JunoCam images at PJ72

John Rogers (BAA) (2025 June 2)

At PJ71, on 2025 April 4, little data was returned because the spacecraft twice went into "safe mode": once, about an hour before perijove, and again about 45 min after perijove. This occurs when the onboard system detects a serious anomaly, and turns off all non-essential functions. It has only happened twice before during Juno's mission, at PJ2 and PJ47. At PJ71, it was probably triggered by the intense radiation belt through which the spacecraft was passing. All JunoCam images were lost except for some late lo-res outbound ones, so we are not posting a PJ71 report. Nevertheless, the mission controllers restored normal operations over the following two weeks, in time for PJ72.

PJ72 was on 2025 May 7, following the same pattern as other recent flybys, and the imaging was fully successful. As always, this report is based on work by the NASA JunoCam team (Drs Candy Hansen, Glenn Orton, & Tom Momary), with image processing and map projections by Gerald Eichstädt unless otherwise stated. Conventions & abbreviations are as in previous reports.

Io

The encounter began with a distant view of Io (Figures 1 & 2). The view was much the same as at other recent perijoves, but from an even larger range of 89,000 km. However, it enabled us to look again at the fallout from the huge volcanic eruption near the south pole, which was first seen at PJ68 and had changed substantially at PJ70. The PJ72 south polar projection map (Figure 2) can be compared with earlier ones in our PJ70 report, and shows no detectable changes since PJ70. So the largest-scale deposition all occurred between PJ66 (2024 Nov.24) and PJ70 (2025 March 2), although of course, less obvious volcanic activity may have continued thereafter.

On the dark side of Io, the large red ring around Nusku which appeared at PJ60 can still just be partially discerned in the long-exposure image 13.

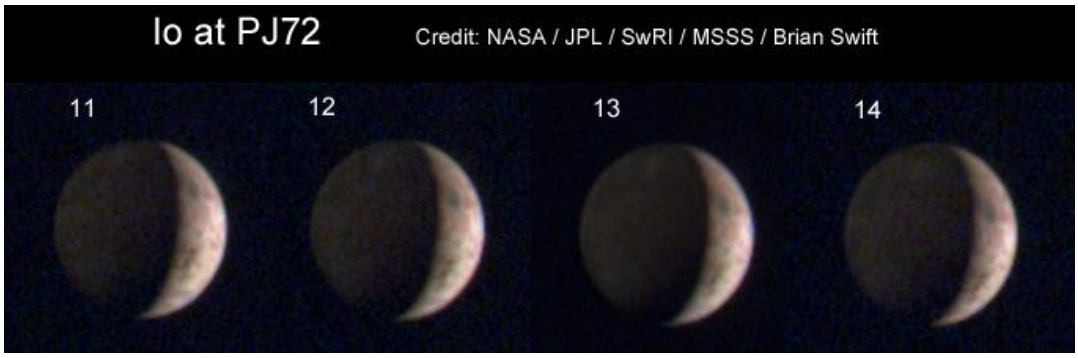

Figure 1. Images of Io, processed by Brian Swift.

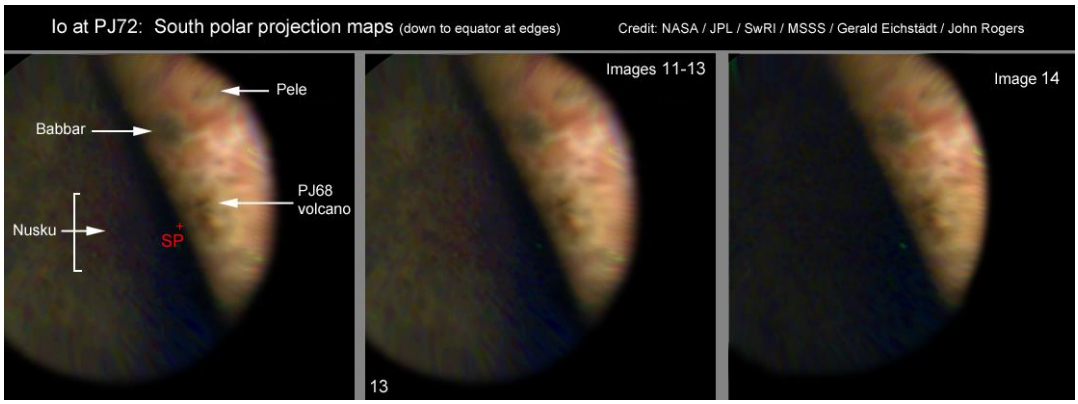

Figure 2. Images of Io, processed and map-projected by Gerald Eichstädt, merged & annotated by JHR.

