

## **Jupiter in 2020, Report no.10: The S2 domain in 2020**

**John Rogers** (BAA), reporting results from the JUPOS team  
(Gianluigi Adamoli, Rob Bullen, Michel Jacquesson, Hans-Joerg Mettig) and the  
JunoCam team (Candy Hansen, Gerald Eichstädt, Glenn Orton, Tom Momary)  
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This report on the S2 (S.S. Temperate) domain is being posted several years late, as there was so much excitement in the NTB, NEB and STB in 2020 that we did not get round to a final analysis of the SSTB at the time, although maps and charts up to June were included in our 2020 Report no.4. Here we summarise the domain's features, with a set of ground-based maps (Fig.1), a set of JunoCam maps (Fig.2), and the JUPOS chart (Fig.3). In fact, there were no notable changes during the year, apart from the appearance of one small FFR (Figs.4&5) and possible late quiescence of two others.

### *Anticyclonic white ovals (AWOs):*

JunoCam had spotted AWOs A7 and A5a merging at PJ24 on 2019 Dec.26, when they were adjacent to oval BA (see our PJ24 report). This left seven long-lived AWOs (A1-A5, A7, A8). A1 to A3 were closely spaced throughout the year, their centre-to-centre distances generally being between 13° and 22°. A4 and A5 also gradually converged on them until by late December (the end of the apparition) the array of five spanned only 83° – nicknamed the “string of pearls” by the JunoCam team.

Mean drift rates (DL2, deg/30d): A1 to A3, -27; A4, -28; A5, -32; A7, -37\*; A8, -32\*.

\*These speeds are from June to Nov. A7 drifted faster from early March to mid-April (-39) then slower from late April to late May (-28), before adopting almost constant drift from early June until Nov. (-32). A8 underwent synchronised variations though less extreme. The cause of these variations is not known, although we note that they passed oval BA in Feb-March, then passed the GRS in May-June.

### *Cyclonic features:*

*from Report no.4 (2020 July):* “There are no white oblongs now. Two were present in 2019 Sep-Oct. (an old one between AWOs A1-A2, and a new one between A2-A3). But in 2020, in the PJ25 map (Feb.17) and subsequent ground-based maps, those sectors are very short and appear to be FFRs. The long sector between A8-A1 (part of which has been alongside STB Segment A) was mostly white up to early June apart from a narrow SSTB(N); but in June and July it is more shaded.”

*Folded Filamentary Regions (FFRs):* The cyclonic sectors can be completely documented now that ground-based maps (hi-res for ~6 months around opposition) are complemented by JunoCam maps (every 53 days, though not always covering all longitudes well), and by a Hubble map on 2020 Aug.25. As there were no white oblongs nor large dark circulations, the only large cyclonic features were FFRs, all but one of which existed throughout the apparition, at least up to Sep. as follows. (SSTB sectors are referred to the flanking AWOs.)

A1-A2 and A2-A3: FFR in each sector, from 2019 Dec.26 (PJ24) to 2020 Aug.25 (HST), and from April to August (amateur); not well viewed after August.

A3-A4 and A4-A5: FFR in each sector, from Dec.(PJ24) or Feb.(PJ25) to Sep.(PJ29) (not viewed thereafter); and from March or April to Sep. (amateur), but not recorded as active in Oct-Nov.

A5-A7: The p. half of this long sector was not well viewed by JunoCam. Amateur maps showed it as a reddish-brown segment from Feb. to April, then dark (May-Nov.); also dark in HST map (Aug.25). The f. half was a large FFR (2019 Dec.—2020 Dec., JunoCam; & April-Nov., amateur).

A7-A8: This sector was undisturbed up to May, but amateur images show a new small FFR developed: it first appeared as a small white spot on April 26-28, which became an expanding

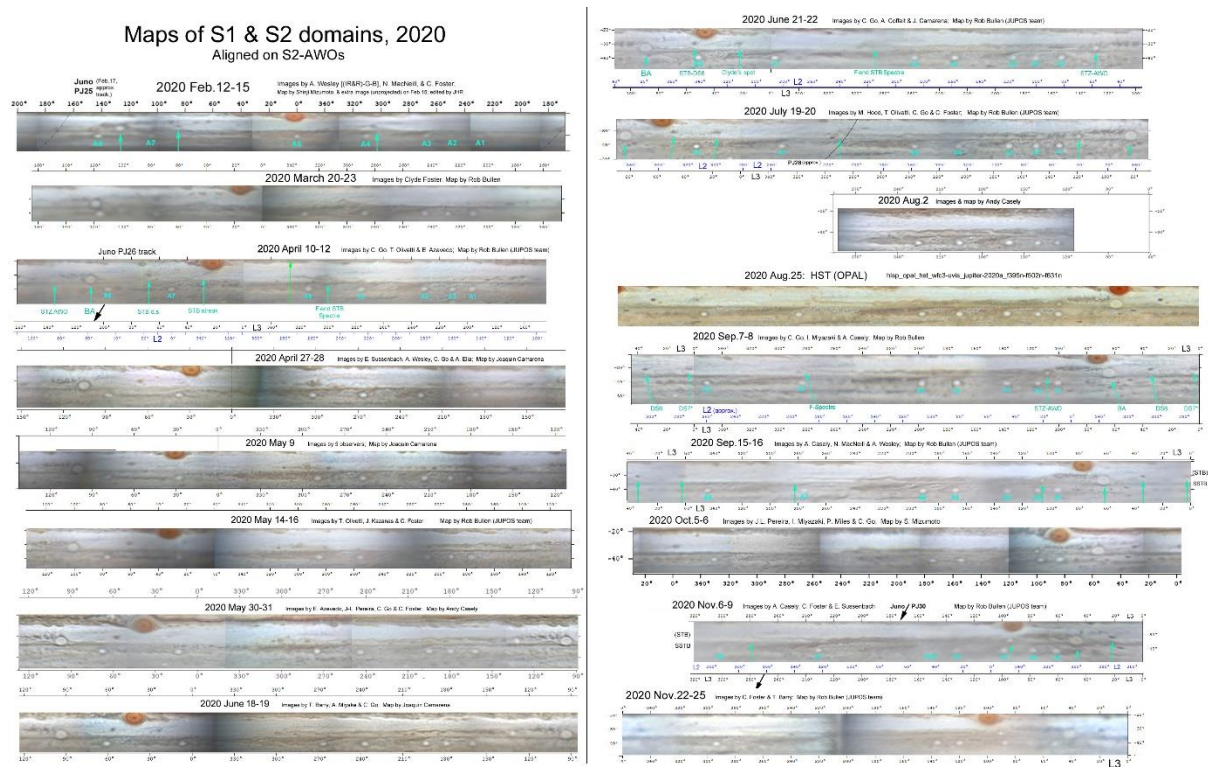
turbulent region (Figure 4). Unlike “Clyde’s Spot” in the STB, which erupted nearby on May 31, it was not methane-bright when it appeared, although tiny, weakly methane-bright spots were recorded within the complex in early June. JunoCam maps showed this small FFR on June 2 (PJ27), containing tiny bright white spots, one of which was methane-bright (Figure 5). This FFR gradually expanded as AWOs A7 and A8 moved apart, up to Nov.8 (PJ30), but amateur images suggest that it was smaller again in Nov., and it was small on Dec.30 (PJ31).

A8-A1: This long sector was remarkably quiet and pale, except for a narrow dark SSTB(N). It contained some slow-moving small dark spots.

*Slow-moving dark spots:* The JUPOS chart shows a number of tracks for such spots at 40°S in the A8-A1 sector from June to Oct., and only a few short or indistinct tracks for them elsewhere. Speeds (DL2) ranged from -10 to -16 deg/30d; mean DL2 = -11.6 (±4.2; N=6). We speculate that these could have formed in disturbance streaming past A8 from the new FFR p. A8.

There was also a slow-moving, very dark cyclonic spot, at ~38°S, which was alongside oval BA when it first darkened in late June; it may have developed from a much fainter spot as it passed BA. JunoCam showed it as a small dark oval (PJ30, similar to STB-DS6 nearby); it was perhaps paler reddish-brown on Dec.30 (PJ31). It was well tracked by JUPOS from July 1 to Nov., with DL2 = -20.9 (July 1 – Aug.20) then -24.4 (Aug.23 – Nov.7).

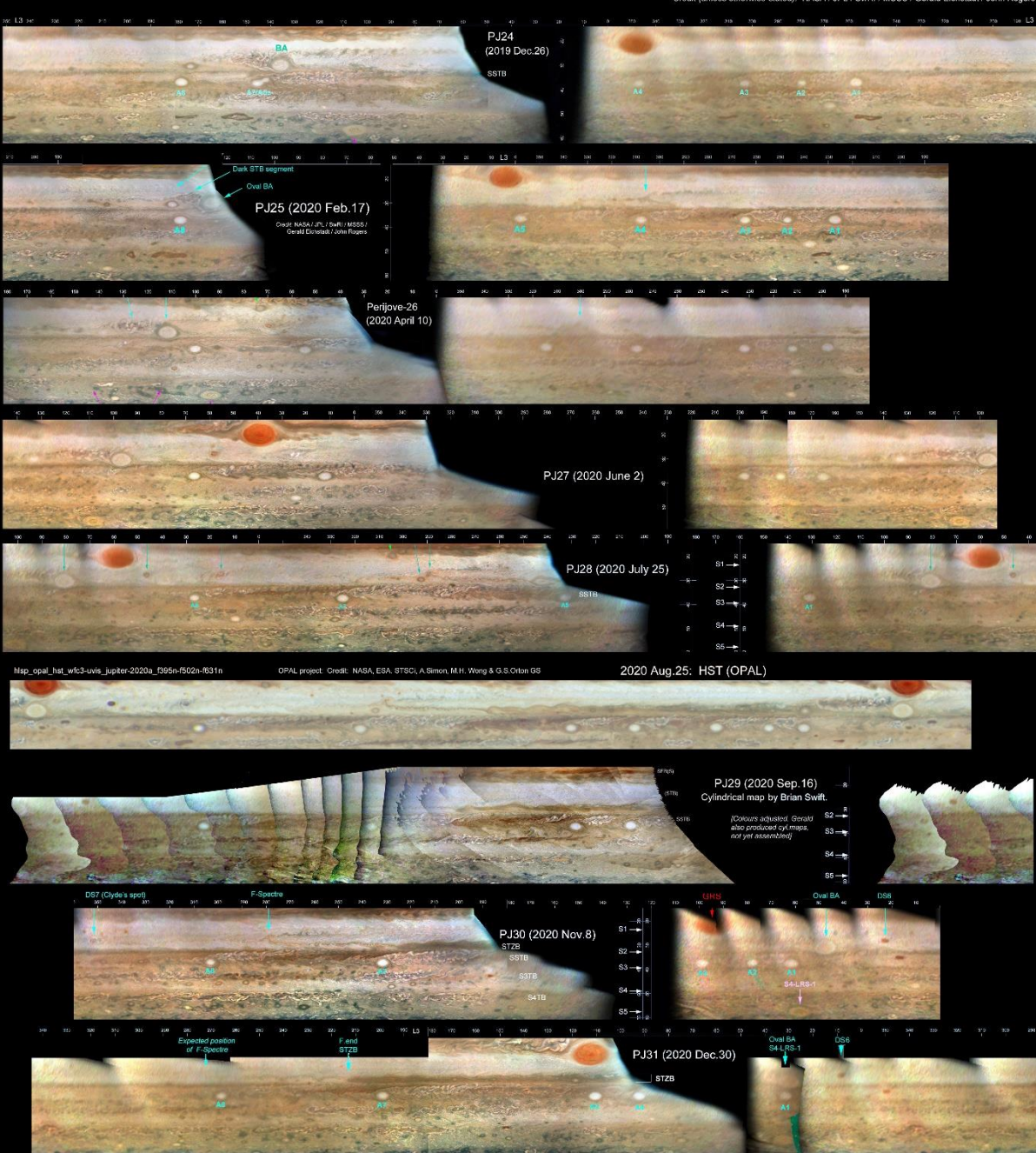
### Figures (miniature copies):



**Figure 1.** Maps of the S1 & S2 domains in 2020 from amateur images, aligned on some of the S2-AWOs. Most of these are taken from our already posted reports, so there are some arrows indicating S. Temperate features from which the labels have been cropped off. (North is up in all figures, and longitudes are in L3 unless otherwise stated.)



Maps of S1, S2 & S3 domains from JunoCam, 2020, aligned on S2-AWOs

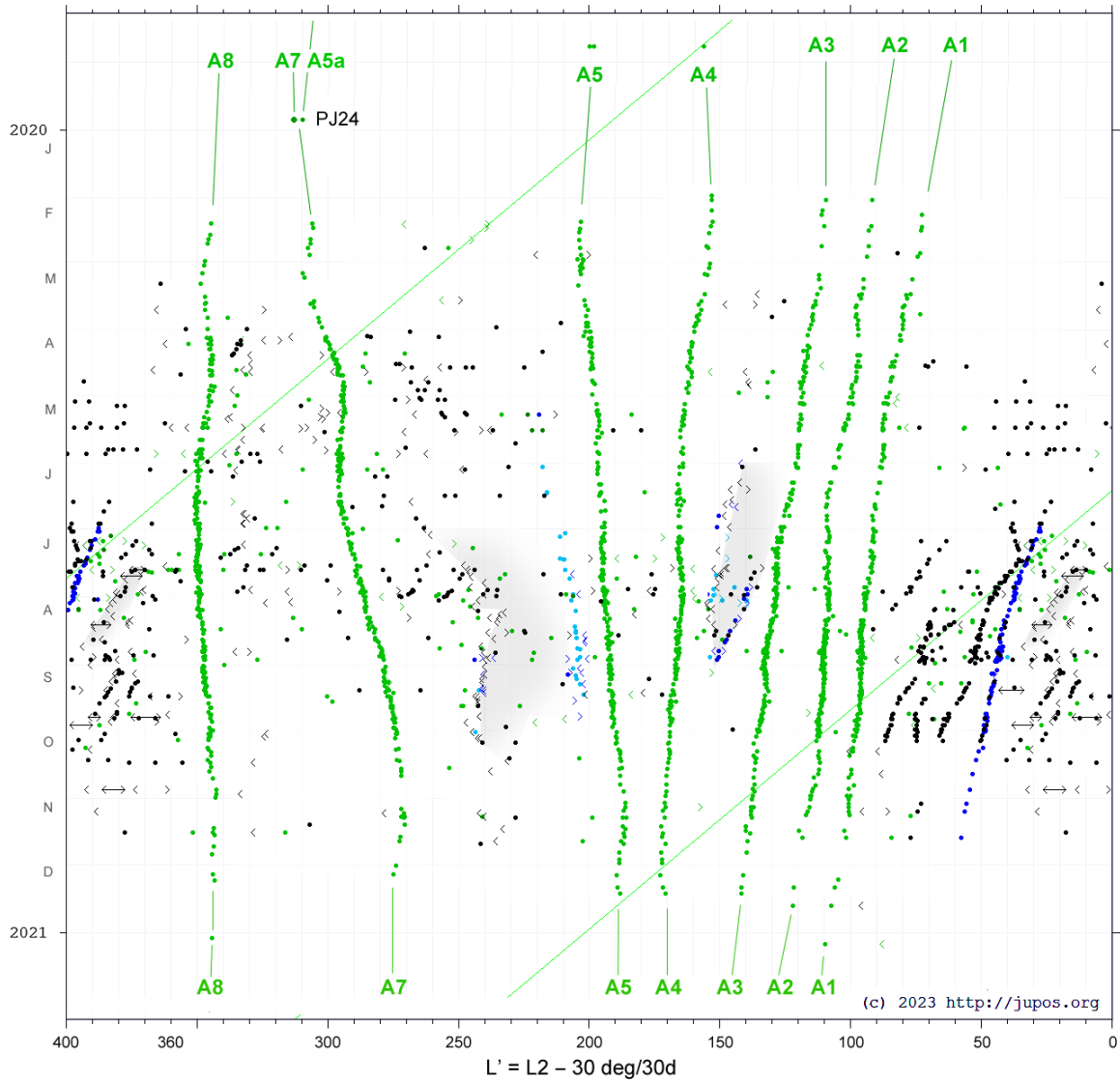


**Figure 2.** Maps of the S1 & S2 domains in 2020 from JunoCam (taken from our already posted reports), plus one from Hubble.

## S2 domain

Latitudes: -42/-39 (all data): green = White spots (AWOs), black = Dark spots  
 -39/-37 (selected tracks): cyan = White spots, dark blue = Dark spots;  
 (CWOs) pink = Red spots

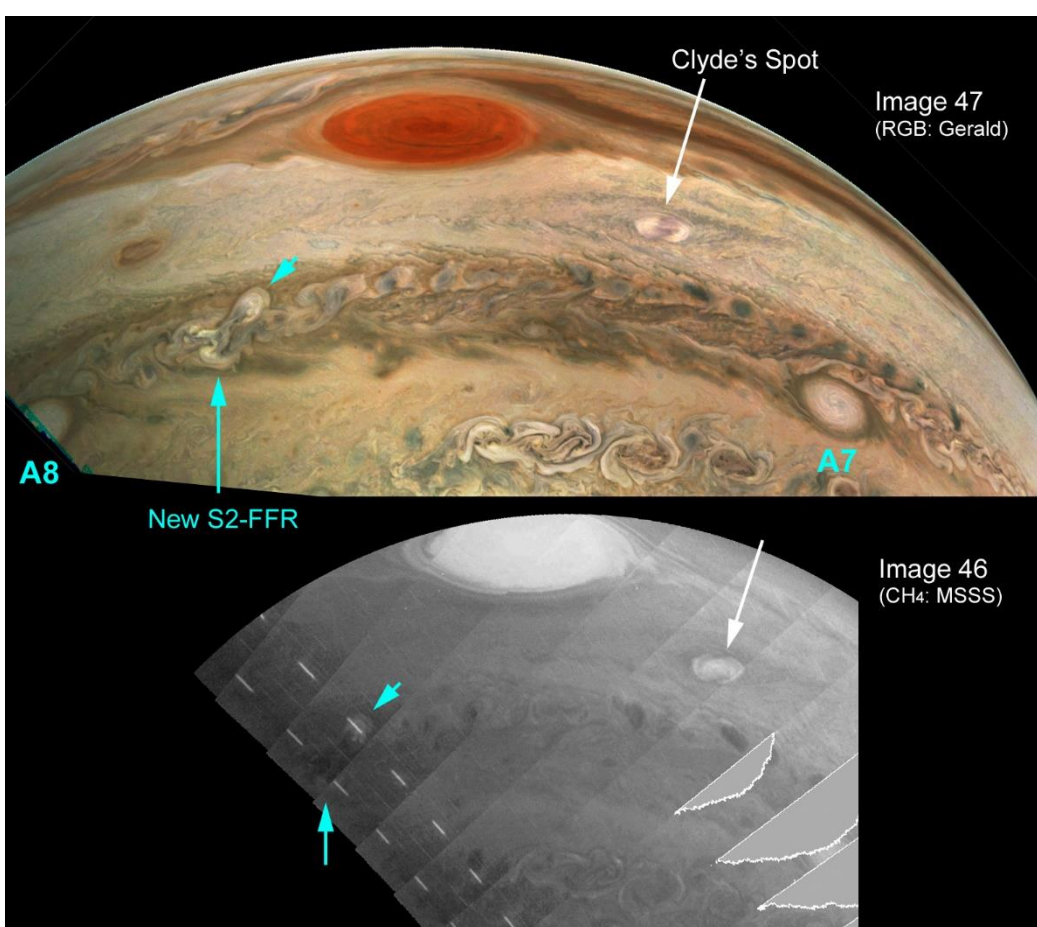
$L' = L2 - (174,0^\circ - 1,0000^\circ/d * (T - 2018 \text{ Jan } 01,5))$



**Figure 3.** JUPOS chart of the movements of spots in the S2 domain during 2020, measured from amateur images by the JUPOS team. This is plotted in an arbitrary longitude system with longitude increasing to the left, to match the maps.



**Figure 4.** Images showing the start of a new small FFR in 2020 April-May. The start of Clyde's Spot in the STB in May-June is also included.



**Figure 5.** Images showing the new small FFR from JunoCam at PJ27 (2020 June 2). The two-day-old Clyde's Spot is also included.