Juno at Perijove-10 (2017 Dec.16): What the images show (Part I)

John Rogers (BAA) (2017 Dec.23)

At Juno's perijove-10 (PJ10) on 2017 Dec.16, JunoCam again returned a superb set of closeup images. But the closest views look obviously different from those at previous perijoves, because of the changing orbital orientation (Figure 1). Since PJ1 (2016 Aug.27), Jupiter has orbited for 36 deg around the Sun, while Juno's polar orbit remains in an approximately fixed plane. So, whereas at PJ1 it orbited over the terminator and scanned features directly below while pointing its solar panels and antenna towards the Sun and Earth, this is no longer possible. If the spin axis is pointed towards the Sun and Earth – as it must be to provide maximum solar power and optimum tracking for the gravity mapping – the scanning instruments, including JunoCam, are tilted at ~36 deg to the nadir. This was not evident at PJ9 because the spacecraft was tilted to view the nadir, but it is obvious now. The spacecraft track is over the mid-afternoon, and the closest images look towards the fully illuminated limb. After a few more perijoves, the images at closest approach will miss the planet altogether – although the camera will always view the high latitudes as it passes over the poles (Figure 1).

At PJ10, this new viewing angle gives some advantages, because it reveals a wider area, giving a regional view of the low latitudes. Figure 2 shows the best amateur ground-based images of the track during and soon after PJ10 – excellent achievements given that the planet is still low in the dawn sky. PJ10 covered similar longitudes to PJ8.

The northern hemisphere closeups were downloaded within a few days, and the southern hemisphere ones some days later. As usual, they were posted by the JunoCam team in the form of projections as if viewed from a single point above the spacecraft's trajectory, at reduced resolution. These are the versions used in most of the figures herewith. Kevin McGill made some full-size colour images from the raw data immediately, and Gerald Eichstädt followed for all images within 24 hours; a few excerpts from Gerald's are included here. This report has been done quickly so as to be posted before Christmas. When maps of all the images have been made and compiled, a further instalment will be posted.

Abbreviations (as usual): AWO = anticyclonic white oval; FFR = [cyclonic] folded filamentary region.

North Polar region (Figure 3): The view over the north pole is now narrow, but still shows the now-familiar features; the circumpolar cyclones (a line of 3 of them), the masses of chaotic cyclonic features, and the bundles of white and brown haze bands lying over the (now rather disturbed) bland zone.

High northern latitudes: The swirling chaos here is as dazzling as ever, and image 23 (Figure 4) gives an outstanding 3-dimensional impression of the cloud surfaces, including cyclonic ovals in the N4 and N3 domains (white arrows: a small grey one in a FFR in N4; a large orange one in N3). Both of these ovals are evidently lower than the surrounding ridges of clouds, and on top of these ridges are rows of the tiny bright white elevated clouds.

N.N. Temperate (N2) domain (Figure 5): These views are probably just p. (east or downstream of) the NNTB-FFR that was viewed at PJ8. Alongside an orange NNTB, there is a dense string of anticyclonic vortices in the NTZ and on the NNTBs (N2) jet. One gets the strong impression that dark bluish-grey patches on and around these vortices may be genuinely dark blue-grey haze, as also suspected in the PJ8 images of the NNTB-FFR. This recalls Kevin Baines' theory

that similar spots on Saturn are dark due to soot generated by lightning in nearby thunderstorms. On Jupiter, the NNTB-FFR is a very likely location for thunderstorms, and the PJ8 and PJ10 images together can be interpreted as showing sooty aerosol being drawn into the incipient NNTBs jet spots downstream of it.

North Temperate (N1) domain (Figure 5): Here we see an impressive rifted sector of the NTB(N), with two FFRs and dense small-scale turbulence. This rifted sector is probably tens of degrees f. (west of) the extrapolated track of the known one, and may be new since PJ9. The orange NTB(S) is still prominent.

North Equatorial Belt (Figure 6): All 4 images cover the same sector of the NEB. The N half of the belt is now fading again and there is intricate texture here. A well-developed sinuous rift stretches diagonally through the NEB, and a compact bright spot just S of it is probably a new cloud eruption. With the wider field of view at this perijove, we see a typical NEBs dark formation ('hot spot') with festoon in the EZ, and two bright plume nuclei further f.

Equatorial Zone (Figures 6 & 7): The full-size image 30, this time returned at high quality, shows that mesoscale waves are widespread.

South Equatorial Belt: This sector of the belt is now quiet. Figure 8 is a spectacular view taking in the SEB and the STB Ghost (see Figure 9 for key).

South Temperate domain (Figure 9): As expected, and as at PJ8, these images give a superb sequence of views of the cyclonic circulation called the STB Ghost. This time they cover mainly the f. (west) half, and the dark grey-and-orange complex Sf. (SW of) it, which I call the recirculation loop (although it is not obvious from these images which ways the winds are blowing within it; many dark features seem to have congregated here). We will again attempt to visualise the circulations of these features from maps of these images, although this will be limited by the short duration of the fly-over.

