Juno at PJ19 (2019 April 6): What the pictures show

John Rogers (2019 May 20)

Perijove-19 (PJ19) was on 2019 April 6. Juno crossed the equator at 12:21 SCET (13:01 UT as seen from Earth), at L1=216, L2=155, L3=108. Ground-based imaging was important to show what Juno was flying over, and a set of amateur images and maps has been posted in our 2019 Report no.4 at: https://britastro.org/node/18161.

During this perijove, the spacecraft was turned so that the MWR could widely scan the atmosphere below. But with this orientation, JunoCam had to be switched off, to avoid looking into the Sun as the spacecraft spins. JunoCam was turned back on as the spacecraft climbed up to high southern latitudes. Therefore, the imaging covered only southerly regions.

The coverage was sufficient to map most of the southern hemisphere down to the SEB south edge; **Figure 1** shows cylindrical maps in both RGB and methane band. The patterns around the GRS are interesting and are explained in our Report no.4 (URL above).

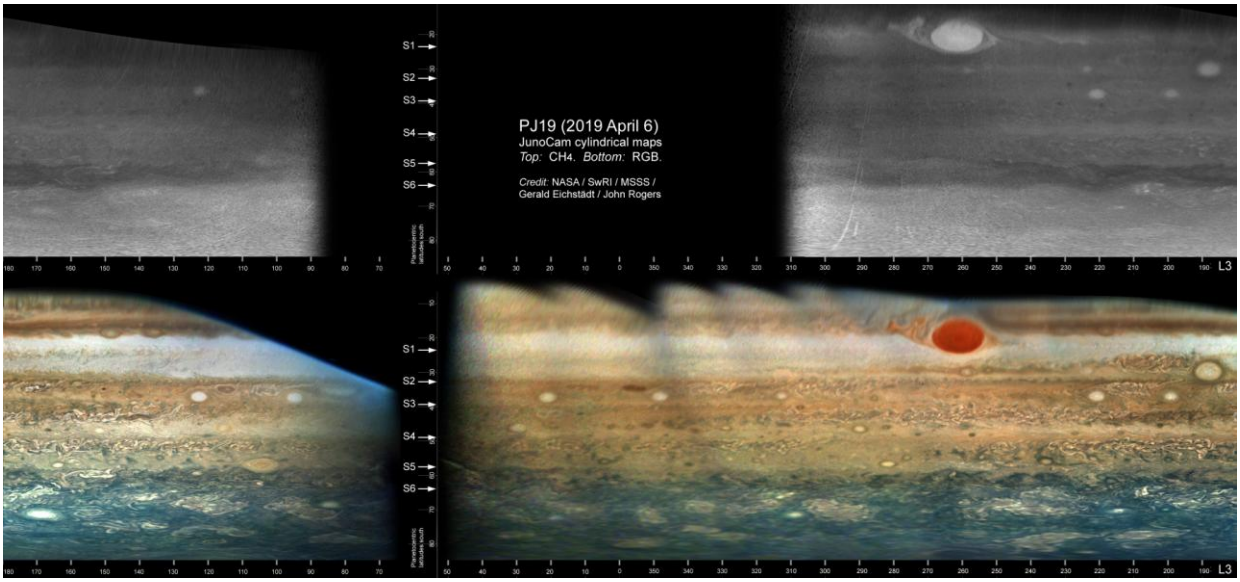

Figure 1

The first image (**Figure 2**) shows some of the most important features of the S. Temperate and higher domains: Oval BA (still almost colourless); S4-LRS-1; and the disturbed region of the S. Temperate domain preceding oval BA. In amateur images we have noticed a small pair of grey streaks there, and this image reveals them to consist of three cyclonic vortices (Figures 2 & 3). I have been expecting a new STB structured segment to form here, so perhaps these vortices will merge in the coming months to create it?