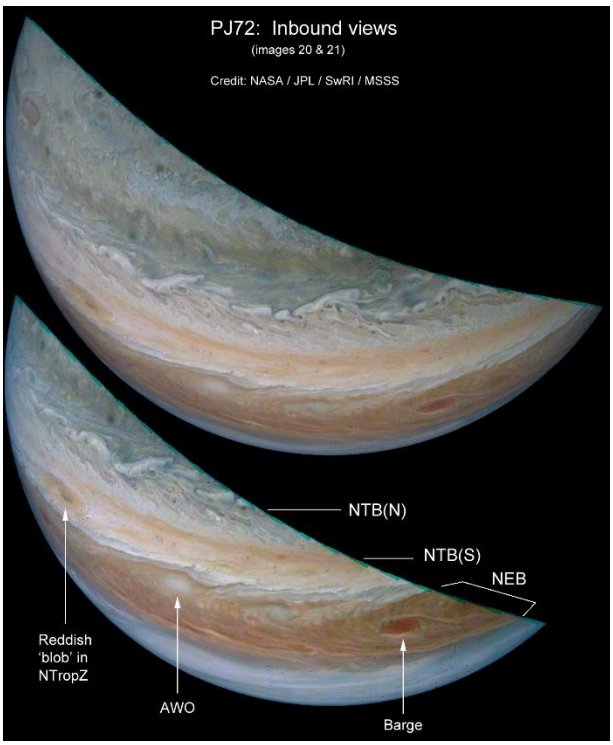

Figure 3. Images 20 & 21, showing the NEB & NTB. Coloured dots represent bad pixels due to radiation hits, as these images were taken while the spacecraft was travelling through the intense radiation belt.

