{SEBn-2008_Our report to post.doc}

The SEBn jet and SED in 2008

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(using data from the JUPOS team:
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This is our final report on the behaviour of the SEBn jet-stream and the South Equatorial Disturbance (SED) in 2008. A preliminary report (up to 2008 August) was included in Ref.1 on our web site. This final report was largely written in 2011 August, and much of it was incorporated in Ref.2, published in Icarus. In the present version (finalised for posting in 2012 August.) we give more details, and we present the images and charts according to our usual conventions with south up and east to the left.

The SED in 2008 was still an impressive feature, with a distinctive 'stormy sector' p. it. **(Fig.1)** The appearance of the main complex **(Figs.2 & 3)** ranged from the classic 'active' form with rift and great white spot (early May) to a remarkable cream-coloured large oval (late July) that contrasted with the innumerable small blue-grey streaks over the rest of the EZ.

The main complex passed the GRS on April 29 and June 23 and August 17. This year it was not visibly rejuvenated when passing the GRS, but instead, its bright rift was reinforced several times by connecting to rifts in the mid-SEB convective outbreaks that were ongoing over a wide range of longitudes during this apparition These events support the hypothesis that the usual rejuvenations of the SED are not due to the GRS itself, but to the mid-SEB rifted region that usually follows it. This year, the extensive mid-SEB outbreaks were performing that role instead. However, it became quiescent after passing the GRS in 2008 Oct., and was never again a prominent feature.

Methane images showed it as a methane-dark patch with SEBn 'step-up', just as in previous years when it was active **(Fig.3).**

The SED had a drift rate of DL1 = +32 deg/month (u3 = 89.6 +/-0.4 m/s) from April to June, then decelerated; DL1 = +36 deg/month (u3 = 87.9 +/-0.2 m/s) from early July to late November. L1 = 30 at opposition on July 9.

Preceding the main complex there was an impressive 'stormy sector' of small but high-contrast spots and projections, throughout this period **(Fig.1)**. At the start of June it appeared rather chaotic, but all through July and August it consisted of a regular array of at least 6 conspicuous chevrons with spacing 8 deg. increasing eastward to 9 deg. as they accelerated.

The JUPOS chart **(Fig.4)** shows the motion of these SEBn features very clearly, and beautifully confirms the pattern that we have reported since 1999 (ref.3): the chevrons move faster with increasing distance p. the SED. This year, individual chevrons could be tracked accelerating in this flow. Final averages of distances, speeds and latitudes (omitting five spots which were anomalously slow for their longitudes) are as follows (Table 1):

Longitudes	***DL1***	**+/-**	***U3***	**+/-**		***lat.***	***SD***	***N***
(deg. E of SED)	***(°/30d)***		***(m/s)***			***('graphic)***		
0-45	-30,2	2,7	120,0	1,3		-7,46	0,28	12
45-110	-42,6	6,5	126,0	3,1		-7,15	0,24	26
110-160	-62,1	6,0	135,2	2,8		-7,36	0,18	5
220-320	-71,8	8,4	139,9	4,0		-7,18	0,28	6

Thus the chevrons moved more slowly east of the SED, showing a gradient of speed covering ~160 degrees longitude **(Fig.6)**. Around the remaining longitudes, most chevrons moved with the peak speed of u ~ +140 m/s. In addition there were a few slower-moving ones. The mean latitude was 7.23 (+/-0.27, s.d.) deg.S, with no correlation with speed **(Fig.7)** (although some of the slow-moving projections closest to the SED had slightly higher latitudes, presumably because the SEBn was deflected by the SED itself). These values are very similar to those recorded in 2000 during the Cassini flyby (ref.3).

Subsequent analysis of Cassini movies has revealed that the chevrons in 2000 were oscillating in latitude with a 7-day period, representing waves with a wavelength of ~20 deg (ref.2). We therefore examined our 2008 data to see if such oscillations could be detected, but were unable to identify them. Plotting the latitudes along the individual chevron tracks showed some possible variations but no convincing oscillations in latitude. Plotting the ensemble of chevron latitudes against longitude (in relevant longitude systems) did not reveal any wave pattern. These negative results are not surprising, because the oscillating spots in the Cassini movies were difficult to recognise in static maps, and the waves guiding them were never visible, because of confusion by other, shorter-lived and chaotic streaks in the same latitude band. Only long-term spacecraft imaging provided the continuous hi-res coverage necessary to trace these remarkable oscillations.

