Jupiter in 2022/23: Report no.5

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This update again focusses mainly on the regions of interest that have been described in our reports nos.3 & 4. As always, we are very grateful to all the observers who provided images. Some of the phenomena were also covered by JunoCam on 2022 Dec.14-15, just before and at Perijove-47. S. Mizumoto continues to post up-to-date charts and maps on ALPO-Japan at: http://alpo-j.sakura.ne.jp/Latest/j_Cylindrical_Maps/j_Cylindrical_Maps.htm.

At the start of 2023, observers are enthusiastically adopting a new app in WinJupos, to separately derotate the planet and the moons & their shadows. This makes it vastly easier to put the moon and shadow cleanly in the correct position without smear. Chris Go, Tiziano Olivetti, Phil Miles, Anthony Wesley, and other leading observers, have adopted it.

Overview of the planet in 2022

Figure 1 gives an overview of the major changes in belts and zones during 2021 and 2022, and Figure 2 is a recent map of the whole planet.

The NNTBs (N2) jet has carried numerous dark spots (vortices) throughout the year, and this activity still continues.

The NTB continued to fade throughout 2022 until it has been reduced to a narrow faint featureless line at 25°N.

The NEB has been the most interesting region, as it started the year with the north and central parts very pale and quiescent; there were very dark brown ‘barges’ but early in 2022 they faded. Only the narrow brown NEB(S) was dark, and the usual NEBs dark formations (‘hot spots’) were replaced by small ‘super-fast’ features. In autumn 2021, the only activity had been small bright white spots appearing occasionally in a slow-moving sector of the NEB(S). In 2022 these convective plumes became more and more frequent and widespread, and they generated disturbance both to the south (where the usual features have reappeared most of the way round the NEBs) and to the north (where diffuse brown material wrapped around the faded barges). The result is that the NEB has largely revived in width and darkness, but slowly and mostly quietly: unlike comparable revivals of the SEB and NTB, and NEB expansion events, this revival has not been driven by prominent convective ‘rifts’ in the main part of the belt. In 2022 Aug. and Oct., a small bright ‘rift’ from NEB(S) extended into the mid-NEB, and in 2022 Dec., two bright outbreaks occurred within the mid-NEB for the first time in over a year (as described below), apparently confirming that the belt is returning to normal. Nevertheless, the barges are still faint.

The EZ had strong colour at the start of 2022 but it rapidly faded during spring and summer. Since Sep., only a faint dull yellowish tint remains across the zone, along with typical blue-grey festoons.

The SEB has not changed greatly for several years. Since late Nov., the convective activity f. the GRS has been more extensive than in previous months. The GRS shrank to its smallest ever size in June, and has only fluctuated slightly since then.

The S. Temperate domain is the other region where interesting changes are occurring, as described further below. A number of structured sectors and local spots have evolved and converged to the extent that a dark STB now exists around more than half of the circumference, while a strong outbreak of dark spots continues on the STBn jet.

North Equatorial Belt (NEB):

The previously reported activity has continued and expanded. The small brilliant eruptions at ~10°N in NEB(S), drifting at DL1 ~ -2 deg/day, continued until mid-December. But then, two such eruptions occurred slightly further north, in mid-NEB on Dec.14 and 19. Mizumoto's chart shows that both moved with DL1 = +4.9 deg/day, up to Jan.8, appropriate for mid-NEB features. These are the first outbreaks in the main body of the belt since the fading started over a year ago, and a further sign that the belt is returning to normal.

The first of these is shown in Figure 3. It was actually just visible on Dec.12 (Clyde Foster), on the Sp. edge of a faded barge, at 13°N. But it was first clearly recorded by Trevor Barry on Dec.14: new and very bright, but only weakly methane-bright if at all – as confirmed by JunoCam on Dec.14/15, and by Chris Go on Dec.16.

The second, similar eruption appeared on Dec.19 (T. Olivetti, I.Miyazaki, E. Sussenbach, G.T. Shanos), at ~12.5°N, in an identical location on the Sp. edge of a (different) faded barge. Other observers recorded it on Dec.20; on Dec.21 it was much brighter (J. Tomney); and on Dec.22 it was still very bright white and also strongly methane-bright (A. Wesley).

