5 AWO appears methane-bright, like AWOs elsewhere, which is unusual for it. All this adds to evidence that the appearance of these northern haze layers depends strongly on the viewing angle.

Circumpolar cyclones (CPCs)

The map of the northern octagon is in Figure 8. Comparing with previous PJs (see our PJ52 report Fig.5), the CPCs have not changed much, except that CPC-8 has a coarser morphology than at PJ52. The NPC is centred 0.6° from the pole, which is typical. The anticyclonic ovals (red arrows) are still interesting: the little one north of CPC-7 is still there, but the little one that is usually north of CPC-3 or 4 has drifted round to be N of CPC-5, as it was at PJ50; and the large one that we have tracked outside the octagon is still exactly where it was at PJ52.

Closeups of haze bands

As at PJ52, we again have closeups of large diffuse haze bands illuminated near the terminator (Figure 9), mainly over the N5 domain, and extending part way over the adjacent domains (the Bland Zone happens to be disturbed at this point).

South polar region

The outbound map of the SPR is in Figure 10. In the southernmost band of FFRs ($\sim 65\text{-}71^\circ\text{S}$), as at PJ52, we do not see a 1:1 correspondence with FFRs at the previous perijove, but there is a general similarity in distribution if the map is rotated by 30° , equivalent to the retrograde drift rate that we established earlier in the mission.

On following pages:

Figures (small copies)



Figure 1. PJ53 image 115, showing Io and Jupiter as Juno approached.

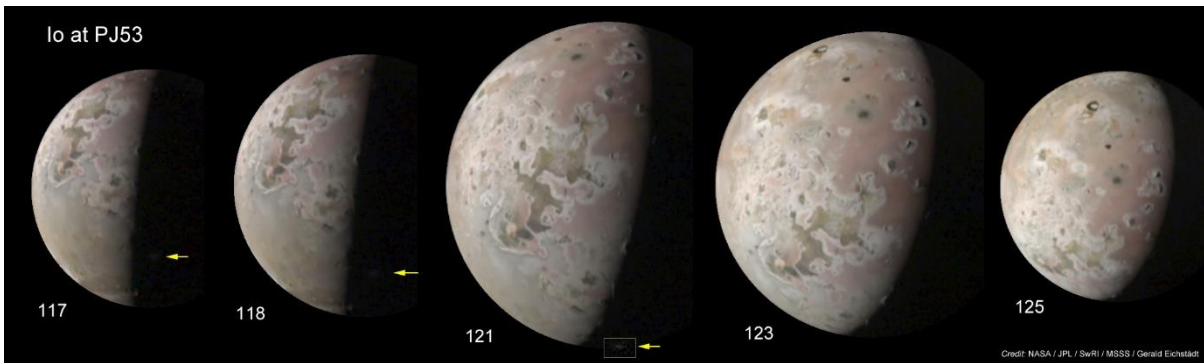


Figure 2. Some of the PJ53 images of Io, processed by Gerald Eichstädt, enlarged x2.24. Yellow arrow indicates the Prometheus plume. In image 121, it was on the dark limb and is shown in an enhanced portion of the raw image (box). (Io images were also expertly processed by several other people including Jason Perry and Kevin Gill.)