High southern latitudes (Figures 9 & 10): There are good views of long-lived AWOs and FFRs in the S2, S3 and S4 domains.

South Polar region: Figure 10 shows the polar colour and methane images, and one of the outbound colour images. Of the two long-lived ovals in the S4 domain, LRS-1 is bright in the methane image as usual but AWO-3 is barely perceptible. The bluish, methane-bright South Polar Hood is a permanent haze layer overlying the polar region, and within it there is a long sinuous dark band (marked by white arrows), also dark in the methane image which supports the view that it is a clear lane in the Polar Hood. The same band has been seen at the last several perijoves [see our PJ9 report], often appearing as a bundle of dark and bright haze bands. It always curves across the periphery of one or two of the circumpolar cyclones, so I suspect it is connected with the dynamics of this remarkable cluster of cyclones.

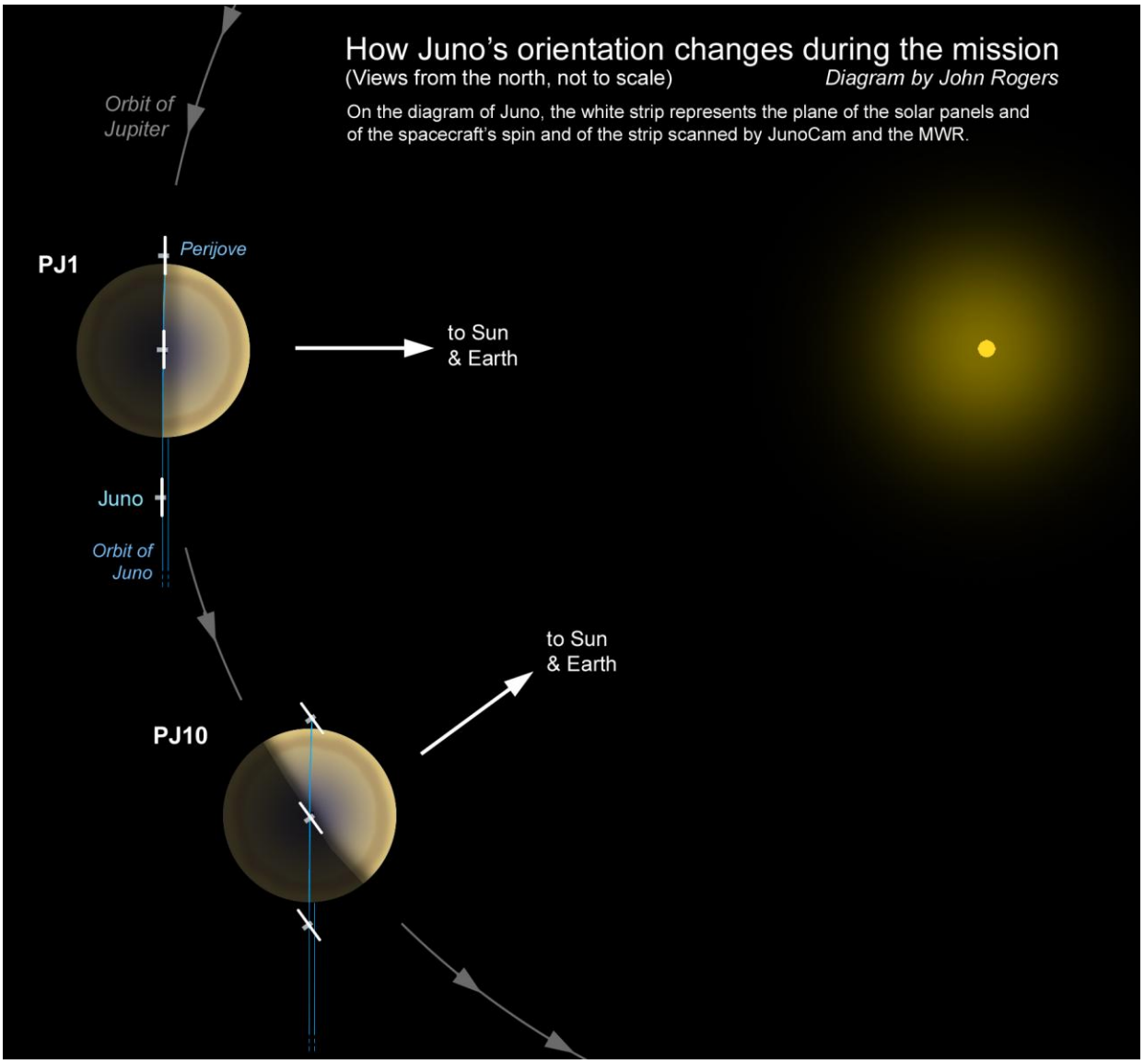
How Juno's orientation changes during the mission
(Views from the north, not to scale)
Diagram by John Rogers
On the diagram of Juno, the white strip represents the plane of the solar panels and of the spacecraft's spin and of the strip scanned by JunoCam and the MWR.
Orbit of Jupiter
PJ1
Perijove
to Sun & Earth
Juno
Orbit of Juno
to Sun & Earth
PJ10

