JunoCam images at PJ70

John Rogers (BAA) (2025 April 9)

Juno's Perijove-70 occurred on 2025 March 2, with closest approach at altitude 3500 km, latitude 59.3ºN, time 16:04 UT at spacecraft (16:46 UT Earth-received time). Equator crossing was 26 min later, at L3 = 225. These events were on the night side as usual. Before then, during the last hours of approach, JunoCam had a distant but very informative view of Io's latest eruption, then a good daylit view of the present upheaval of the N. Temperate Belt.

Eruption on Io

Juno had a distant pass by Io, 3.6 hours before perijove, from a range of almost 80,000 km. JunoCam's images still had sufficient resolution to show the results of the huge new volcanic eruption that was first detected at PJ68 (Figure 1).

This eruption had appeared since PJ66, from a previously unknown volcano, producing extensive surface deposits at PJ68. These included an irregular ring of brown patches ~1200 km across, centred on a very dark spot at ~73ºS, 220ºW, with a pair of dark grey streaks adjacent to it (see our PJ68 report). A NASA press release [https://www.missionjuno.swri.edu/news/nasa-juno-mission-spot-powerful-volcanic-activity-io-to-date] reported that JIRAM showed those dark grey streaks to be dramatically hot, in fact the most intense hot-spot ever observed on Io (Figure 1A). So all these observations suggested that the dark grey streaks were new, active lava flows, presumably from a newly opened caldera.

The PJ70 images show definite changes in the deposits around this eruption (Figure 1C). To view these changes most clearly, Gerald has made south polar projection maps from all of the recent Io images, and the region of interest is compared in Figure 2.

The PJ60 map has the highest resolution, showing the region before the eruption (Figure 3), and can be compared with the incomplete Voyager/Galileo map. The future source lay in a complex region between several small mountains. At PJ60 there were already two grey-brown lava flows, and somewhat similar flows were present in the Galileo images over 25 years earlier, so it was not clear if they had been recently active. At PJ68 (Figure 2), the two new lava flows largely overlay the old ones, and brown and white patches had covered large areas around the source, and a small caldera nearby had become black with a brown halo – possibly a second eruption source. At PJ70, despite lower resolution, there have been substantial changes to the brown and white patches near the source, especially below and right of the source in the maps. So the eruption has continued since PJ68.

This appears different from the typical large sulphur-rich plume eruptions that produce giant red rings, such as Nusku at PJ60, others in Galileo coverage, and and Pele permanently. The deposits are more patchy, and brown and white, not red. (All colour descriptions are uncalibrated and subjective, but the difference with Pele in the same images is unmistakable.) It may be that the newly opened source has disgorged a pair of exceptionally fast-spreading hot lava flows, and these may have generated the brown and white deposits, perhaps by a mixture of silicate lava mixing explosively with a SO_2-rich substrate, and perhaps with sulphur or other materials specific to the polar region.

