JunoCam at PJ20 (2019 May 29): Part II: Polar regions

John Rogers (BAA) (2019 June 19)

North Polar Region

Circumpolar cyclones (CPCs):
The arrangement of the north polar CPCs is remarkable (Figure N1 – compared with PJ15 when a similar view was presented). Four CPCs are visible, all still retaining most aspects of their usual morphologies, but the ditetragon is still deformed in the same way as at other recent perijoves, if not more so; one side of it is now distinctly concave. Specifically:

CPC-7, the filled cyclone that has been unusually far S, is still so (81.3°N) (PJ18, 81.5°N; PJ15, 81.0°N).

CPC-8, still the least well formed of the chaotic cyclones, has moved even further N than before (85.0°N) (PJ15, 84.6°N).

CPC-1, a filled cyclone, is internally disturbed, and has also moved further N than usual (83.3°N) (original mean for filled CPCs, PJ1-PJ5, 82.7°N).

Blinking of the maps from images 17 & 21 (7.6 mins apart) shows that the inner disk (diameter 2800 km), with its internal S-shaped cloud strips, rotates as a rigid disk by 2.2° (±0.1°) between the images. This implies a wind speed of 118 (±13) m/s on the edge of the disk, one of the highest speeds we have measured. The surrounding spiral arms rotate more slowly.

CPC-2, still the most regular spiral of the 'chaotic' set of cyclones, apparently with a distinct central 'eye', remains at the original mean latitude for chaotic CPCs (83.4°N).

Also remarkable is the sighting of a small AWO due N of CPC-1. There was also one N of CPC-4&5 at PJ17, and the long-lived large one N of CPC-7 that was last in view at PJ18. Only the AWO N of CPC-7 has been seen multiple times and is large enough to displace the adjacent CPC. If these are all fixed in place (which we cannot assess), AWOs have now appeared in 3 of the 4 major corners of the ditetragon.

The PJ20 map also shows two small AWOs outside the ditetragon, in contact with filled CPC-7 and -1. Distinct AWOs are not common this far north.

Bland Zone & Haze bands (Figure N2 = polar maps):
There are excellent views of the Bland Zone (≈N6 domain), which shows exemplary blandness (Figure 5). The usual bundles of bright and dark linear haze bands are present within the Bland Zone: conspicuous at the dawn terminator, and faintly visible all along the afternoon sector. At both dawn and dusk terminators, there are also conspicuous bundles of bright and dark bands running almost N-S from there down to at least 48°N, across the N5 and N4 domains.

Methane image (Figure N2 = polar maps):
Just one methane image was taken, at the closest position to the north pole, but as that was 10.3° latitude from the pole, it extends down to lower latitudes than before on one side of the pole. This has the advantage of showing the N4 and N3 domains better than before. Features in this map include:

--The same prominent haze bands as in the RGB images near the terminator in the N6 and N5 domains.

--The methane-bright (MB) North Polar Hood (NPH), with large-scale waves on its N edge at 53-56°N.

--At 43-58°N (in the N5 and N4 domains), good definition of the relationship between the MB waves/streaks and the visible streaks and FFRs. In N5, the MB waves marking the edge of the NPH lie over FFRs, perhaps with some relation to them, but in at least one place it coincides with a narrow white haze band that cuts across a FFR. In N4, where the brighter white strips in FFRs are MB as usual, one narrow MB streak is close to a FFR bright strip but significantly displaced; possibly an example of an FFR giving rise to a mobile MB haze streak?

--At 39-50°N (in the N4 and N3 domains), there is a clear distinction between anticyclonic ovals, which are MB, and cyclonic ovals, which are methane-dark, regardless of their visible colour (red & blue arrows in Figure N2).

