JunoCam at PJ22 (2019 Sep.12): What the pictures show

John Rogers (2019 Oct.12)

At PJ22, Juno crossed the equator at L1=169, L2=338, L3=333. The longitude was only 35 deg. higher than for PJ21, so approximately the same sectors of the polar regions were imaged, and the SEB west of the GRS was captured at both perijoves. But at low latitudes, the camera was looking towards the horizon, as this was a Gravity orbit.
This was the last of four orbits with unusually high perijove altitudes: 7974 km for PJ22, reverting to the more typical 3500 km for PJ23. (Minimum altitude, a few minutes after perijove, is ~120 km lower, due to the oblateness of the planet.) Meanwhile, on Oct.1, Juno completed a 10.5-hour burn with its reaction thrusters to avoid passing through Jupiter's shadow before PJ23; from now on its orbit will be on the other side of jovan midnight.
Background information and conventions in this report are as in previous such reports.

North Polar Region

Circumpolar cyclones (CPCs):
Figure 1 is the PJ22 polar projection map showing the ditetragon (octagon with fourfold symmetry) of CPCs. It largely overlaps the PJ21 map [see our PJ21 report]; both show the anomalous corner of the ditetragon where CPC-7 has moved exceptionally far from the pole. The pattern is almost the same as at PJ21, but slightly more extreme: CPC-7 is now at 81.1°N, and CPC-6-7-8 subtend an acute angle of 69 (±2) deg, instead of the expected angle of ~120 deg. We still wonder whether CPC-7 will be expelled from the ditetragon. There is still a smaller extra cyclone just south of CPC-6.
CPC-7 is a large cyclone of the 'filled' type, and it appears that the small dark spots within it (possibly holes in the cloud deck) may be cyclonic eddies around the periphery of the central anticyclonic counter-spiral, which is clearly visible.

Polar hood and haze patterns:
Figure 2 shows the composite north polar projection maps, (A) from colour images, (B) from methane-band images. The methane-band map shows much detail, especially FFRs and broader haze structures, but the large-scale patterns revealed at PJ12 etc. are not evident, partly because of the restricted longitude coverage, and probably also because of the viewing angles. Now that JunoCam can only take images in a short period as it swoops low over the north polar region, it looks directly down on the thickest part of the North Polar Hood so the optical depth is minimised, but looks obliquely at lower-latitude haze structures near the horizon, where the optical depth is enhanced.

Northern hemisphere

As Juno descended over the high northern latitudes, it recorded the usual spectacular scenes, and images 20 & 21 showed two AWOs in the NNTZ: NN-WS-6 (also seen at PJ21), and a newer one, which is smaller but brighter. Images 22 & 23 show the newer AWO close up (with popup clouds) as well as the adjacent turbulent NNTB (with diffuse red patches over small cyclonic eddies, as first seen inVoyager images).

Figure 3 is a pole-to-pole cylindrical map made by Brian Swift, and Figure 4 is a larger-scale map from the NNTB to the equator made by Kevin Gill. (These 'citizen scientists' now make beautiful cylindrical maps from JunoCam images, in addition to Gerald Eichstädt.)

A highlight of PJ22 was that Juno flew over (and through) the shadow of Io cast on the NEB. The shadow is shown in the maps (Figures 3 & 4), and in various renditions of image 28 and others in Figure 5.
Images in Figure 5 are taken from the JunoCam web site and shown here as reduced screenshots. These illustrate a variety of ways in which JunoCam images can be processed (all with north approx. up). Figure 5A is the standard 'version 01' of image 28 reprojected from a point above Juno's track as posted by the camera team, with contrast enhanced by JHR. Figure 5B is part of image 26, shown in true colour, and Figure 5C is part of image 28, in slightly enhanced colour, both by Björn Jónsson. Figure 5D is image 28 with enhanced contrast and colour, by Gerald Eichstädt. Figure 5E, by Kevin Gill, is a composite of images 22-28, reprojected from the point of view of image 28, so it shows the 'fish-eye' view of the planet visible from Juno at that moment in time, from the NTZ to the NEB. Figure 5F is part of the raw image, made up of alternating strips in red, green and blue.