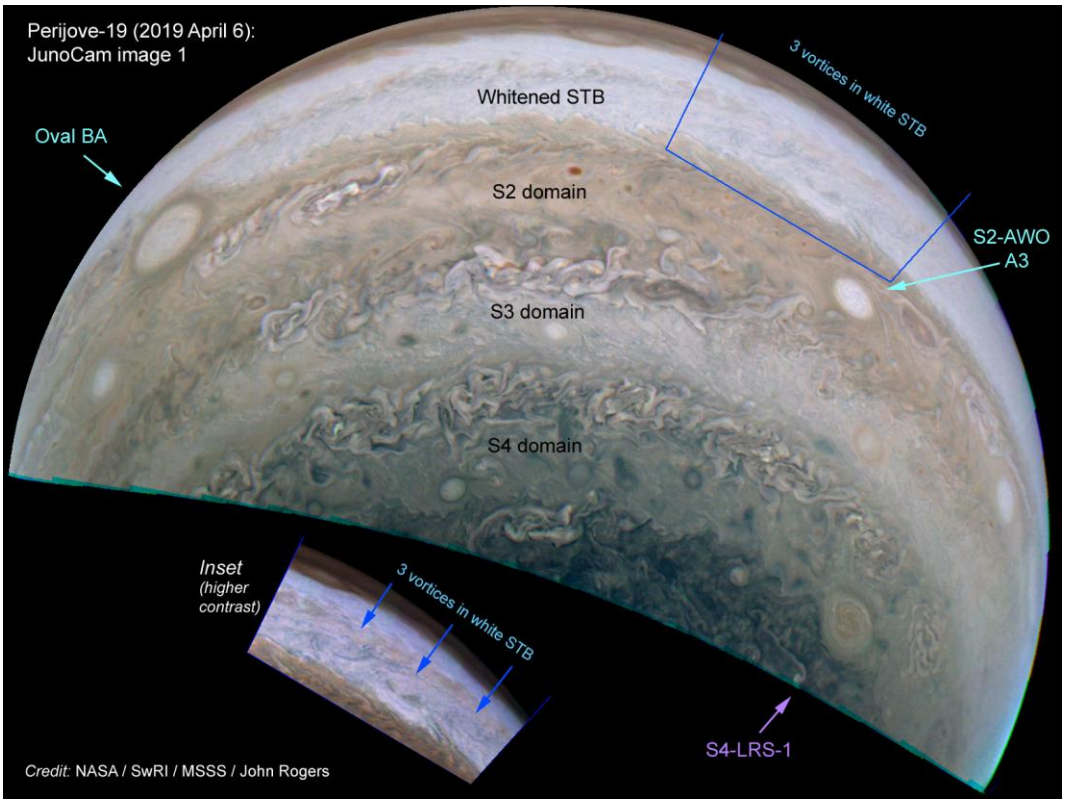

Figure 2

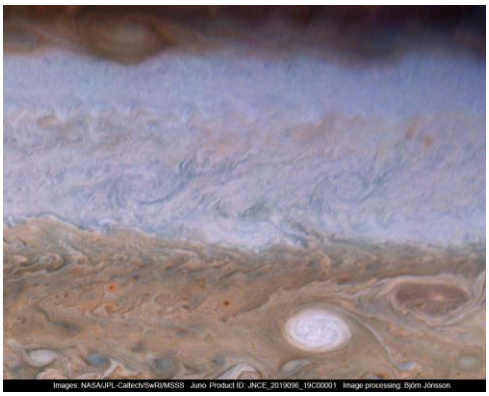

Figure 3

South Polar Region

In the absence of low-latitude imaging, the JunoCam team used the allocated data volume for exceptionally frequent imaging of the south polar region, including a wide range of RGB exposures to give good-quality images covering the terminator, and multiple methane images to be merged into good-quality maps with reduced noise. Gerald Eichstädt produced his usual sets of polar projection maps, which were merged to make the composites shown here. At recent perijoves he has been able to reduce the residual distortions still further, so animations of the maps now show wind motions more sensitively. Two animations of his south polar maps are attached:

(1) RGB maps down to 60°S, from 4 images (8,21,35,47). This shows the usual features very well: The S6 jet, winding along the large visible wave pattern (which borders the dark blue, methane-bright South Polar Hood, and winds around the FFRs), and circulation in FFRs (folded filamentary regions) and an AWO (anticyclonic white oval) and CPCs (circumpolar cyclones). Between the S6 jet and the CPCs there are only incomplete zonal flows: at ~70°S, retrograde flow only in the FFRs; at ~74-76°S, a prograde stream adjacent to some circulations, but I suspect this is only local.