Tracking features on the NEBs edge, JUPOS measurements confirm the marked difference between the active sector and the remainder. From June to early Nov. the active sector and many features within it had very slow (i.e. positive) drifts in L1, while features outside it mostly had fast (i.e. negative) drifts. Speeds faster than DL1 = -20 deg/30d had a continuous range from -25 to -75 with a mean of -45.4 (±15.2; N=19) deg/30d, i.e. -1.5 deg/day, still within the 'super-fast' range. Since mid-Nov., we have not recorded super-fast speeds, perhaps because of the expansion of 'normal' NEBs activity although decreasing resolution may also be relevant.

An especially dark, blue-black spot on NEBs appeared on 2023 Jan.4, as reported by Trevor Barry, also captured by John Rozakis & Manos Kardasis on that evening. It was also very dark in methane images on subsequent days, but was subsiding on Jan.10-11, having drifted from L1 ~ 19 --> 23. This was another of the very dark NEBs formations that were recorded in 2022.

Great Red Spot (GRS):

Since late Nov., the convective activity f. the GRS has been more extensive than in previous months. The appearance of two new bright plumes in this sector is shown in Figure 5.

More flaking events have been recorded, e.g. one on Nov.11-13 after a SEBs ring entered the Red Spot Hollow on Nov.8-9 (Figure 5). Large SEBs rings were also tracked entering the Red Spot Hollow on Dec.28, Jan.1, and Jan.8. A notable red flake was recorded at the f. end of the GRS on Jan.2 (Tom Williams) & 4 (Clyde Foster, Isao Miyazaki, et al; also methane-bright); another may be present in lower-resolution images on Jan.10 & 11 (Miyazaki).

South Temperate Belt (STB):

Two notable changes occurred flanking the turbulent STB Segment G in December.
On the p. side, many distinct dark spots became visible again on the STBn jet.
On the f. side, the cyclonic white oval WS6 became disrupted with dark spots inside, and appeared to merge with Segment G.

The transformation of WS6 was discovered by Mizumoto and documented in a series of maps on the ALPO-Japan web site (URL above). Here we show a gallery of original hi-res images (Figure 3) and a cropped, labelled version (Figure 4). The transformation began gradually around Dec.12, and the white oval became darkened and chaotic. In methane images, it had originally been a dark spot often with a light rim, but during this period the light rim sometimes seemed expanded at the expense of the dark centre. By Dec.28, IR and RGB images suggested that it had become part of the turbulent Segment G. However, it was still comparatively blue and strongly methane-dark, unlike Segment G proper. This

appearance has been sustained up to Jan.12, and suggests that the former WS6 still has its own distinct circulation.

This was a remarkable event, and very well recorded by observers. We think it is the first observation of a large cyclonic white oval being transformed and (perhaps in the near future) incorporated into an adjacent turbulent sector. It can be compared with the much larger transformation of the STB Ghost when it encountered the dark STB segment following oval BA, several years ago. But that process (like the near-identical transformation of the STB Remnant, several years earlier) began with a convective outbreak inside the Ghost, whereas we did not see any distinct bright or methane-bright outbreak within WS6. It may have been destabilised by its proximity to Segment G, and although it is still a distinct oval in mid-Jan., this may yet become fully integrated with Segment G.

Figures (miniature copies):