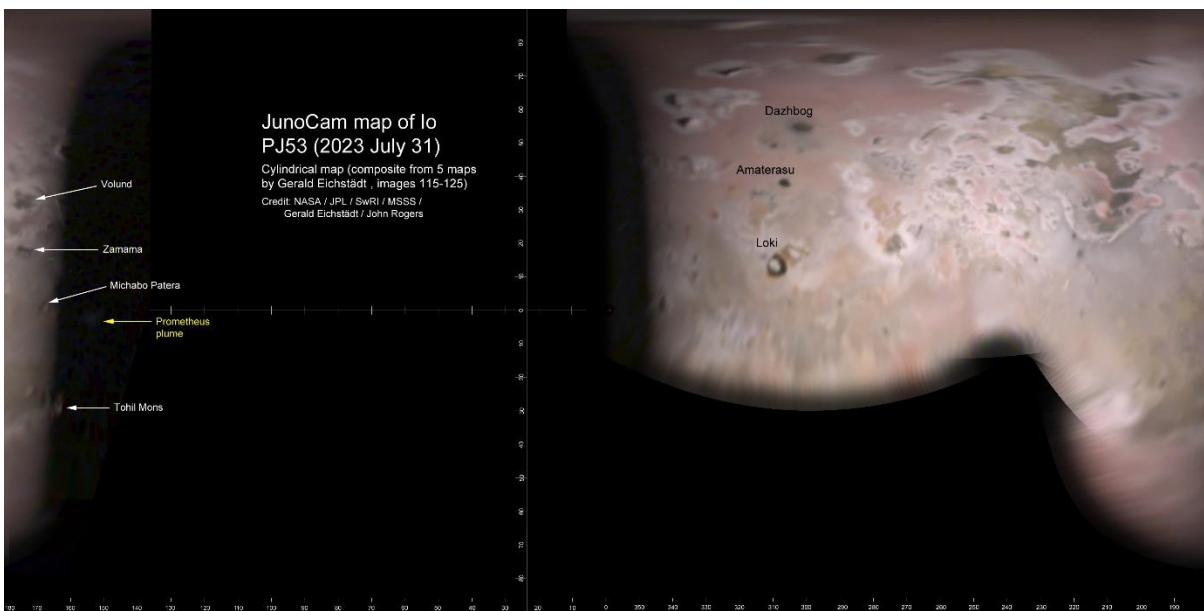


Figure 3. Map of Io from PJ53 images, with some features labelled.

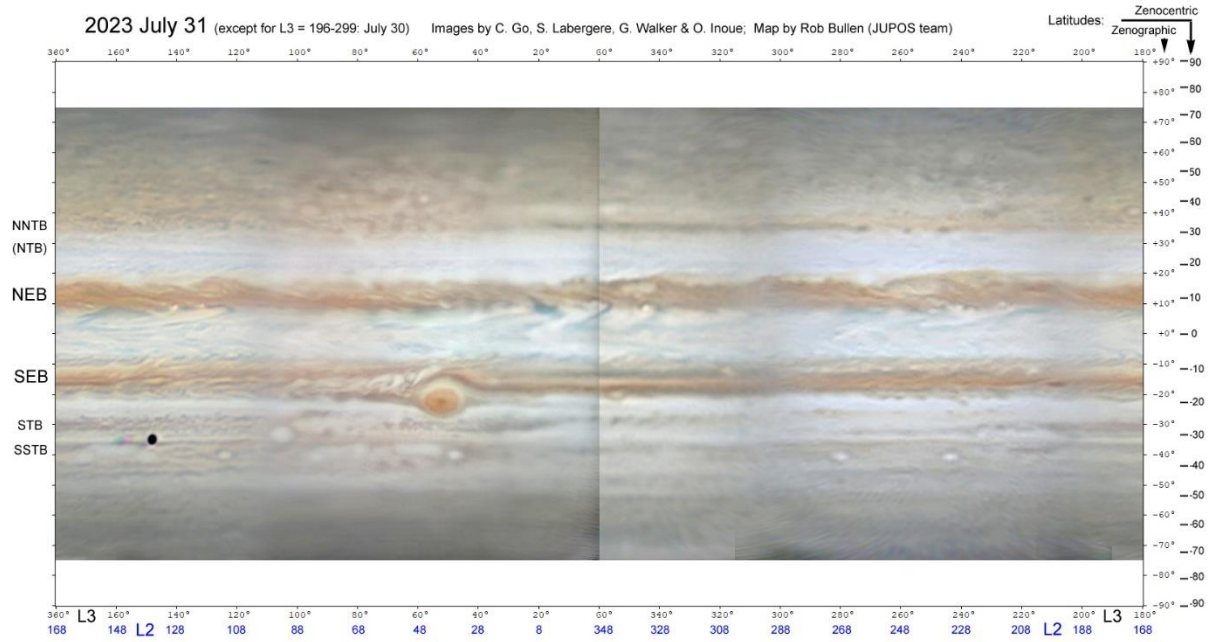


Figure 4.