(2) RGB maps with high-pass filtering to maximise contrast, from 14 images (8 to 35) composited into 10 running-mean images spanning 35 min (by Gerald). This reduced artifacts and image noise, but protected most of the detail. This smoothed animation shows the circulation of all the CPCs and FFRs, and stasis in the gap. Some haze bands (near bottom of the frame) appear to show obvious movement in latitude during the animation, passing over FFRs! – due to the changing illumination?
URL: https://www.missionjuno.swri.edu/Vault/VaultOutput?VaultID=21141&t=1557760266

Figure 4(A-F) shows a set of composite south polar maps, extending down to 60°S:
(A,B) RGB map (with planetocentric grid in B); (C,D) Map of regions near terminator, to show haze bands (outlined in D); (E) Methane-band map; (F) Composite L(CH_4)RGB map by Gerald, extending down to the STropZ. They give excellent views of the now-familiar features. Some were noted above for animation (1). Also:

A large bright AWO (anticyclonic white oval) at 72°S, L3=169, weakly methane-bright. This is the one that has been tracked by the JUPOS team in amateur images in 2019 Feb.-March (see our Report no.4).

Haze bands:

As at PJ18, the haze bands are mostly tenuous and not prominent, but the high-quality coverage shows that they are widespread (Figure 4C,D). Especially:
--Widespread narrow bands running obliquely SE-NW at 55-64°S, i.e. aligned with the zonal wind profile up to the S6 jet at 64°S, as previously observed.
--A few streaks in opposite orientation at ~65-70°S, , i.e. aligned with the ZWP across the FFRs.
--In two places, these streaks curve S and E in large ⊃-shaped bundles. The one in the upper part of the map, when on the terminator, is bright and rainbow-coloured (Figure 5) and methane-bright (images 12-16, not shown here). The one in the lower part is in similar position to part of the former Long Band (PJ5-PJ12), but much less conspicuous, similar to PJ18. Alignment with the methane map suggests that areas inside the ⊃ are darker in methane than areas outside (SW of) the ⊃.
--Two bright streaks connected to the above, in similar position to part of the former Long Band, appear to show obvious movement in latitude in animation (2), up to 300 km/35 min! This highlights the difficulty we have had at earlier perijoves in matching haze bands between different maps, and as we suspected, such rapid movement must be due to the changing illumination.

Circumpolar cyclones (CPCs):
[Note: We now number the CPCs as in Adriani et al.(2018, Nature).]

The arrangement of the pentagon is the same as usual, including the permanent gap between CPC-1 and CPC-2, but over the last 3 perijoves there has been vigorous weather in this gap, and the appearance of CPC-2 has changed considerably (Figures 5 & 6). At each of PJ17, PJ18 and PJ19: at least one FFR has been intruding in the gap and interacting with CPC-2, and there has also been at least one small AWO in or near the gap, with a small dark sharply-outlined cell adjacent. I think this compact cell is a small cyclone, as was shown by animations at PJ17 and probably PJ19. But due to the different positions and arrangements of these features, it is not possible to tell whether they are the same features from one perijove to the next. The animations show no net movement of features in the gap.

The central CPC is now centred 2.3° from the pole, i.e. almost at its lowest latitude, and in a similar position to PJ18 (Figure 7).