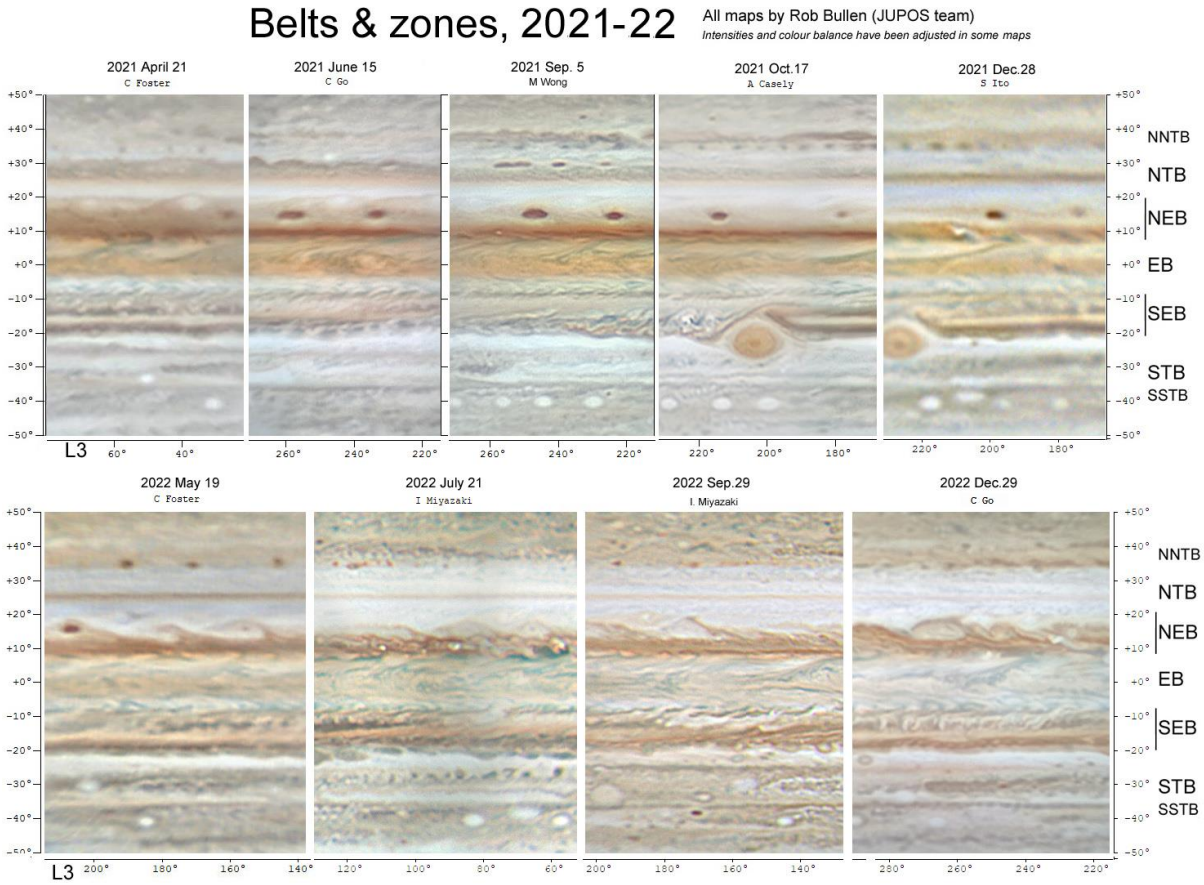

Figure 1. Sections of cylindrical maps showing the changes in belts and zones during 2021 and 2022, notably the shrinkage then slow revival of the NEB, and the fading of the EZ colour. (Differences in the SEB and STB are mainly longitudinal rather than temporal.)

