Mid-SEB Outbreak in 1998

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Summary

The most interesting phenomenon was the mid-SEB outbreak in the apparition of 1998. Miyazaki found a group of white spots of SEBZ located at 315-345 degrees of system-II (L2) in March 31, 1998. This source of outbreak moved slowly forward at the rotation period of 9h55m18.8s. A lot of white spots, which were supplied from the source, expanded rapidly forward the SEBZ, and the preceding end reached at L2=100 in early August. Many white spots of outbreak filled up the region of 190 deg. of the longitude in SEBZ. This preceding end had the rotation period of 9h54m21.4s.

When the preceding white spots reached at L2=100 deg. in early August, they disappeared as the white spots got into the SEBn. This feature was maintained at the preceding until the end of apparition. The source of outbreak moved slowly forward, but the activity of outbreak source became weaker in September. Therefore the white spots, which were located at the following end, disappeared within the region of 50 deg. until the end of September. The longitude of the preceding end maintained at about L2=100-130 since October. On the other side, because the following end of outbreak moved slowly forward, it became shorten to the 40 deg. length in December.

1. What is the mid-SEB outbreak?

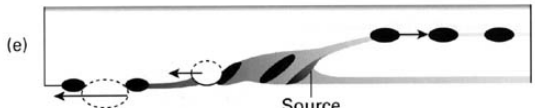

Figure 1. SEB Disturbance

Figure 2. mid-SEB outbreak

2. Early observations of mid-SEB outbreak (from March to May 1998)

Miyazaki reported that three white spots occurred at L2=315-345 of SEBZ in March 31, 1998. This was the first report of the mid-SEB outbreak, because the solar conjunction was in February 23. Secondly, Ikemura's CCD image in April 10 showed the dark spot and the preceding white spots in L2=350. In April 29, these were confirmed

that several white spots were expanded at the locations L2=300-330 by Ikemura's CCD image and Iga's drawing (Figure 3).

Pic du Midi laboratory released the CCD images of near-infrared and methane band in May 7. These images showed that a conspicuous white spot was located at L2=340 in SEBZ, and a series of white spots was located at L2=260-340 (Figure 4). At this time, we confirmed that this activity of SEBZ was the mid-SEB outbreak.

By the way, I was interesting another activity in SEBZ in May to June. We observed the group of the dark spots located at further forward region of the preceding end of mid-SEB outbreak. These dark spots moved forward rather fast than the white spots of outbreak, these were located at the latitude of SEBn, and these had the rotation period of 9h53m23.1s (drift: -100.86 degrees/30days) (See Table 7). These dark spots was reached at the just following end of GRS in the end of June. Did these dark spots relate to the mid-SEB outbreak? I think that these are the north branches of the mid-SEB outbreak as the SEB Disturbance has the same branch.