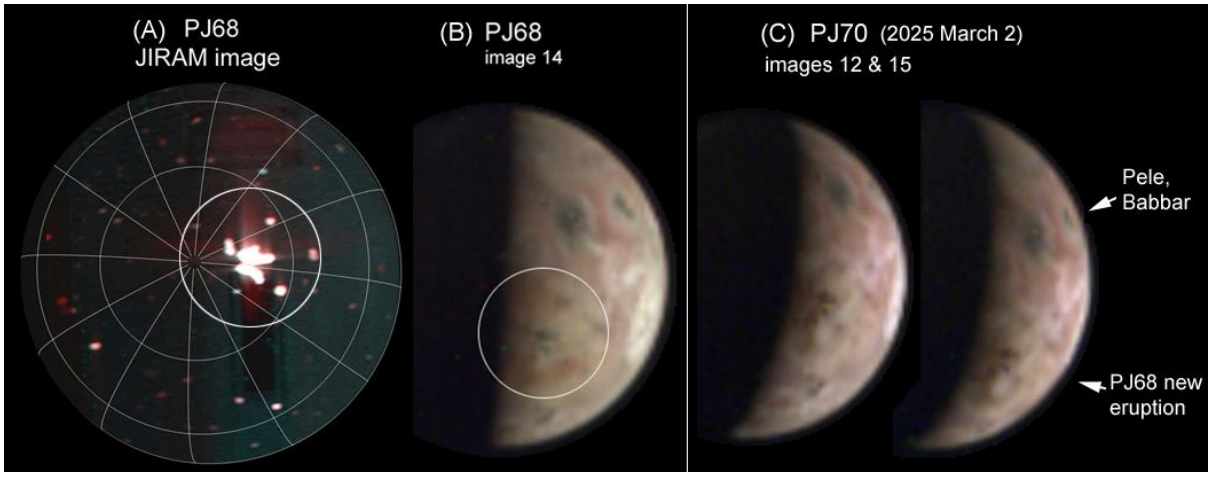

Figure 1. Images of Io showing the new eruption. (A) PJ68, JIRAM (NASA PIA26527; *Credit:* NASA/JPL-Caltech/SwRI/ASI/INAF/JIRAM). (B) PJ68, JunoCam; (C), PJ70, JunoCam (*Credit:* NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers)

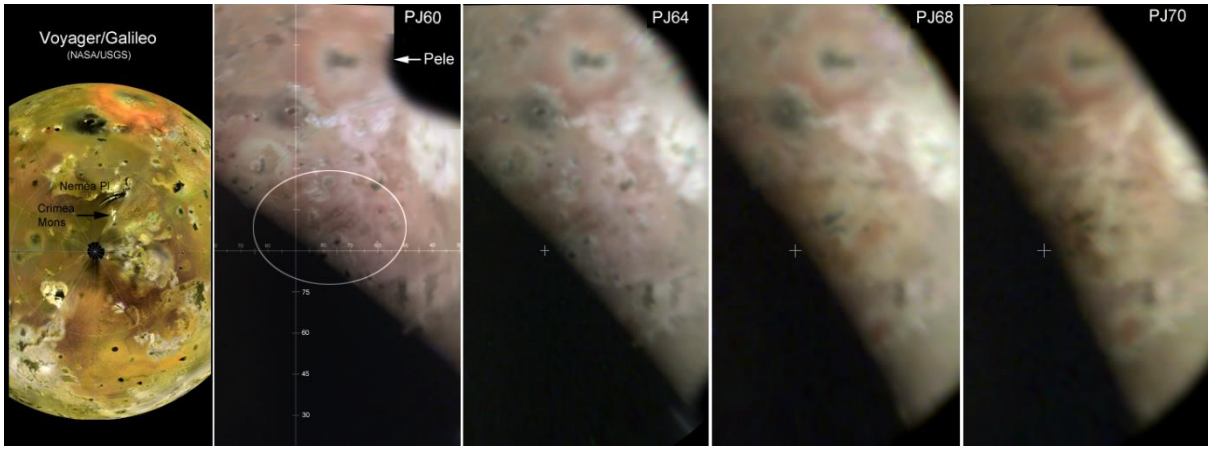

Figure 2. South polar maps of Io. Left: Galileo/Voyager map, polar orthographic projection (NASA/USGS map). Other panels: JunoCam image maps, polar equidistant projection (NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers).