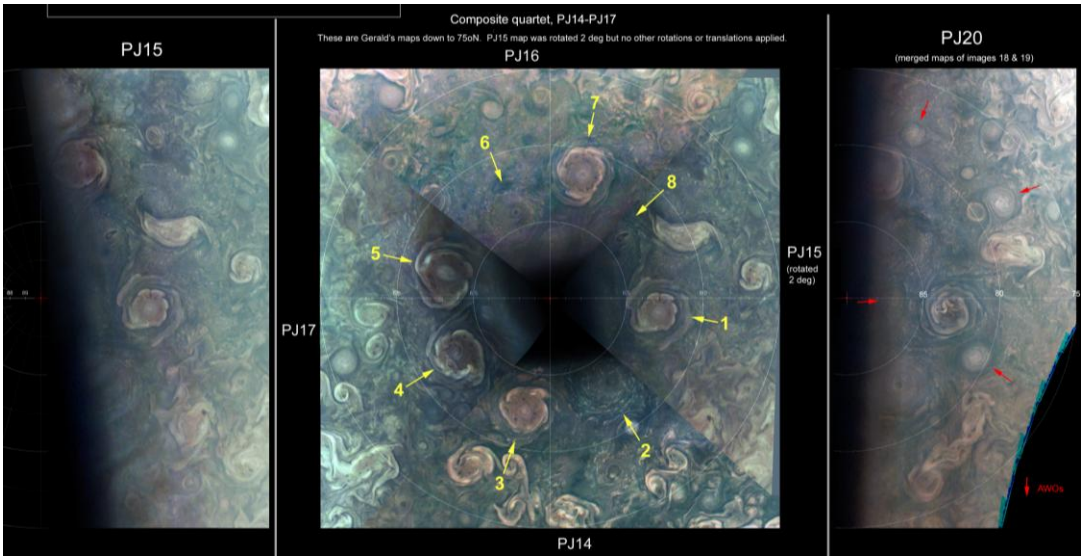


Figure N1. North polar maps of CPCs. *Left*, PJ15 (for direct comparison with PJ20). *Centre*, Composite of PJ14-PJ17, showing the whole ditetragon, with CPCs numbered. (There were no north polar images at PJ19.) *Right*, PJ20. Note that this set of maps differs from my previous sets: it retains Gerald's standard scale and orientation (previous ones were reduced in size and rotated 180°), and CPCs are numbered as in Adriani et al.(2018).

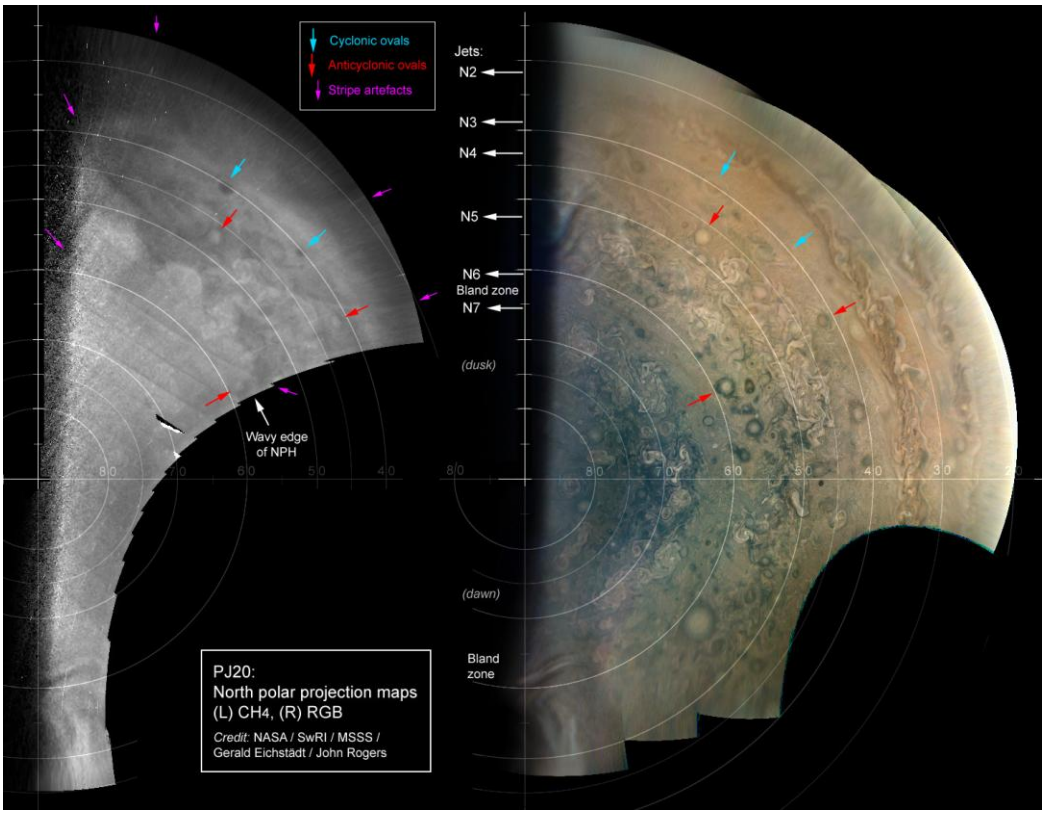


Figure N2. North polar maps of N. hemisphere at PJ20 (RGB & CH4). These are composites of polar projection maps, down to 60°S at the edges, compiled from individual maps by Gerald.