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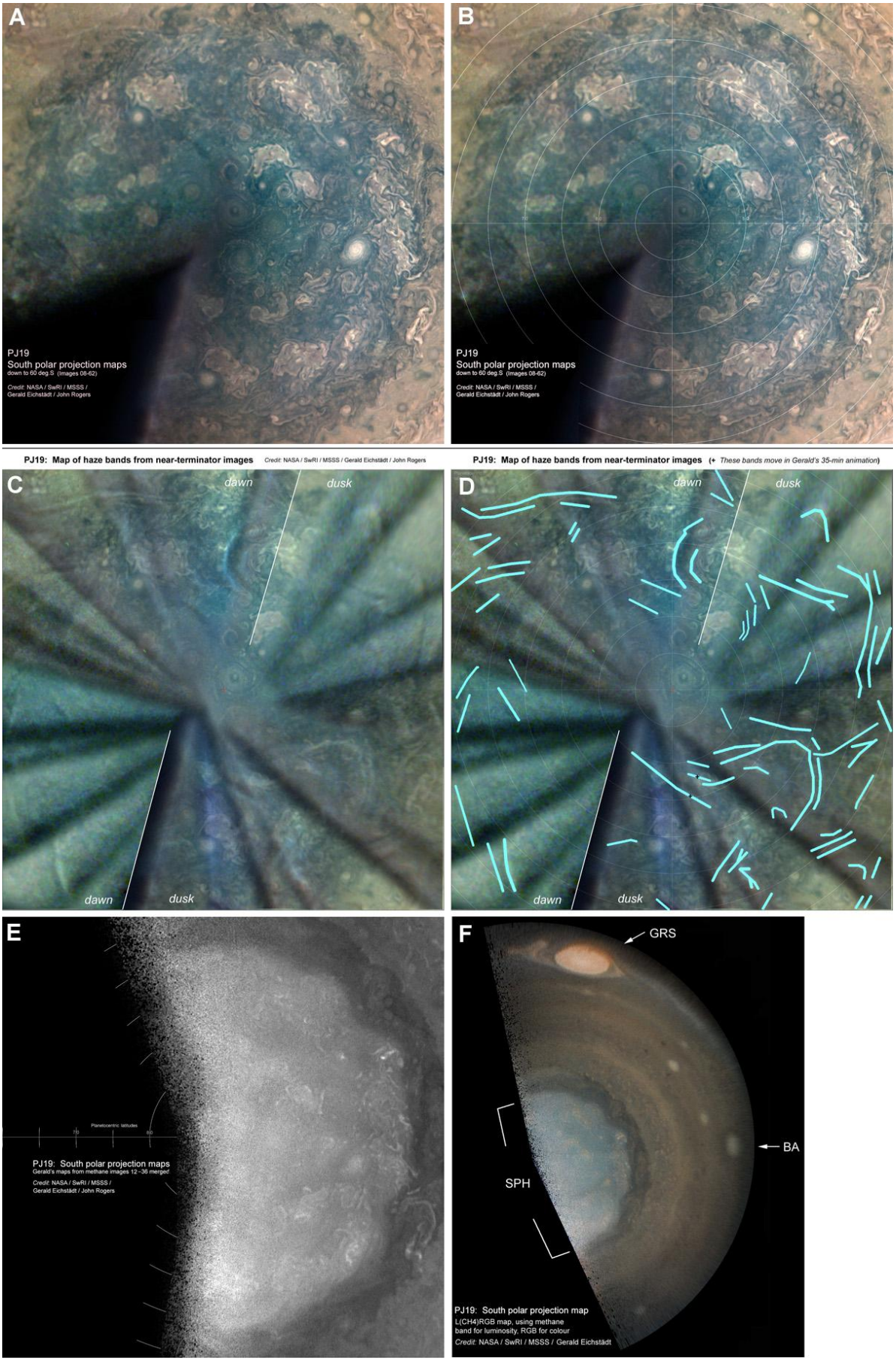
A
PJ19
South polar projection maps
down to 60 deg S (images 08-62)
Credit: NASA / SwRI / MSSS /
Gerald Eichstädt / John Rogers
B
PJ19
South polar projection maps
down to 60 deg S (images 08-62)
Credit: NASA / SwRI / MSSS /
Gerald Eichstädt / John Rogers
PJ19: Map of haze bands from near-terminator images
Credit: NASA / SwRI / MSSS / Gerald Eichstädt / John Rogers
PJ19: Map of haze bands from near-terminator images (+ These bands move in Gerald's 35-min animation)
C
dawn
dusk
dawn
dusk
D
dawn
dusk
dawn
dusk
E
Planetocentric latitudes
70
80
PJ19: South polar projection maps
Gerald's maps from methane images 12 - 36 merged
Credit: NASA / SwRI / MSSS /
Gerald Eichstädt / John Rogers
F
GRS
BA
SPH
PJ19: South polar projection map
L(CH4)RGB map, using methane
band for luminosity, RGB for colour
Credit: NASA / SwRI / MSSS / Gerald Eichstädt