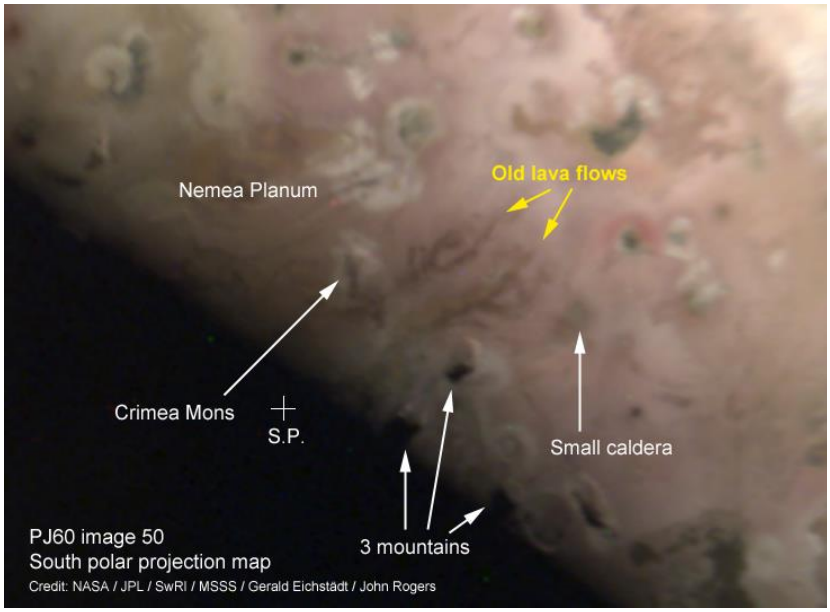

Figure 3. South polar map at PJ60 (full-resolution detail).

NTBs jet outbreak

After the Io flyby, when Jupiter came into JunoCam's field of view, the North Temperate domain was well viewed and one of the three great convective plumes in the NTBs jet outbreak should have been in view – if it still existed. (The outbreak will be fully described in our 2024/25 Report no.5, to be posted very soon.) This is the third such outbreak that has occurred during Juno's mission but JunoCam has never yet been able to capture a good image of a plume. Unfortunately, third time was not lucky: the two remaining plumes (numbers 2 & 5) both faded on Feb.25 as they approached the turbulent wake following the other plume, and decelerated then disappeared on or before March 1 (Figure 4A).

So JunoCam did not see a plume, but did have the best-ever view of the turbulent wake that comprises the reviving NTB (Figures 4B & 5). Incidentally, exactly the same thing happened on 2007 May 11 when Hubble was pointed to image a NTBs plume, and it disappeared on the previous day (Figure 6).

