JunoCam at PJ51: What the pictures show

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Juno's Perijove-51 (PJ51) occurred on 2023 May 16. The highlight was Juno's fairly close pass by Io; Figure 1 shows Io and Jupiter together. As the spacecraft was turned to view Io, there was a substantial gap in the inbound images of Jupiter. However, no planned images were lost, and enough were obtained on the inbound and outbound legs to give a map covering most of the planet. This is valuable as the planet was only just becoming visible to ground-based observers, with only lo-res amateur images available so far.

Juno has been flying over Io on almost every odd-numbered orbit since PJ41, passing progressively closer, and at PJ51 it had its closest pass yet, with a minimum altitude of 35,500 km. Figure 2 presents the best images of Io that JunoCam has yet taken, with some of the volcanic features labelled. They include the largest caldera, Loki, which seems to have changed somewhat since the Galileo Orbiter era. But there are still no visible plumes nor deposits from large recent eruptions in this area. These images can be compared with those from earlier flybys in our PJ47 and PJ49 reports, and also with those from JIRAM 5-micron at those flybys in which dozens of hot spots (volcanoes) are located on the JunoCam images: https://www.missionjuno.swri.edu/news/nasas-juno-mission-getting-closer-to-jupiters-moon-io

Turning to Jupiter, Gerald Eichstädt has again made a global map and north and south polar maps, from the inbound and outbound images, using an automated assembly procedure. Figure 3 presents the global cylindrical map. We note that the NTB is almost absent, the NEB is largely normal apart from the still-faded barges, and the EZ is now almost colourless. The most noticeable change since PJ50 is the appearance of a S. Tropical Band, discussed further below. Individual features can be identified by comparison with our PJ50 map.

Figure 4 is Gerald's north polar projection map, down to 45°N at the edges. Small yellow arrows indicate haze bands at the terminator. At left is the map for methane image 87 alone; it shows the main edge of the North Polar Hood at 64°N, and extensive haze bands over the N5 and N4 domains; these showed up well as they were near the limb in this image.

Figure 5 is an enlargement of the north polar map, down to 75°N at the edges, showing the circumpolar cyclones (CPCs). This can be compared with our PJ50 map: CPCs 1 to 4 are almost unchanged, and the four AWOs marked on the PJ50 map can be re-identified: three on the periphery of the octagon of cyclones, and one inside it. Thus we can now start to track AWOs outside the octagon for the first time. CPC-7 (the displaced one, at top of the map) is seen clearly for the first time since PJ46, and is exceptionally distorted.

The images just after north pole crossing again give closeup views of haze bands at the terminator. Examples of white bands with prominent brown companions or shadows are in Figure 6, and can be located on the maps (Figures 3 & 4). Juno then passed onto the night side. Perijove was at 42.7°N at L3 = 145, and equator crossing at L3 = 162, in the dark.

In the PJ50 map on April 8, there was a prominent dark hook around the GRS and I predicted that it would extend into a dark S. Tropical Band (STropB) emerging from the GRS – but the maps from PJ51 and the first ground-based images (compiled in Figure 7) showed no such thing. In fact, a STropB was indeed emitted, and prograded at a typical speed (estimated as DL3 ~ -2 to -2.5 deg/day for the p. end; the f. end is too tenuous to measure). But the Hook that produced it was short-lived; it had almost disappeared by PJ51 on May 16, so the whole of the STropB was already detached from the GRS. Shinji Mizumoto and Kuniaki Horikawa

(ALPO-Japan) estimate that the STropB emission began in late March (already tenuously visible at PJ50) and ended in late April (shortly before PJ51).

Ascending over the high southern latitudes, JunoCam views the planet as a broad crescent, so it is possible to map the south polar region (Figure 8).

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Figures (small copies):

Figure 1. Jupiter with Io in the foreground. (PJ51 image 61, processed by Kevin Gill.)