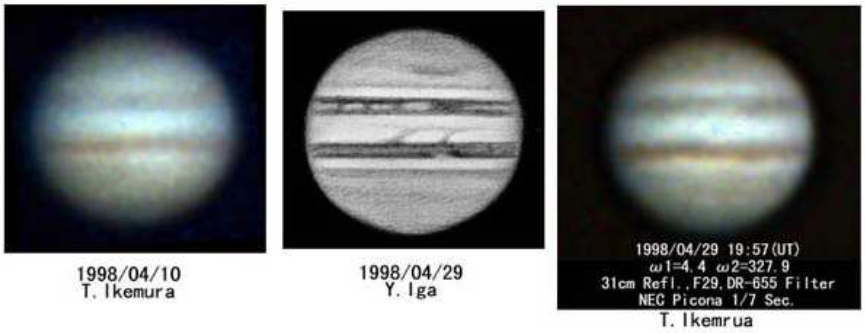

Figure 3. Early observations in April 1998

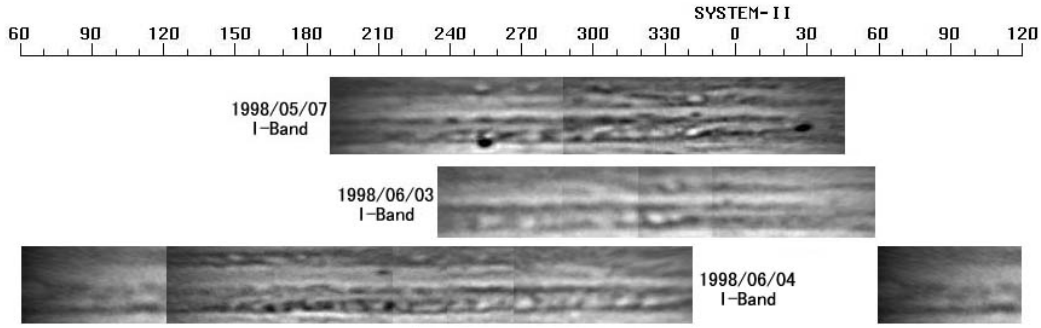

Figure 4. Strip maps from Pic du Midi laboratory (generated by author)

3. Intensive Activities of mid-SEB outbreak (from June to August)

We had many observations under good condition after June (Figure 5). These showed the typical features of mid-SEB outbreak; many white spots occurred at the source moved forward rapidly, and formed a chain of white spots in SEBZ (Figure 6).

The source of the outbreak moved forward slowly by the rotation period of 9h55m18.8s (drift: -15.93 degrees/30days) (See Table 7). The source was located at L2=290 in the end of August, and this maintained to supply a lot of white spots in this period.

The preceding end of the outbreak moved forward rapidly by the rotation period of 9h54m21.2s (drift: -58.3 degrees/30days) (See Table 7). When the preceding end reached at L2=100 in the end of July, these spots moved northward of SEBZ, and always disappeared at L2=100. There was the constantly turbulent region, called Post-GRS Disturbance, in area of L2=100-130, but this region was separated exactly from the activities of outbreak. The region of the outbreak was extended to the half of SEBZ (L2=100 to 290) in the end of August; there were alternatively many white spots and many bluish dark columns in SEBZ.

