

North Temperate Disturbances: Is NTB rifting necessary?

John Rogers (2010 July 28)

Study of the North Temperate Disturbance (NTD) in 2009 has led to a model [Ref.1] 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. This is the first NTD for which observations have been made at the very high resolution and frequency required to detect these phenomena, particularly the eddying. The rifting could be detectable in hi-res snapshots, and in this note, I review the few hi-res images available for earlier NTDs, to see whether rifts were present as required in the model. (Most of these images have previously been published in the JBAA or in my book.)

Rifts are probably common in the NTB even in normal times. There are long rifts in maps from HST (1994, 1998) and Cassini (2000), when the NTZ was clear with no NTD. They have not been often recognised because they are on a small scale, and because the NTB had been absent from the beginning of the ‘webcam era’ of amateur imaging until 2007. So the presence of rifts in images of NTD will not prove the model, but it will be a test of it.

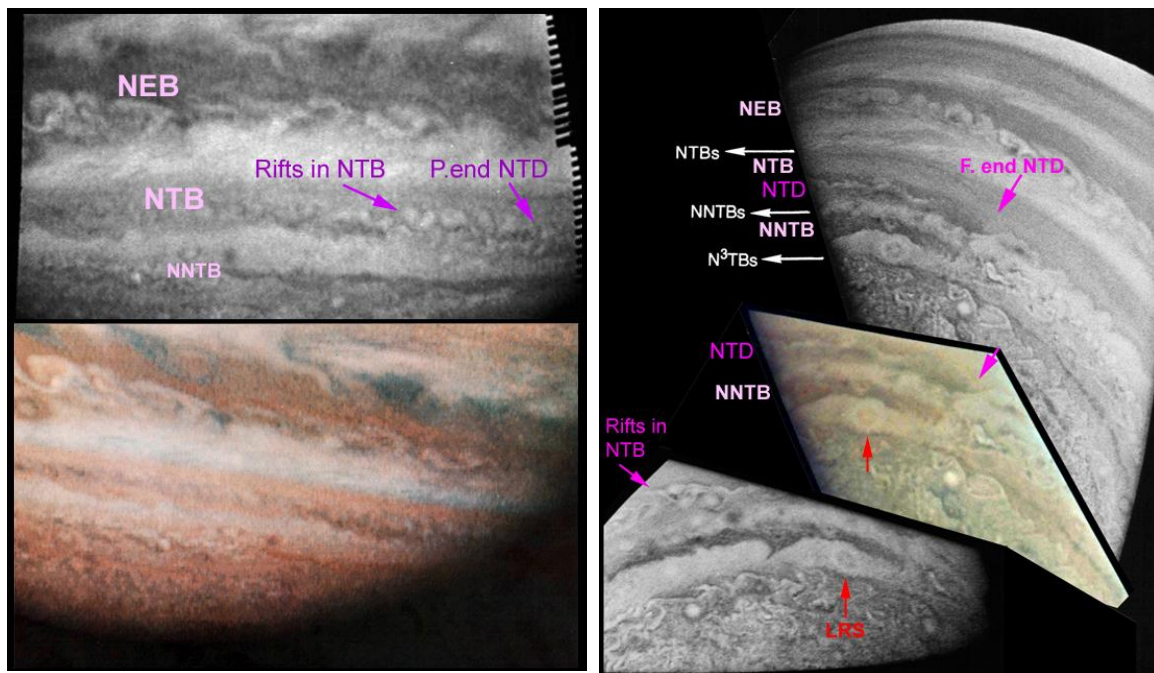


Fig.1 (left): Close-up image from Pioneer 10, 1973 Dec., showing rifts at the p. end of the NTD. *Top:* red light image, rectified; *bottom,* 2-colour version. (South is up in all images.)

Fig.2 (right): Close-up images from Pioneer 11, 1974 Dec., flying over the N. polar region, showing the f. end of the NTD (aligned with the f. end of a dark brown NNTB segment). An oval in the NNTZ contains a reddish annulus and could perhaps be NN-LRS-1, which has been tracked from 1993 to the present.