South Polar region

Figure S1 (a&b) is the composite of Gerald's south polar projection maps. Excellent animations can be made from the aligned maps, showing the wind motions over large sectors; these will be suitable for measurement. One example is the attached ***animation***. Apart from the now-familiar motions (circulations in the CPCs and FFRs; wavy motion of the S6 jet), it also clearly shows the S5 jet (delineated as a line of little white flecks), and one FFR which is rapidly elongating southwards (large yellow arrow on Figure S1b). Figure S3 is the composite methane band map, which confirms all the usual features.

Several small AWOs can be seen within the SPR, both around the pentagon, and in the larger ring at 71-74°S. In Figure S1b, the two largest are indicated. One is presumably the long-lived one that was at the same L3 at PJ19; it has moved south (to 73.5°S) and accordingly is no longer retrograding. The other, very bright one, at 72°S, appears to have retrograded by 31° in L3 since PJ19, which is typical.

CPCs:

Figure S1e is the best detailed image of the CPCs (Gerald's map projection). Although long exposures were taken to obtain the best images possible, the pentagon of CPCs was not recorded as clearly as usual because the central cyclone (SPC) was centred 2.0° latitude beyond the south pole towards the dark side when Juno passed over it; so the SPC was overlapping the terminator. However, as the planet rotated in the hours after south pole crossing, JunoCam was able to record all the CPCs at lower resolution (Figure S1a&b).

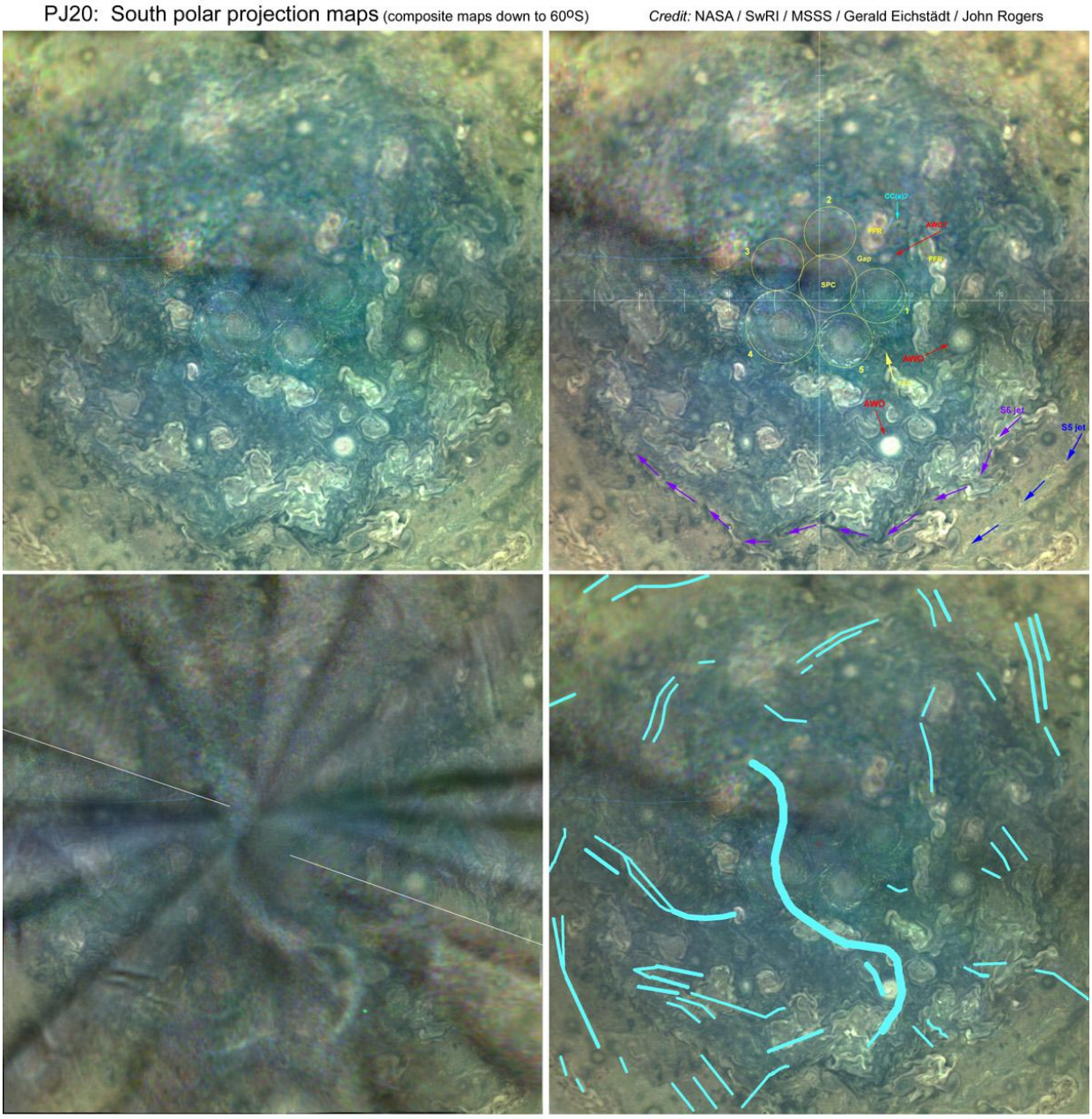
The pentagon is still intact. The centre of the SPC followed a course from PJ17 to PJ20 which was very similar to that from PJ11 to PJ15 (Figure S2). Now we wait to see whether it will go round this small loop again, or on a larger loop taking it closer to the pole as it did twice from PJ1 to PJ13, or will do something new.