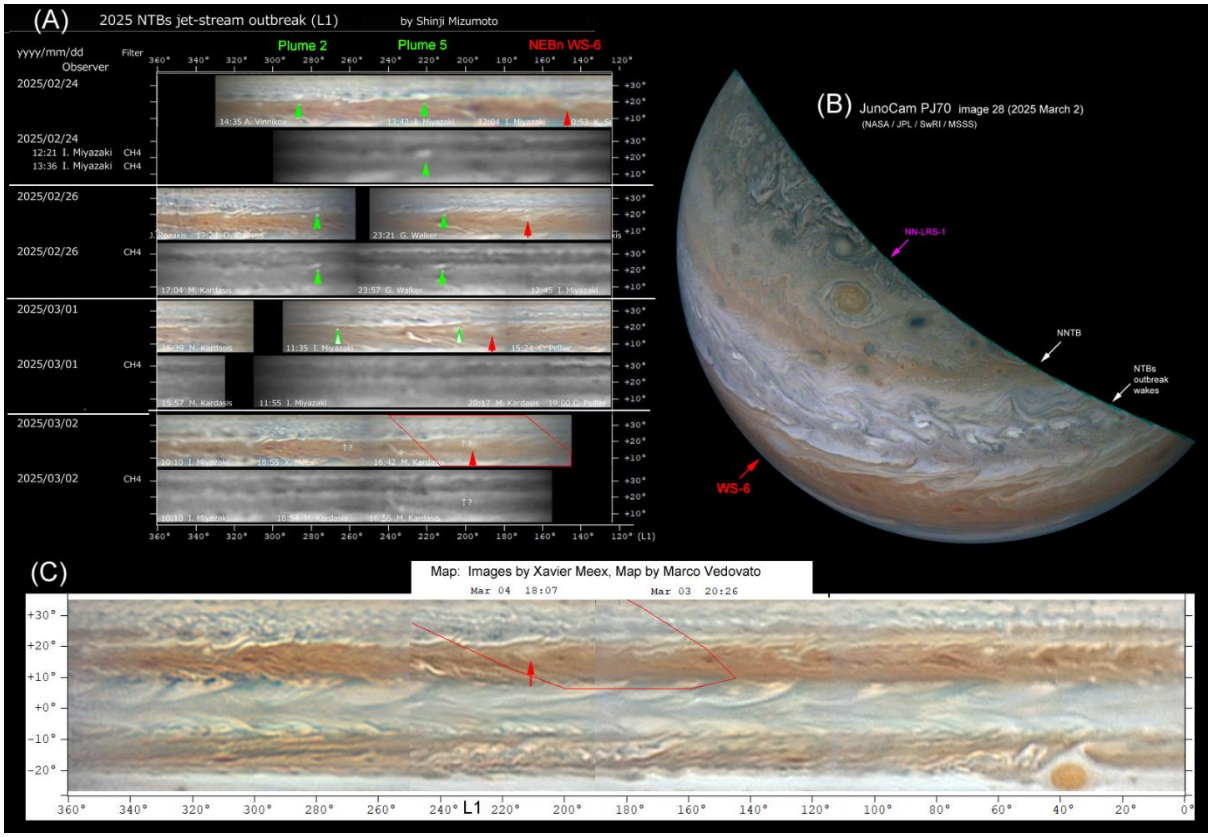

Figure 4. The NTB around the time of PJ70. (A) Ground-based maps of NTB up to March 2 (made by Shinji Mizumoto), showing how plumes 2 & 5 both disappeared in the previous few days; (B) JunoCam's PJ70 image 27 showing the region where the remains of plume 5 would have been, adjacent to the NEBs AWO called WS-6; (C) Ground-based map on March 3-4 (made by Marco Vedovato), with the area of image 27 (B) outlined in red. (More ground-based whole-planet maps around PJ70 were made by Shinji Mizumoto and Rob Bullen, available on request.)