In conclusion, the amateur observations from 2008 clearly confirm our previous conclusions (ref.3) about the SED and its influence on the speed of the SEBn jet.

***References**:*

(1) Rogers JH (2008) 'Jupiter in 2008: Full Interim Report.'
http://www.britastro.org/jupiter/2008report06.htm

(2) Simon-Miller AA, Rogers JH, Gierasch PJ, Choi D, Allison MD, Adamoli G, Mettig H-J (2012). 'Longitudinal variation and waves in Jupiter's south equatorial wind jet.' Icarus 218, 817–830. [doi:10.1016/j.icarus.2012.01.022]

(3) Rogers JH & Mettig H-J. (2008 Dec.), 'Influence of Jupiter's South Equatorial Disturbance on jet-stream speed'. JBAA 118 (no.6), 326-334. *[On-line at:]*
http://www.britastro.org/jupiter/ JBAA%20118-6%20Rogers_SED-paper.pdf

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Fig.1. The SEB on 2008 July 16-19. Map from images by I. Miyazaki and M. Salway, covering ~250 deg. The SED is near the right edge. *South is up in all figures.*

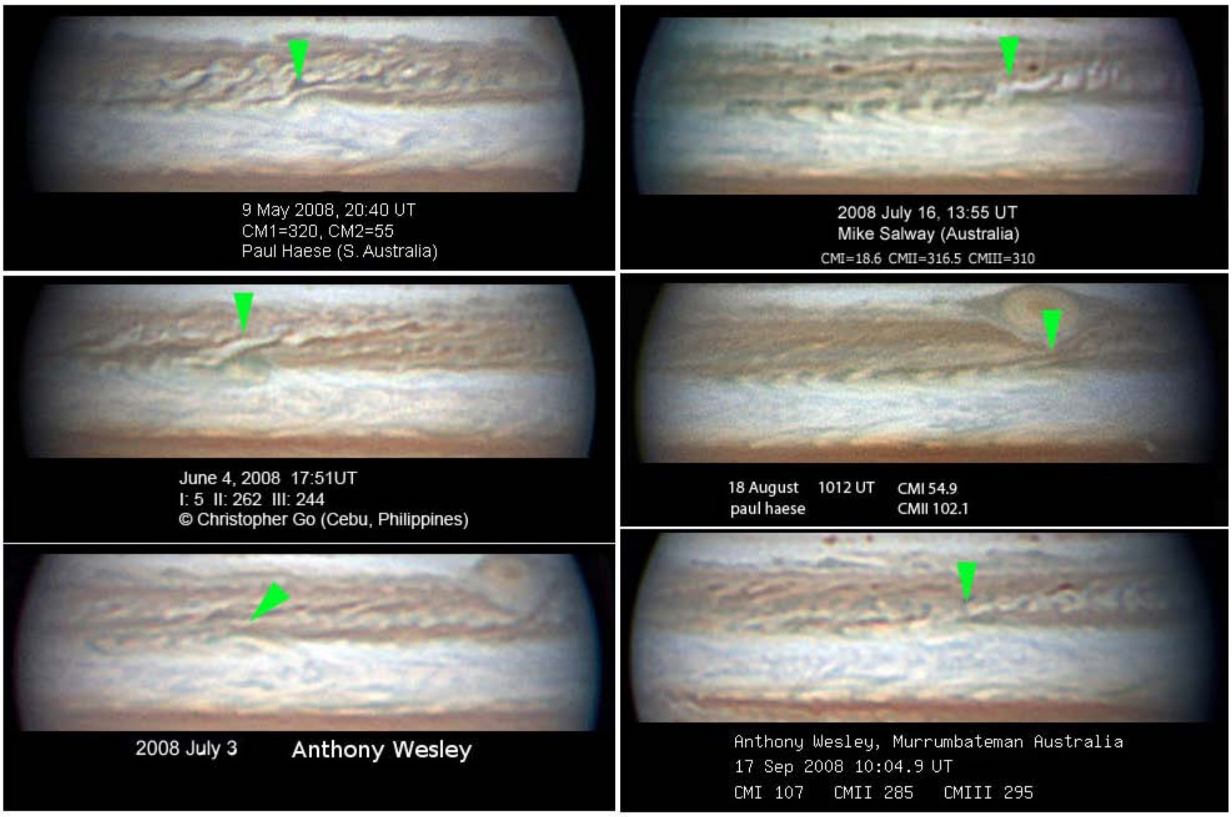


Fig.2. Images showing the SED in 2008 (green arrowhead) with chevrons arising to the left (east) of it. The images include several dates on which it was connected by a bright streak ('rift') to the convective turbulent regions in the SEB.