Figure 1

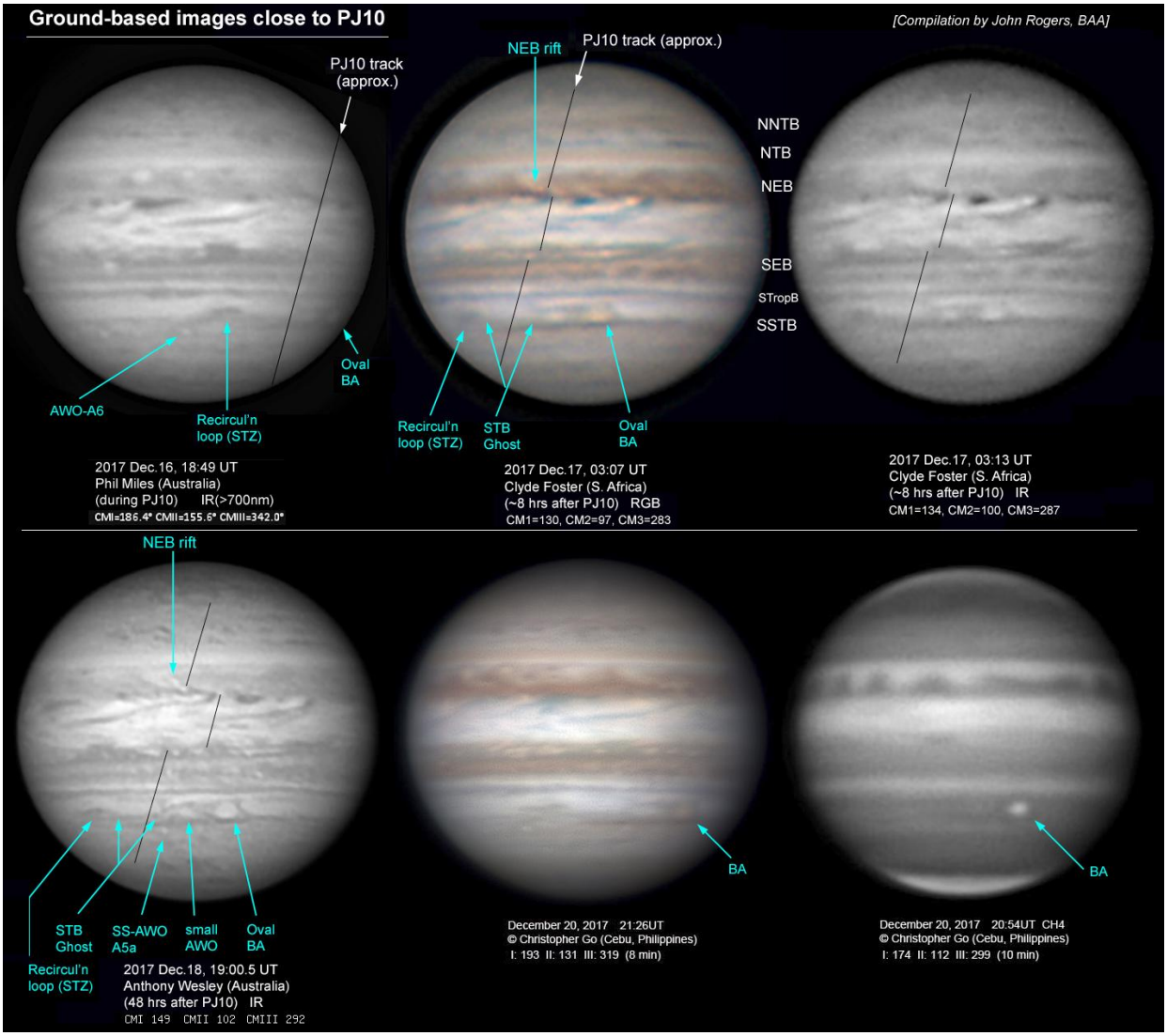
Ground-based images close to PJ10
[Compilation by John Rogers, BAA]
PJ10 track (approx.)
AWO-A6
Recircul'n loop (STZ)
Oval BA
2017 Dec.16, 18:49 UT
Phil Miles (Australia)
(during PJ10) IR(>700nm)
CMI=186.4° CMII=155.6° CMIII=342.0°
NEB rift
PJ10 track (approx.)
Recircul'n loop (STZ)
STB Ghost
Oval BA
2017 Dec.17, 03:07 UT
Clyde Foster (S. Africa)
(~8 hrs after PJ10) RGB
CM1=130, CM2=97, CM3=283
NNTB
NTB
NEB
SEB
STropB
SSTB
2017 Dec.17, 03:13 UT
Clyde Foster (S. Africa)
(~8 hrs after PJ10) IR
CM1=134, CM2=100, CM3=287
NEB rift
STB Ghost
SS-AWO A5a
small AWO
Oval BA
Recircul'n loop (STZ)
2017 Dec.18, 19:00.5 UT
Anthony Wesley (Australia)
(48 hrs after PJ10) IR
CMI 149 CMII 102 CMIII 292
BA
December 20, 2017 21:26UT
© Christopher Go (Cebu, Philippines)
I: 193 II: 131 III: 319 (8 min)
BA
December 20, 2017 20:54UT CH4
© Christopher Go (Cebu, Philippines)
I: 174 II: 112 III: 299 (10 min)