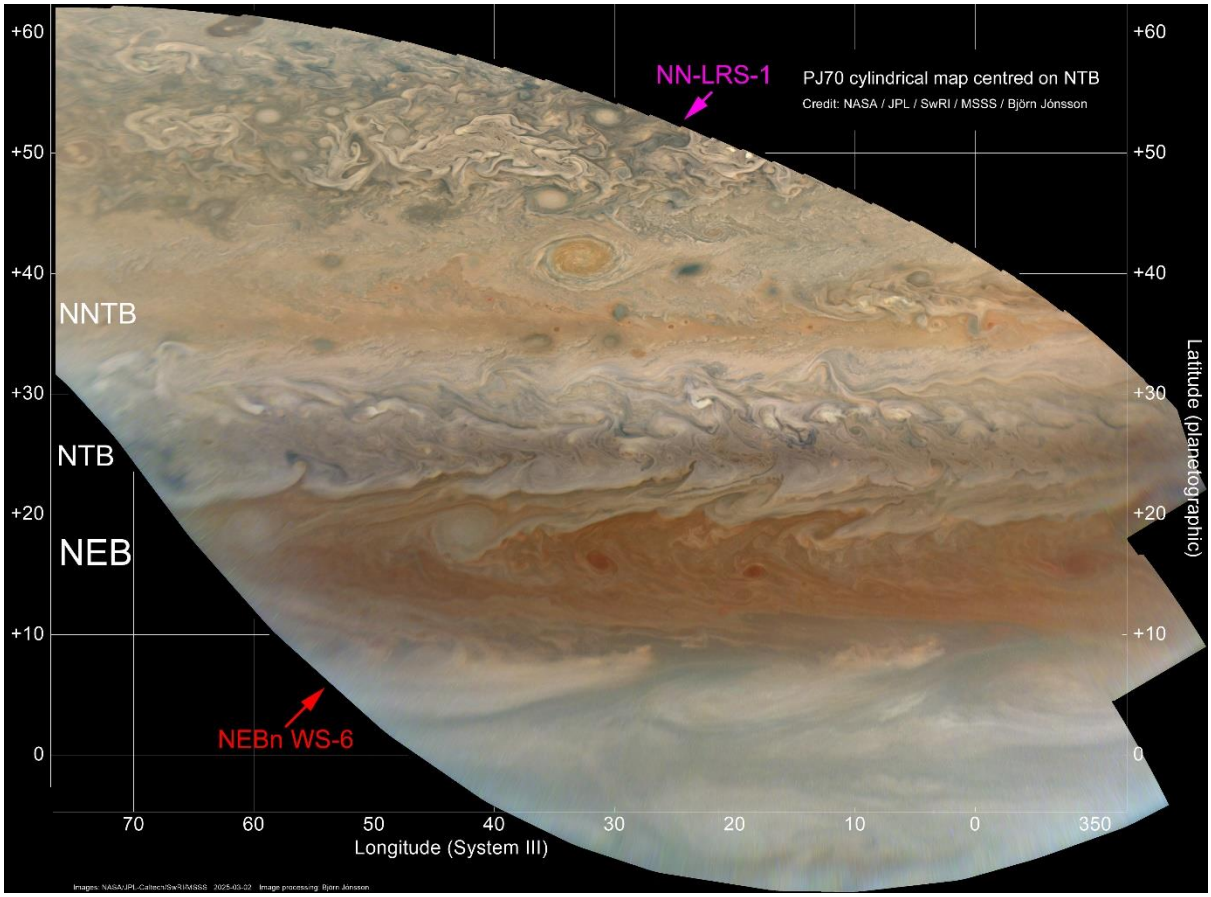

Figure 5. The NTB from JunoCam images in cylindrical map projection by Björn Jónsson. (Also see Figure 7, which includes the methane-band map covering this area; there are no methane-bright plumes there.)

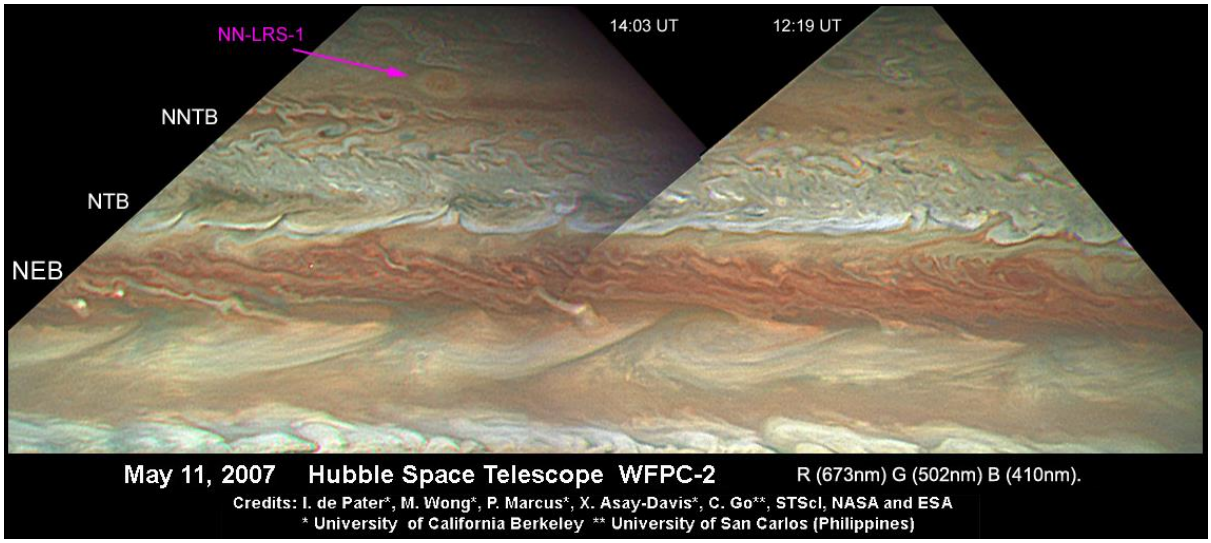

Figure 6. The NTB in images from Hubble S.T. on 2007 May 11, the day after the plume disappeared.