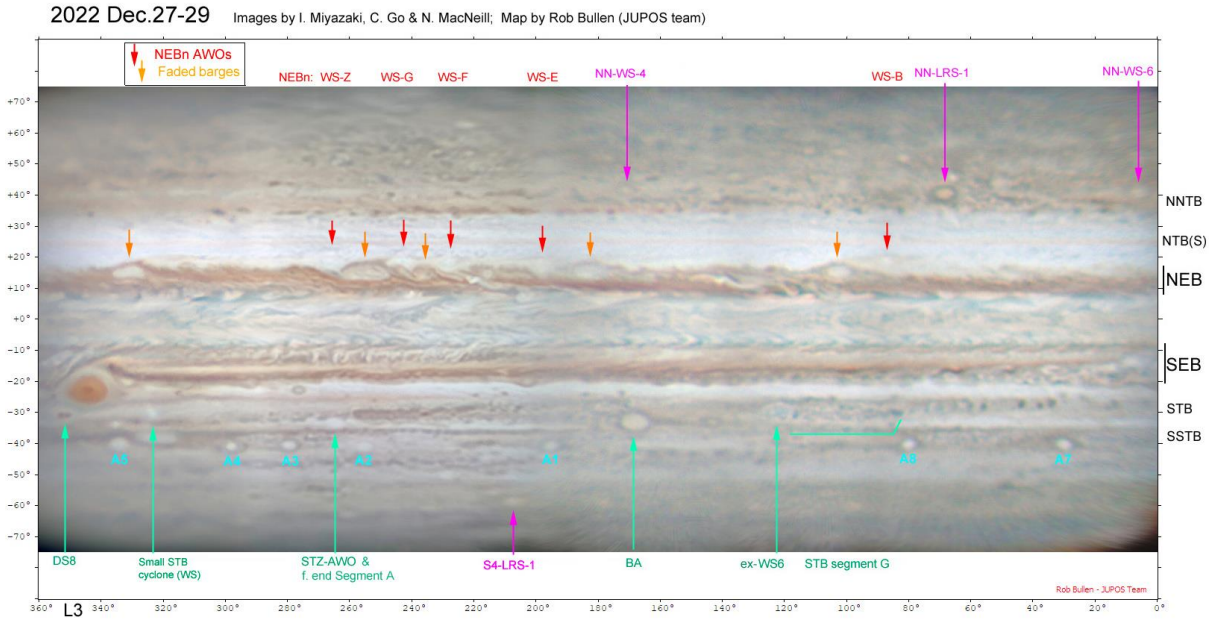

Figure 2. Global map from 2022 Dec.27-29, with major features labelled. (As always, unlabelled versions of maps etc. are available if needed.)

Figures 3 & 4: *On following pages.*

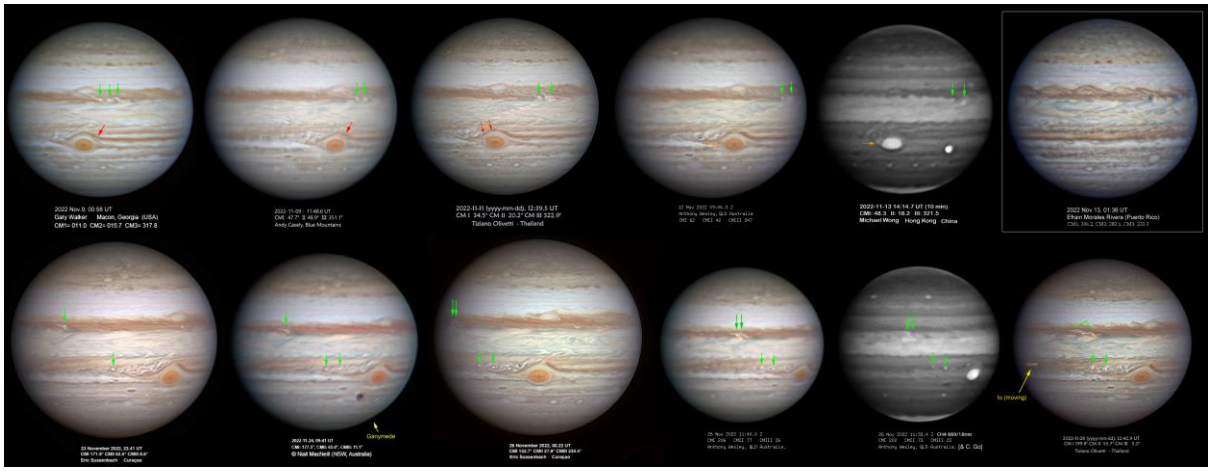

Figure 5. Images of the GRS region in 2022 Nov. *Top row:* A SEBs ring (red arrow) enters the Red Spot Hollow; a red, methane-bright flake (orange arrow) emerges a few days later. *Bottom row:* Two new bright white spots (green arrows) erupt in the SEB f. the GRS, extending the rifted region. They are methane-bright on Nov.26. Also, in both rows, note several bright outbreaks in NEB(S) (green arrows); they are methane-bright on Nov.13, though not obvious as the dark brown NEB(S) is also methane-bright. F. the outbreaks in this methane image, the interface between bright NEB(S) and very dark mid-NEB has a notable series of waves all across the disk. *Inset*, Nov.13: View showing the regular array of NEBn AWOs and faded barges (affected by rifting from the NEB(S)).