Figure 2

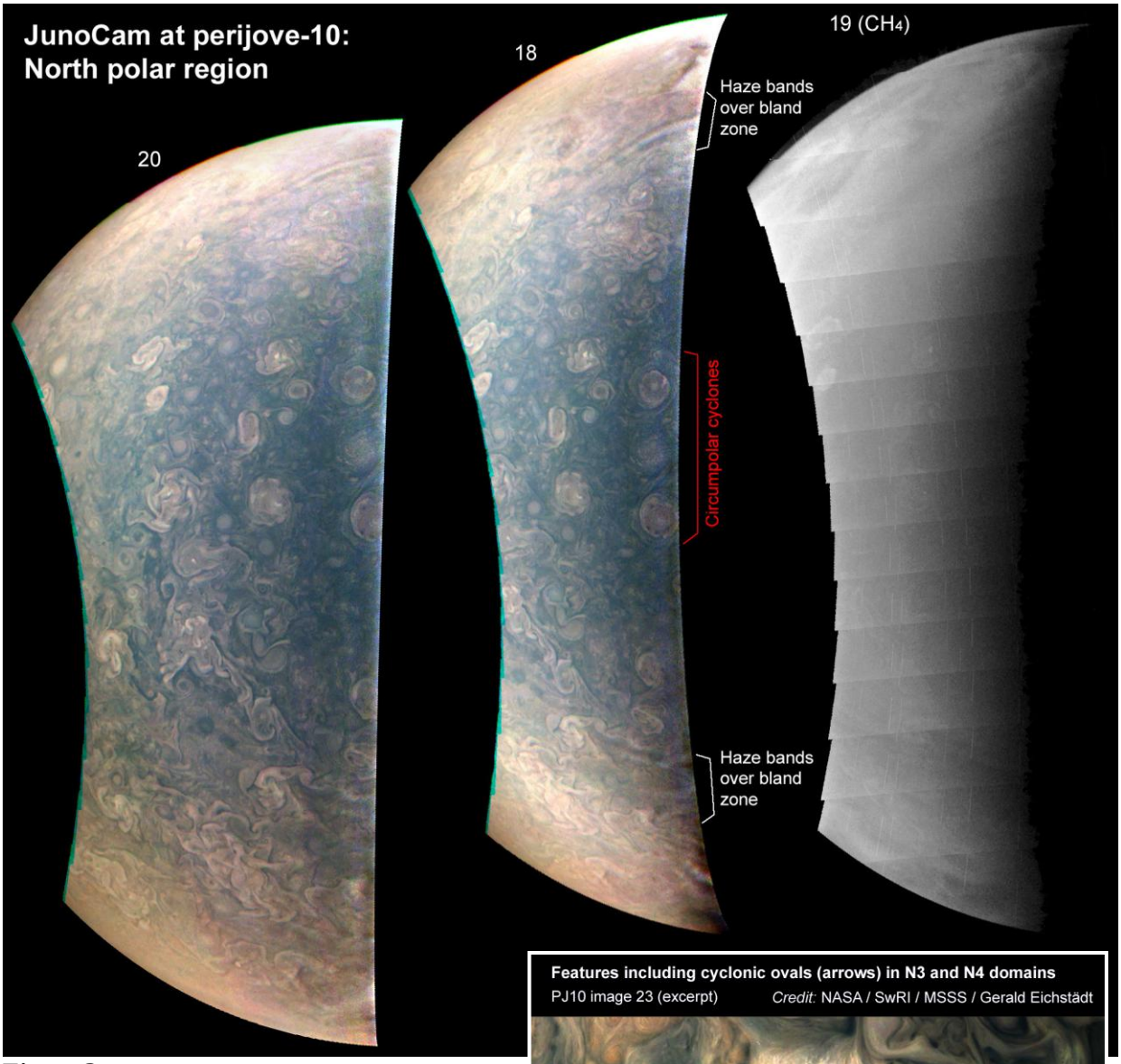

Figure 3

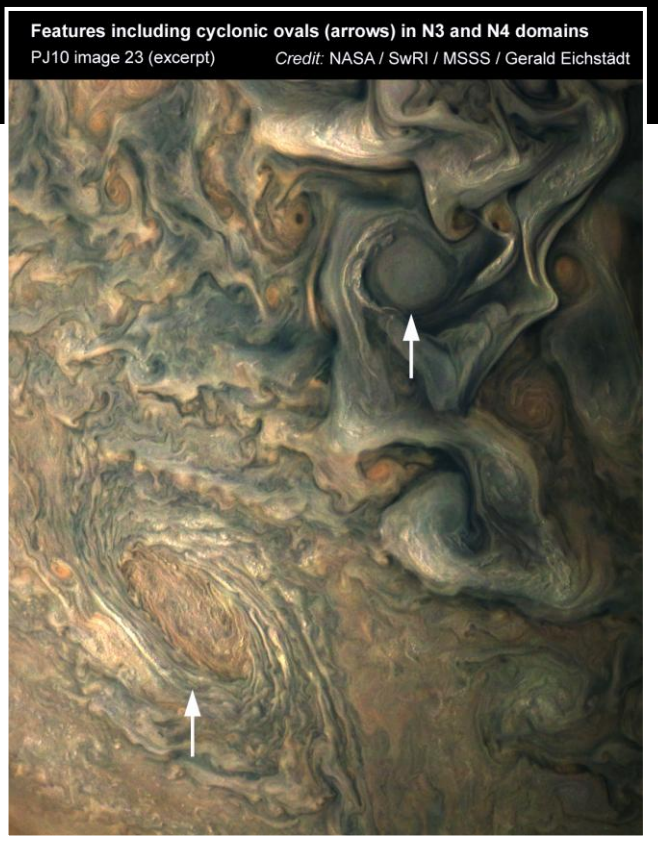