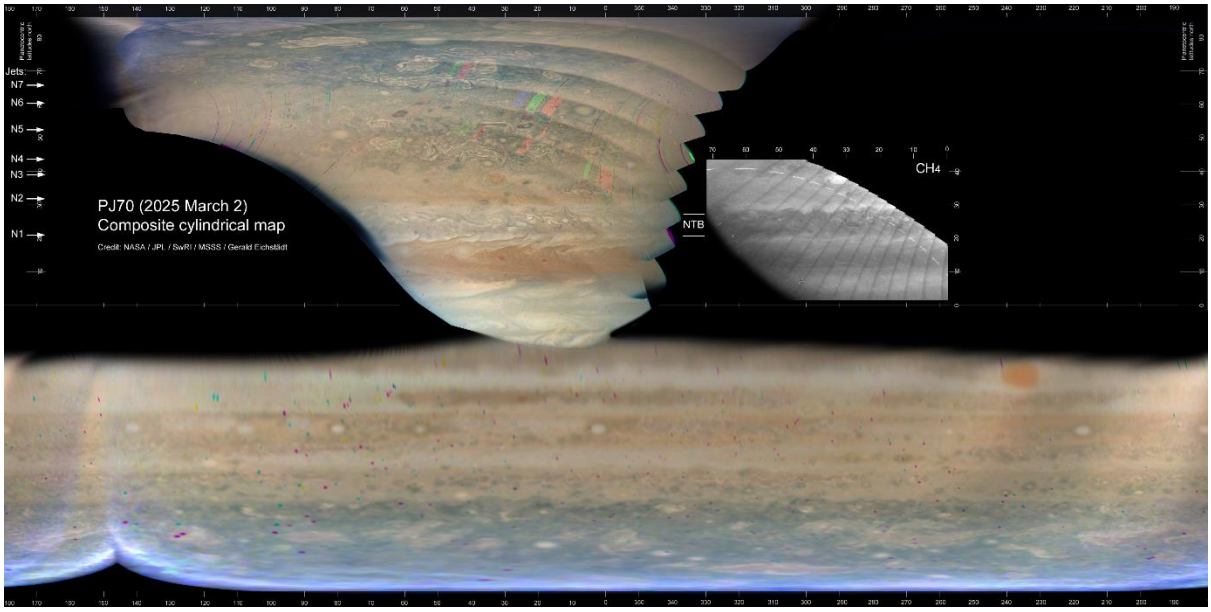

Figure 7. Global cylindrical map from the PJ70 JunoCam images, including the methane absorption map covering the NTB: hi-res inbound in northern hemsphere, lo-res outbound in southern hemisphere.