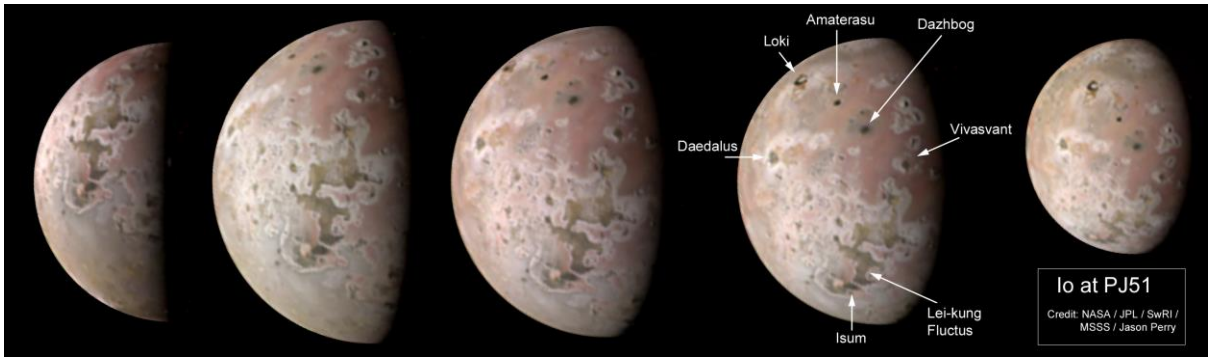

Figure 2. The best images of Io from PJ51, processed by Jason Perry. On one image, some volcanic features are labelled (by JHR -- omitting the 'Patera' designations for brevity).

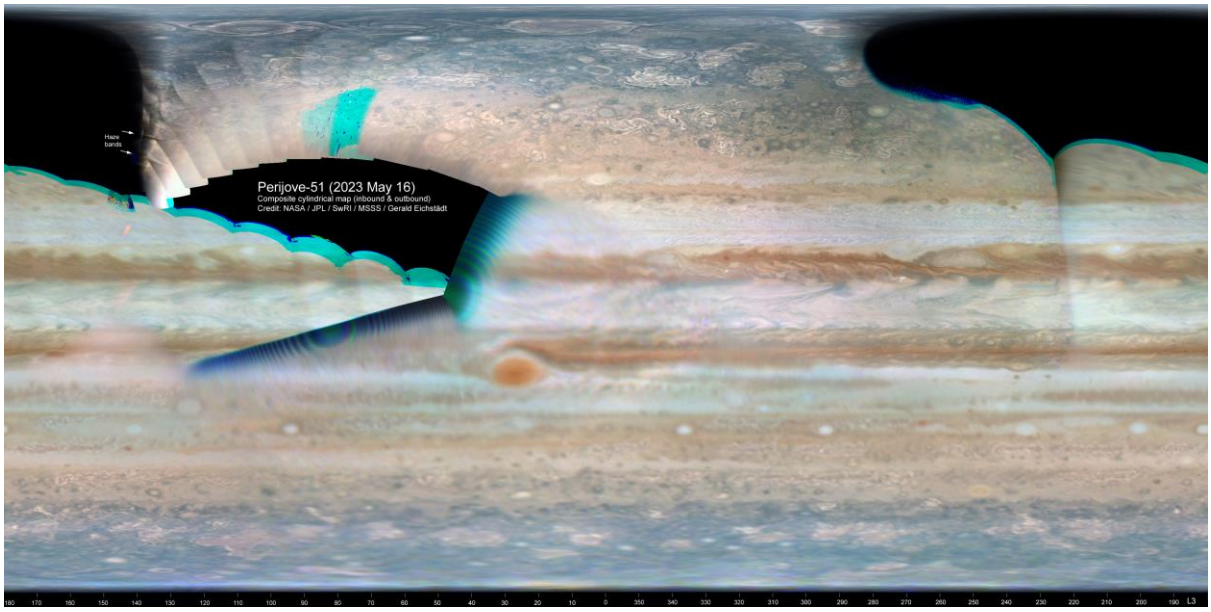

Figure 3. Global cylindrical map.