The Gap between CPCs-1 & 2 is fairly wide and there is still a FFR intruding into it, along with smaller, poorly-resolved features (Figure S1b). From their shapes and colours, these may be an AWO and one or two compact cells (CCs), similar to the configuration at PJ19 and possibly the same features.

Haze bands:

Figure S1c is a composite map favouring the regions near the terminator, so as to show haze bands (dawn side at top, dusk side at bottom). Figure S1d plots their positions on the 'sunlit' map. As usual there are widespread subtle bands, oblique in accordance with the ZWP north and south of the S6 jet (64°S).

The longest feature is a rather broad band that snakes right across the pentagon of cyclones. It shows red shadowing at the dusk terminator. Its 'lower' half in the map is very like the earlier Long Band, but its 'upper' half is unprecedented, running directly across CPCs-3 & 4. So, as at other recent perijoves, there is a haze feature in similar position to the old Long Band, but outside the previous range of positions, and apparently not so dense.



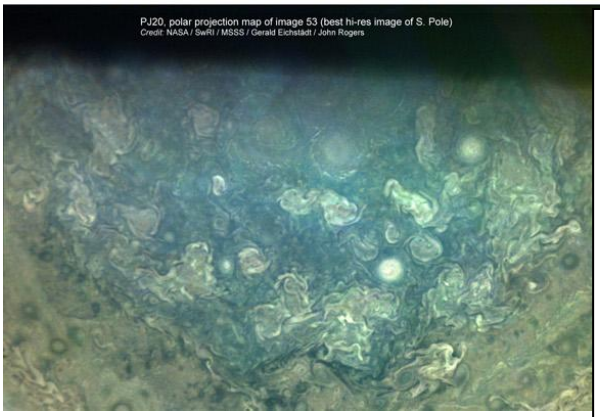


Figure S1. Composites of south polar projection maps, down to 60°S at the edges, compiled from individual maps by Gerald.
(a) RGB map. L3=0 to the left in all maps.
(b) RGB map with labels: Circles are the CPCs (numbered as in Adriani et al., 2018). A few FFRs and AWOs are labelled. CC(s)?, possible compact cells in the Gap, as at PJ18 & PJ19. The large yellow arrow indicates rapid motion southwards of one FFR. *[Also see copy below]*
(c) Map favouring the regions near the terminator, so as to show haze bands (dawn side at top, dusk side at bottom). **(d)** Haze bands in (c) plotted on the 'sunlit' map (a).
(e) Map of the single best detailed image of the CPCs (image 53).