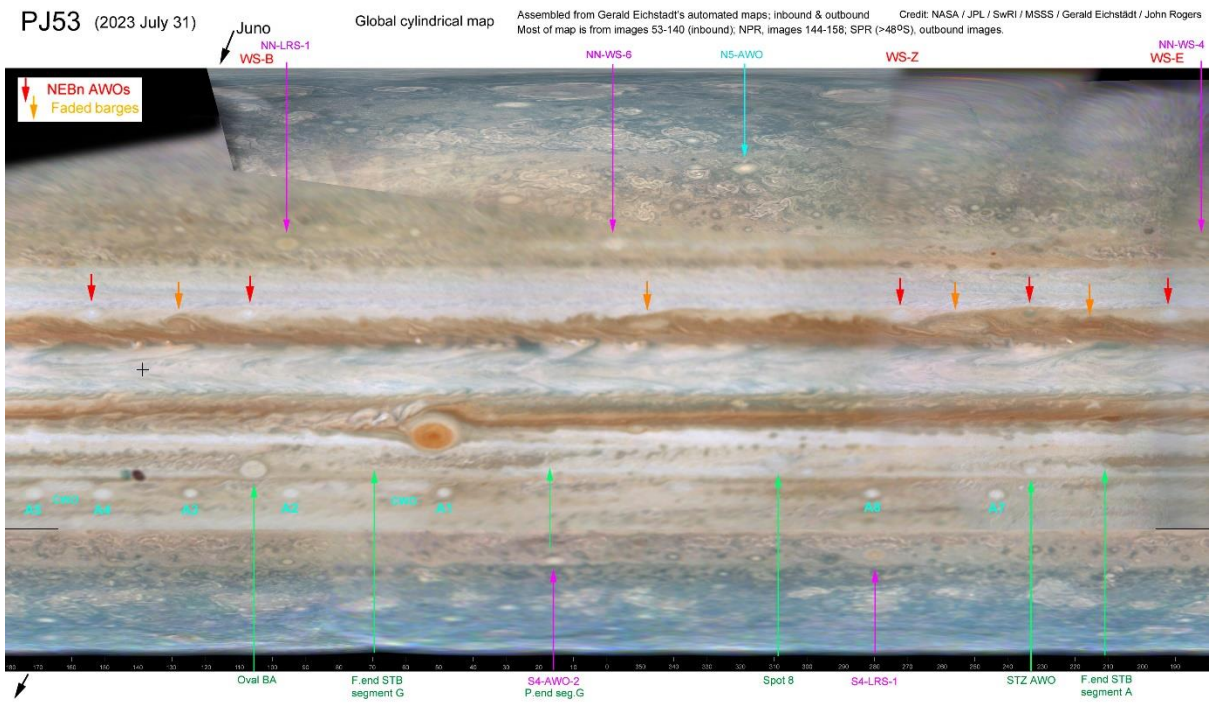


Figure 5.