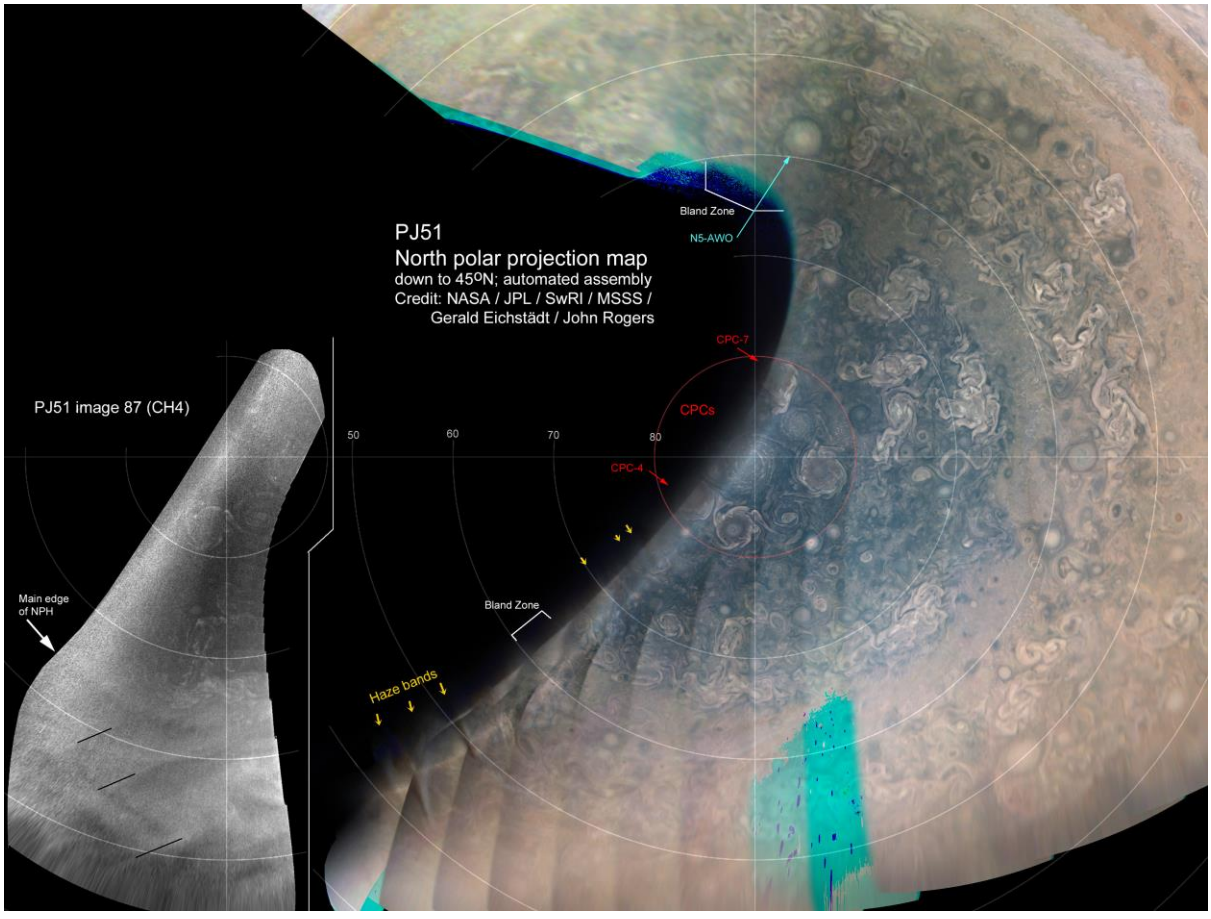

Figure 4. North polar projection map, in RGB, with map from CH4 image 87 at left. (Note artefacts of processing in these maps,, which should not be confused with real structures: a bright band parallel to the terminator; seams between images; and the image strip structure marked with lines on the methane map.)

