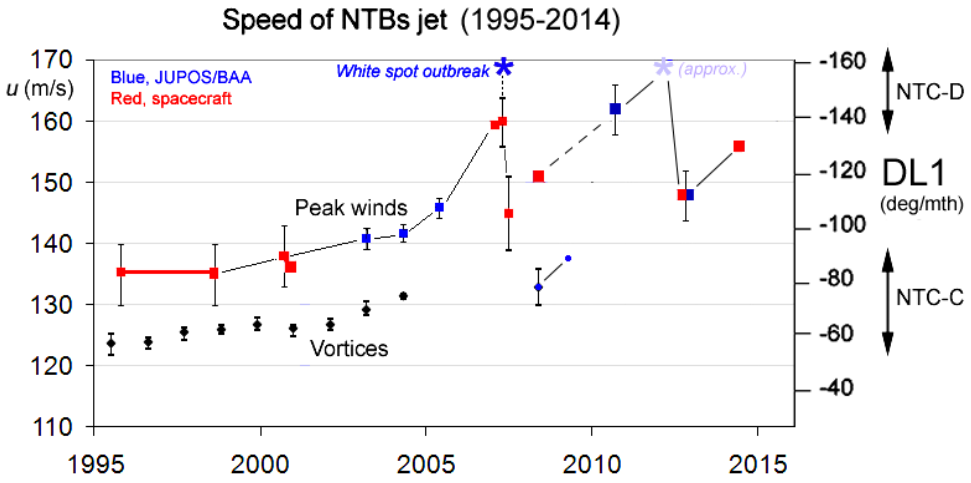
Prospects for Jupiter in 2015-2017

John Rogers (2015 March 31)

In February, a colleague asked me if we could forecast how Jupiter's atmosphere might be behaving over the next three years, during the JUNO mission. While it may seem implausible to make a long-range weather forecast for Jupiter that we cannot do for Earth, we can actually make some informed projections, given the multi-year length of Jupiter's atmospheric cycles and our recent improvements in observing and understanding them from amateur data. So here is an attempt at a long-range forecast; it will be interesting to revisit it 3 years from now!
In the following prospectus, I will consider the largescale phenomena in three major domains, i.e., the cycles of fading/revival/jetstream outbreaks on the NTB, NEB, and SEB. All of these sometimes obey approximate periodicities of 3-5 years, but then the periodic cycles stop for many years, which cannot be predicted. By contrast, the largescale phenomena on the STB are more deterministic. For more details of all these phenomena, please see the 'Reference Articles' page on our web site.

North Temperate domain:
Prediction: A new NTBs jetstream outbreak is very likely to occur in 2016 or 2017, most likely in the first half of 2017 (followed by NTB revival and coloration).
Background: These outbreaks occur at intervals of 4.9 (±0.2) years, and we have recently found that the NTBs jet visibly accelerates in the years before the outbreak, until it attains the super-fast speed that allows the super-fast plumes to erupt. (The acceleration was shown in Rogers et al.[2006, Icarus], before the 2007 outbreak, then we successfully predicted the 2012 outbreak on this basis. The whole scenario fits well with the modelling by Sanchez-Lavega et al.)
Rationale: Grischa Hahn has produced zonal wind profiles from both amateur and HST data in recent years – most recently, from the HST data of 2014 April – and it seems that the jet is accelerating again, as shown on the attached chart. Also, the NTB(S) has faded as it usually does before an outbreak. However, since the following figure was produced, Marco Vedovato has produced ZWPs from amateur images in 2015 Feb. and March, and finds u = 148 and 149 m/s – indicating that the speed is not steadily increasing. Nevertheless, it is still fast enough to reach critical speed when the 5-year periodicity would indicate, to give the next outbreak in early 2017.



North Tropical domain:

Prediction: A new NEB broadening event is probably beginning now (2015 March-April). New barges and ovals will develop about a year later.

Background: These events have been occurring at intervals of 3-5 years since 1988. The most recent was an extreme version, viz. NEB fading and revival, in 2012, but usually they consist of less dramatic broadening of the NEB to the north. NEB rifts often appear to be actively involved in the initiation of these events, but their role has been unclear since they are present most of the time. Using JUPOS data for previous years, I have recently found that several NEB broadening events have started in association with rifts that are slower (DL2 ~ -2 deg/day) and more northerly than the general run of rifts. So these may be the special disturbances that trigger expansion events.

