

JunoCam at PJ52: What the pictures show

John Rogers (BAA) (2023 July)

Juno's perijove-52 (PJ52) was on 2023 June 23. Now that the close pass is on the night side, the most informative imaging is in the approach phase and over the north pole. During the close pass, long exposures in the green filter were taken to search for lightning flashes; these are not discussed here. (Perijove was at 43.6°N with altitude ~3500 km, and equator crossing was at L3 = 100.) Outbound, Juno viewed the planet as a sunlit crescent, providing a lo-res map of the south polar region.

The images taken were as follows:

Image no:	1-45	Inbound rotation 1
	47-128	Inbound rotation 2
	145-157	N. Pole & terminator (hi-res)
	158-177	Lightning search (dark side)
	180-217	Outbound (SPR)

This report, like all in this series, is due to the work of the NASA JunoCam team: Drs Candy Hansen (Principal Investigator), Glenn Orton, Tom Momary, and Mike Caplinger (of Malin Space Science Systems); and Gerald Eichstädt, who produces the complete sets of high-quality processed images and map projections. Details were given in our PJ6 report. Gerald produces both cylindrical and polar map projections of all the images, and also assembles them into composite maps using automated (though not automatic) procedures.

Abbreviations and conventions are as in previous reports, including: p. = preceding (east), f. = following (west). AWO = anticyclonic white oval, FFR = (cyclonic) folded filamentary region, CPC = circumpolar cyclone. Latitudes are planetocentric. Longitudes are System 3 (L3).

Inbound global maps

The inbound images covered two complete rotations so Gerald produced two global maps, of which the second, hi-res one is shown as [Figure 1](#) with features labelled. This is the best global map yet obtained since solar conjunction. Blinking the two inbound maps shows the motions of the zonal jets clearly. The RGB maps are accompanied by CH₄ maps ([Figure 2](#)). While all the AWOs are methane-bright, all the quiescent cyclonic circulations are methane-dark, including: a pale orange oval in the NNTB at L3 = 302; all five faded barges in the NEB; SEB spot 8; and several white oblongs and ovals in the SSTB.

The ongoing revival of the NEB is of special interest, and [Figure 3](#) shows both ground-based and JunoCam maps of it since November. There has only been slight progression of the revival over this time; the sector from L3 ~ 216-255 (p. WS-Z) has darkened northwards, and some of the faded barges may have darkened slightly if at all. There is a new, properly dark barge at L3 = 216.

The NEB sometimes shows transverse wavetrains of ~1000 km wavelength, seen especially in Hubble images and in some past JunoCam images. Two successive wavetrains can be seen within L3 = 196-220, lat. 12-16°N, with wavelengths 1.0° (1200 km) and 1.12° (1350 km) respectively, overlying the retrograde jet and the new dark barge.

In the STB, STB Segment G (which developed from Clyde's Spot) is now 53° long and passing the GRS, and there is still an outbreak of dark spots in the STBn jet p. it. Spot 8 has indeed changed from a dark oval into a white oval.

North polar region

Juno's orbit reached 84°N, but its low altitude of only 18,000 km at that point, while giving great resolution, meant that the central North Polar Cyclone was not completely in view until slightly later as Juno descended towards perijove, when it was dimmed by haze towards the limb. Nevertheless, the views of the circumpolar cyclones (CPCs) were superb, and with the sun now being higher than last year, a composite map showed 7 out of the 8 CPCs (Figure 4). (This map was assembled manually so as to select the best views of the CPCs, some of them enhanced from terminator views.) In Figure 5, they are labelled and compared with the previous 3 perijove views. There is no change in the morphologies of individual CPCs, except that the displaced CPC-7 is no longer disturbed.

The main discovery is that we can track a particularly large AWO around the periphery of the octagon from PJ49 to PJ52 (79°N ; large red arrow in Figure 5) – the first time we have tracked one. This AWO seems to have merged with a smaller one p. it since PJ51. It is slowly prograding, consistent with the circulations of the CPCs, just as we found for some AWOs around the south polar pentagon. This contrasts with the slow retrograding drift that we suggested for 'extra cyclones' slightly further from the pole [see our PJ39 and PJ44 reports]. Together with our new ground-based measurements of the drift of the northernmost belt of FFRs at ~67-73°N [see our 2022-23 Report no.6, to be posted very soon], we are seeing more and more of the circulation patterns in the North Polar Region.

