Jupiter in 2011/12: Final report up to 2012 Feb.

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EXTENDED SUMMARY

This report covers the apparition up to 2012 Feb. The planet was largely quiet with belts appearing largely normal. The SEB was recovering after the Revival of 2010/11, while the NEB was narrowing in preparation for what would turn out to be a spectacular Revival starting in 2012 March.

Images attained even higher resolution than before as observers started using new derotation software in WinJUPOS. As a result, we can offer this detailed report, as well as long-term reports which provide new understanding of selected regions of the planet. **Fig.1** is a map of the whole planet.

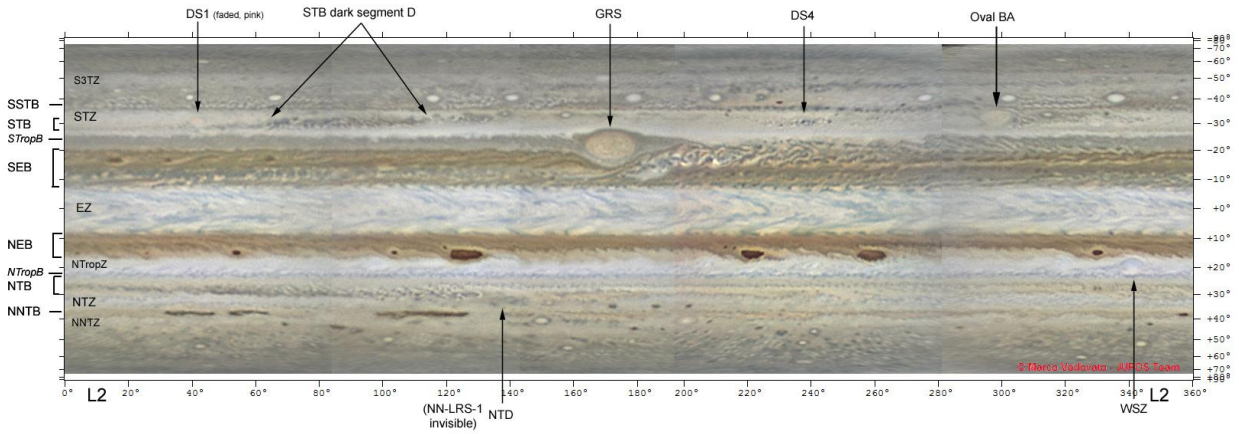

Fig.1: Map of the planet, 2011 Nov.19-20 (images by Damian Peach, map by Marco Vedovato).

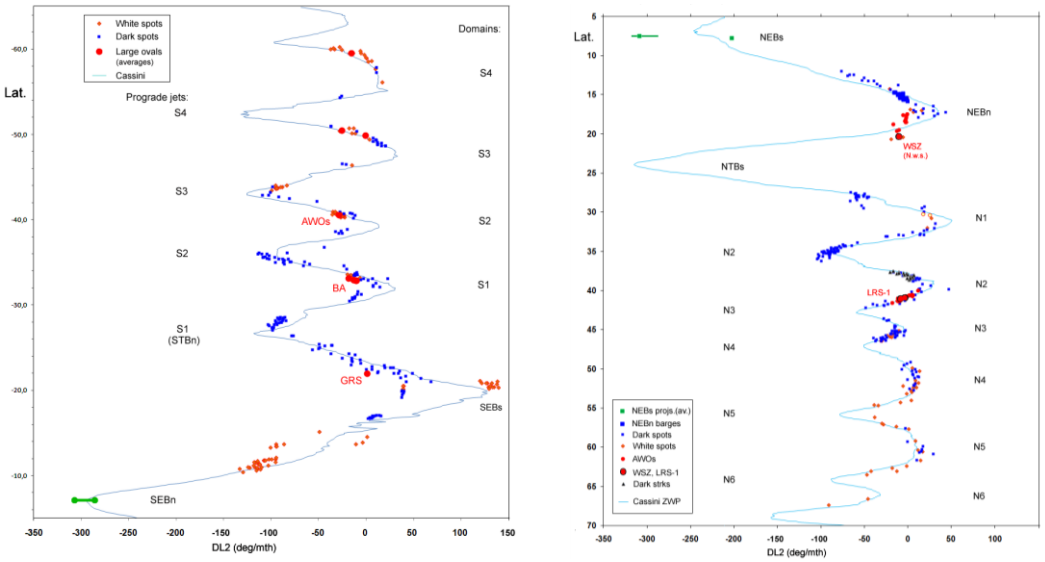

Fig.6&7: ZDP (chart of speed versus latitude) for the southern (L) & northern (R) hemispheres.