Equatorial Zone

The ochre shading that has covered most of the EZ for the past year may be fading slightly, according to ground-based amateur images, although this is only a subjective impression. The PJ22 images of the EZ are extremely oblique, but suggest the presence of extensive areas of patterned clouds and some waves.

Southern hemisphere

The images cover (obliquely) the rifted sector of SEB following the GRS; Figure 6 is a map made by Björn Jónsson (one was also made by Kevin Gill). The STB is all whitened along this sector, with the f. end of the STB Spectre visible. Further south, the maps show S2-AWOs A3, A2 and part of A1 (A1 being the largest).

South Polar Region

Figure 7 presents four composite polar projection maps, which can be compared to those in our PJ21 report. The colour map at PJ22 (Fig.7A) is not our best, due to the spacecraft's higher altitude over the south pole with each successive perijove, and also due to the less favourable lighting now that the solstice is past.

In our PJ21 report, we noted two large AWOs retrograding at 73°S. Since PJ21, one has remained at ~73°S and retrograded by 38 deg in L3, which is typical, but the other has moved up to 76°S and slightly prograded. This may be the first time we have seen such a large AWO move so far south.

Haze bands:
Maps of near-terminator hazes show widespread bands, though mostly inconspicuous. Here I just show them diagramatically (Fig.7C). The most prominent features are bright hazes near the dusk terminator. There is an extensive area of these in the upper left quadrant – but little was visible there ~5 hours later at dawn. A ⊃–shaped bright band at dusk, in the lower half of the map, is reminiscent of similar bands at previous perijoves, but at lower longitude.

Circumpolar cyclones (CPCs):
In addition to the less than favourable factors mentioned above, the pentagon of CPCs was again centred towards the unlit hemisphere when Juno flew over at PJ22. Nevertheless, the map (Fig.7A & 7B) shows 5 of the 6 cyclones, although CPC-2 and the gap are not clearly visible.

The central cyclone (SPC) is still centred far from the pole, at 88.1°S, in the same position as at PJ16 and PJ21.