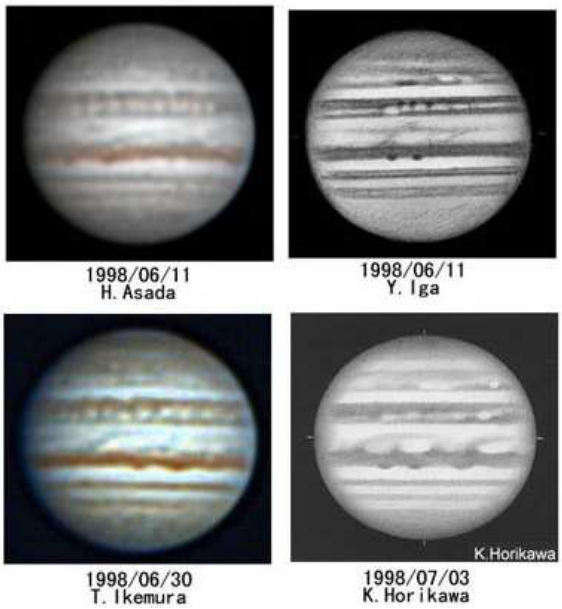

Figure 5. Intensive Activities of outbreak

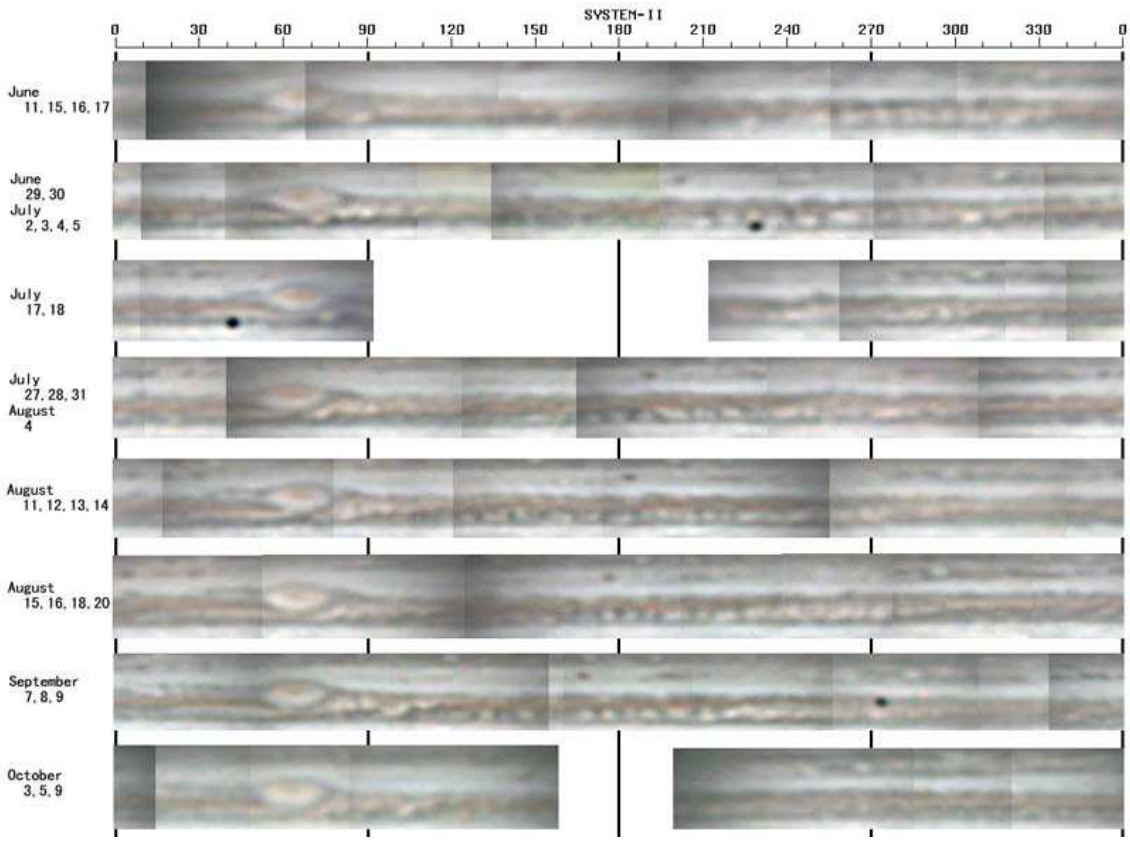

Figure 6. Strip maps by Asada's CCD images in June to October 1998 (generated by the author)

Feature	Period	Degree/day	Degree/30days	Samples
WS P.end	**9h54m21.4s**	**-1.9345**	**-58.03**	**18**
WS F.end	**9h55m18.8s**	**-0.5309**	**-15.93**	**18**
DS P.end	**9h53m23.1s**	**-3.3618**	**-100.86**	**18**