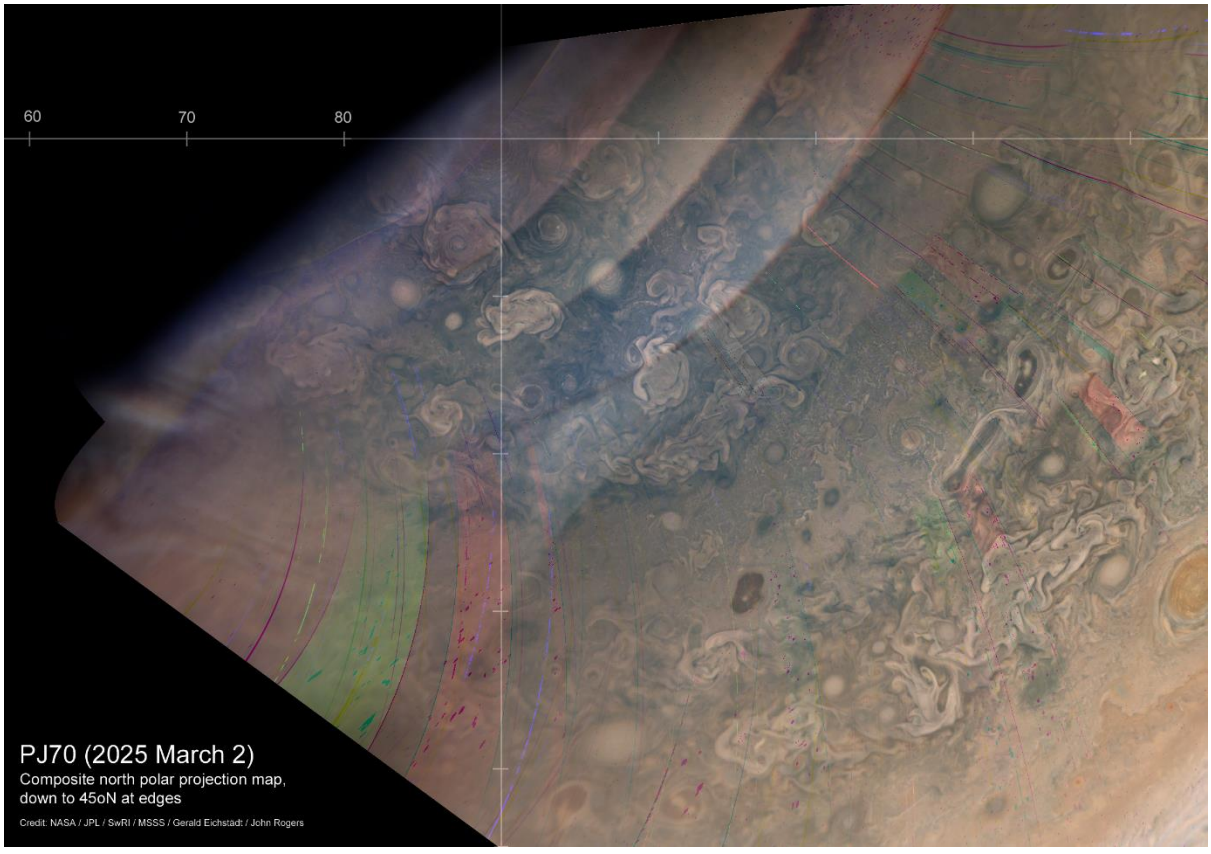

Figure 8. North polar map, down to 45ºN.

North polar region

The subsequent images over higher northern latitudes, while Juno was passing through the worst radiation belt, again suffered from radiation-induced dark spots and lines in individual colour channels, leading to coloured spots and strips on several images. Fortunately, enough data was obtained to give an extensive map (Figures 7 (upper) & 8), and JunoCam was back to normal for the closeup imaging of the northern circumpolar cyclones (Figure 9).

