*Jupiter in 2013/14 Report no.9:* **The GRS and adjacent jets: Further analysis of amateur images, 2013/14** 

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## **Figure legends and miniatures**



**Figure 1.** Chart showing length of the GRS, 2003-2014 (updated version of the chart in our Report no.7.)

## Latitude & width of Great Red Spot, 2006-2014





**Figure 2.** Charts showing latitudes and width of the GRS, 2006-2014. (A,B) Individual measurements on selected hi-res images. (C,D) Apparition means. Data from Table 1.



Figure 3. JUPOS chart of GRS, showing the 90-day oscillation.



Figure 4. Circulation of the GRS, 2014 Feb.

(Left) Set of reprojected GRS images with measurements of position angle (PA). (Right) Chart of PA measurements, showing P = 3.6 to 3.8 days. South is up in all figures unless otherwise stated. (Also see **Supplementary Movie**.)



**Figure 5.** STBn jet spots, 2013/14: JUPOS chart, plotted by G. Adamoli, highlighting points belonging to measured tracks, plotted in a longitude system moving at DL2 = -90 deg/month.



**Figure 6.** STBn jet spots, 2013/14: ZDP. For early spots (blue), the mean speed and the ZDP were slower than for later spots (red). Trend lines have been drawn by eye. Spots which passed the GRS (open diamonds) had lower latitudes and a range of speeds; spots which then survived beyond the STB Ghost (open triangles) had much slower speeds. For charts broken down by month, see **Suppl. Fig. S1**.



**Figure 7.** STBn jet spots, 2013/14: Tracks for 11 individual spots, plotted as longitude (L2) vs latitude. Positions of the GRS and the STB Ghost are indicated schematically. The spots move from right to left; trend-lines (fitted by Microsoft Excel) show the decline in latitude down to the GRS. Note the marked increase in latitude as each spot passed the GRS, and for those which survived, return to an approximate extrapolation of the previous track. These were selected spots which were well tracked, showed a progressive decline in latitude, and reached conjunction with the GRS. For separate tracks of longitude and latitude vs time, and derived parameters, see **Suppl. Fig. S2a**.

STBn jet spots: Tracks of individual spots past GRS

GRS was at L2 = 208 throughout (JUPOS analysis by GA, edited by JHR)



## Figure 8.

Images of the GRS region, 2014 Feb.12-24, showing STBn jet spots passing the GRS. The same set of images was shown in Report no.6 [Fig.6] and Report no.7 [Fig.4], and they have now been reprojected as maps by M. Jacquesson, some of which are used in this figure where the GRS was near the limb. The set of maps is also shown in **Fig.4** (circularised to measure the GRS circulation) and in an animation (**Supplementary Movie**). The series of images is continued in **Fig.S10**.



**Figure 9.** Images of the GRS region in 2014 April, spanning the time of HST imaging on April 21, with STBn tracked. Chris Go's image coincided with the first HST image set. (South is up. For lat. & long. charts of these spots, see Fig.S2B.)



**Figure 10.** ZDPs for spots in the SEBs and STropZ, 1999-2014, with the Cassini ZWP [Porco et al., 2003] for comparison. Reproduced from our final reports posted for these apparitions (inc. Fig.8 of our 2010 Report no.22). In general, red colours denote white spots and blue or black denote dark spots; green denotes certain anomalous dark spots. For full colour keys see the original reports.

Although most spots lie close to the Cassini ZWP, some groups of SEBs jet spots between  $\sim$ 20.5 and 22 S lie above and right of the ZWP: i.e., they lie further south or retrograde faster than expected from the ZWP). Usually these are oval vortices (the oval in (A) indicates the typical latitudinal extent in Cassini images); also the first SEBs spots in the 2007 SEB Revival; and, most egregiously, the dark spots in the 2010 SEB Revival. (In 2010 and 2011/12 there were also wave-trains on the SEBs, which had much slower retrograding speeds of  $\sim$ +70 deg/mth and +39 deg/mth respectively.)

## **Supplementary Figures**



Linear fit has been done by eye for panels (b) (grey) and (c) (brown, reproduced in other panels for comparison)

Fig. S1. STBn jet spots, 2013/14: ZDPs broken down by months.



**Fig. S2.** STBn jet spots, 2013/14: Tracks for individual spots, in longitude and latitude. (Similar analysis was performed for all 66 spots in the outbreak.)

(A) Tracks for 4 well-tracked spots. These are examples in which the latitude decreased steadily, then increased suddenly as the spot passed the GRS; the first two also showed deceleration as the spot passed the STB Ghost.

(b) Tracks for 4 later spots, which were near the GRS at the time of the HST imaging on April 21. (See **Fig.9** for the images. These spots were late in the apparition so were not tracked as thoroughly as earlier spots; they are included in **Table 3** but not in other charts. Tracks for d62 and d63 were not well enough determined to include.) Like the earlier spots, most of this group had latitude decreasing steadily, then, if tracked to the GRS, increasing sharply.

Conjur	nctions of ST	Bn jet spot	s with GRS			
	Conjunction	Increase	Peak	Speed passing GRS:		
	date (approx)	in lat.	lat.	dt	<u>dL2</u>	DL2
		(deg)	(deg.S)	(days)	(deg)	(deg/d)
d19	Jan.16	1,1	28,7	3,71	-14,5	-3,91
d22	Jan.22	1,5	28,8	2,06	-9,1	-4,43
d23	Jan.26			4,57	-18,0	-3,94
d26	Jan.31	1,0	28,2	3,32	-16,0	-4,82
d27	Feb.3	0,8	28,7	4,54	-20,3	-4,47
d34	Feb.16	1,2	28,8	3,71	-15,2	-4,09
d35	Feb.18	1,9	28,6	2,49	-12,1	-4,85
d36	Feb.21	1,2	29,0	2,90	-14,5	-5,00
d38	Feb.25	1,0	29,1	1,28	-6,4	-5,00
d40	Mar.2			4,99	-21,0	-4,21
d41	Mar.3			1,67	-8,7	-5,22
Mean		1,21	28,74	3,20	-14,16	-4,54
SD		0,34	0,27	1,24	4,73	0,46
N		8	8	11	11	11
onjuncti	on date: Estimat	ed from dates	either side,			

Increase in lat: From the consensus lowest lat. before GRS passage started, to peak lat.(next column). Peak latitude: Single meas't close to conjunction, or mean of 2 meas'ts if available.

(Typical SD of lat. meas'ts is 0.3 deg, and lat. was usually declining steadily until GRS passage started.) Speed passing GRS: Difference in time and L2 between closest obs'ns before and after conjunction.

**Fig. S3 = Table 4.** STBn jet spots, 2013/14: Table of conjunctions of STBn jet spots with the GRS, showing the temporary increase in latitude and speed during the passage.



**Fig. S4.** Images showing STBn spot d19 passing the GRS.

**Fig. S5.** Images showing STBn spot d41 passing the GRS.



Fig. S6. SEBs jet spots in 2014, approaching and encountering the Red Spot Hollow.