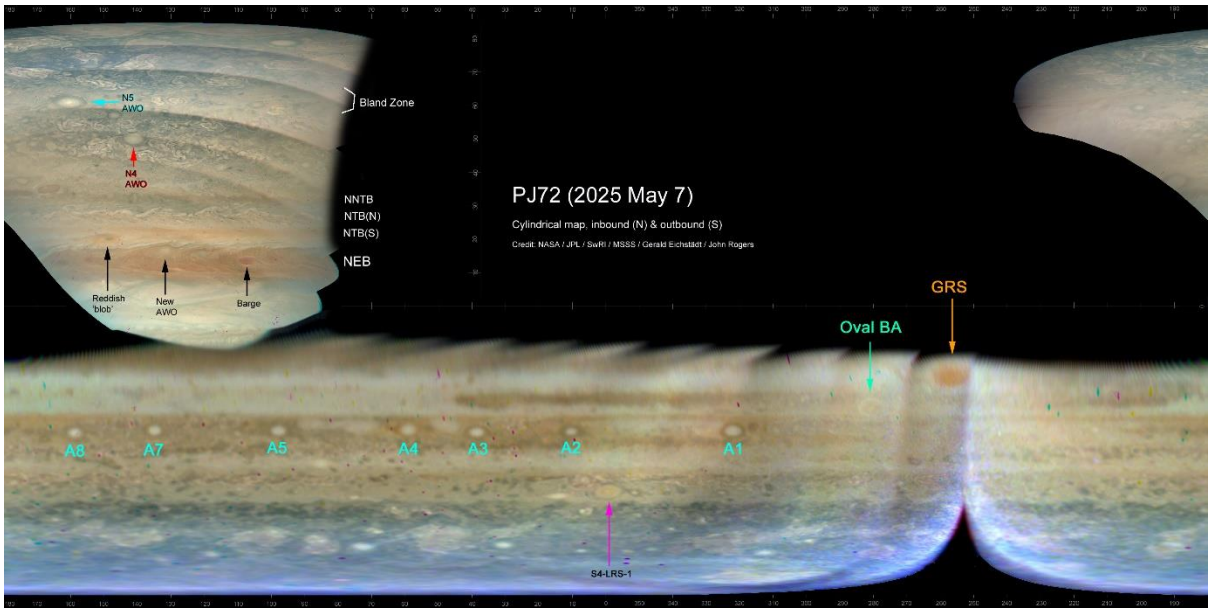

Figure 4. Cylindrical global map, made by Gerald Eichstädt.

Figure 5. Hi-res cylindrical map of the NEB from image 20, made by Kevin Gill, showing the AWO and the cyclonic barge (see Figure 3).

Inbound views of Jupiter
The late inbound images gave good views of a sector of the northern hemisphere (e.g. Figure 3): see the global map (Figure 4). These can be compared with our annotated ground-based map of the planet on April 14-16, in our updated 2024/25 Report no.6 at: https://britastro.org/section_information_/jupiter-section-overview/jupiter-in-2024-25/report-no-6. (This was our last complete colour map of the planet at reasonable resolution in the 2024/25 apparition.) After the north pole crossing, Juno's perijove was at 61.0ºN, and equator crossing was at approx. L3 = 327.5, both on the dark side as usual.

NEB: Following the 2023 NEB expansion event, there is now a fine array of cyclonic brown ovals and anticyclonic white ovals ('barges & portholes') around the planet. The PJ72 images give a good view of one new AWO (which just appeared in April) and one barge (Figure 5). (Closer views of such circulations were obtained earlier in the mission.)

Also notable is a long train of transverse waves (near-vertical albedo bands on the map), located over the retrograding jet at 15-16ºN (latitudes are planetocentric unless otherwse stated), esp. where it is deflected S of the AWO and N of the barge. The wavelength is 1.12º long. (1340 km). These waves have been recorded several times before by JunoCam and by Hubble.

NTropZ: A notable feature is the ochre, dark-cored oval in the N.Tropical Zone, near the left edge of Figures 3 & 4, at L3=148. This had been tracked as a 'reddish blob' on the NTBs edge by amateur images since mid-March, when it developed at the following end of a rapidly reddening sector of the reviving NTB(S). Up to late April it had a mean drift of DL1 = -25 deg/30d, varying between -28 and -11 deg/30d, at or near 21.4ºN (24ºN planetographic). In ground-based images it always appeared diffuse or featureless, but the PJ72 closeups show it is clearly anticyclonic, having moved south to 20.2ºN (22.8ºN 'graphic). Similar 'reddish blobs' were recorded on orange NTBs in 1964-65, 2012, and 2020. One in 2020 was imaged even more closely by JunoCam at PJ30, and had similar anticyclonic structure, although it was further south, at 19.3ºN (21.8ºN 'graphic).

NTB: Comparing Figures 3 & 4 with the PJ70 map, we can see how the wake of the NTBs jet outbreak is evolving into a reviving NTB. The dark band in the wake has evolved into the typical orange NTB(S) (which the JunoCam team in 2016-17 called the 'Big red stripe'), while the turbulence along the N edge of the wake at PJ70 has moved further N and is now involved with the wave structure around 28ºN (although this wave structure itself, on the retrograde jet, is a normal feature that has been present at this latitude throughout). The turbulence now visible around this latitude suggests how NTBs jet outbreaks can often suppress the expression of anticyclonic vortices at 31ºN on the NNTBs jet. JunoCam likewise recorded the texture of the 'Big red stripe' and reviving NTB after the outbreaks in 2016 (see review in our PJ6 report) and 2020 (e.g. our PJ30 report).

High northern domains: As well as extensive FFRs, the images show large AWOs in the N4 and N5 domains that the JUPOS team have tracked throughout the 2024/25 apparition. The N5 AWO is the long-lived one, tracked for many years, presently far north at 60.8ºN so that it appears isolated in the Bland Zone.