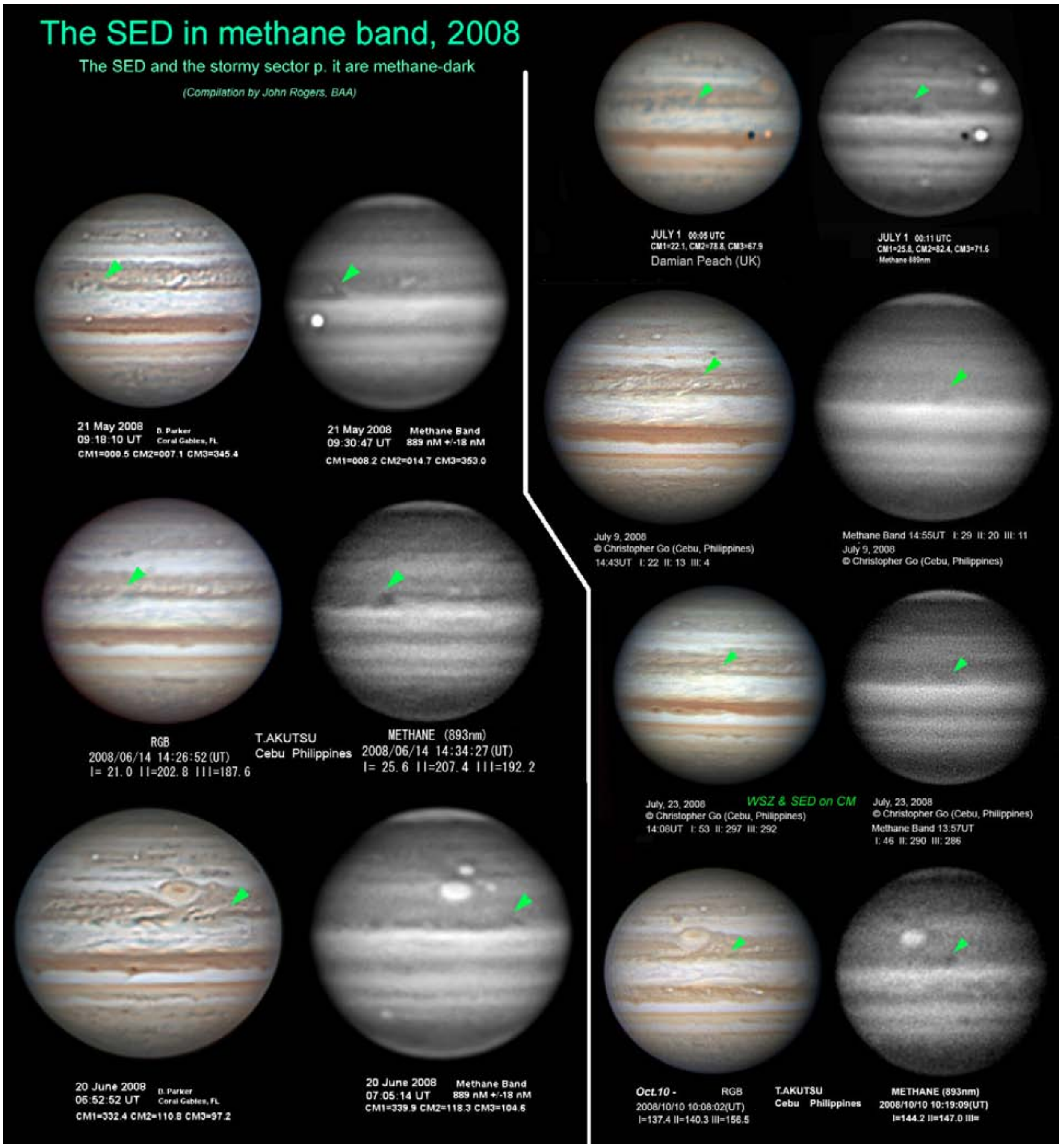


Fig.3. The SED in the methane band (889 nm), 2008. The SED itself is a very methane-dark spot, and the stormy sector of EZ(S) p. it is also methane-dark, as in previous years when it was similarly conspicuous. Variations in appearance may be intirnsic, but may also depend on different filters and different imaging processing used by the observers.

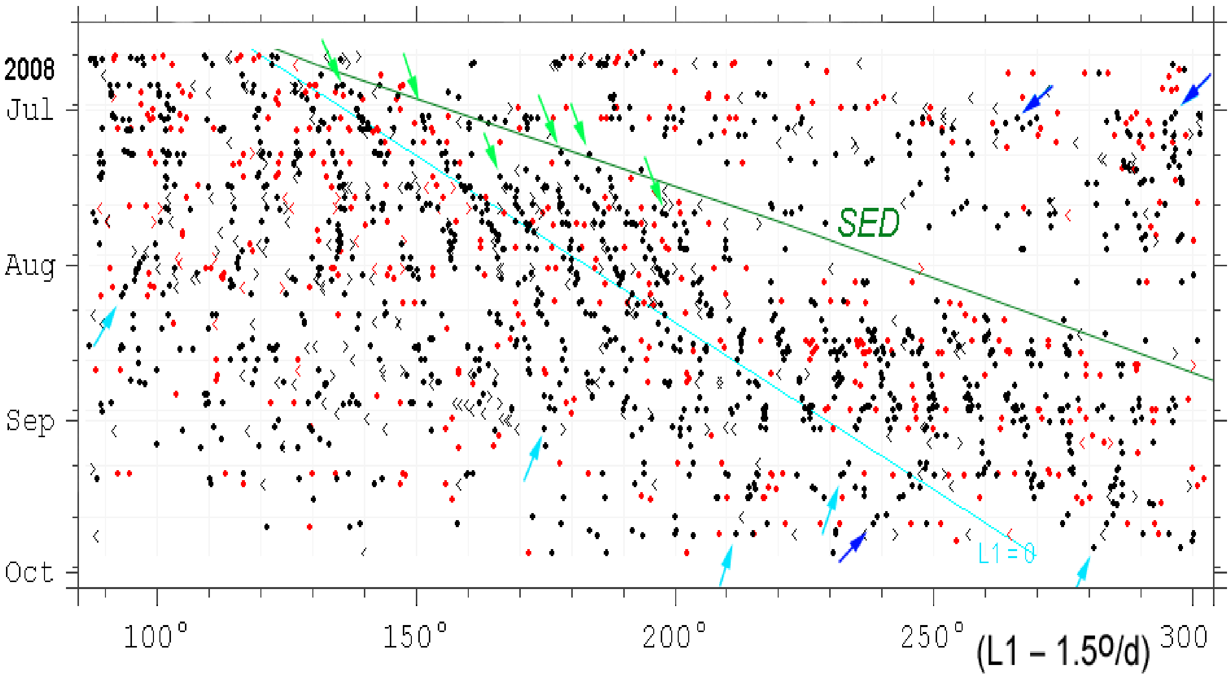
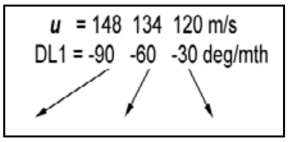


Fig.4. JUPOS chart of longitude vs time, for spots between 6.0 and 9.0 deg.S, plotted in a system moving at -1.5 deg/day relative to System I [-8.8633 deg/day relative to System III]. The chart shows dark spots, i.e. chevrons (black points) and bright spots between them (red points). Note how the tracks of chevrons begin slowly on the east side of the SED (e.g. green arrows) then accelerate (e.g. cyan arrows) so the fastest tracks are far to the east of the SED (e.g. dark blue arrows). The box at right indicates the gradients corresponding to 3 representative speeds.