The JUPOS data yield a zonal drift profile (ZDP; **Fig.6&7**) from 60ºS to 68ºN. This records the peaks of most prograde jets: S3, S2, S1 (STBn) and SEBn; NEBs, N2, N3 and N4. For the retrograde jets on NEBn and in mid-latitudes, the full wind speeds are seldom recorded by spot tracking; instead, the profiles appear blunted. But we do detect the peak retrograde jet speed for several small spots in the S1, NEBn, N2, and N3 domains. At higher latitudes, we record plenty of spots with the same speed as the

retrograde jet in the S4, N4 and N5 domains. The chart shows excellent agreement with our previous results for 2005, 2006, and 2007, and also with the zonal wind profile from spacecraft.

The high southern regions (S2 to S5 domains) and S. Temperate region (S1 domain) have been covered in our long-term reports [Refs.1,2]. Long-lived anticyclonic white ovals (AWOs) were tracked in the S4 and S3 domains, with remarkable speed variations, and in the S2 domain, where there were 9 of them.

Oval BA had only faint ochre colour. It lost its dark rim and decelerated sharply as the dark STB segment f. it shrunk, which we now recognise as typical behaviour [Ref.2]. On the other side of the planet was a long dark segment of STB, elongating after passing the GRS. A new small circulation developed ~60º p. BA, which would become the next STB structured segment in subsequent years. The STBn jetstream spot activity ceased after oval BA decelerated.

The GRS was a pale orange oval encircled by a dark grey rim. The STropZ was mostly occupied by a massive dark grey S. Tropical Band, probably a late consequence of the SEB Revival. Between this and the SEB proper were several lines of small spots with diverse drifts, some representing the zonal winds up to full speed of the SEBs jet, others with more modest speed. The latter constituted a wave-train which we can now reveal as a common feature of the SEBs jet independent of the state of the SEB. A similar wave-train was seen in 2010 during the SEB Fade and again during the SEB Revival (see Appendix 1; and paper in preparation).

The SEB was fully revived, and in 2011 June-July, the southern half f. the GRS was unusually feature-less and pale orange-brown (the typical 'orange flush'). We find that this is a typical phase just after a SEB Revival, when the appearance does not indicate whether the SEB will start fading again or will resume its normal state. This time, normal convective activity resumed on Sep.21 with bright white spots appearing f. the GRS.

The Equatorial Zone was exceptionally devoid of large features, as were the SEBn and NEBs.

On the NEBs, most of the usual large dark formations had disappeared in 2010-11, and the last remaining ones disappeared in 2011-12. In the sectors of NEBs thus vacated, smaller dark projections all moved with 'super-fast' speeds (~140 m/s), which were modulated by the few small 'normal' features as long as they lasted, and then accelerated further to 139-151 m/s. [See Appendix 2, and paper in preparation; Ref.3 is a summary.] This remarkable change has several profound implications. First, the NEBs has taken on the same appearance, dynamics, and speed, as the equivalent jet on SEBn. This is further evidence that the two jets are essentially symmetrical, with an underlying speed in the range ~150-170 m/s. Secondly, the manifestation of the jet at the surface is suppressed by the presence of large slow-moving formations, which are probably Rossby waves. In the NEBs jet, there are usually many such formations, which suppress the super-fast speeds completely; but none were present in either jet by the end of 2011. Thirdly, the disappearance of the normal NEBs dark formations was probably a consequence of the concurrent disappearance of mid-NEB rifts. The change in the NEBs in 2011/12 was evidently coupled to the cycle of NEB narrowing, and seems to be an historical reversion to the situation that existed before 1912.

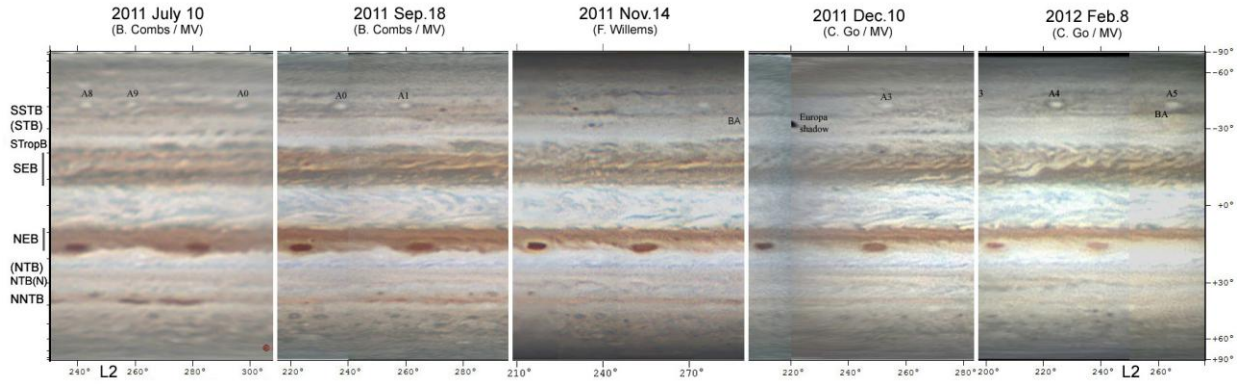

Fig.26: Maps showing the NEB shrinkage, with 2 dark barges. (2011 July; Sep; Nov; Dec; 2012 Feb.)

Exceptionally, no rifts were present in the NEB after 2011 July. There were however 6 remarkably dark barges, 3 of which were very large and conspicuous, and white spot Z remained a major feature [Ref.4].

The recession of the NEBn edge is shown in **Fig.26.** Up until August, the NEB spanned 8.5 to 17ºN. Thereafter, the northern half began to fade as if for the expected next NEB cycle; but exceptionally, the fading and narrowing continued until by late Jan. there was just a narrow NEB between 9 and 12.5ºN, which was also somewhat fainter than usual. The NEB had not been so narrow nor faint since the 1920s. Just as in the comparable fadings of the SEB, it seems likely that all these phenomena were initiated by the cessation of rift activity in the belt [Ref.3]. As we observed this exceptional narrowing of the NEB, we suspected that it was setting the scene for the first NEB Revival in living memory. Indeed, a NEB Revival would begin in 2012 March and proceed during solar conjunction.

In the N. Temperate region (N1 domain), complex structures had developed during the years following the great NTBs oubtreak and NTB Revival in 2007, and they appear to be characteristic sequels of such outbreaks [Ref.5]. In 2011/12, most of the NTB was pale, and the only conspicuous features were a pair of very dark brown streaks on NTB(N).

Up to August, there was only a short quiescent sector of small-scale rifting, and no N. Temperate Disturbance (NTD); but hi-res images showed the rifted sector was much more developed from Sep. onwards. This, plus the recirculation of a pair of spots in the NTZ, led to the reappearance of the NTD in Nov., confirming our previous model of NTDs [Ref.5]. Meanwhile the very dark streaks reddened and faded.

The N2 jet had numerous spots, appearing at a specific longitude up to Sep. There was a dark NNTB in July-August, consisting of many variable segments, but then most of them reddened and faded, until just two were left, and most of the NNTB was just a very pale ochre band. NN-LRS-1 lost almost all its reddish colour; 3 long-lived AWOs were also tracked in the NNTZ [Ref.6].

The phenomenon of cyclonic dark spots or streaks reddening just before they fade was amply confirmed by many examples in 2011/12: a small, very dark spot in STB latitude; the pair of very dark brown streaks on NTB(N); and most of the dark segments of NNTB.

The north polar region (N3 to N5 domains) contained innumerable mottlings and small spots, many of which we tracked; they all moved with the known zonal winds **(Fig.6&7)**. The most remarkable finding was an AWO which moved from the N4 to the N3 domain, crossing the N4 prograde jet, and splitting then recombining as it did so. Another white spot was recorded as far north as 67.3ºN, with a remarkably fast drift, on the flank of the N7 jet. Irregular light patches were recorded (but not tracked) up to 70-75ºN.

References *to our ancillary reports which include further details of this apparition:*

1. Rogers J, Adamoli G, Hahn G, Jacquesson M, Vedovato M & Mettig H-J (2014), 'Jupiter's southern high-latitude domains: long-lived features and dynamics, 2001-2012'. http://www.britastro.org/jupiter/sstemp2014.htm
2. Rogers J, Adamoli G, Hahn G, Jacquesson M, Vedovato M & Mettig H-J (2013), 'Jupiter's South Temperate domain: Behaviour of long-lived features and jets, 2001-2012'. http://www.britastro.org/jupiter/stemp2013.htm
3. Rogers J, Adamoli G.,Hahn G., Jacquesson M.,Vedovato M., Mettig H-J, (2013), 'Jupiter's North Equatorial Belt: An historic change in cyclic behaviour with acceleration of the North Equatorial jet', EPSC (London, 2013), http://meetingorganizer.copernicus.org/EPSC2013/EPSC2013-384.pdf
4. Rogers J (2013), 'White spot Z: its history and characteristics, 1997-2013'. http://www.britastro.org/jupiter/2013_14report03.htm
5. Rogers J & Adamoli G (2015) 'Summary of the North Temperate Disturbance, 2009-2012' *[posted herewith]*
6. Adamoli G & Rogers J (2013 Jan.) 'NNTZ: Anticyclonic ovals, 2008-2012', in: 'Jupiter in 2012/13: Interim report no.9' Appendix 1: http://www.britastro.org/jupiter/2012_13report09.htm