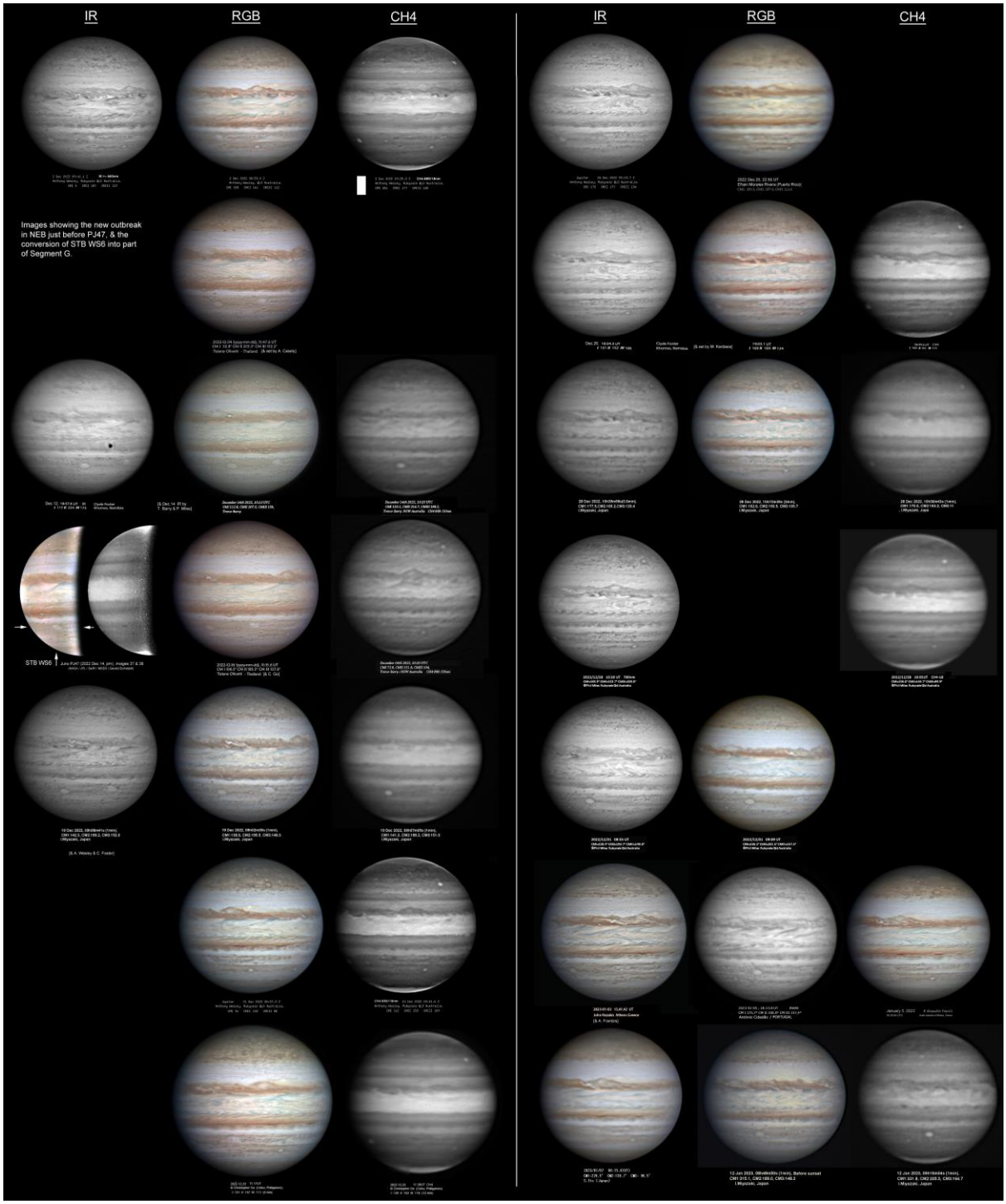

Figure 3. A set of hi-res images in 2022 Dec., showing the new outbreak in mid-NEB that started on Dec.14 (just before PJ47), and the conversion of STB WS6 into part of Segment G (see Figure 4).