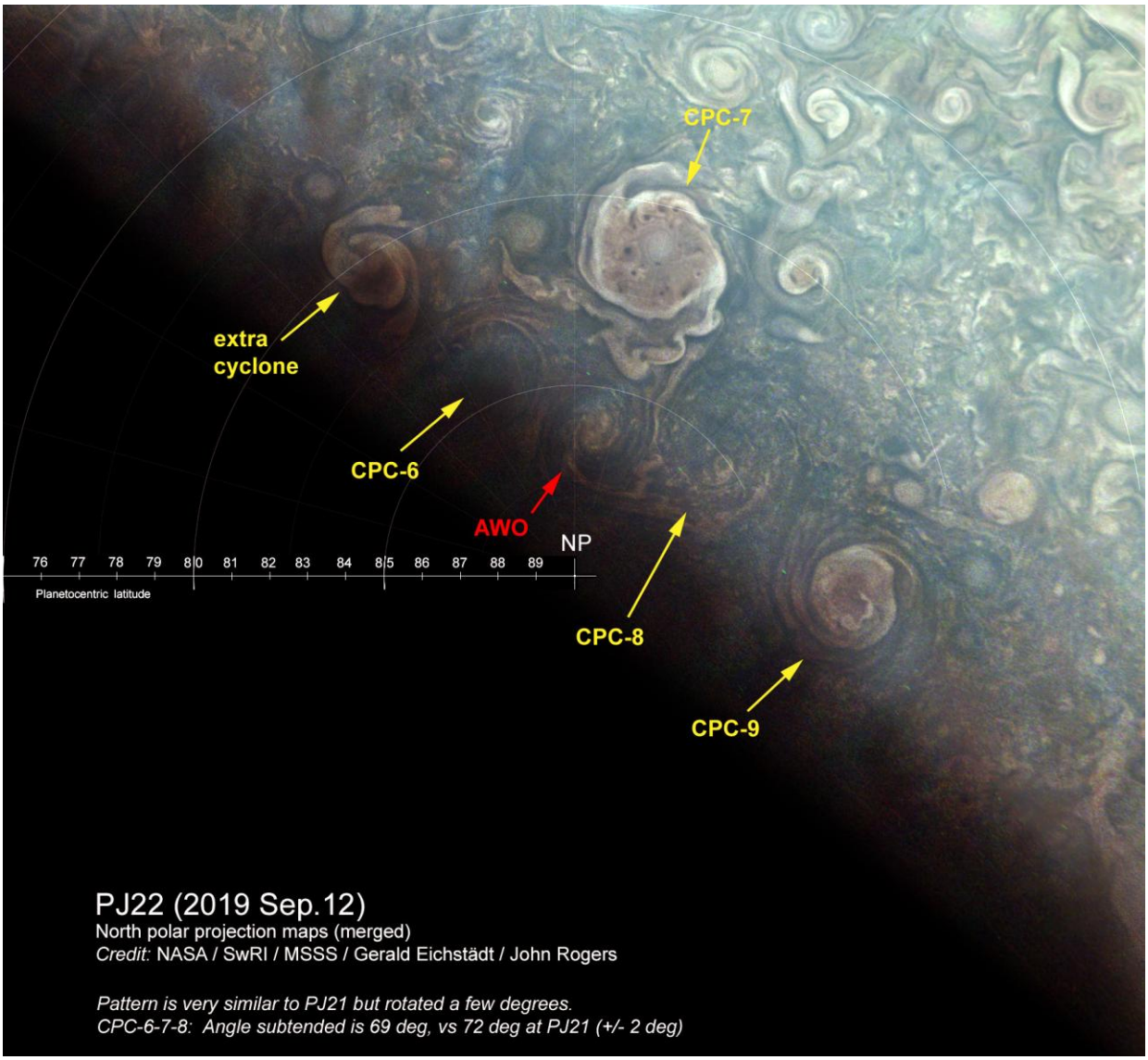

Figure 1

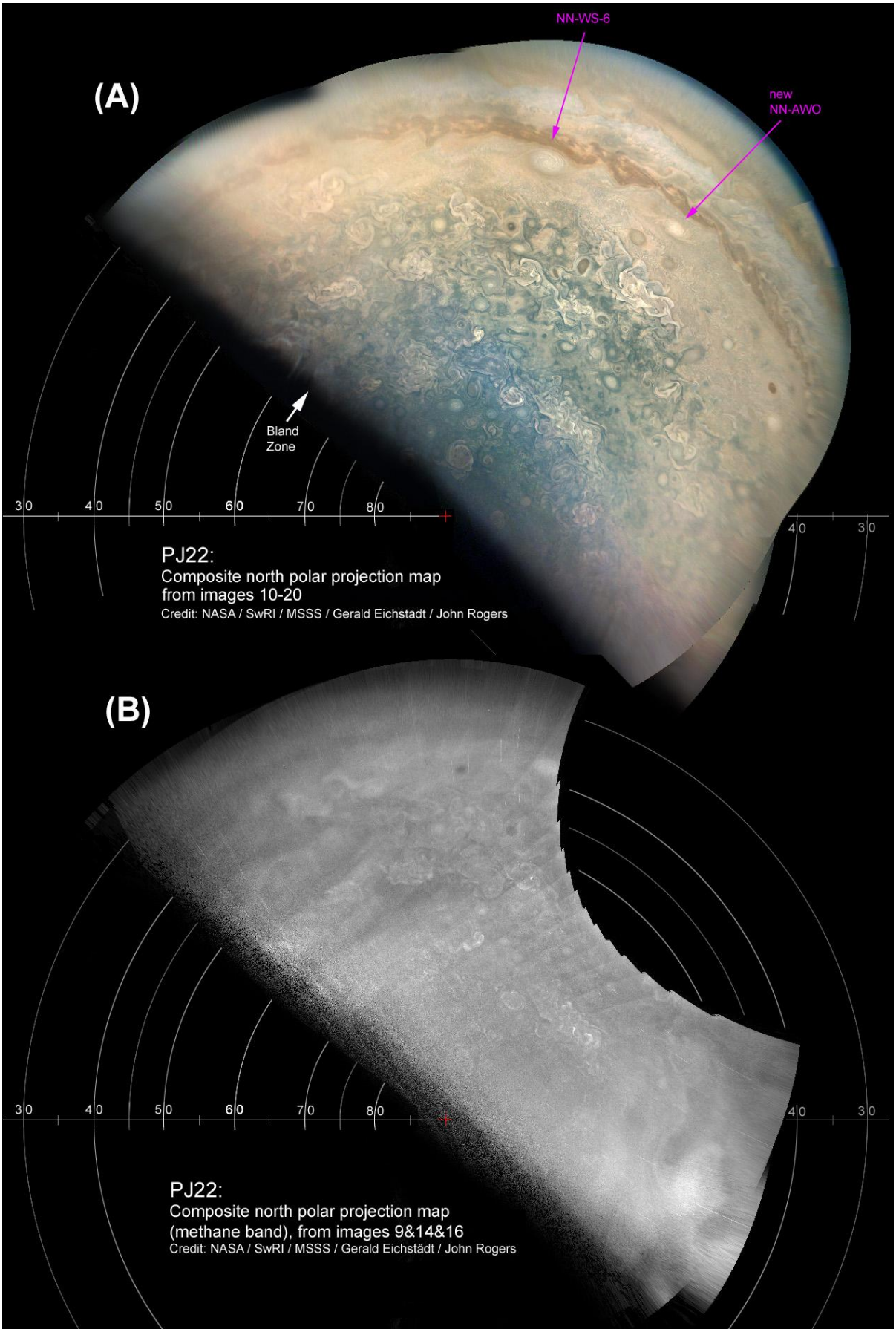
(A)
NN-WS-6
new
NN-AWO
Bland
Zone
30
40
50
60
70
80
40
30
PJ22:
Composite north polar projection map
from images 10-20
Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers
(B)
30
40
50
60
70
80
40
30
PJ22:
Composite north polar projection map
(methane band), from images 9&14&16
Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers

Figure 2

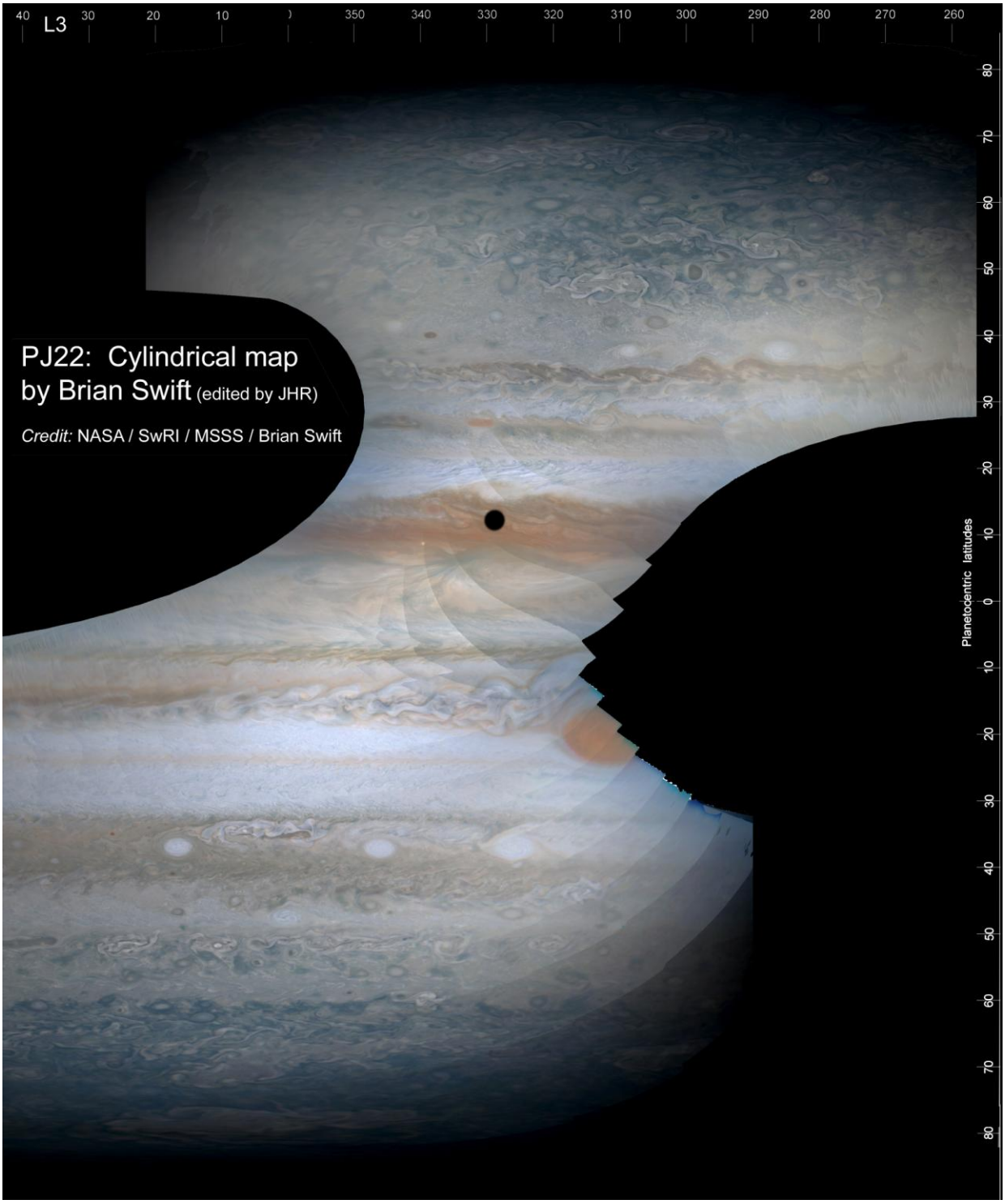
L3
40
30
20
10
350
340
330
320
310
300
290
280
270
260
PJ22: Cylindrical map
by Brian Swift (edited by JHR)
Credit: NASA / SwRI / MSSS / Brian Swift
Planetocentric latitudes
80
70
60
50
40
30
20
10
0
10
20
30
40
50
60
70
80

Figure 3

PJ22 Cylindrical map from NNTB to equator (half scale)
Credit: NASA / SwRI / MSSS / Kevin Gill