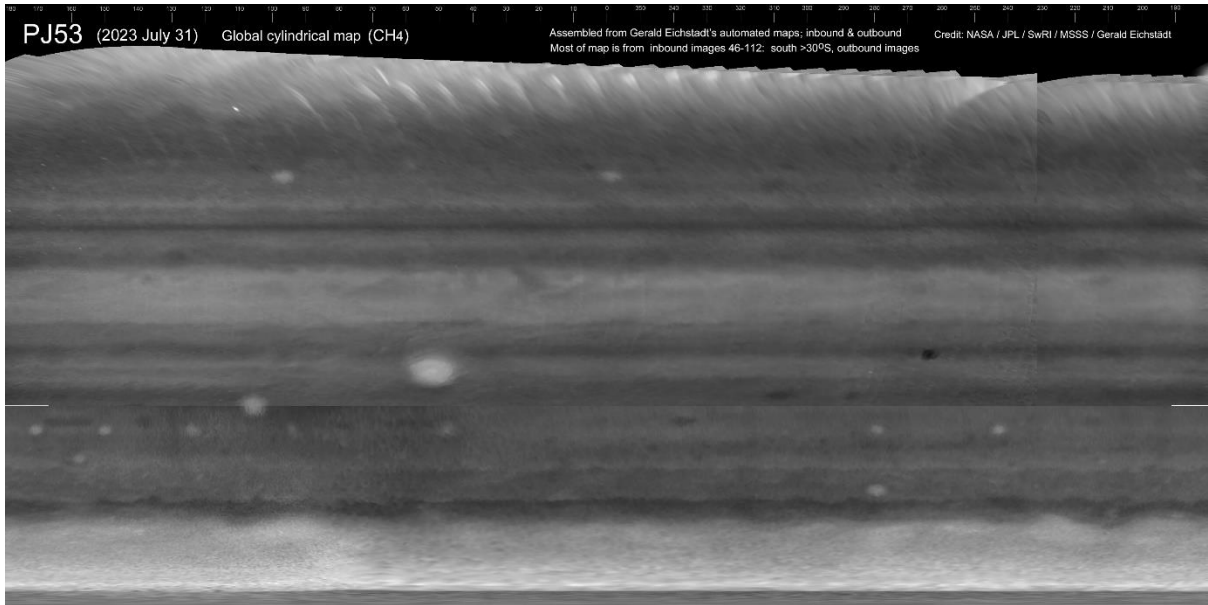


Figure 6.