North Polar Region (NPR): Circumpolar Cyclones (CPCs):
Figure 6 is the north polar map, plus the full-resolution image of N-CPC-5; Figure 7 is a combined north polar map from PJ68 & PJ72, showing the whole octagon. Most of the CPCs were captured only in image 29, which was recovered late and was very dark, perhaps due to radiation – but it was well worth it.

It revealed one of the most substantial changes that we have ever seen in a CPC. CPC-5 had always been a typical 'filled' cyclone with lobed border and anticyclonic core, but now it is a circular featureless cloud deck, apart from a scattering of tiny flocculent white clouds on it (Figure 7). As shown in Figure 8, CPC-5 was still a typical filled cyclone at PJ60, then at PJ65

and (less distinctly) PJ66 it contained only a small anticyclonic vortex and a cyclonic vortex (both off-centre), as noted in our reports on those PJs. We have not had a good view of it since then until now. Its present state is unusual, so we wait to see how it will evolve.

The only comparable change seen in Juno's 8.7 years of imaging has been the transition of northern CPC-4 from chaotic to filled around PJ12. With this second transition, we begin to get an idea of the timespan of changes in these remarkably stable cyclones.

Meanwhile CPC-6, one of the 'diverse' or 'chaotic' type which change morphology more frequently, became very chaotic for several PJs but has now reverted to a more regular appearance somewhat similar to CPC-5.