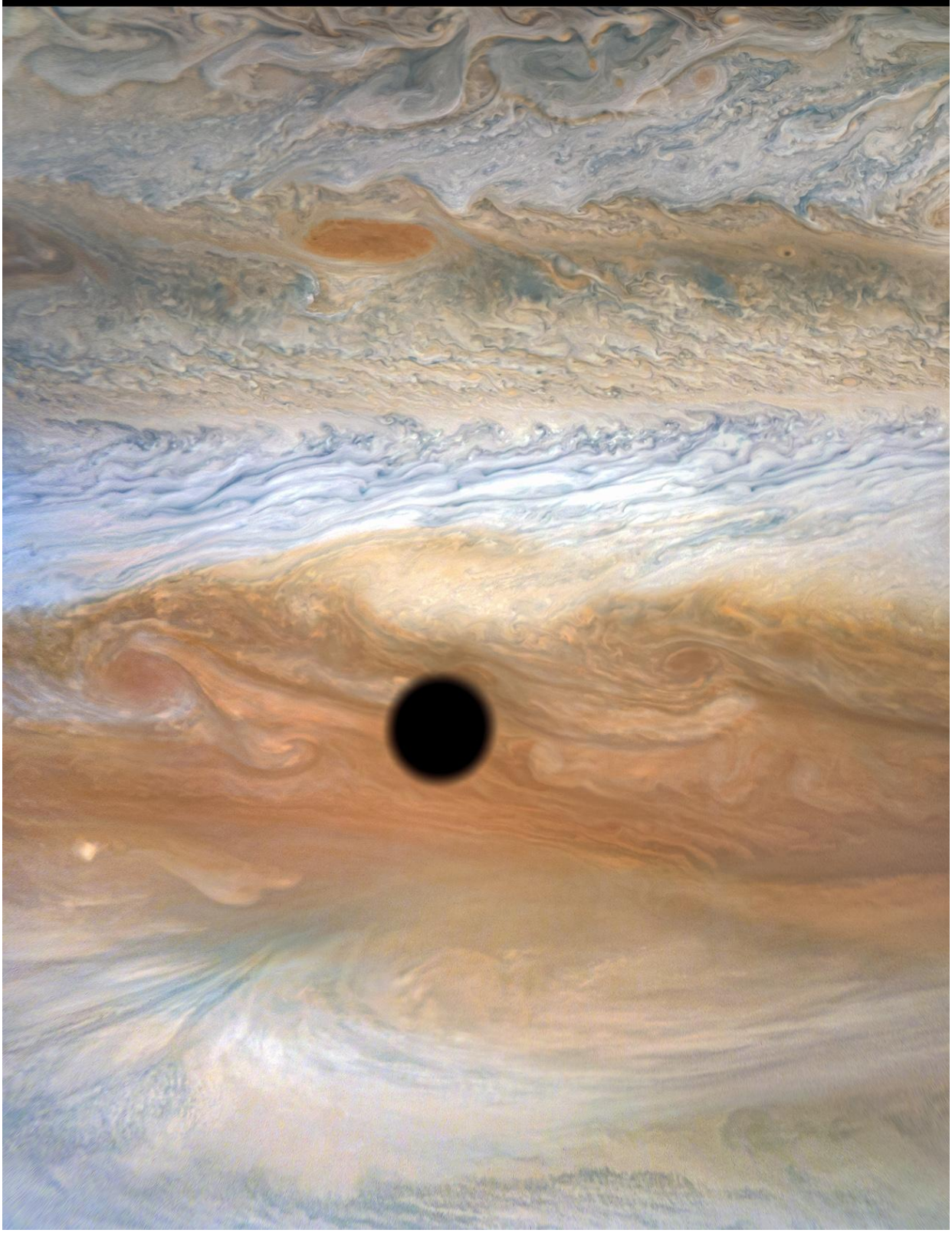

Figure 4

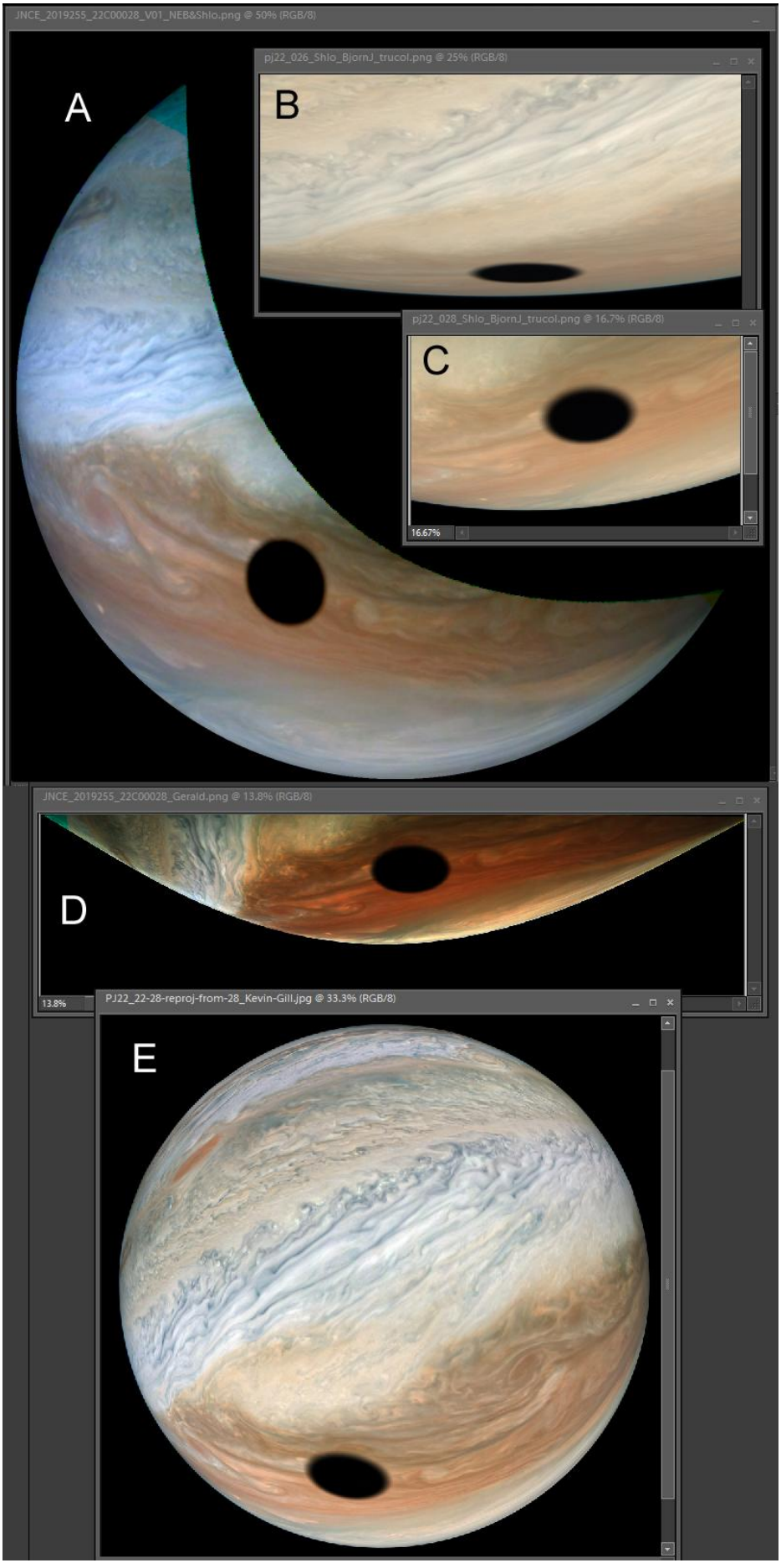
JNCE_2019255_22C00028_V01_NEB&Shlo.png @ 50% (RGB/8)
A
pj22_026_Shlo_BjornJ_trucol.png @ 25% (RGB/8)
B
pj22_028_Shlo_BjornJ_trucol.png @ 16.7% (RGB/8)
C
16.67%
JNCE_2019255_22C00028_Gerald.png @ 13.8% (RGB/8)