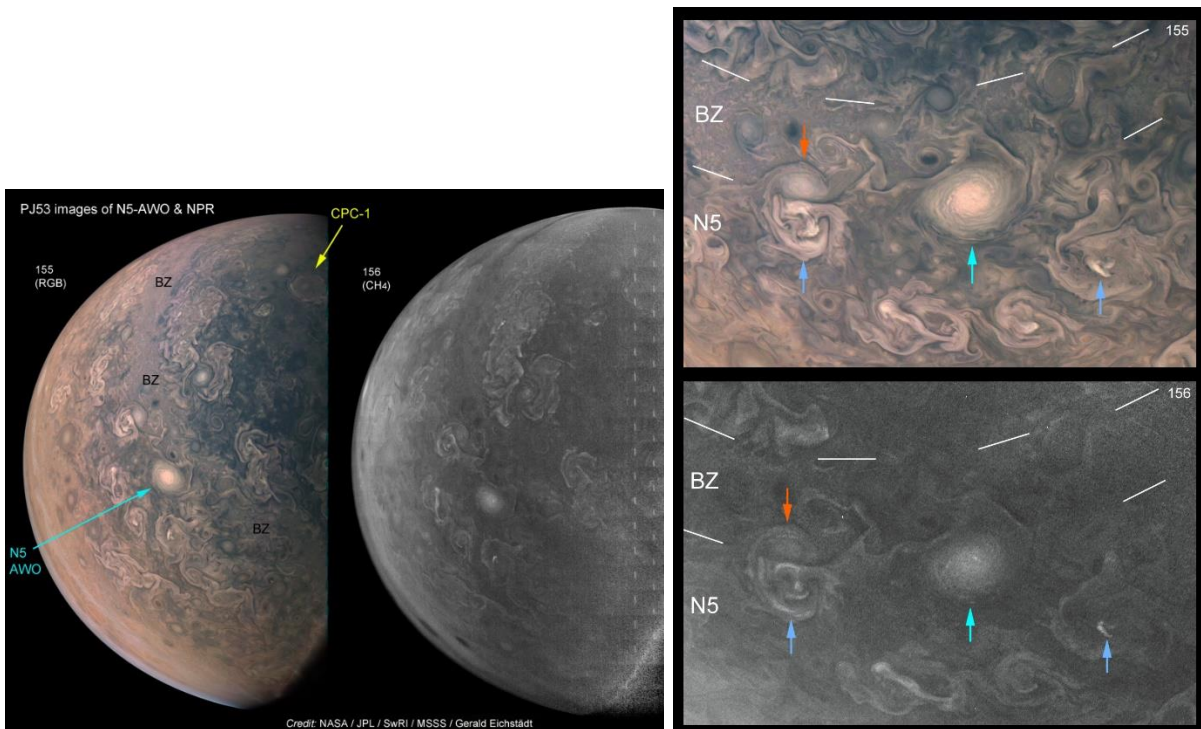


Figure 7. (A) Two of the last inbound images, showing the N5 domain, Bland Zone (BZ), and NPR (1/4 scale). (B) Full-scale excerpts from those images, rotated to put north up, showing the large N5 AWO (cyan arrow) and other interesting features of the N5 domain. Blue & red arrows, left: a cyclone-anticyclone pair, in which the cyclone is a mini-FFR. Blue arrow, right: an example of a very bright white plume, shadow-casting and methane-bright, surrounded by green haze – very likely to be a vigorous thunderstorm -- in the middle of amorphous grey swirls that may be a formerly-active FFR.