High-latitude hazes

The high-latitude terminator was not included in the images leading up to north pole crossing; but afterwards, images 155-157 gave v-hi-res views of haze bands near the terminator from about 70 to 50°N, over the N6 and N5 domains. As Figure 6 shows, these all included a prominent pair of bright 'rainbow bands' [mauve arrows] separated by a prominent dark band, with the complex swirls of the N5 domain dimly visible through them. Remarkably, a lesser dark band crosses one bright band orthogonally [brown arrow].

South polar region

Figure 7 shows Gerald's composite south polar projection map. Even with the orbital period reduced to 38 days, one cannot confidently identify individual FFRs in the SPR from one perijove to the next. However, if the map is rotated by 30.4°, equivalent to the drift rate of 0.80 deg/day that we measured for features in the southernmost belt of FFRs, the overall pattern of FFRs in this belt is similar to that at PJ51, suggesting that many have persisted.

As the mission proceeds, the phase angle of these outbound images is increasing, and the haze patterns seem to be more widespread, both at the terminator and on the sunlit side. The early outbound images suggest a pervasive pattern of fine haze streaks in and around the bluish, methane-bright South Polar Hood (e.g. 184 & 186 in Figure 8). (A composite map of these near-terminator hazes is yet to be made.) Many are vaguely concentric to the pole, and these could be ripples in the SPH or, more likely, in a haze layer below the SPH, since they are also seen outside the SPH, and the edges of the SPH are not usually apparent as terminator features. The long-lived Long Band seems to be still present, in some form, seen as a broad, slightly dark band on the sunlit side, plus the characteristic)-shaped extension catching sunlight at the terminator (white arrows, image 195 in Figure 8).

Figures (small copies):

Figure 1:

PJ52 (2023 June 22-23) Global cylindrical map, mostly from last inbound rotation (images 45-151) plus high southern latitudes from outbound (images 180-217)
Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt

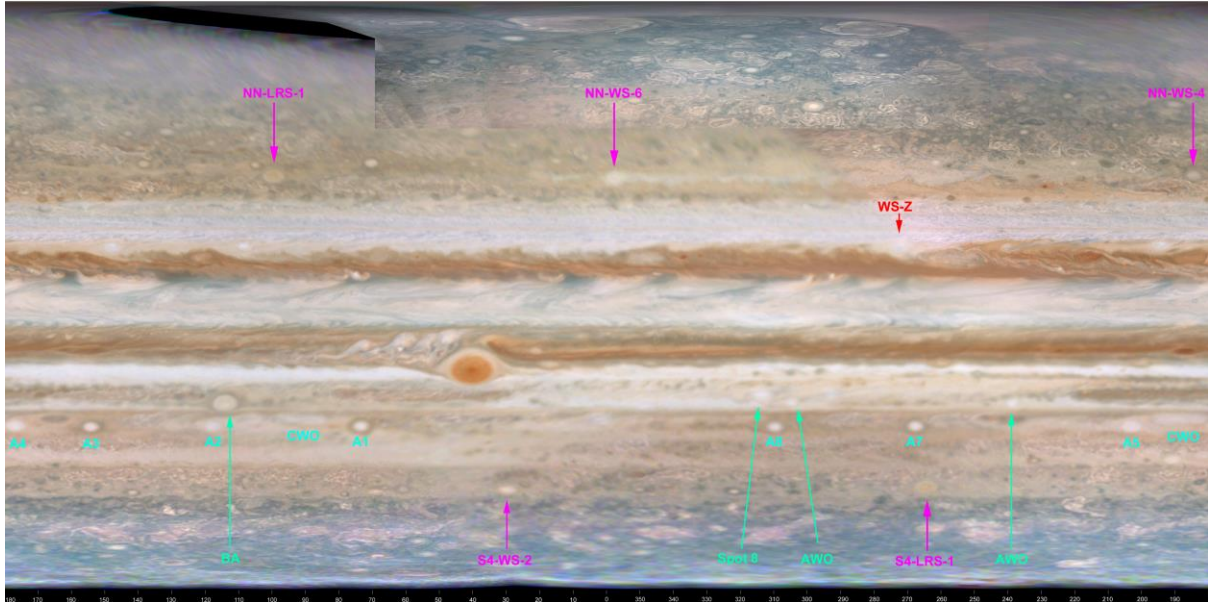


Figure 2:

PJ52 (2023 June 22-23) Global cylindrical map, mostly from last inbound rotation [SPH added from previous rotation] Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt

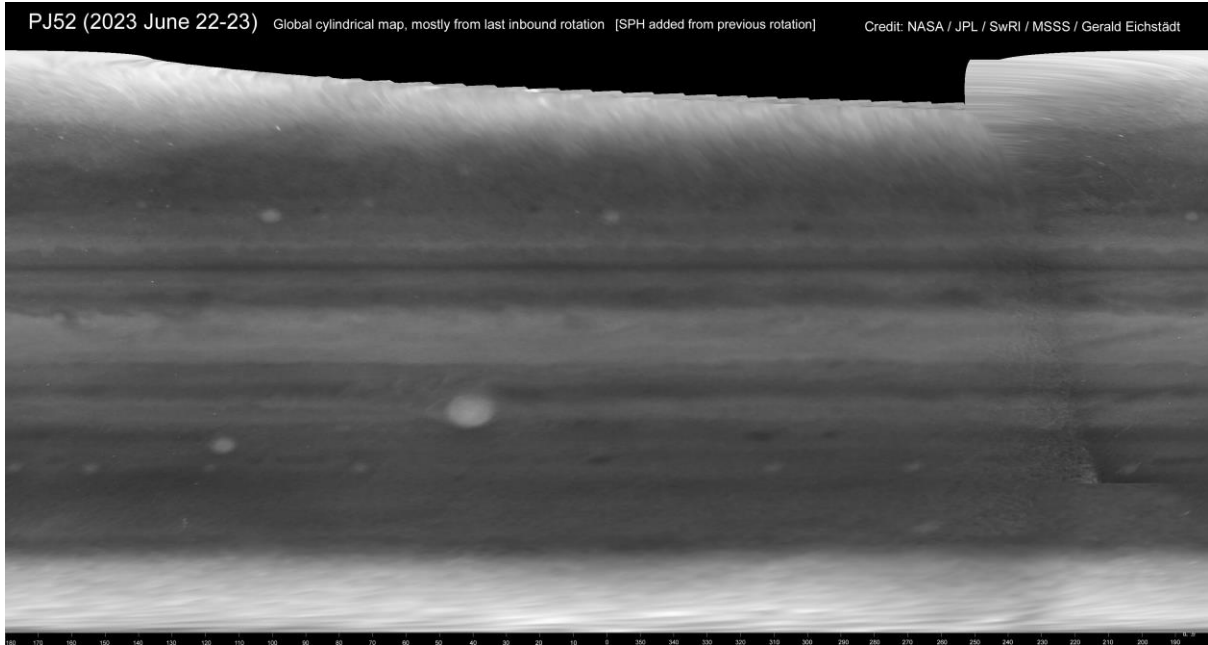
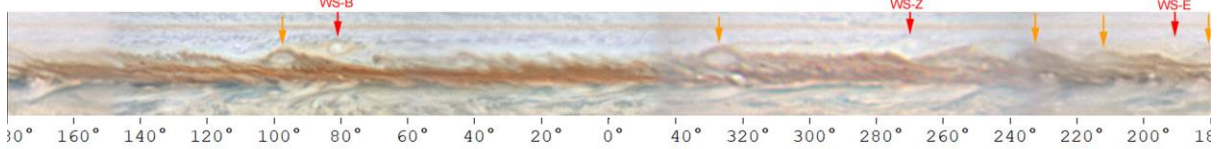
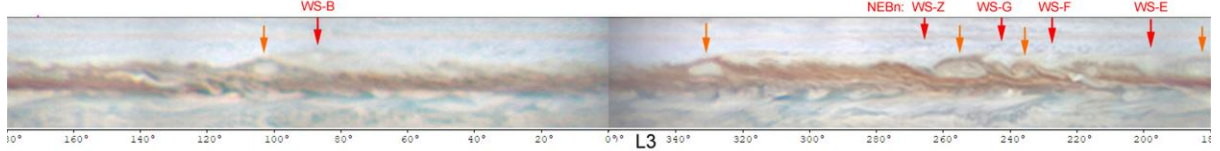