D
13.8%
PJ22_22-28-reproj-from-28_Kevin-Gill.jpg @ 33.3% (RGB/8)
E

Figure 5

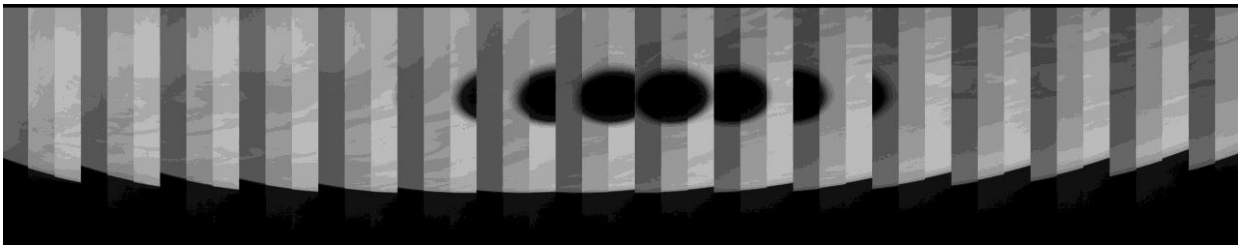

Figure 5F: Part of the raw image 28
[added to this report, 2019 Oct.27; subtle brightness variations are lost in this miniature PDF]