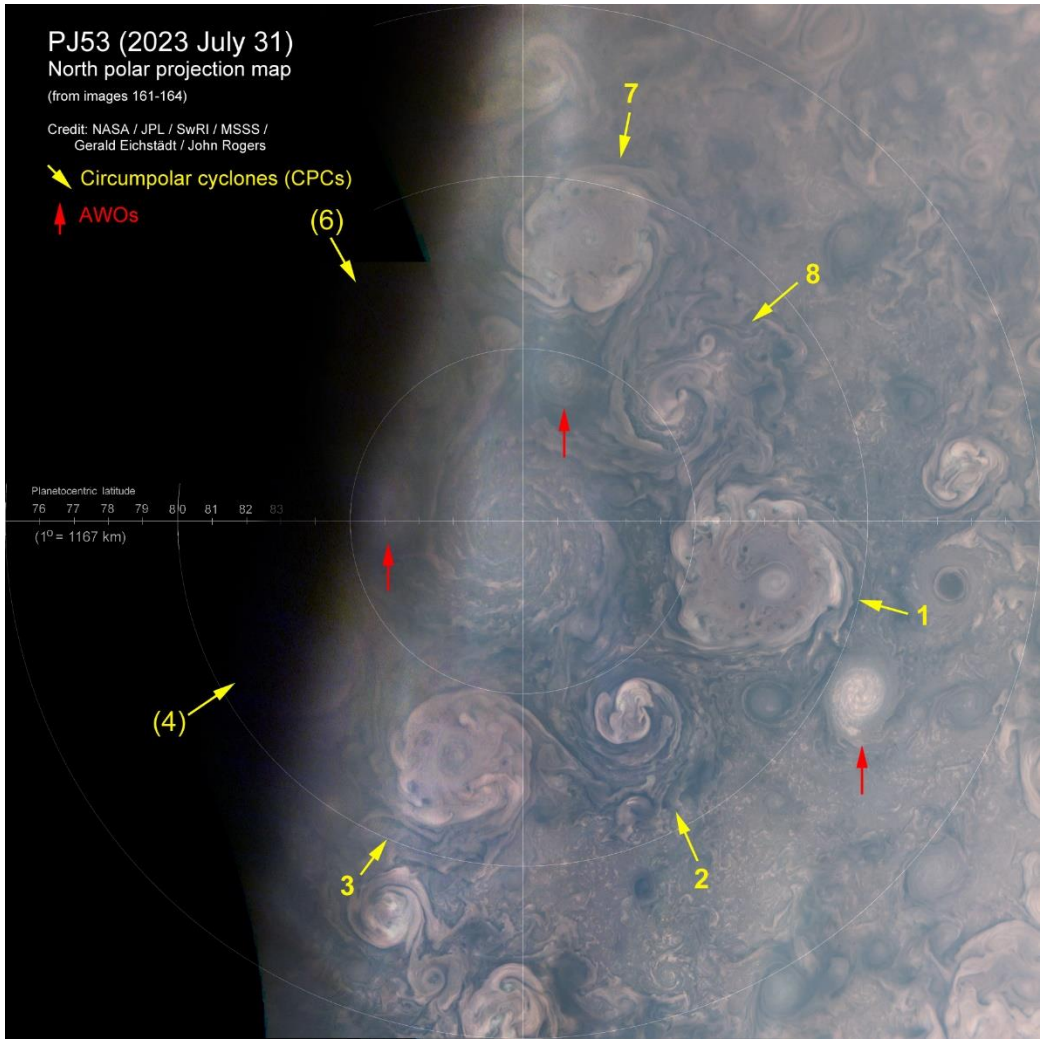


Figure 8.

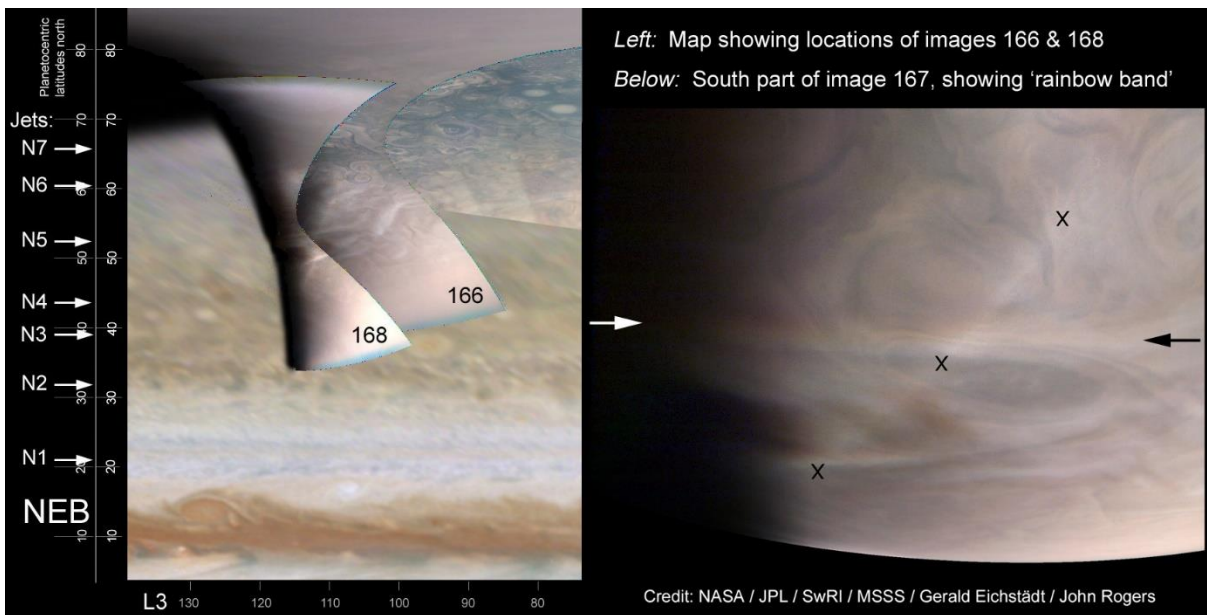


Figure 9. (L) Cylindrical maps of images 166 & 168. (R) Part of image 167 (half scale) showing haze bands, including a 'rainbow band' over the N5 domain (marked with arrows) and dark brown patches over the N4 domain. The bright arc marked x x x is a processing artefact. North is up.

PJ53 South polar projection map

Down to 45°N at edges. L3=0 to left.

Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt

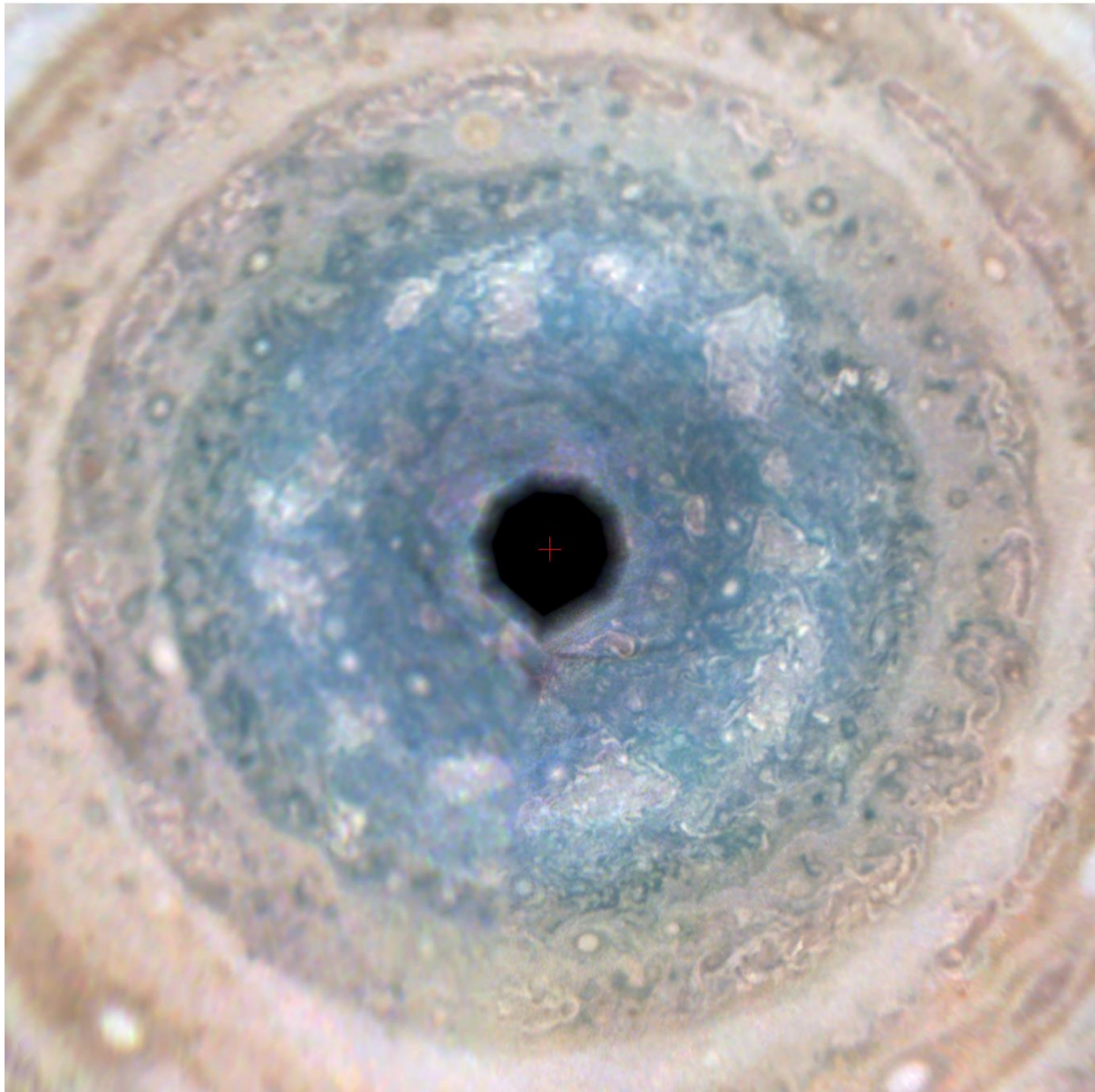


Figure 10.