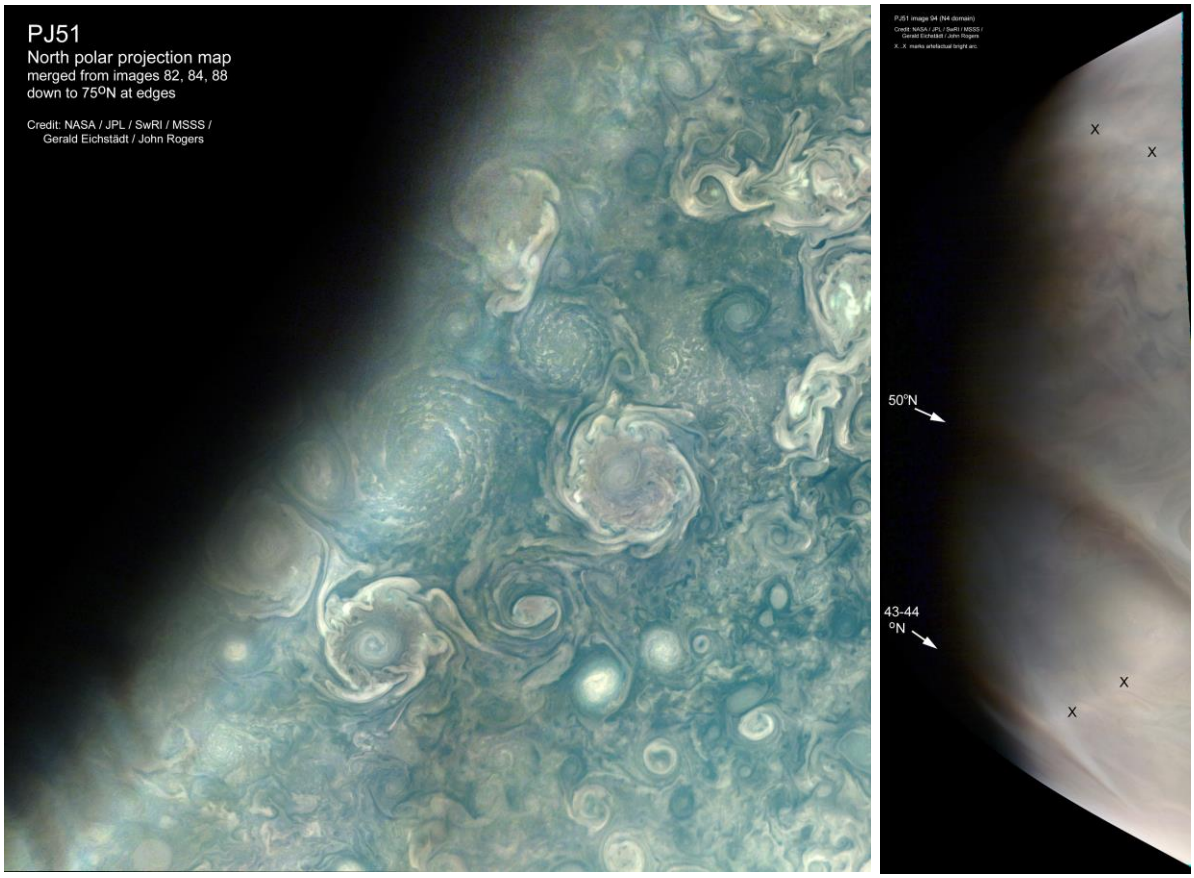

Figure 5. North polar projection map of the polygon of CPCs.

Figure 6 *(R).* The terminator on the N4 domain, showing haze features. (Image 94.)

Figure 7 *[on next page]*.

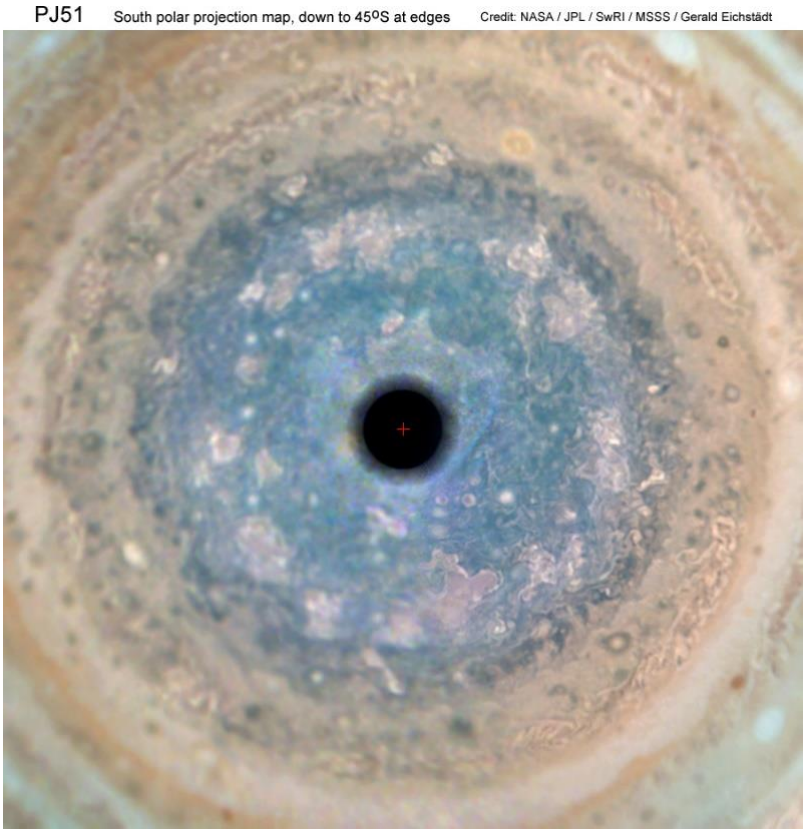

Figure 8 *(R).* South polar projection map, in RGB.