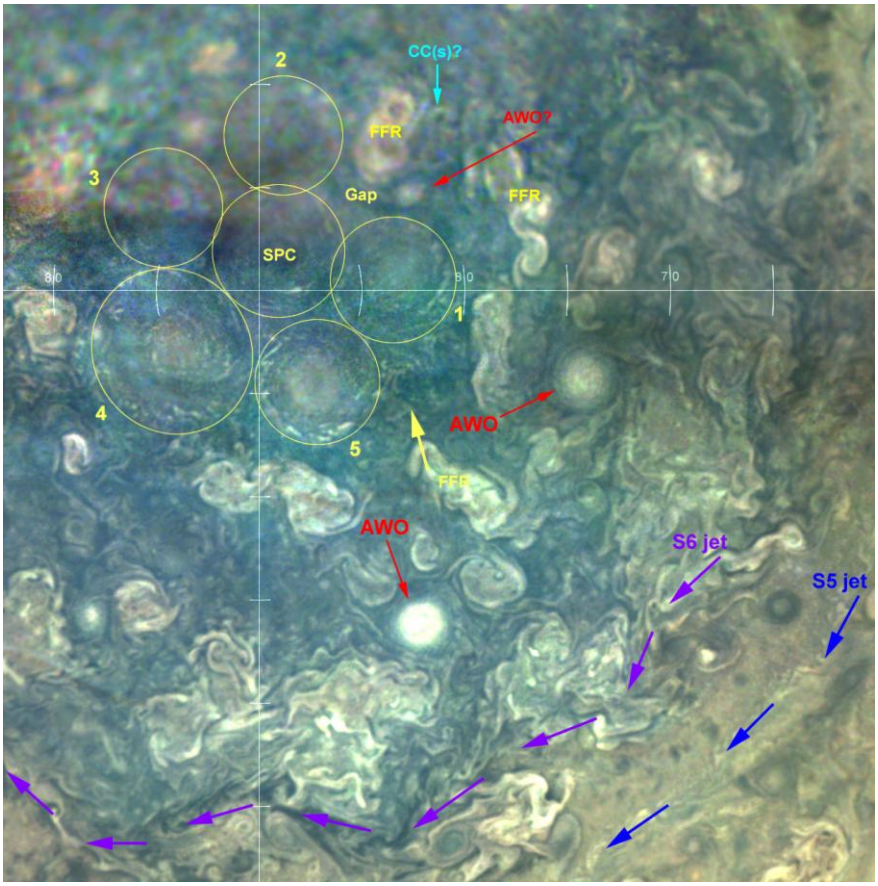


Fig.S2b *(excerpt)*

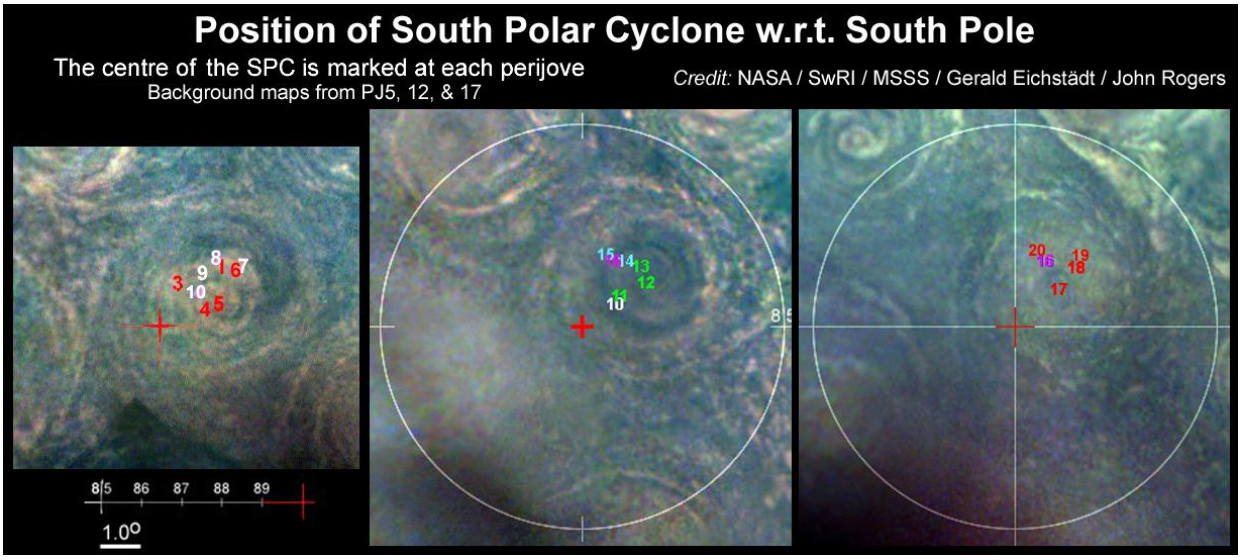


Figure S2. Position of the centre of the SPC, throughout Juno's mission.

