Jupiter in 2016-17, report no.8 (expanded)

Mergers of small ovals in the S2 domain

--John Rogers (2017 May 20)

On March 5, Damian Peach noticed that a pair of very small anticyclonic white ovals (AWOs) in the S.S. Temperate (S2) domain* were in contact and likely to merge. He and other observers, notably Clyde Foster, took images of this region over the following days and succeeded in documenting the interaction, despite the small size of the ovals. Figure 1 is a compilation of the images.

As you can see, one oval swung round the other on March 5-7 and by March 10 only one was left. However, it was rather dull, and some bright material – either remnants of the second oval, or newly generated cyclonic disturbance – formed a streak out to the west on March 8-10.

We cannot be certain that the ovals merged; it is possible that one was just torn apart. This is an ambiguity that we have encountered repeatedly, particularly with encounters of larger AWOs in the N. Tropical domain. Atmospheric dynamics suggests that the ovals merged, at least partially, so perhaps it is reasonable to continue referring to such events as 'mergers'. If so, we can expect the remaining oval to emerge as bright as before and larger (but see below).

Such interactions between very small ovals could not have been regularly tracked until recent improvements in amateur imaging. They are probably common and would be unremarkable, except that this one fits into a pattern that is developing in this sector of the S2 domain.

This was at least the fourth such merger of tiny AWOs in this sector in the last 15 months, as suggested by the JUPOS chart (Figure 2). A single AWO with an oscillating track (now named A5a) has been the more westerly partner in each event, absorbing smaller ovals that come towards it from the east. The first such event, in 2015 Dec., has not previously been documented; the relevant images are assembled in Figure 3. One in 2016 June was shown in our final report on 2015/16 [Ref.1 Fig.21], although hi-res imaging ended as they were merging. There was probably another such merger early in Feb., 2016, with an exceptionally small eastern oval (see first map in Figure 4). Another event in 2016 August would be unknown but for the JunoCam images at perijove-1, which showed a pair of ovals undergoing the same type of interaction (see last map in Figure 4). So the event in 2017 March was the fourth or fifth in this series. Another occurred on 2017 April 1, although it was not so well covered by images.

These mergers are between tiny short-lived ovals, which are too small to have been reliably observed until recently. But there were a couple of similar events in 2010, contributing to the present long-lived ovals A6 and A7 [Ref.2].

These very small AWOs are not numbered and belong to the 'small, short-lived' category. To quote from our long-term report on this domain [Ref.2].

> "There have always been between 6 and 9 long-lived AWOs in this domain from 1986 to 2013. They have similar drift rates, and tend to form clusters, though when they approach close together (see below), they almost always drift apart again as though repelling each other.....
> In contrast, transient AWOs also appear (seven recorded, but the recent frequency has been about one every two years), but do not last more than 1-2 years; and they can disappear either by merging, or by shrinking to invisibility.
> It is notable that the number of the [long-lived] AWOs has remained between 6 and 9 throughout the 27 years reviewed, suggesting that the number is somehow regulated.... [An] hypothesis is that these ovals develop to take up surplus energy and vorticity that cannot be accomodated in the jets, so a certain number of them may be required for this function, regardless of their spacing."

The present activity is nicely consistent with this historical behaviour. Possibly there is no fundamental difference between small and large types, but the smaller ones are free to drift and thus to merge or be disrupted, whereas the larger ones span much of the width of the domain and thus tend to be more stable, especially as they usually end up in regular alternating chains of cyclonic and anticyclonic circulations.

It is intriguing that these events are happening just as two of the long-lived ones merged: The recent merger of A8 and A0 was the first since 2002, and reduced their number from 9 to 8. It is possible that these mergers are gradually reinforcing the remaining AWO (A5a), which has absorbed all the others, and that it will now become a ninth long-lived one. However, comparing the images from 2015 Dec.15 [Fig.3] to 2017 March 15 [Fig.1], it seems to be only slightly larger, if at all.

The other interesting aspect of these tiny ovals is their relationship to a large cyclonic 'folded filamentary region' (FFR) further p. (E) in the SSTB*. It is increasingly evident that many jovian phenomena are generated by disturbance from such cyclonic turbulent regions [e.g. Ref.1]. I suspect that this is the case here: that these tiny ovals are generated repeatedly by waves or turbulence emanating westward (in the f. direction) from the giant FFR (Fig. 4). (The ovals themselves are not always drifting west relative to the FFR; as shown in the JUPOS chart (Fig.2), some oscillate.) Nevertheless, they eventually merge into A5a at the f. (east) end of the series. This behaviour is very similar to that in the S. Temperate (S1) domain, where spots emerge westward from turbulent dark sectors of STB, and often merge to form small anticyclonic ovals [e.g. Ref.1, & our long-term reports on the S. Temperate domain]. There is increasing evidence that much the same process happens in most domains on Jupiter [e.g. Ref.1].

*[*Footnote on nomenclature:* I refer to this latitude band as the S2 domain following our standard nomenclature [ref. long-term S.S.Temp. report]. The dark belt in which these ovals are often embedded is colloquially called the SSTB; but this can be ambiguous because 'belts' generally belong to the cyclonic (low-latitude) half whereas AWOs belong to the anticyclonic (high-latitude) half, whereas in this narrow domain they often occupy overlapping latitudes.]

Ref.1: Rogers J & Adamoli G (2016) 'Jupiter in 2015/16: Final report.'
https://www.britastro.org/node/8263

Ref.2: 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

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