Rationale: It is now nearly 3 years since the last event, so periodicity would suggest a new event some time in 2015-2017. Actually, the latest JUPOS charts of NEB rifts show that whereas rifts in 2013/14 had DL2 ~ -4 deg/day, new rifted regions appeared with -2 deg/day in 2014 Oct. and Dec. – just the sort to initiate a new broadening event! Indeed, since last autumn the NEBn has been slightly more ragged and wavy, so Christophe Pellier has already suggested that the new broadening event was already starting. On 2015 March 31, Chris Go noticed a pair of prominent new northward projections, which may well indicate that the event is now getting under way.

South Tropical domain:

Prediction: The present level of activity in the SEB will probably continue, including the rifting f. the GRS (and possibly in a mid-SEB outbreak elsewhere). A new cycle of SEB fading and revival is less likely.

Background: During 'normal activity', as now and during the Voyager missions, there are always rifts f. the GRS, and sometimes elsewhere in distinct 'mid-SEB outbreaks' which cannot be predicted. We can confidently predict that the present normal activity will continue indefinitely – until it doesn't (cf. the New Horizons flyby in 2007). Cycles of SEB fading and revival sometimes occur at 3-year intervals, and in recent decades they have occurred in pairs 3-4 years apart (most recently, 2007 and 2010), separated by many years of normal activity.

Rationale: The activity f. the GRS is now very restricted and could stop at any time; but given the timings of recent cycles, I think it more likely that it will be renewed with white spots appearing at higher longitudes, so that the present normal activity will continue for several more years. This also seems likely because historically, cycles in the SEB and the NEB have tended not to run concurrently.

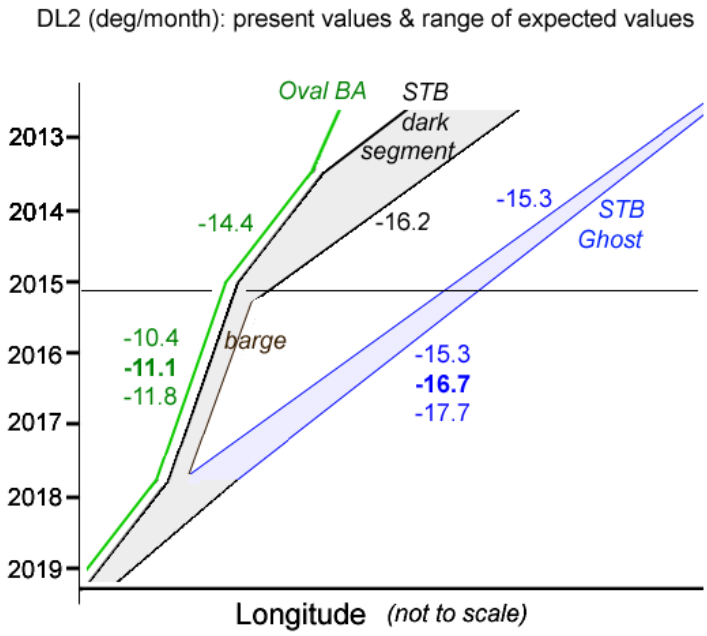
South Temperate domain:

Prediction: The STB dark segment f. oval BA will be a quiescent barge, continuing to shrink. Nothing much will happen here until the STB Ghost catches up with it, most likely in early 2017 but possibly not until 2018.

Background: The major phenomena consist of linear interactions of STB structured segments, one of which is dominated by oval BA, as described in our recent long-term report.

Rationale: Oval BA has recently decelerated (around 2015 Jan.1), as the dark STB segment f. it has shrunk, and will soon turn into a quiescent barge. Oval BA now has a typical 'slow' drift of -11.5 deg/month. The other structured segment, the 'STB Ghost', drifts faster and will eventually arrive at the f. side of oval BA and induce intense disturbances; but it is now 160º away, and on the basis of historical drift rates, the collision is unlikely to be before 2016 Oct. (unless something else develops p. the STB Ghost, which could happen); most likely around 2017 April; possibly as late as 2018 Oct. The forecast tracks are diagrammed below.

Present & forecast disposition of STB structured segments
(Speeds are DL2; for DL3, subtract -8.0 deg/month.)



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