Figure 3:

2022 Nov.5-7 Images by C. Go, S. Ito & I. Miyazaki; Map by Andy Casely

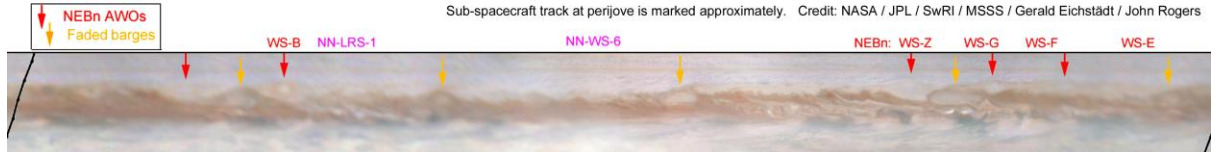


2022 Dec.27-29 Images by I. Miyazaki, C. Go & N. MacNeill; Map by Rob Bullen (JUPOS team)

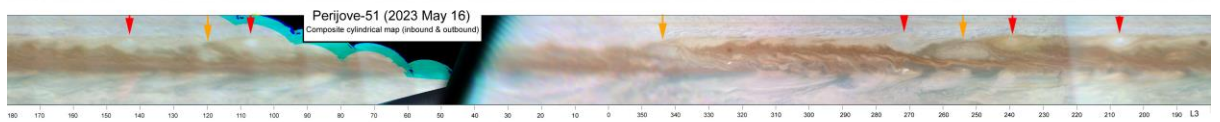


PJ49 (2023 March 1) Global cylindrical map

Assembled from Gerald Eichstädt's automated maps on 3 successive rotations spanning 35 hours, inbound & outbound. Sub-spacecraft track at perijove is marked approximately. Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt / John Rogers



PJ50 (2023 April 8)



Perijove-52 (2023 June 22-23): Map from final inbound rotation Credit: NASA / JPL / SwRI / MSSS / Gerald Eichstädt

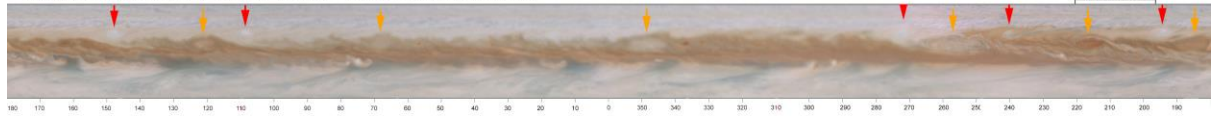


Figure 4:



Figure 5:

Maps of the north polar octagon, PJ49-PJ52, down to 75°N. Large red arrow marks a single large AWO.