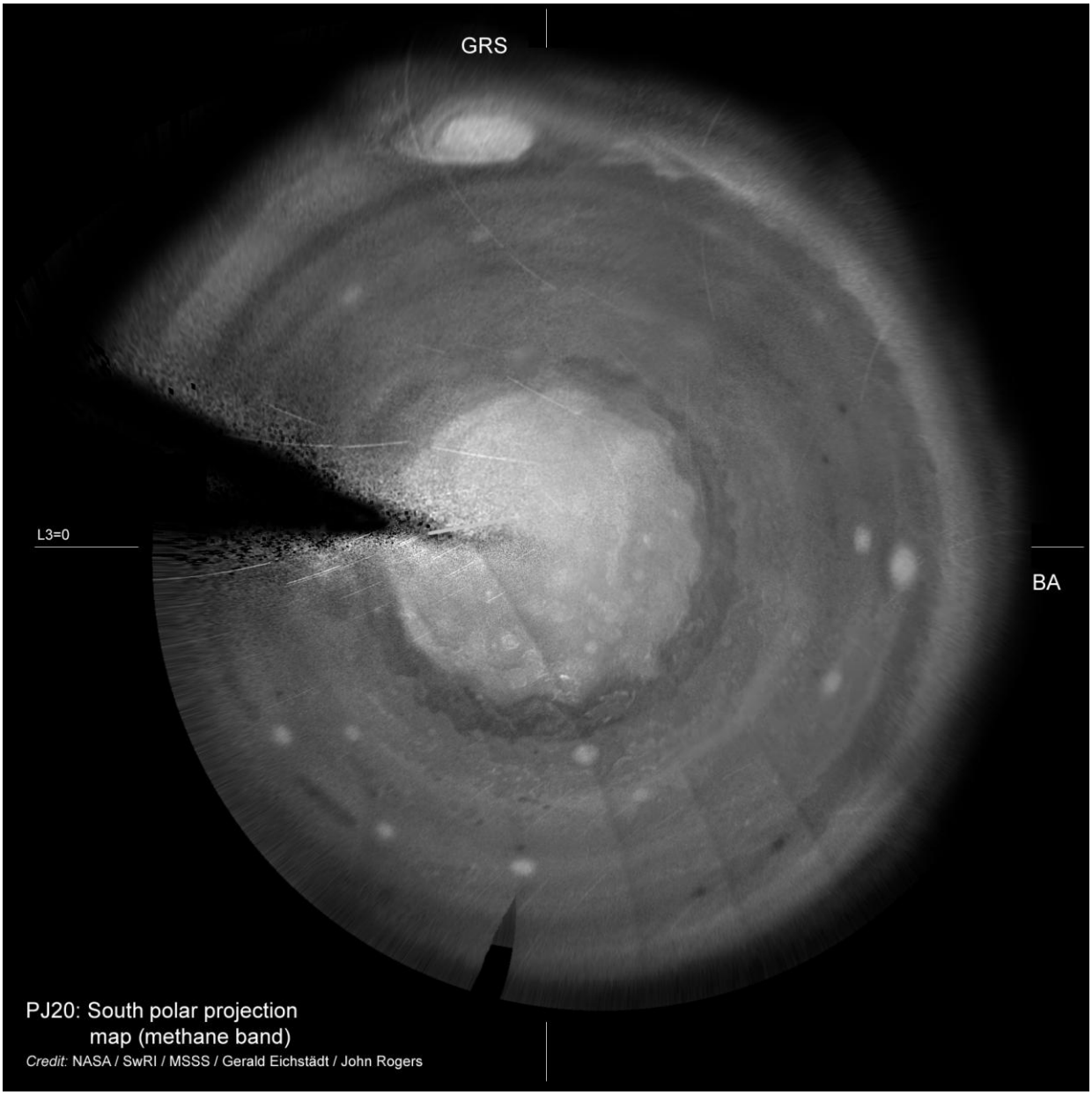


Figure S3. Composite south polar projection map in methane band, covering the whole hemisphere.