Table 7. Rotation Period of the mid-SEB outbreak

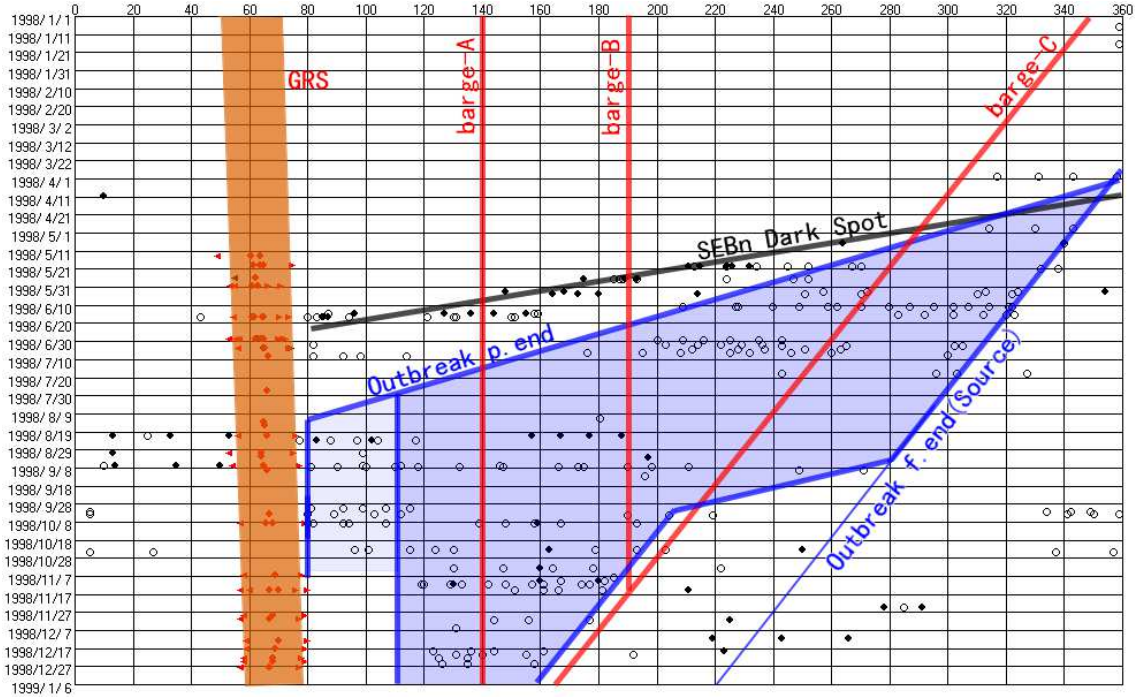

Figure 8. Drift chart of mid-SEB outbreak

Blue area: the white spots of outbreak

Black line: Drift of the preceding end of the dark spots of outbreak

Red line: Drift of three barges

Orange: Great Red Spot

Cyan: the region of Post-GRS Disturbance

4. Receding of the mid-SEB outbreak (from September to December)

The mid-SEB outbreak became weaker in September. The source of outbreak was located at L2=280 in the early September, maintained to supply many white spots. But during a month, the white spots disappeared gradually in the region of L2=230-280 where was the preceding of the source. In the end of September, the following end of active region was located at L2=210, and this location supplied white spots as a new source (Figure 8). This new source also moved forward slowly as the same drift, but I could not decide that the new source was the new generation of outbreak.

The white spots of the preceding end of outbreak, were separated from the activity of Post-GRS Disturbance, moved northward into SEBn, and always disappeared at L2=100. But the white spots of outbreak disappeared at L2=130 in November, because the Post-GRS Disturbance was not active. The region of outbreak was L2=130-190 (length was 60 degrees) early in November, and became shorter to L2=130-160 (length was 30 degrees) in the end of December.

5. Model of mid-SEB outbreak

The mid-SEB outbreak in 1998 was 5-th appearance after 13 years since 1985. Except 1966-1968, the source of outbreak occurred within 100 degrees following the GRS. The source of outbreak occurred at the location of the 280 degrees following GRS in 1998. As the length from the source to the disappearance (following GRS) was longer than past events, this activity of mid-SEB outbreak was very intensive and long-lived.

There were three reddish barges (or the streak that the barge was expanded to the east and west) in the middle of SEB (SEBc) from the detailed CCD images. Two barges of them were located at L2=140 (barge A) and L2=190 (barge B), and had no drift. Another barge was located at 60 degrees in front of the source, and moved forward slowly as the same drift of source (barge C). When the white spots of outbreak moved forward from the source and encountered with the barge C, the activities of white spots changed to the northward of SEB. Furthermore, when this region moved forward and encountered with the barge B and A, the region of the activities became narrower northward. Finally, the white spots disappeared at the location of L2=100. By the interactions of the barges, SEBZ was separated to four sectors as to run down the steps. The region, which disappeared in September, was the last sector from barge C to the source. It seemed also that the white spots accelerated more whenever came in other sector.

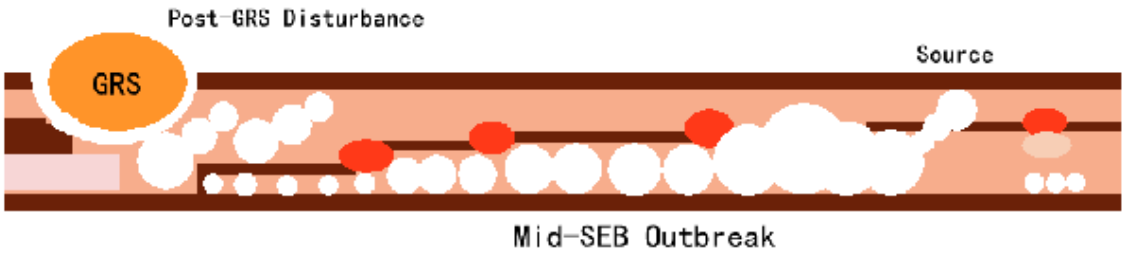

Figure 9. Model of the mid-SEB outbreak

Reference:

(1) J.H.Rogers, The Giant Planet Jupiter, Cambridge Univ. Press (1995)