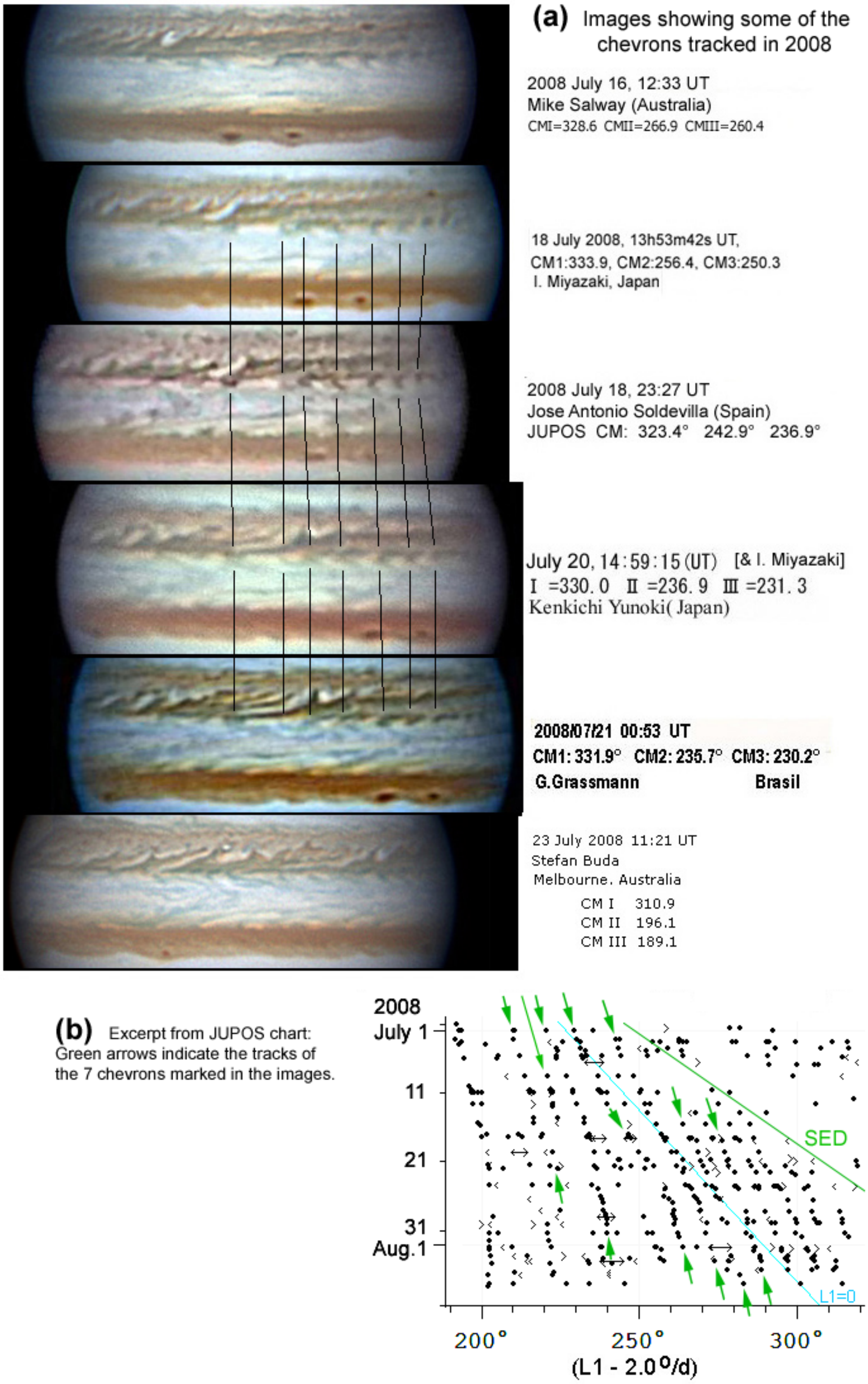


Fig.5. Example of tracking of chevrons in 2008 from ground-based images.
(a) Images showing a train of chevrons in 2008 July. (Aligned on small NEBs projections which were moving rapidly at ~ -2 deg/day in System I.).
(b) Excerpt from the JUPOS chart showing the same region. Green arrows indicate tracks of the 7 chevrons marked in the images. Longitude is in a system moving at -2.0 deg/day in System I.

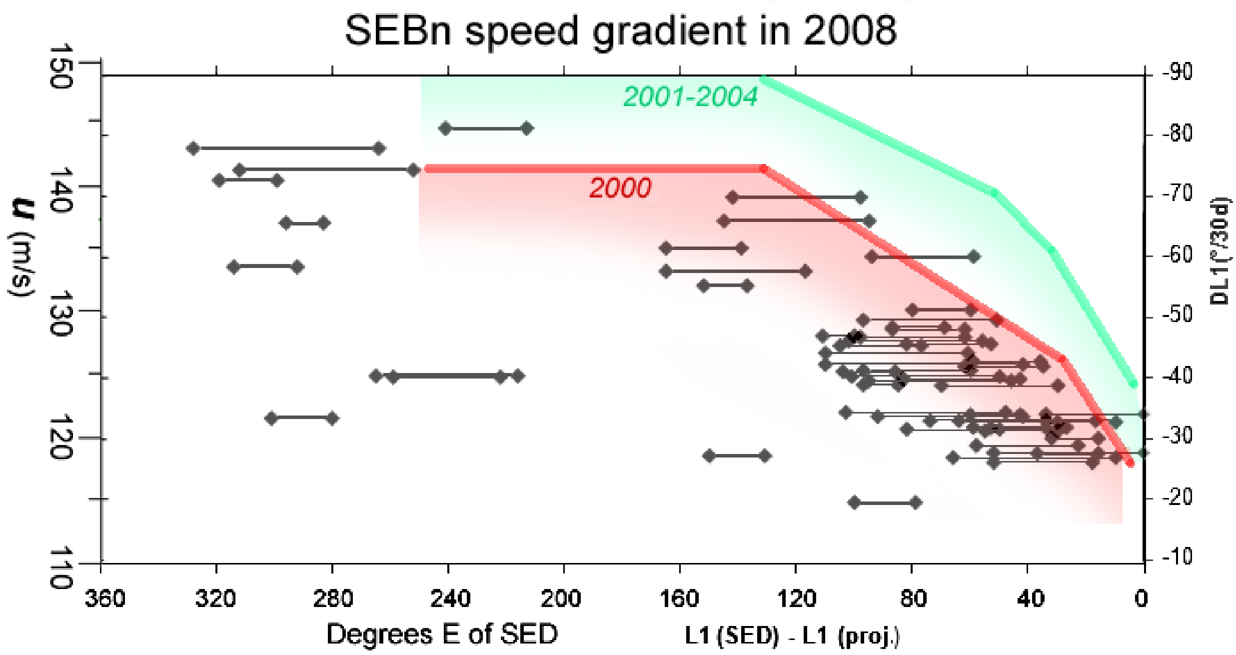


Fig.6. Variation of speed with longitude relative to the SED: Chart of speeds of chevrons vs distance east of the SED in 2008. For each measured track segment the start (right) and end (left) are shown, with the mean speed. Coloured lines indicate approximately the gradients observed for starts of tracks in 2000 and 2001-2004 [ref.3]; the 2000 gradient (during the Cassini flyby) agrees well with the 2008 data. Speed scales are in m/s in System III (left) and in degrees per month in System I (right). Means from these data are in Table 1.

Fig.7. Chart of speed vs latitude, showing that the different speeds are not due to different latitudes. Mean wind profile from Cassini (Porco et al., 2003) is shown for comparison.