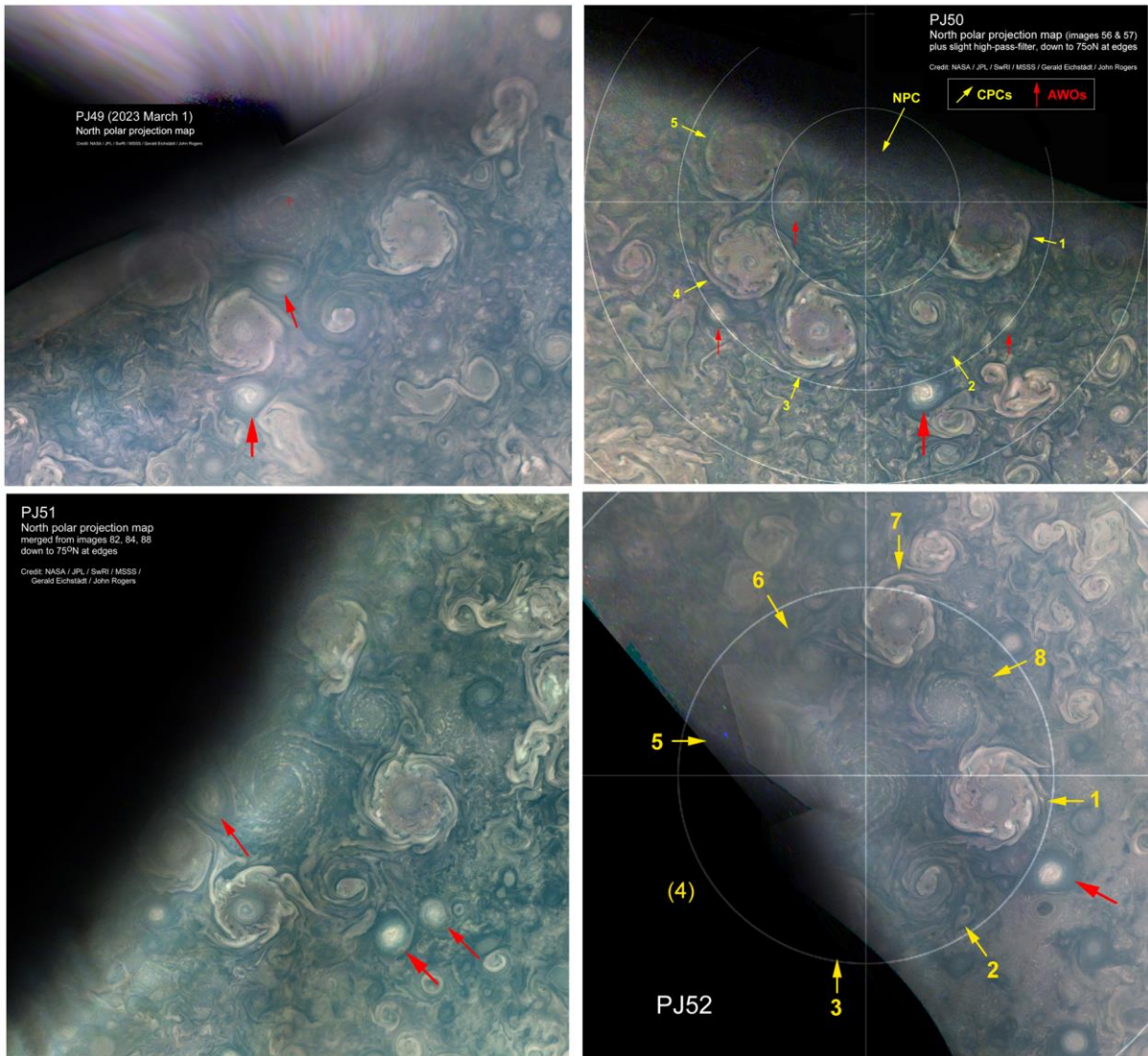


Figure 6:

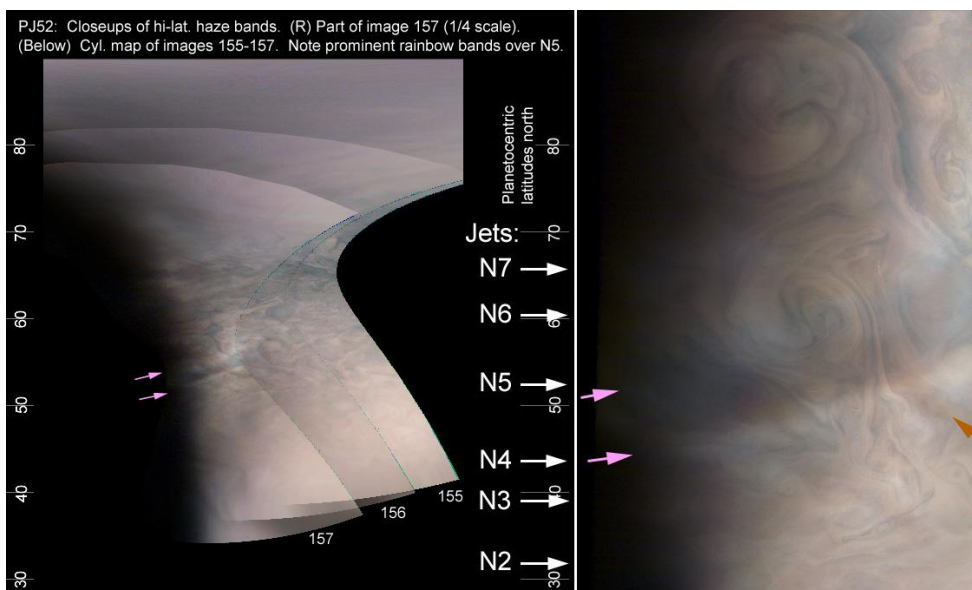


Figure 7:

PJ52 South polar projection map

Down to 45°N at edges. L3=0 to left.