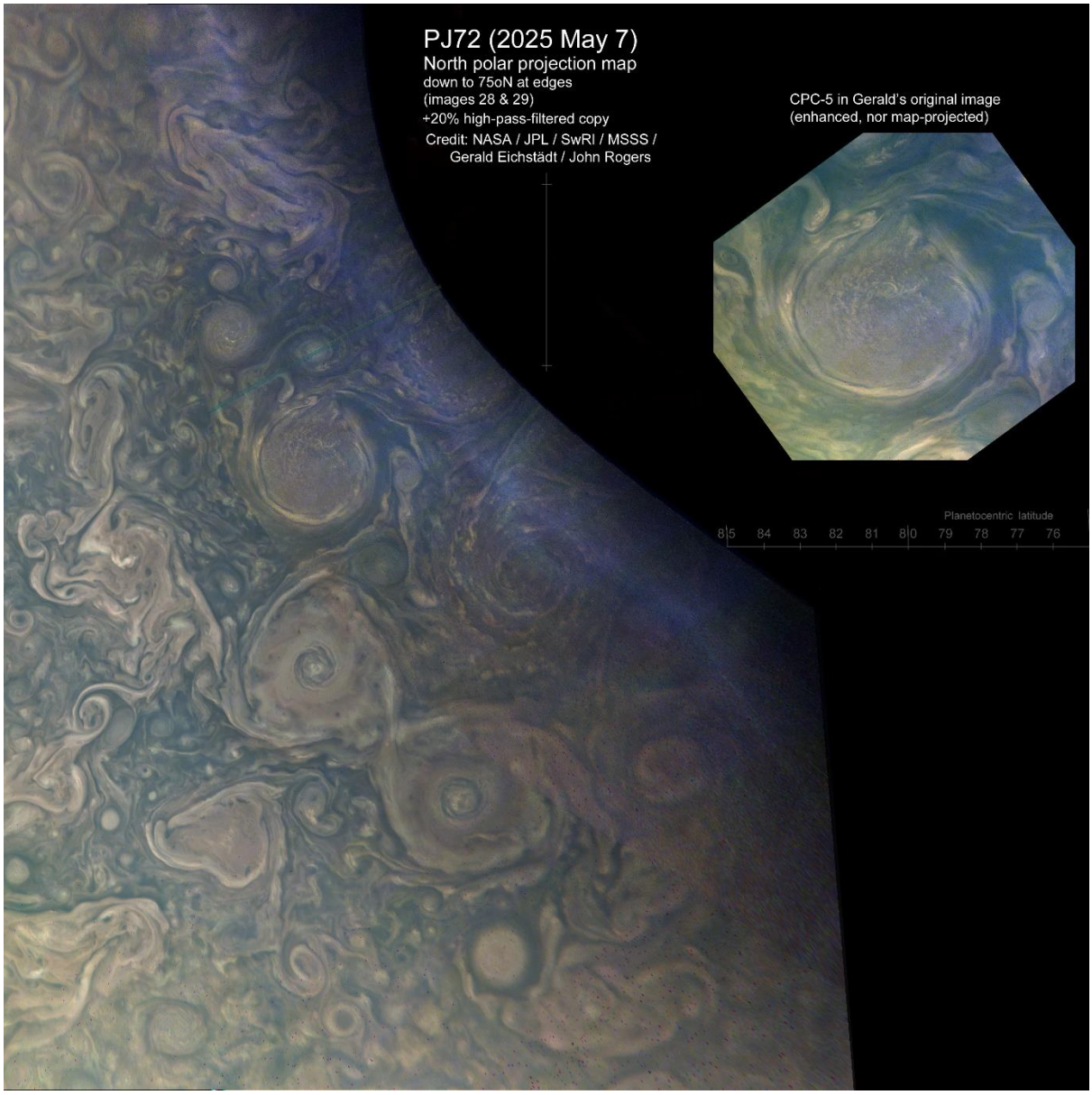

Figure 6. North polar projection map, plus the full-resolution image of N-CPC-5 at top right.

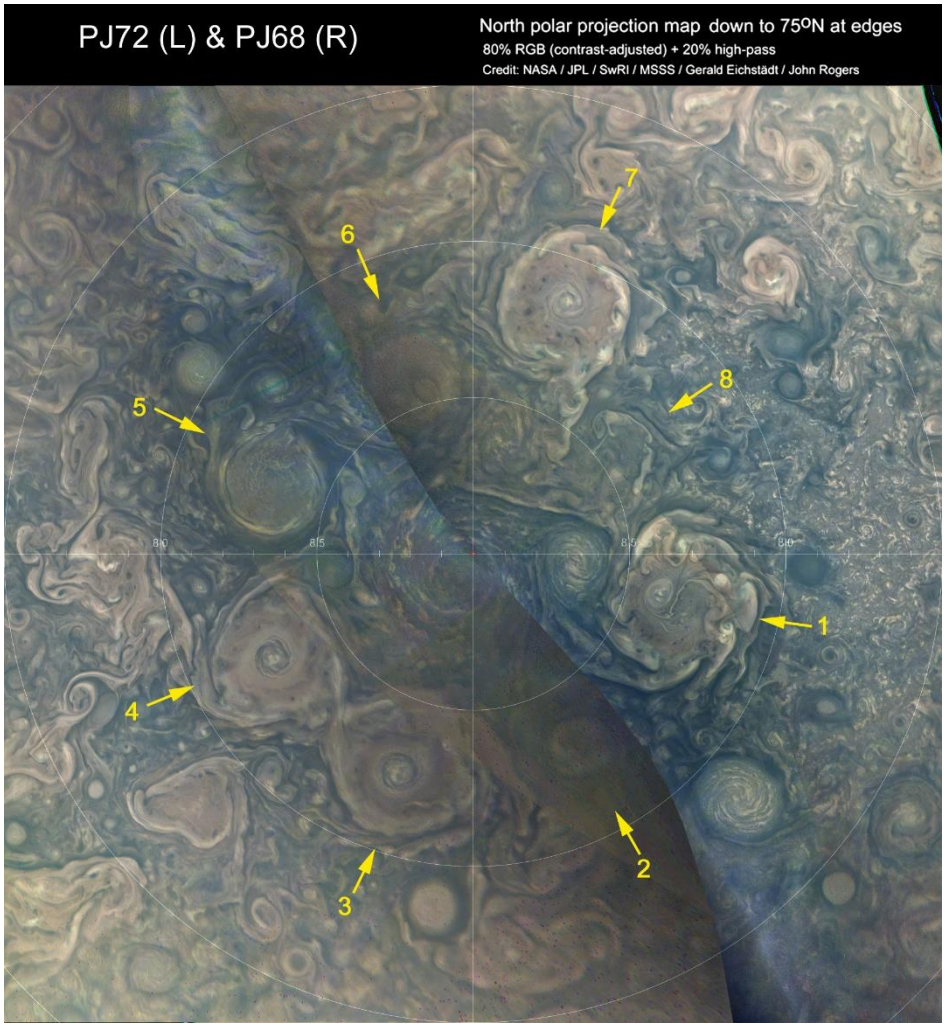

Figure 7. Combined north polar projection map from PJ68 & PJ72, showing the whole octagon, with CPCs labelled.

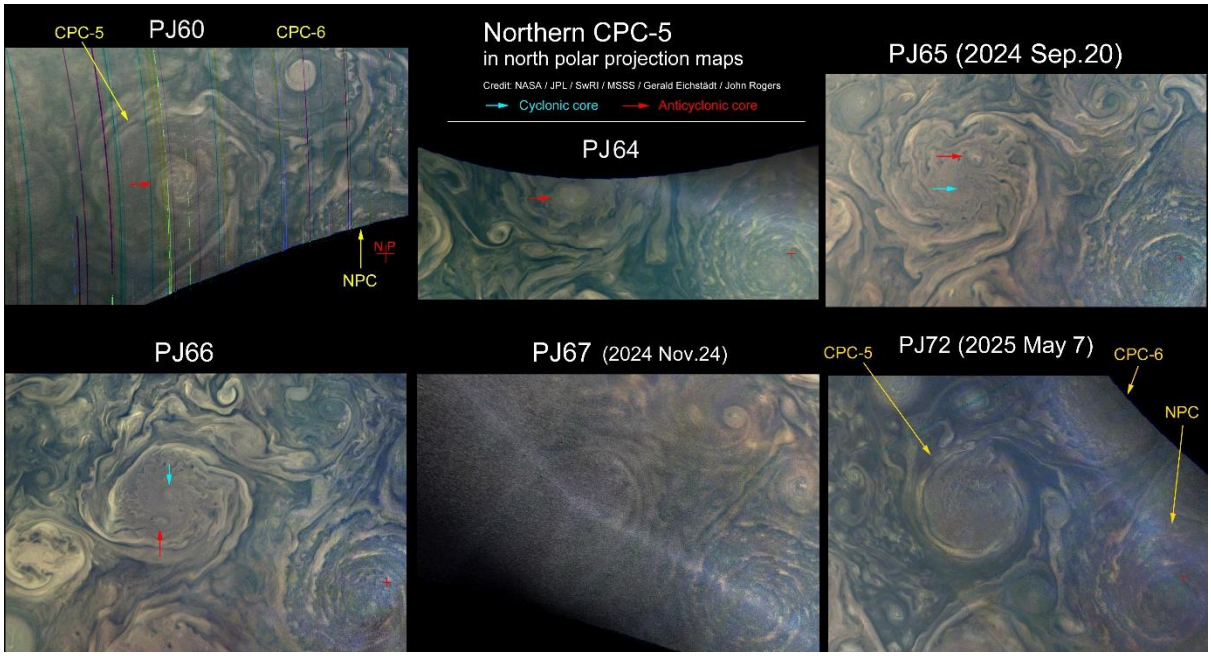

Figure 8. Excerpts from our north polar projection maps since PJ60, showing how CPC-5 has changed.

South polar region: Haze bands

In recent perijove reports, I have usually just presented Gerald Eichstädt's composite map (Figure 9), but this time I also inspected his individual maps which show bright and dark haze bands near the terminator as the planet rotates. Figure 10 shows the most interesting sector. These images show a prominent pattern of haze bands left and below from the south pole (red cross), changing from dark to white according to the lighting. This is most notable for the ⊃-shaped band almost directly 'below' the south pole, although as always, this could be a case of adjacent dark and bright bands which show up differentially according to the lighting. This band is illuminated well beyond the terminator in the last image. The pattern is very reminiscent of the 'Long Band' earlier in the mission. As we can no longer observe the present configuration of the south polar pentagon of cyclones, we cannot say whether the haze pattern has the same relation to it.

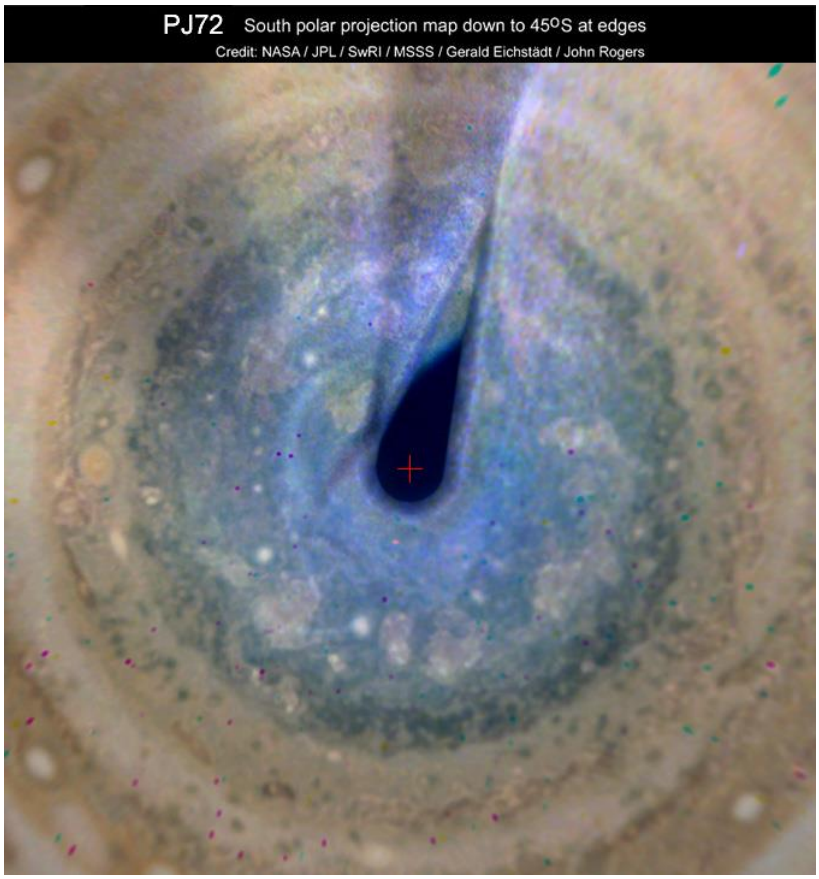

Figure 9. Composite south polar projection map, made by Gerald Eichstädt.

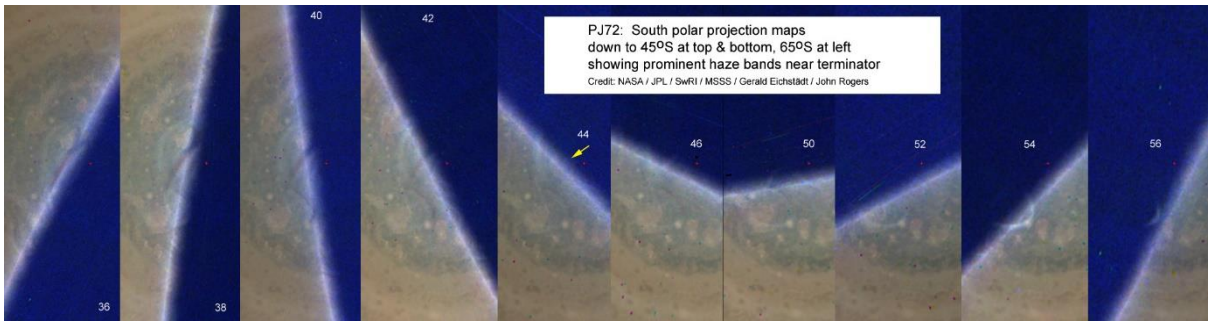

Figure 10. A sector of the SPR projected in Gerald's south polar projection maps from individual images during PJ72's outbound phase. (The yellow arrow points to a likely CPC.)