Figure 4

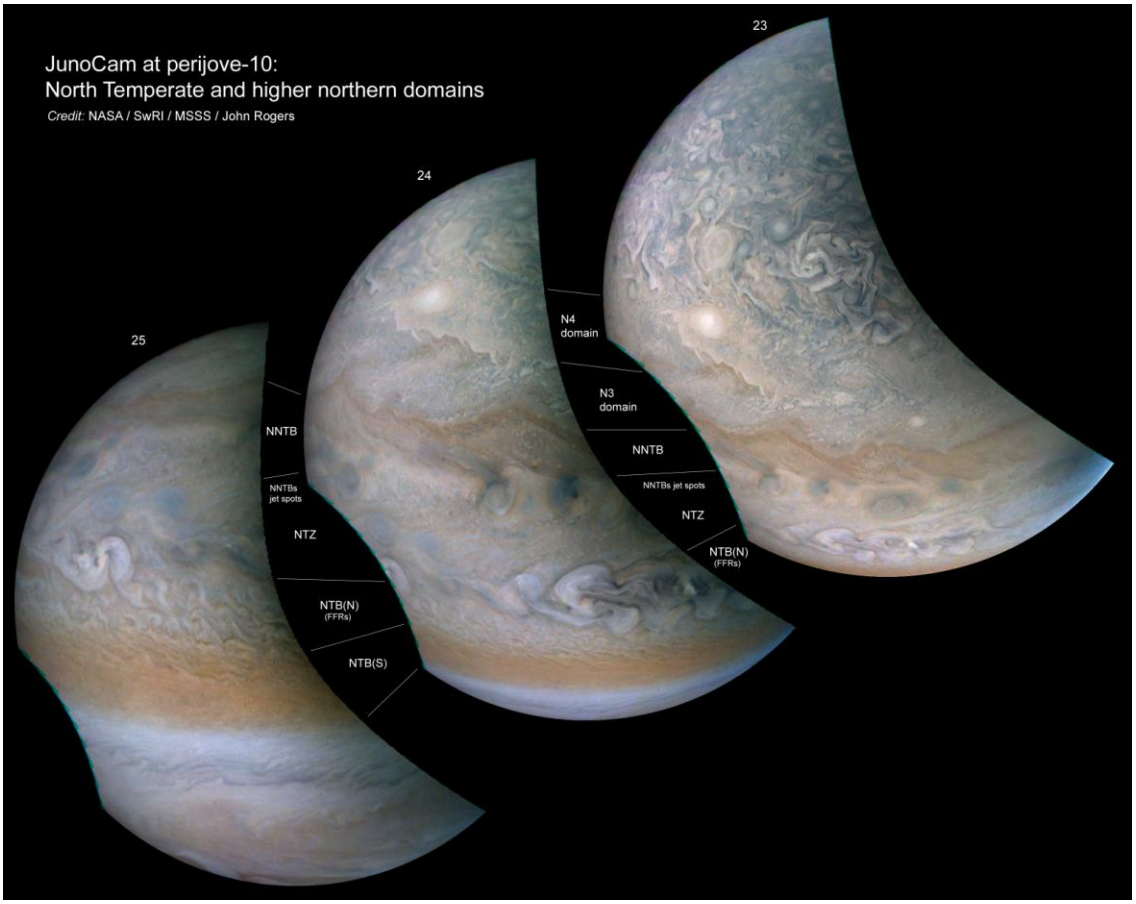

Figure 5 (above)

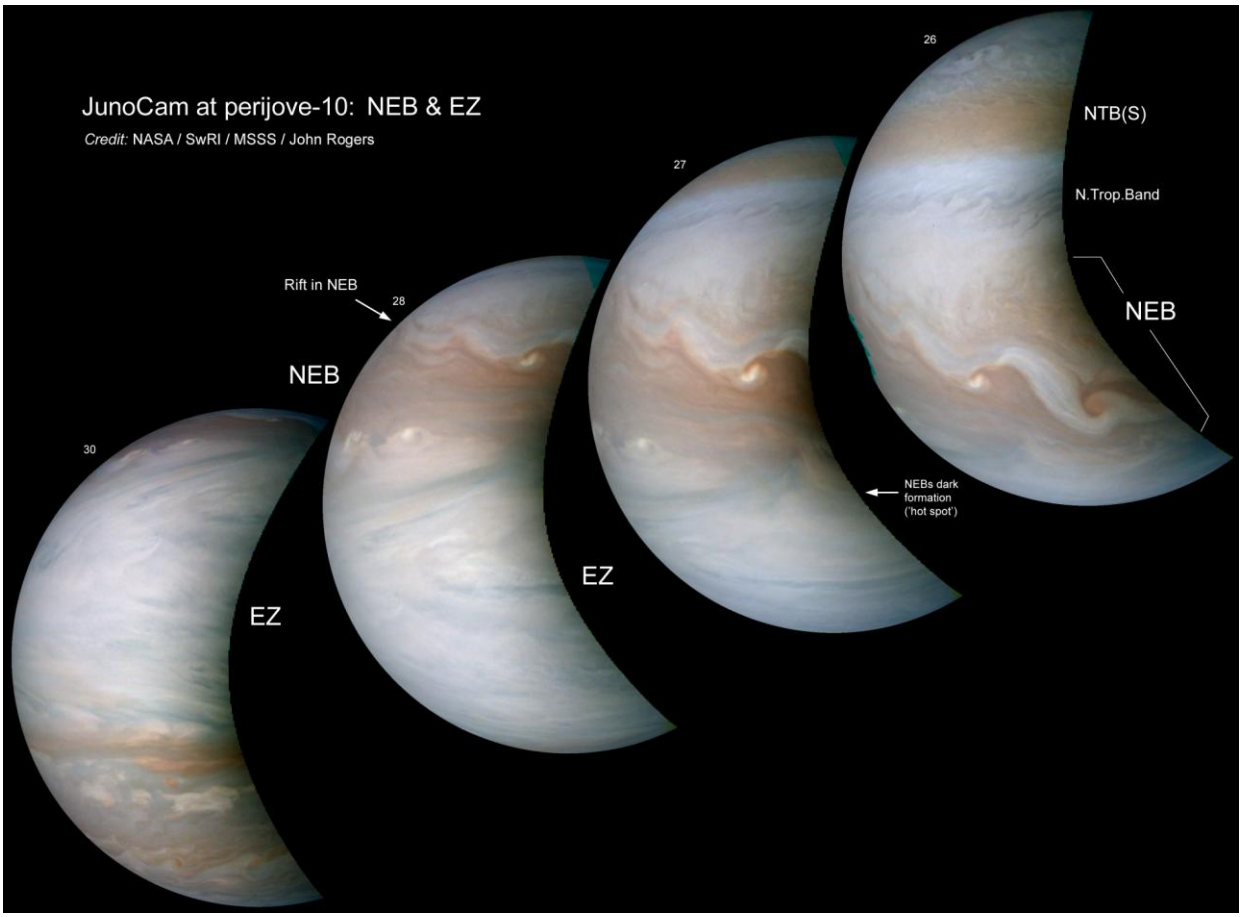

Figure 6 (below)

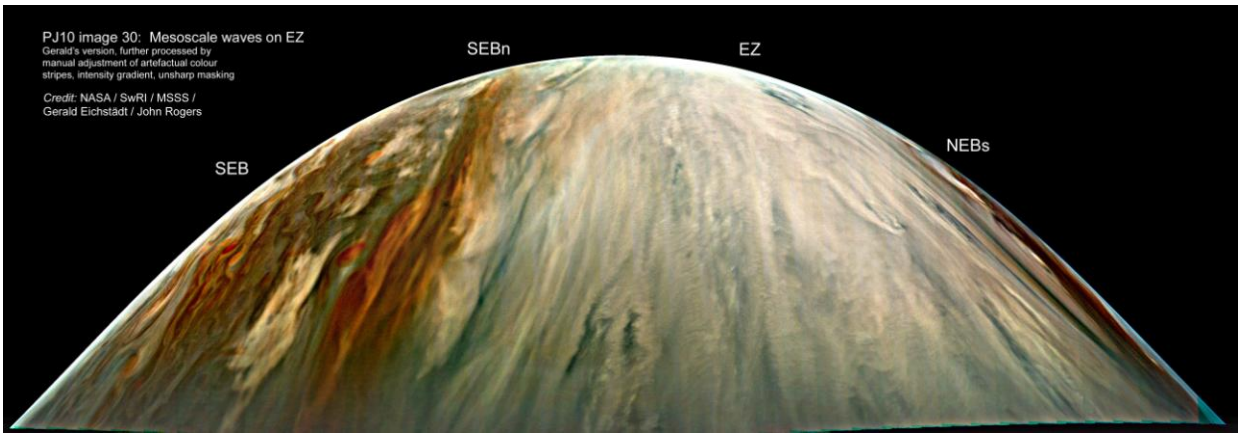

Figure 7

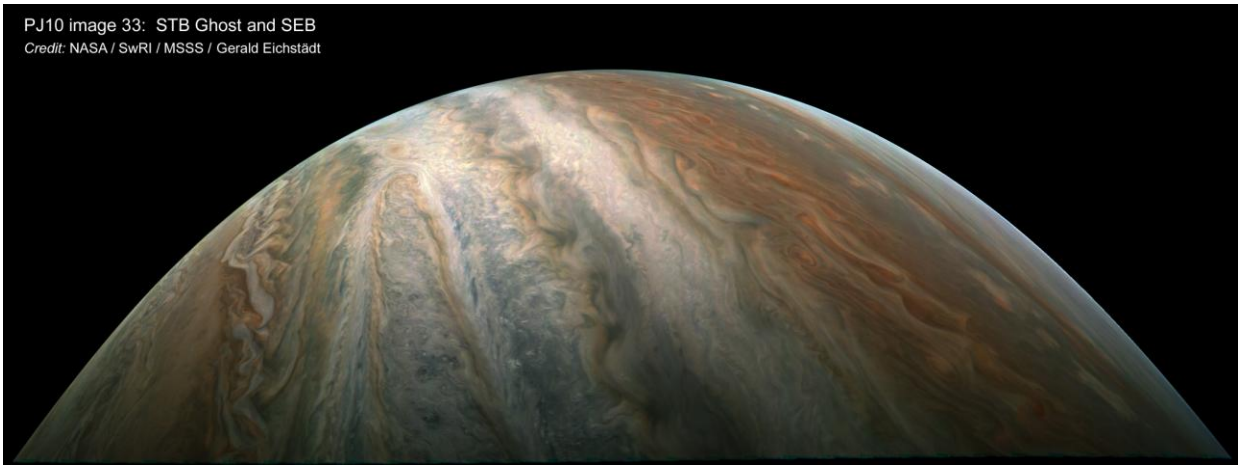

Figure 8

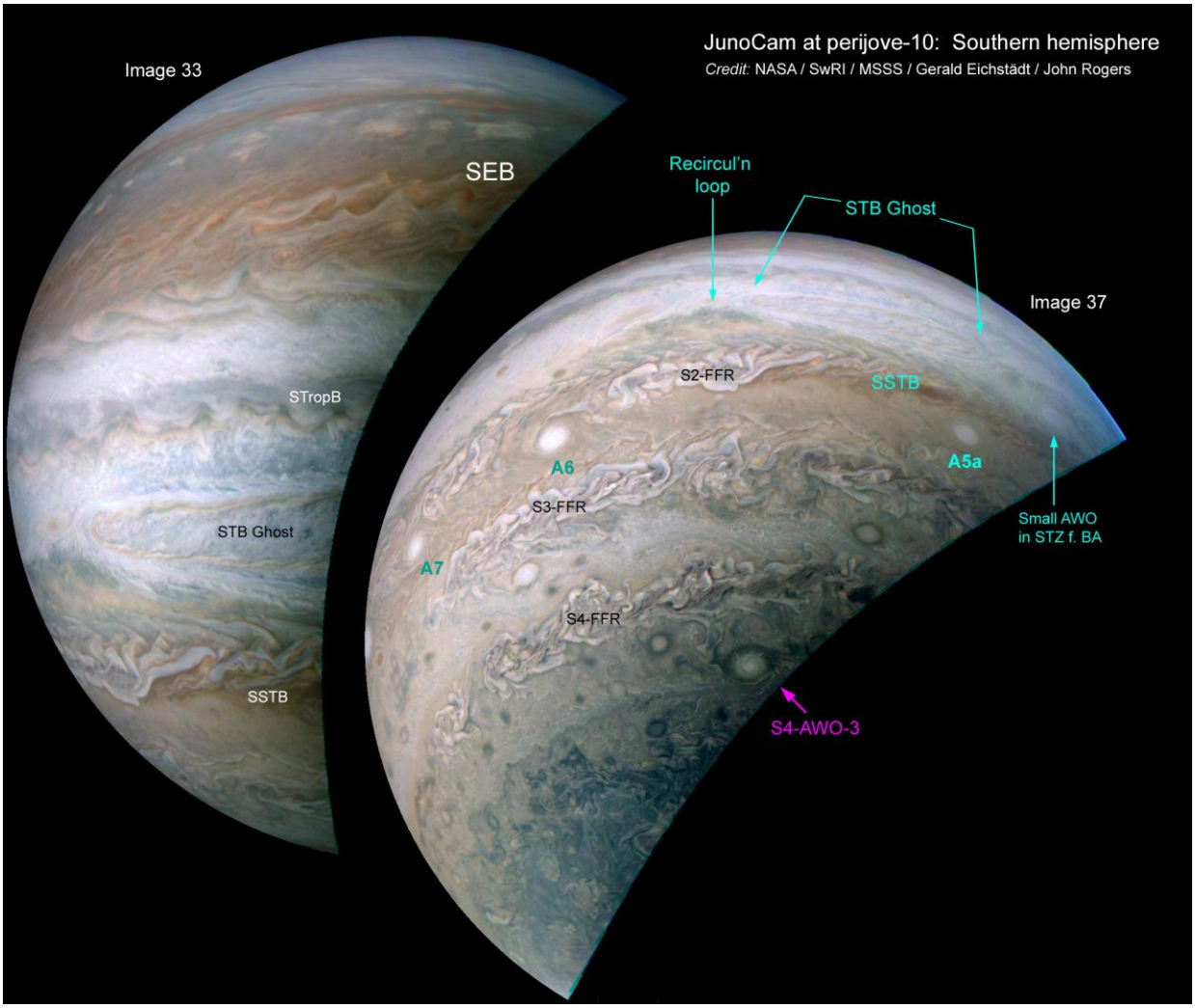

Figure 9 (above)

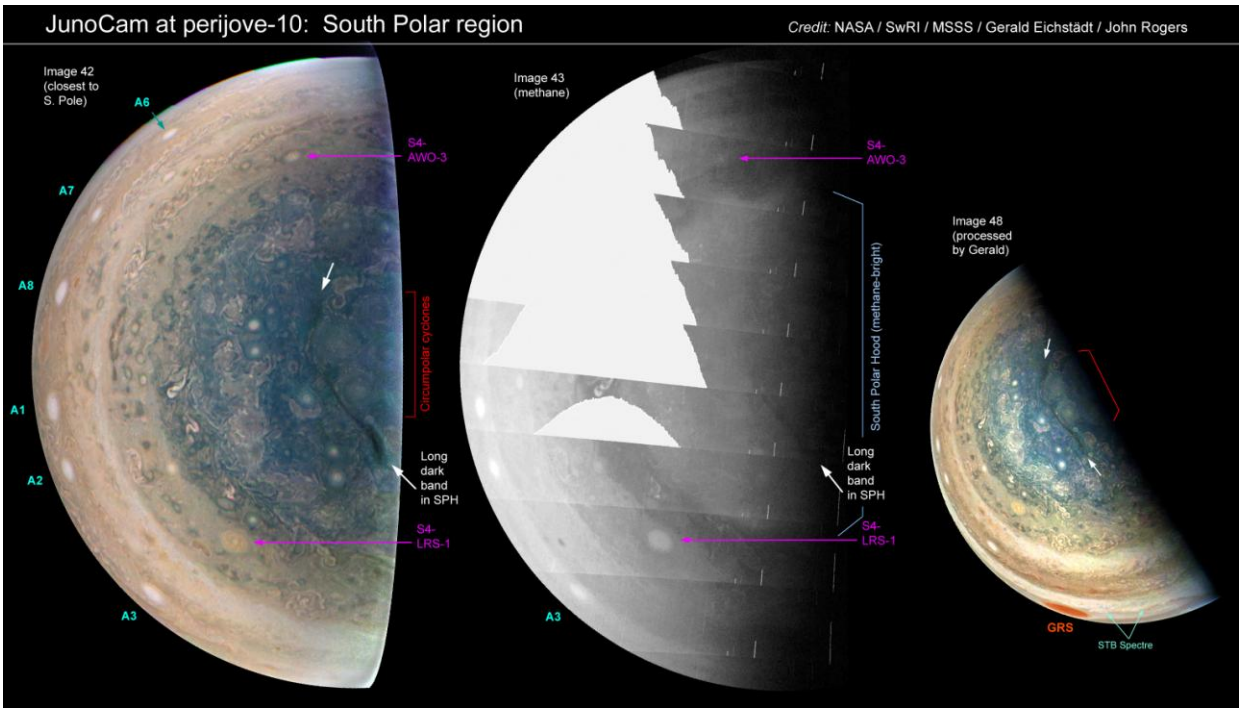

Figure 10 (below)