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

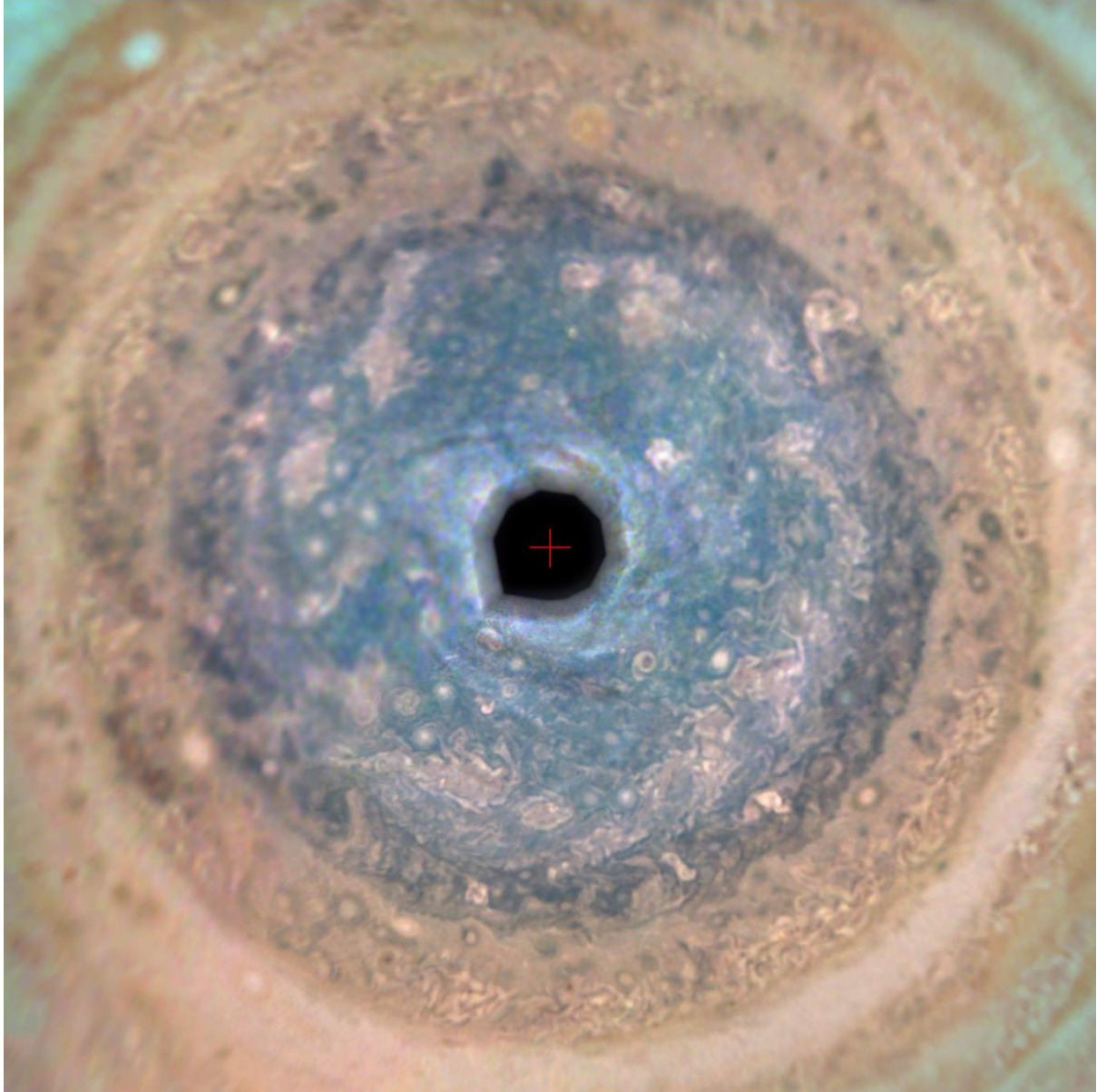


Figure 8:

