Jupiter in 2013/14: Interim report no.6 (2014 March)

John Rogers (British Astronomical Association), including data from the JUPOS team (Gianluigi Adamoli, Michel Jacquesson, Hans-Jörg Mettig, Marco Vedovato).

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Summary

This report summarises the state of Jupiter's atmosphere up to 2014 March, with numerous images and maps from observers. All regions are basically normal, and there have been only minor changes since our last report in December. This report includes details of interesting phenomena in the S3 domain, the STBn jet, the Equatorial Region, and the N1 (N. Temperate) domain. The N. Temperate domain has been divided into 8 sectors during this apparition, including two mini-rifted sectors of the NTB which appear to have generated two darkened sectors of the NTZ called N. Temperate Disturbances. In mid-Feb., two new mini-rifted regions appeared: one was notable for the brilliant white spot which initiated it, and the other was notable for the very dark spot which it soon generated in the NTZ.

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General overview and acknowledgements

The planet still shows an essentially normal appearance in all regions, just as described in our Report no.4 in December [ref.1], so that report still applies up to 2014 March. This report focusses on various local features that have aroused interest. A companion report, no.7, focusses on the Great Red Spot.

Fig.1 comprises a set of hi-res maps from mid-February, with the major spots marked. Fig.2 presents a gallery of methane-band and ultraviolet images around the planet. Figs. 5 and 6 present sequences of hi-res images from mid-Feb., covering different longitude sectors, to show the day-by-day changes in a wide range of features, with methane-band images also in Fig.6. We have proposed a new nomenclature for the domains and jets [ref.2], which is used here in parallel with the traditional nomenclature. The new version is simpler for the higher latitudes, but the familiar version may still be preferable for general use for lower latitudes.

Since most of the features studied here are small, this report is largely illustrated with hi-res images. However, images from all observers have contributed to tracking the planet's features and we are very grateful to all observers for their images. We also thank the ALPO-Japan for providing many images via their database at: http://alpo-j.asahikawa-med.ac.jp/Latest.

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The S3 domain and jet

The v-hi-res images from observers have resolved several small but interesting features in the S3 domain and S3 jet, all of which fit in well with our recent conclusions about this little-known domain [ref. 2]. One feature was a chain of **slow-moving dark spots at ~49ºS** (DL2 ~ 0) [Figs.3 & 4C]. A turbulent cyclonic patch at L2 ~ 300 could have been the origin of these dark spots f. it. Meanwhile the **long-lived AWO at ~50ºS** (labelled S3-AWO in figures) was rapidly prograding until it encountered the chain of slow dark spots, when it halted in L2, then resumed prograding until it hit the next dark spot, then halted again... [Figs.3 & 4C] -- a process that may be still continuing. This process could be merely a coincidental resumption of the usual oscillation of this oval, but it seems that it was a repeat of a similar interaction in 2011 Oct [refs.2 & 3].

In the **S3 prograde jet** (formerly called S^3TBn jetstream), there have been 5 exceptionally prominent white spots, and one dark spot. The 5 white spots were sometimes almost as bright as the S2 AWOs, which they were passing [Fig.4]. These 5 white spots existed as early as 2013 Sep., and Dennis Put first drew attention to one on Oct.6, though no.5 did not become prominent until early Dec. Nos.1 & 2 merged in Nov., and nos.3 & 4 in Jan., and they may have disappeared in Feb. These spots had mean latitude 43.9ºS (+/-0.2), mean speed DL2 = -98 deg/mth, with a range of DL2 from -85 to -102 deg/mth, following a cyclonic gradient on the S side of the S3 jet peak [Fig3C], exactly like S3 jet spots in previous years [ref.2].

The S2 (S.S. Temperate) domain

The ten AWOs remain in three stable arrays, with spacings of 13-24º **[Fig.1]**, moving with mean DL2 = -27 deg/mth. For their previous history see [ref.2]. AWO A7a was new in 2013 August. They are well shown in **Fig.4**.

Between A3 and A4, a cyclonic white oval developed in early Nov., which was surprisingly methane-bright and remained so into Dec. In recent methane images **[Figs.2 & 6]**, it is not quite so bright, though still brighter than its surroundings. It is still very bright at visible wavelengths. From its appearance, nestled between AWOs A3 and A4, observers are calling it “the Mickey Mouse spot”.

The S1 (S. Temperate) domain

The description in our previous report (No.4: ref.1) still applies. The STB Ghost has now passed the GRS [**Figs.1 & 4**]. It is still methane-dark [**Fig.2**]. Oval BA has maintained an almost constant speed DL2 = -14.3 deg/mth since Sep., with a long dark STB segment f. it [**Figs.1, 4, 5**]. This is still emitting a chain of slow-moving small dark spots in the f. direction in the STZ, and a chain of rapidly-moving very dark streaks and spots in the p. direction on the STBn jet.

STBn jetstream outbreak and S.Tropical Zone

The outbreak of dark spots on the S1 jet (STBn jetstream) began during solar conjunction in mid-2013, as an expected consequence of the collision of a dark STB segment with oval BA in early 2013 and the establishment of this dark, micro-turbulent STB segment f. BA since then [refs.4 & 5].

Table 1: Speed of STBn jet spots (JUPOS charts):
DL2 (deg/mth), measured from JUPOS by JHR:

	Sep, Oct:	Nov:	Dec,Jan:
Mean:	-78,4	-85,0	-95,5
SD:	0,8	3,3	1,3
N:	3	5	10

The speed of these jetstream spots (**Table 1**) was initially low, DL2 = -78 deg/mth, just as in the two previous outbursts following STB collisions (2003/04, 2010) [ref.5]. But it sped up rapidly, and from the start of December has been stable at -95 deg/mth, very close to the mean value in most apparitions. So this STBn jet outbreak, triggered by the collision of STB segments in 2013, has proceeded exactly like the previous examples.

Hi-res images have shown fascinating structure in the outbreak. The origin of the spots can be traced in detail [Fig.4A,C & Fig.5A]; sometimes, one can see the narrow STBn emerging p.oval BA becoming wavy and then breaking up into the dark spots [Fig.5A]. This clearly suggests that the spots form by instability of the jet, perhaps because its speed has been increased alongside the merged STB segments (as shown in our long-term report) to a velocity which cannot be stable. (More illustrations of the STBn jet spots are in Report no.7 [ref.7].)

The colour of these spots has also been of interest: whereas they are initially very dark grey like most jetstream spots, further p. they become brown or tawny, as they become smaller but embedded in a tawny band. They disappear at the STB Ghost or, since it passed the GRS, at the GRS. V-hi-res images of the GRS show a chaotic scene as these jet spots are disrupted on passing the GRS [Fig.6]. More illustrations of this interaction are shown in Report no.7 [ref.7]. Similar processes were described during the previous STBn jet outbreak in 2010 [ref. 6].

A diffuse yellowish colour was notable in the STropZ p. the GRS from Nov. to Jan., and in a halo around the GRS from Jan. onwards, at least when these regions were not too disturbed. The origin of this colour was unclear, but I suggest it may have come from the tawny STBn jet spots themselves when they were disrupted on approaching and passing the GRS. Alternatively, as some observers suggested, it might have come from the GRS itself, which was smaller than ever before (see below). From late Jan. onwards, as the source of the STBn jet spots drew closer to the GRS, they have been still dark grey when they reached it, and the yellowish colour has been less evident in the STropZ p. the GRS, although sometimes still present both there and around the GRS.

The northern part of the STropZ is occupied by a dark grey band which looks like an additional southern component of the SEB. It is comprised of numerous dark streaks, which have a variety of drifts according to the JUPOS chart; some are near-stationary in L2, while others have DL2 ~ +9 to +12, and a few are faster or slower.

The Great Red Spot

The GRS is at L2 = 209 (March 1) with DL2 = +1.4 deg/mth, which is unusually slow. It is an isolated oval and notably orange **[Figs.1 & 6]**. The speed, appearance, and colour are more typical of times when the SEB is fading, and are surprising as the SEB is currently so active. The GRS is also smaller than ever before, only 13-14º long. Moreover, it also has a shorter circulation period (3.6 days) and possibly faster wind speed (~144 m/s) than ever recorded before, except for a Galileo Orbiter measurement in 2000 May. These exciting results are presented in detail in Report no.7 [ref.7].

S. Equatorial Belt

SEBs jet: In the retrograding jet, the JUPOS chart reveals just three white spots tracked up to Jan., with DL2 = +112, +115 --> +119, and +129 deg/mth; and a few more in Feb., with +122 deg/mth. These are typical of the full speed of the jet.

Light patch p. GRS: Having spent several months just p. the Red Spot Hollow, this long-lived patch is now decreasing in L2 and drifting slowly away from the GRS. It still has the form of a light cream-coloured oblong at ~16ºS with an irregular cream-coloured cloud patch on the north side (Figs. 1 & 6).

Rifted region f. GRS: This is still large and very active, with new white spots arising at the f. end, sometimes very bright and methane-bright, as happened on 2013 Dec.10 and 2014 Feb.13-18 (Fig.6).

SEBn jet: In the prograding jet, the JUPOS chart reveals several dark spots tracked with DL1 = -3.5 deg/day. There is no sign now of a S. Equatorial Disturbance.

Equatorial Region

The EZ is filled with a filigree of blue-grey festoons and delicate streaks [e.g. Fig.5B]. In methane images it is no brighter than other zones, and the festoons are easily visible as methane-dark [Fig.2], indicating that there is not much overlying haze this apparition.

On the NEBs edge there is a typical, prominent array of large dark formations ('projections'), mostly with DL1 = +4 deg/mth. Most of them can be traced for months on the maps [**Fig.8]**, though they have rapid small-scale changes which always make them less obviously continuous at the high resolution of the JUPOS chart [**Fig.9**: grey shaded tracks]. Some are associated with bright white plumes. (E.g. one bright plume at L1 = 267 on Feb.5 which was noted as very bright in the near-infrared by Barry Adcock; this was probably a rapidly prograding white spot (see below), being at L2 ~ 260 on Feb.9.) The large formations are sometimes disrupted by passing rifts in the NEB (examples underlined green in Fig.8).

The JUPOS chart also reveals a plethora of rapidly moving smaller spots, both dark (blue lines on **Fig.9**) and white (dark brown lines); some of these are identified by blue and red arrows on the maps [**Fig.8].** Some of them are conspicuous in hi-res images, being very dark or very bright. Their speeds range widely from DL1 ~ -8 to -28 deg/mth, plus two probable spots with DL1 ~ -38 deg/mth, and one (a white spot crossing large formation **c** in Dec.) with DL1 = -48 deg/mth! They are especially prominent in the range L1 ~ 210-310 where there has only been one large and not-very-stable formation, but they are also seen at other longitudes, sometimes cutting across the large dark formations.

Discussion: NEBs speeds and NEB cycles

The speeds from -8 to -28 deg/mth are typical of small features recorded in this latitude in most apparitions from 2001/02 to 2009 [JUPOS results, reports in preparation], and we now think that these are normal in the NEBs, perhaps representing the faster flow in which the large dark formations are embedded as waves. Although they were rarely detected before 2001, probably due to lower resolution, they may be present in all years except when the large dark formations are particularly dominant (e.g. 1979, during the Voyager encounters, and 2012/13, after the NEB Revival). However, the speeds of ~-38 and -48 deg/mth are less common. We recorded such speeds in 2008 (before the 2009 NEB broadening event) and 2010 (before they accelerated even further in the run-up to the 2012 NEB Revival). Therefore, these fast speeds could be an early sign that the next NEB cycle is about to begin.

According to the usual cycle period of 3-5 years, a new NEB broadening event or Revival could occur as early as 2015. The NEBn edge has retreated southwards, and the dark barges have disappeared, so a new broadening event could indeed occur in 2015. However there are still plenty of very active 'rifts', so until this large-scale convection stops, I think the conditions will not be ready for another full-scale NEB Revival.

N. Tropical region

The dark barges have disappeared, and the NEBn edge is marked by about 7 grey projections with DL2 ~ +9 (±1.5) deg/mth.
In the N.Tropical Zone, the only significant feature is formerly-white Spot Z, which has drifted with mean DL2 = -14.6 deg/mth throughout this apparition. It changed from a grey smudge to a slightly reddish-grey oval in Nov-Jan. [ref.1], and then brightened again during Feb. so that it is now (March) only just perceptible as a very light reddish or pink oval. Despite its low contrast in visible light, it is still very prominent in methane images as a bright oval. **[Figs.2 & 10]**

N1 (North Temperate) domain

The N. Temperate domain is still evolving after the 2012 NTBs outbreak, exactly as it did after the 2007 NTBs outbreak. It has now reached the stage where there are organised disturbed sectors in the NTB with at least one associated darkened sector of the NTZ which we call a North Temperate Disturbance (NTD), just as in 2009. A NTD is a darkened sector of NTZ, and in 2009, we showed that the NTD appears to be generated from a miniature rifted region (strip of convective turbulence) in the NTB, which creates disturbance on the retrograding NTBn jetstream, which leads to eddying and darkening in the NTZ [ref.8, esp. ref.8b]. Sometimes the ends of the NTD are quite well-defined, and affect passing NNTBs jet spots, but not always, and recirculation is sporadic rather than systematic. The association of the NTD with a mini-rifted region at its p. end was confirmed for all previous well-observed examples [ref.8d], and is confirmed again in the present apparition.

The N.Temp. domain looks very complex in images and maps, but is organised into 8 distinct sectors, which have undergone only limited changes in the past 5 months. These are marked on a set of maps [**Fig.11**] and the JUPOS chart [**Fig.12A**], and are described below.
(The sectors are numbered differently from in the maps in the previous interim report [Ref.1].
The last map from that report is repeated as the first map in this one, for consistency.)

Sector number:
(1) A rifted sector of NTB (Nov-Mar.) [**Fig.10A**]. This has generated:
(2) A short darkened strip of NTZ, which can be called a second NTD (Dec-Mar.). At its f. end:
(3) A bright cyclonic white oval (CycWO) (Aug-Feb.) and AWO (Sep-Feb.). In Feb., the CycWO attracted attention as it turned into a new rifted region [**Fig.6**].

> The CycWO and AWO were both unusually prominent. In early Feb., while the AWO became very small, the CycWO became fawn-coloured, and disturbed at the limit of resolution (a small FFR). Then [**Fig.6**] on Feb.17, a tiny white spot appeared in it, which rapidly expanded, and was discovered as a brilliant feature on Feb.19 by Ed Grafton and Chris Go. (Unfortunately, no methane-band images were taken on Feb.17-20, and by Feb.22 this spot was not methane-bright, although it may well have been a convective plume. It was at 29.5ºN.) It quickly became a new rifted region.

(4) A very dark segment of NTB(N) (Aug-Oct.), which became red in Oct., then faded and became a bright cream-coloured oblong in Dec.[ref.1]. This has persisted into March, becoming whiter; and on its N edge a large dark spot has appeared in March (probably due to the new rifting in sector 3).
(5) Several very dark streaks of NTB(N) (Dec-Mar.).

(6) Another rifted sector of NTB (Aug-Jan.). It presumably generated the first NTD (sector 7), but since Jan. it has shown few bright spots, suggesting that its activity has declined. But it is still turbulent in some of Peach's v-hi-res images, e.g. Feb.16 [**Fig.5C**].
(7) The first NTD: darkened sector of NTZ (Aug-Dec.). Since Jan. it has not been consistently dark, suggesting that the NTD may be fading as the rifting in sector 6 subsides; but it is still filled with light fawn shading and a variety of dark spots, some of them very dark.
(8) Undisturbed sector, 160º long, until mid-Feb. when a tiny new rifted region appeared, generating a remarkably dark spot in NTZ (Feb-Mar.) [**Fig.13**].

This sector, spanning the remaining 160º of the domain, was undisturbed until recently, with a normal NTB (pale reddish S half, narrow grey N half), and white NTZ. However, a remarkably dark spot in the NTZ was reported by Dave Tyler on Mar.8. It was so dark that the possibility of an impact origin was considered, but Anthony Wesley and Michel Jacquesson compiled images showing that it had been developing gradually since mid-Feb., and seems to be due to a new focus of cyclonic rifting, the fourth to appear. The best images [**Fig.13**] show a small turbulent outbreak developing in the NTB in early Feb., probably cyclonic, then the very dark spot developing f. it, initially on Feb.16 when one can see tiny dark spots enveloping a tiny white spot, which I suggest was an anticyclonic vortex. The small black arrowheads are suggested identifications of subsequent tiny dark spots which I think were arising from the turbulent outbreak (so small-scale that it is barely visible in some images) and retrograding to merge with the very dark spot, making it especially dark on Feb.21 and Feb.28 and thereafter [**Fig.13**]. All these spots were dark in methane images.

Michel Jacquesson showed that the very dark spot was initially at 32°N (in the anticyclonic zone), and retrograding at DL2 =+24 deg/mth, reaching L2 = 43 when discovered in early March. It has not retrograded quite so fast during March. It is still conspicuous in late March.

Discussion:

These phenomena in the N.Temperate domain are consistent with our model of the NTD [ref.8b]. They are examples where intense (although small-scale) turbulence in the cyclonic belt gives rise to retrograding disturbance which feeds dark material into the adjacent anticyclonic zone. This also happens in most other domains from time to time. A close parallel is in the S. Temperate domain, where a dark turbulent STB segment generates a slow-moving 'Sf. tail' of dark spots which can merge to form an anticyclonic dark spot [ref.5].

The drift rates all belong to the usual N.Temperate Current (NTC). The JUPOS chart [**Fig.12A**] shows that almost all features in sectors 1-7 are drifting with DL2 = +16.3 (±0.3) deg/mth, whereas dark spots or streaks in the f. part of the NTD sector 7 and in the undisturbed sector 8 drift with DL2 ~ =29 (±2) deg/mth. The JUPOS charts do not reveal any rapidly retrograding nor recirculating spots, so far, though closer scrutiny of images might reveal them: for example in **Fig.13**, tiny dark spots were probably retrograding from the new rifted region to form the new dark spot.

The disturbed sector of N.Temp. domain seems to have affected the pattern of belts in the adjacent N.N.Temp. domain (see below).

N2 jet (NNTBs jetstream)

The previous NNTBs jet spots, arising from an outbreak which started in late 2012, had all disappeared or merged into two large red ones by late Dec. [ref.1] (* on maps in **Figs.1 & 11**). These faded to pale brown in Jan., then disappeared. But new small dark spots did appear from late Nov. onwards, more typically dark grey, appearing at L2 ~ 340 --> 320, which is alongside a dark reddish-brown bar of NNTB. Their appearance is shown in detail in **Fig.5C,D;** they emerge from slightly higher-latitude streaks alongside the dark bar, but the ultimate origin of this disturbance may be a bright strip, probably a mini-rifted region with convective turbulence, overlapping and f. this dark bar [**Fig.5C,D**, and inside orange box in **Fig.13**].

Two of these new jet spots, 43 deg. apart, produced an interesting intimation of local gustiness in the jet (indicated by red arrows in **Fig.12B**): in Jan-Feb., they simultaneously performed identical speed variations, while the older spot in between them hardly changed its speed at all (and then disappeared). In Feb-Mar., the NNTBs jet spots are prominent dark rings [Figs.6 & 11]. These spots are not generally interrupted by the NTD(s).

N2 (N.N. Temperate) domain

Alongside the disturbed sector of N.Temp. domain, the NNTB has disappeared and the whole width of the N.N.Temp. domain has brightened. (This can be seen in Fig.11 in Feb-Mar., where the + + + symbols, placed underneath NNTBs jet spots, lie in a bright 'zone' instead of a NNTB.) This whitened sector has sharp boundaries which coincide quite well with those of the disturbed N.Temp. domain. At the p. end is a very dark grey NNTB(N) segment which forms the dark rim of NN-LRS-1 and is spreading f. from it [enveloping the fading red remnants of the previous dark red NNTB bar; Fig.10B]. At the f. end is a very dark brown NNTB segment, where the NNTBs jet spots form [Fig.5C&D & Fig.13].

Another red-brown NNTB bar was very dark in Dec-Jan. as it drifted alongside NN-LRS-1, and as it did so it split in two, evidently disrupted by the anticyclonic circulation of the oval. This event was reported by Kevin Quin and Michel Jacquesson, and hi-res images of it are in **Fig.10A**. Then in early March, the two reddish remnants faded and disappeared as they were enveloped in the very dark NNTB(N) spreading f. from NN-LRS-1 [**Fig.10B**].

References [next page]

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   'The Great Red Spot in 2013/14: Faster shrinkage and evidence for faster wind speed'.
   http://www.britastro.org/jupiter/2013_14report07.htm

8. *From our Reference Articles page (box below), esp. no.8b:*
   http://www.britastro.org/jupiter/reference.htm

N.Temperate Disturbance:
"This is a darkening of a sector of the NTZ, which can last for several years. Some NTDs have developed ~2-3 years after NTBs super-fast jetstream outbreaks, as happened in 2009....
Study of the North Temperate Disturbance (NTD) in 2009 has led to a model which explains it as the product of two phenomena: 'rifts' (turbulent convective disturbance in the NTB), which produce the p. part of the NTD, and generate disturbances on the retrograding NTBn jet; and eddying from the NTBn into the NTZ, which produces the f. part of the NTD."

8a) 'Jupiter in 2009: Interim Report, with new insights into the NTZ disturbance, NEB expansion, and SEB fading.' (by Rogers JH) http://www.britastro.org/jupiter/2009report07.htm

8b) 'Jupiter's North Temperate Region in 2009: The nature of the North Temperate Disturbance.' (by Adamoli G & Rogers JH) http://www.britastro.org/jupiter/2009report08.htm

8c) 'North Temperate Disturbance (NTD) in 2010, and a general conjecture about the behaviour of anticyclonic dark spots' (by Rogers, Mettig, Adamoli, Jacquesson & Vedovato)
in: 'Jupiter in 2010: Interim report: Northern hemisphere': Appendix:
http://www.britastro.org/jupiter/2010report09.htm

8d) 'North Temperate Disturbances: Is NTB rifting necessary?' (by Rogers JH, 2010)
[A historical survey showing that previous N.Temperate Disturbances have always been associated with 'rifts' in the NTB if photographed at sufficient resolution:]
http://www.britastro.org/jupiter/reference/NTD&Rifts_historicalreport-2010jul28.pdf

Figure legends

South is up in all figures.

Figure 1: Maps, 2014 Feb.18-19. (Credits are on the maps.)
(A) Cylindrical projection; System II longitudes; south up; map by Marco Vedovato.
(B) North polar projection; System II longitudes; map by Marco Vedovato. Note the remarkable amount of detail in the polar regions.
(C) South polar stereographic projection, i.e. constant latitude scale; System III longitudes; map by Manos Kardasis. The south polar region, as always, has much less detail but more regular belt patterns than the north polar region.

Figure 2: Images in methane band and ultraviolet, around the planet. Long-lived anticyclonic ovals are marked in purple, and some major cyclonic features in green. (Also see **Fig.6.**)

Figure 3. Charts of the S3 domain. (A) JUPOS chart of longitude vs time, showing the long-lived AWO, a chain of slow-moving dark spots (arrowed), and the tracks of the S3 jet spots.
(B) JUPOS chart for the S3 jet white spots, in a system moving at -3.0 deg/day in System II.
(C) Zonal drift profile for the S3 jet spots (analysis by G. Adamoli).

Figure 4. Images showing the high southern latitudes, inc. long-lived anticyclonic ovals in the S4, S3, S2 and S1 domains. The S4-AWO is slightly reddish, as usual. (For another v-hi-res image of these ovals, see Fig.6, bottom right image.) Note the white spots prograding in the S3 jet (marked in red). The images also show important features in the S. Temperate (S1) domain: **(A,C)** Oval BA with the STBn jet outbreak p. it and the dark turbulent STB f. it; **(B,D)** the STB Ghost, having just passed the GRS.

Figure 5. (A-C) Set of 6 v-hi-res images in 2014 Feb., in 3 separate alignments.
(A) S. hemisphere, showing oval BA and the origin of STBn jet spots p. it. Note how the narrow dark STB(N) becomes wavy and breaks up into the string of dark spots (probably anticyclonic vortices) – a classic illustration of an instability breaking up the flow of a jet into waves and eddies.
(B) Equatorial region. Fine views of some large NEBs projections and a bright NEB rift, which seems to induce transient brightening of a white plume adjacent to one NEBs projection (L1 = 162).
(C) N. hemisphere, showing the origin of the rapidly prograding NNTBs jet spots alongside a dark brown segment of NNTB. The dark spots (anticyclonic vortices), numbered 1-7, seem to form at lower latitude from little narrow streaks, whose origin is unclear, but could be alongside the irregular bright strip further f. (possibly a turbulent mini-rift). The new NNTBs jet spots are prograding into the NTD (NTB sector 7), which at this time consists only of light shading and a scattering of dark spots in the NTZ. The mini-rifted region (NTB sector 6), which is believed to generate the NTD, had been largely quiescent since Jan., but shows intermittent activity in this sequence. Further north, several small white ovals can be seen with differential drifts.
(D) Set of 6 v-hi-res images in 2014 Feb., N. hemisphere, as for (C). The NNTBs jet spots, numbered 1-4, form from ill-defined streaks alongside the dark brown NNTB segment, possibly originating alongside the irregular bright strip, as in (C). [Also see images in **Fig.13**.]

Figure 6. Images of the GRS side of the planet in 2014 Feb. Some features of interest are marked, especially new cyclonic outbreaks in the SEB and NTB. Methane-band images are included, showing that the new white spot in the SEB was initially methane-bright. An alignment of the GRS images is shown in Report no.7 [ref.7].

Figure 7 [*included in Fig.6*]. An image showing the GRS region on 2014 March 6.

Figure 8. Set of maps showing the northern EZ and NEB, 2013 Dec. to 2014 March. (Key and credits are on the maps.)

Figure 9. JUPOS chart for the NEBs.

Figure 10. Two long-lived anticyclonic ovals which are now reddish, in the NTropZ (Spot Z) and the NNTZ (NN-LRS-1). Both are strongly methane-bright. The images also show sectors 1-3 of the disturbed N.Temp. domain.
(A) 2014 Jan. Spot Z is reddish-grey. NN-LRS-1 is orange with a dark grey rim. A dark red-brown NNTB bar splits in two as it drifts past NN-LRS-1, as it is disrupted by the anticyclonic circulation of the oval.
(This is just a small selection of the available views, which include good images by C. Go, J. Phillips, K. Quin, C. Zannelli, P. Lazzarotti, M. Jacquesson, J-J. Poupeau, D. Parker, D. Peach. P. Edwards, S. Hill, M. Phillips, S. Kidd, J. Soldevilla, M. Kardasis, T. Barry, M. Harden, and E. Morales Rivera.)
(B) 2014 March. Spot Z is very light reddish or pink, difficult to discern in visible light, but still very bright in a methane image. NN-LRS-1 may also be lighter with paler orange colour internally. It still has a dark grey rim which has expanded into a long NNTB(N), enveloping the fading remnants of the red-brown bar which split in Jan. (green arrows).

Figure 11. Maps of the northern hemisphere north of the mid-NEB, showing the disturbed sectors of the N.Temp. domain.

Figure 12. JUPOS charts. (A) N.Temperate domain, as annotated.
(B) NNTBs jet spots, in longitude system moving at DL2 = -3.0 deg/day.

Figure 13. Origin of the new mini-rifted region in the NTB and very dark spot in NTZ (in orange box). The orange box also partly encloses the mini-rifted region in the NNTB, which may be the ultimate origin of the NNTBs jet spots. (A version with north up is also available.)