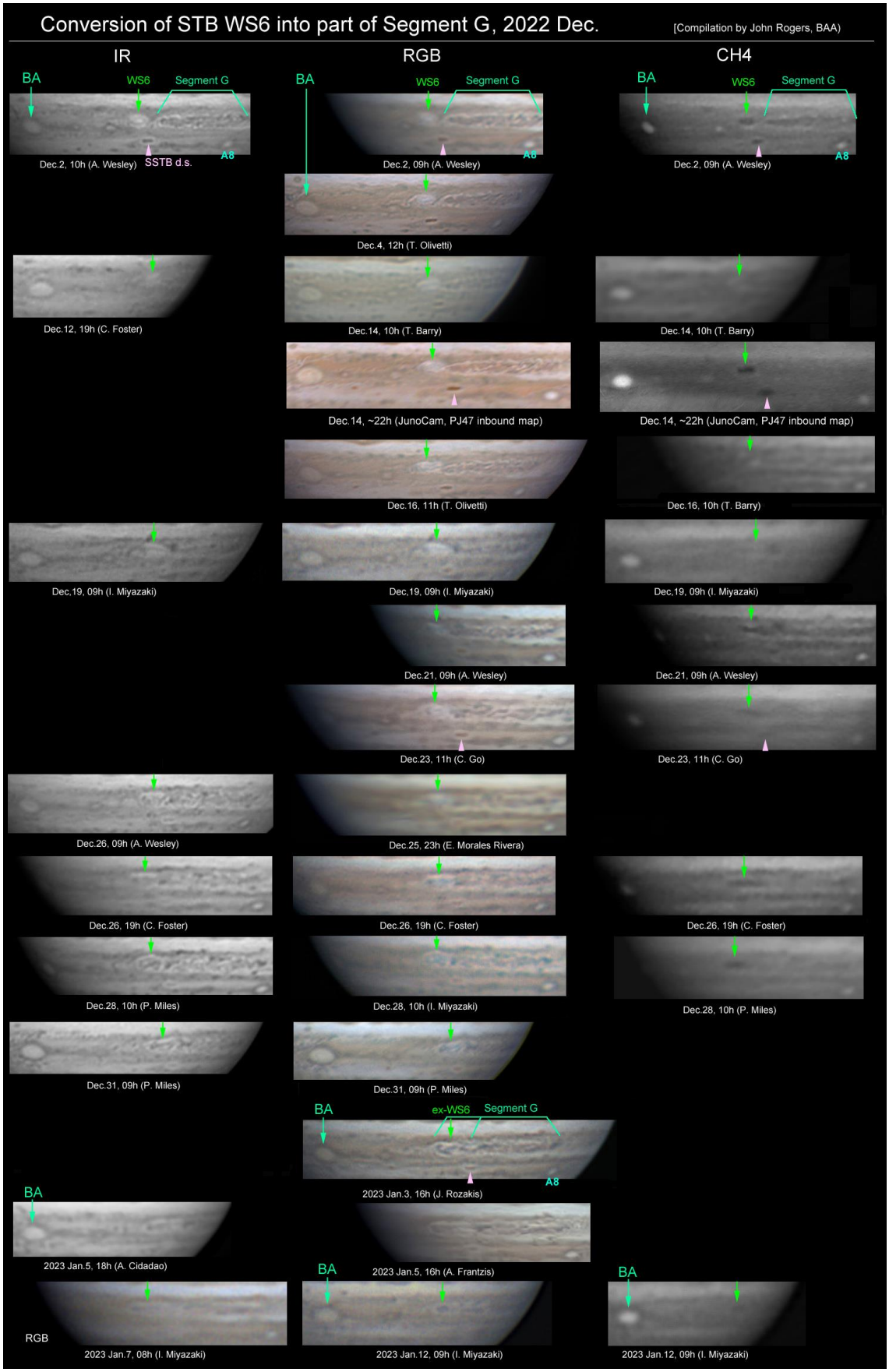

Figure 4. Conversion of STB WS6 into part of Segment G (cropped, labelled copies of images from Figure 3).