Figure 6

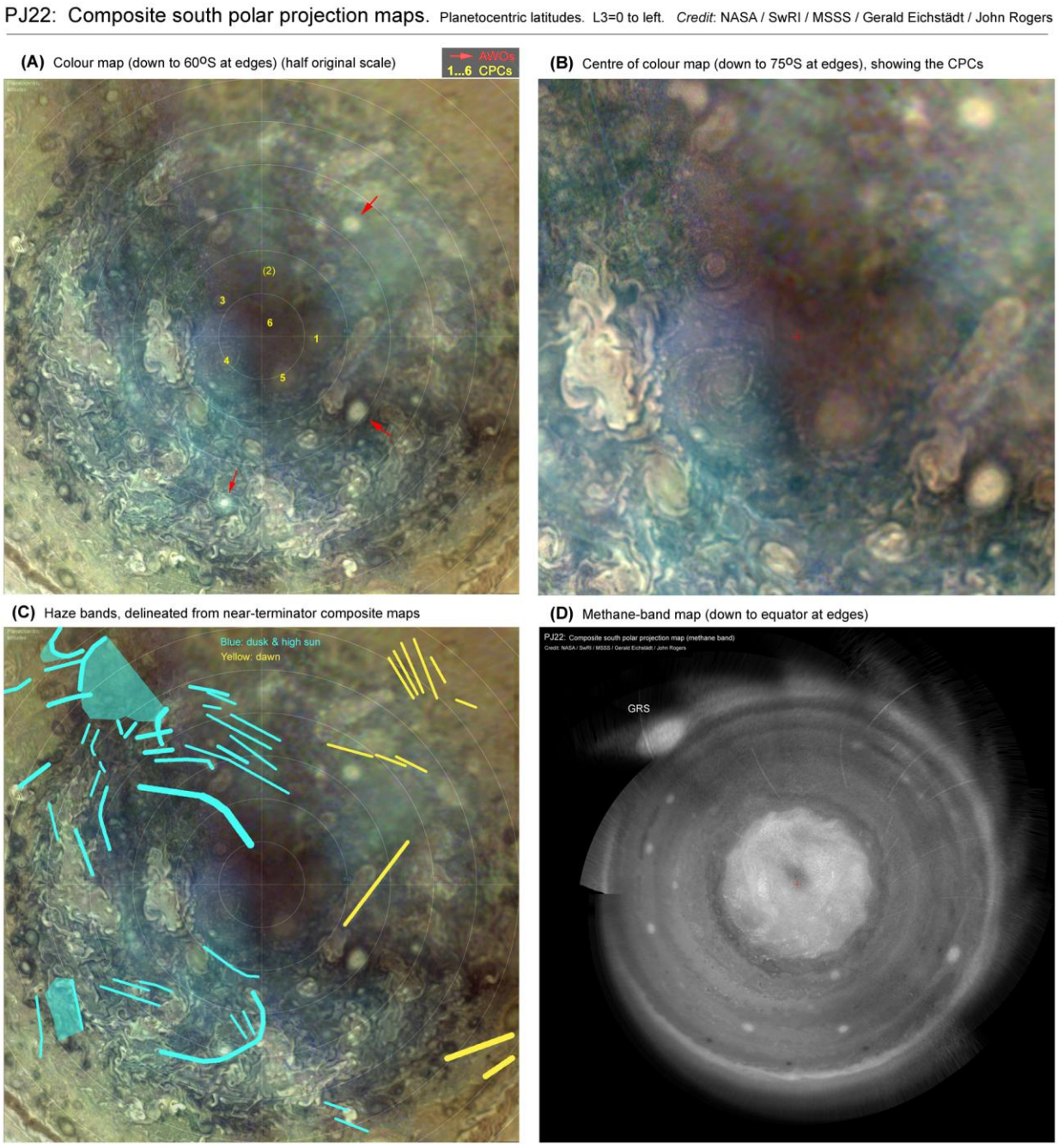
PJ22: Composite south polar projection maps. Planetocentric latitudes. L3=0 to left. Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers
(A) Colour map (down to 60ºS at edges) (half original scale)
AWOs
1...6 CPCs
(2)
3
6
1
4
5
(B) Centre of colour map (down to 75ºS at edges), showing the CPCs
(C) Haze bands, delineated from near-terminator composite maps
Blue: dusk & high sun
Yellow: dawn
(D) Methane-band map (down to equator at edges)
PJ22: Composite south polar projection map (methane band)
Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers
GRS

Figure 7