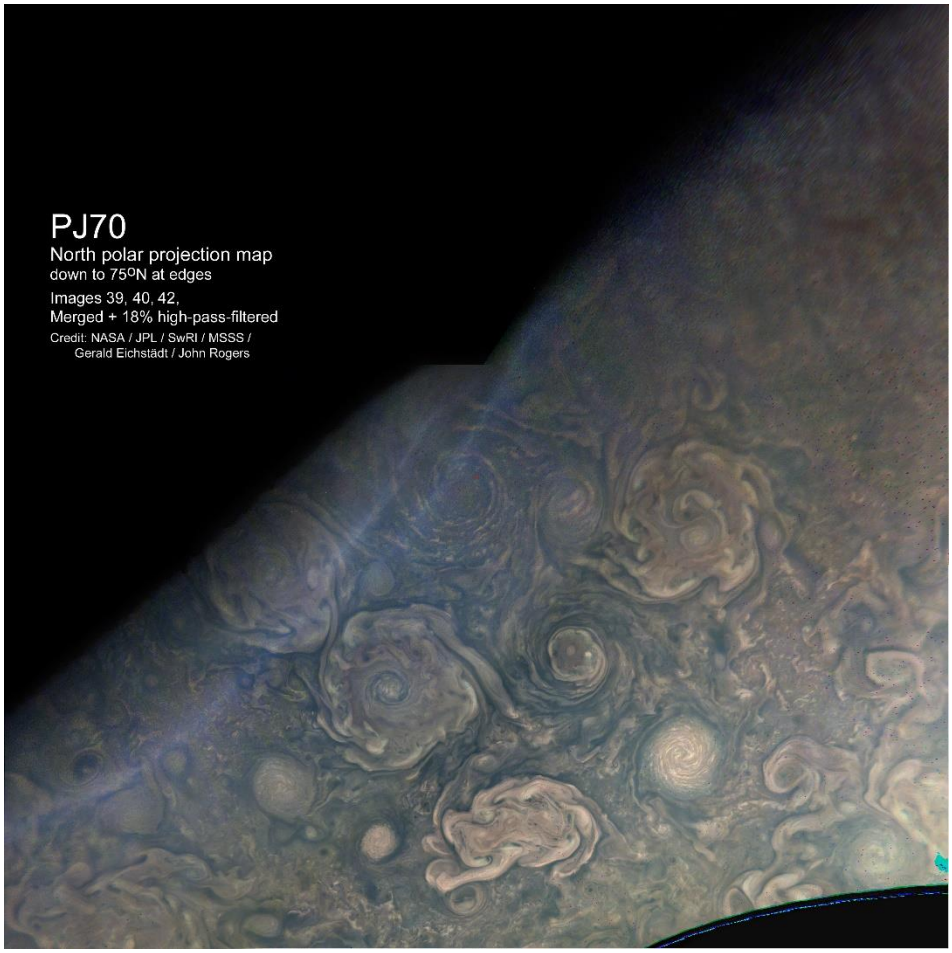

Figure 9. North polar map, down to 75ºN, showing the circumpolar cyclones.

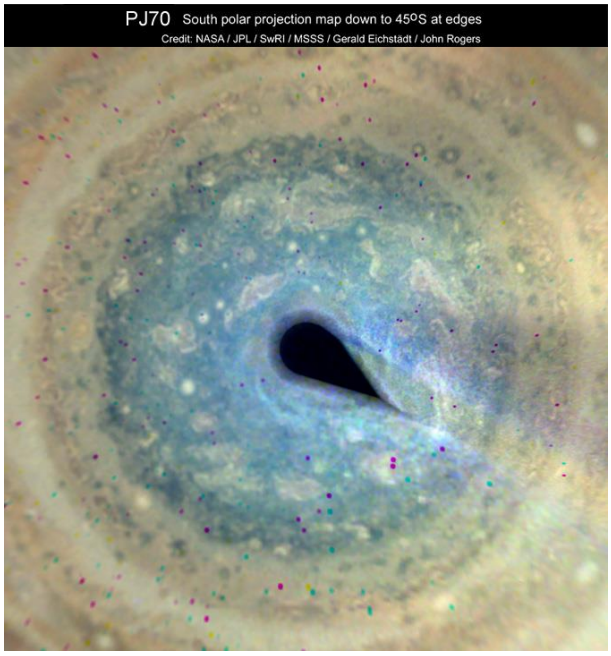

Figure 10. South polar map, down to 45ºS.

South polar region

Finally, Figure 10 is Gerald's map of the south polar region. As the resolution continues to diminish, the coloured dots representing radiation hits become more and more prominent. But some of the CPCs can nevertheless be seen, along with bright haze bands reminiscent of the old Long Band.