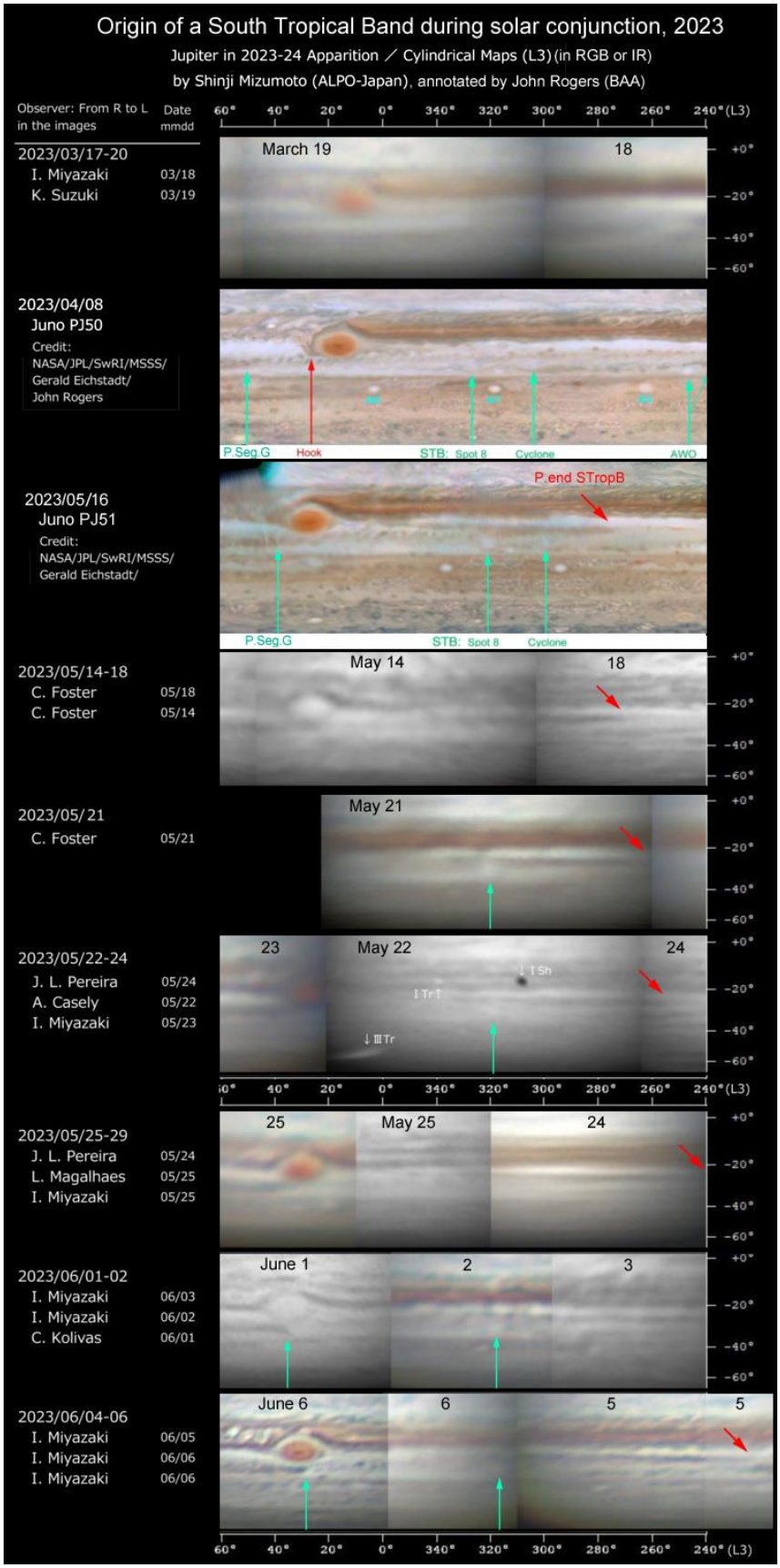

Figure 7. Timecourse of the GRS 'Hook' and South Tropical Band (red arrows), shown in JunoCam maps along with maps from amateur images, made by Shinji Mizumoto. Some S. Temperate features are also labelled (cyan arrows): note that STB Segment G has begun to pass the GRS, and cyclonic Spot 8 is now a white spot.