Figure 4

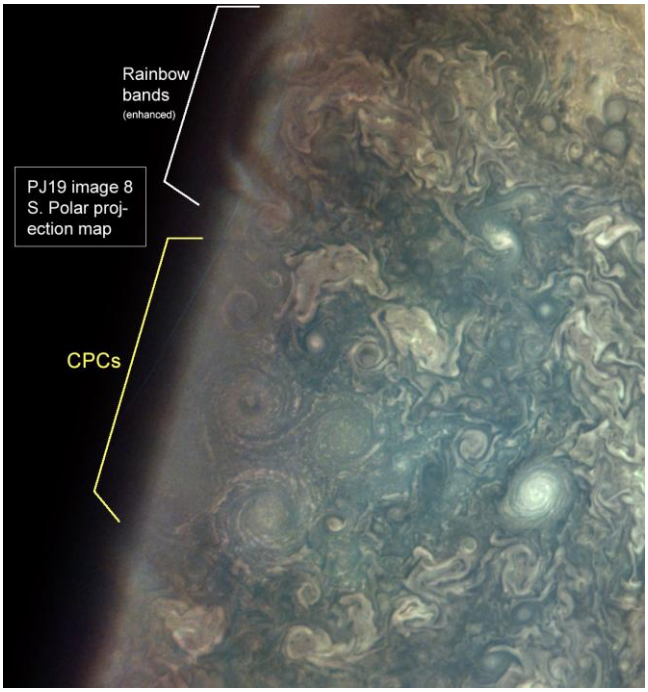

Figure 5

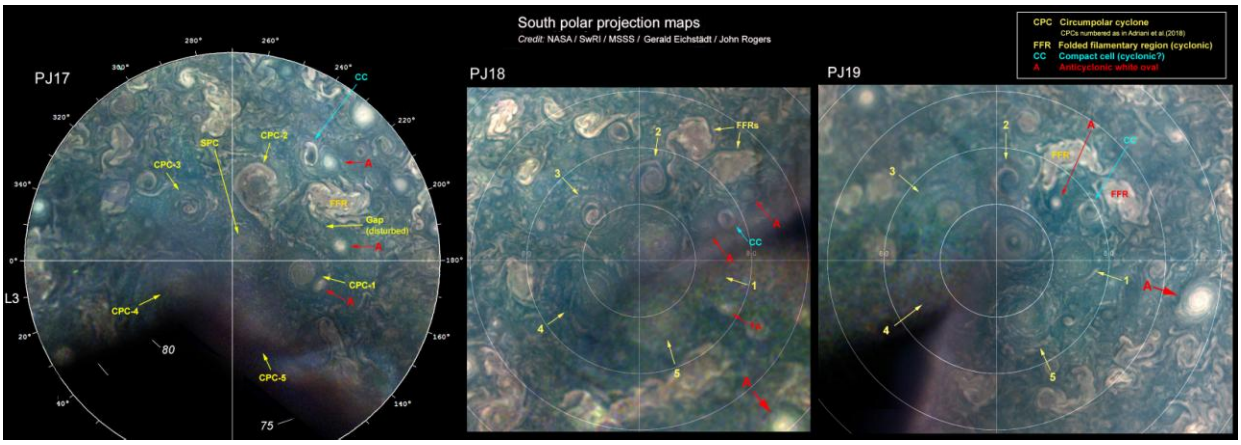

Figure 6

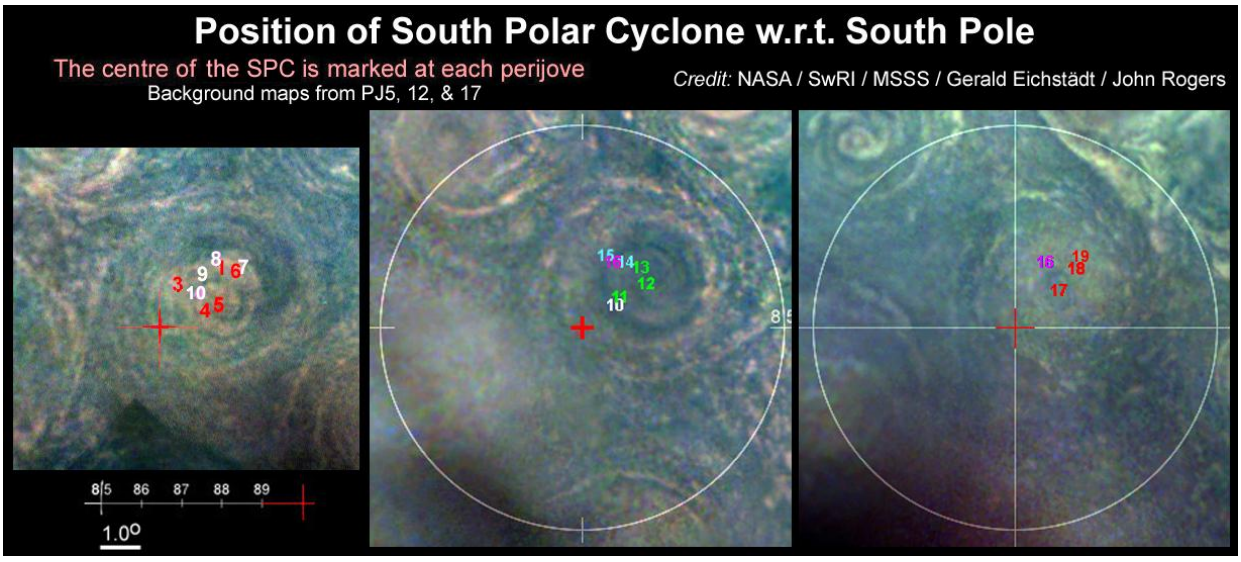

Figure 7