NTD of 1972-75:

Images were taken by the first probes to visit Jupiter, Pioneers 10 and 11, and were discussed in one of my earliest papers on Jupiter [Ref.2]. At that time there was a long-lived ‘step’ from the NTB(N) onto the NNTB, which we now call the f. end of the NTD. In both the Pioneer 10 and 11 images, we described this section of the NTB(N) within the NTD as

follows: “A turbulent white stream divides it into a dark northern half, which ends at the step, and a faint southern half which continues.” [Ref.2] So, there was indeed rifting of the NTB within the NTD. This can be seen in the closeup images in Figs.1-3, which show rifts through the whole length of the NTD.

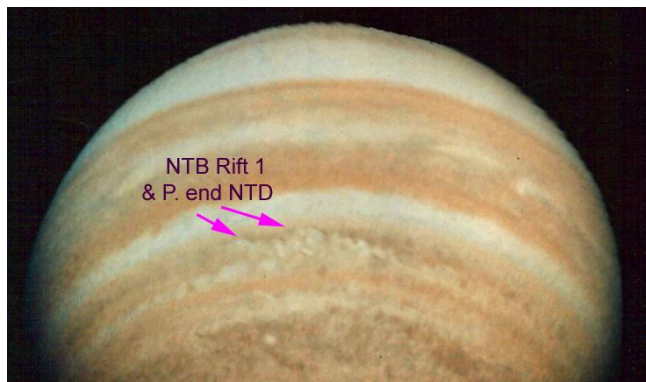


Fig.3. Images from Pioneer 11, 1974 Dec., flying over the N. polar region, showing the full extent of the NTD, with two long rifted regions covering its full extent.

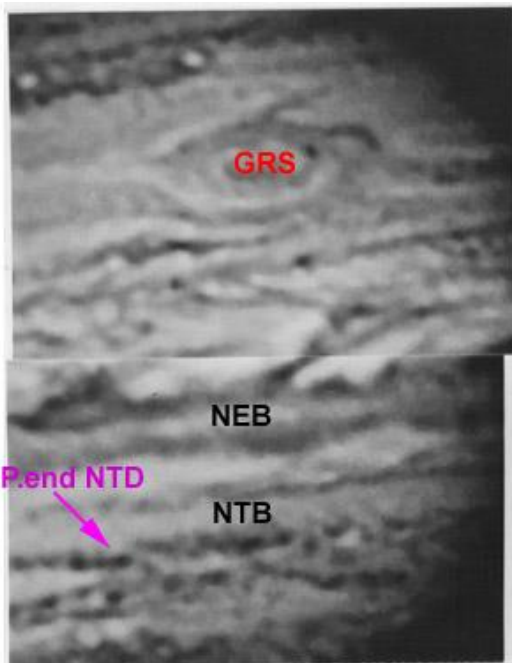
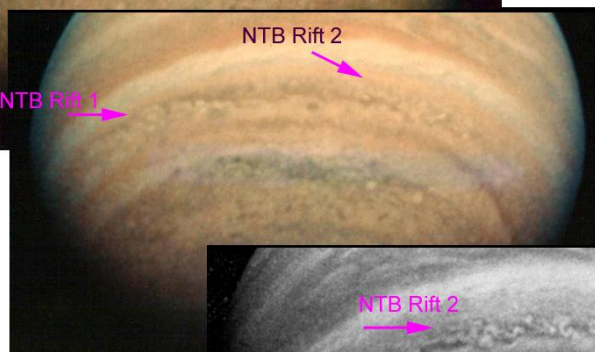


Fig.4 (left): An early CCD image from the Pic du Midi, 1990 Jan.6; taken in red light and highly contrast-enhanced.

NTD of 1988-92:

Hi-res images were obtained from the Observatoire du Pic du Midi in some of these years, including the first hi-res CCD images of the planet in 1990 (Fig.4). This shows the p. end of the NTD in red light. Rifts are not clearly shown, but may be present below the limit of sensitivity.

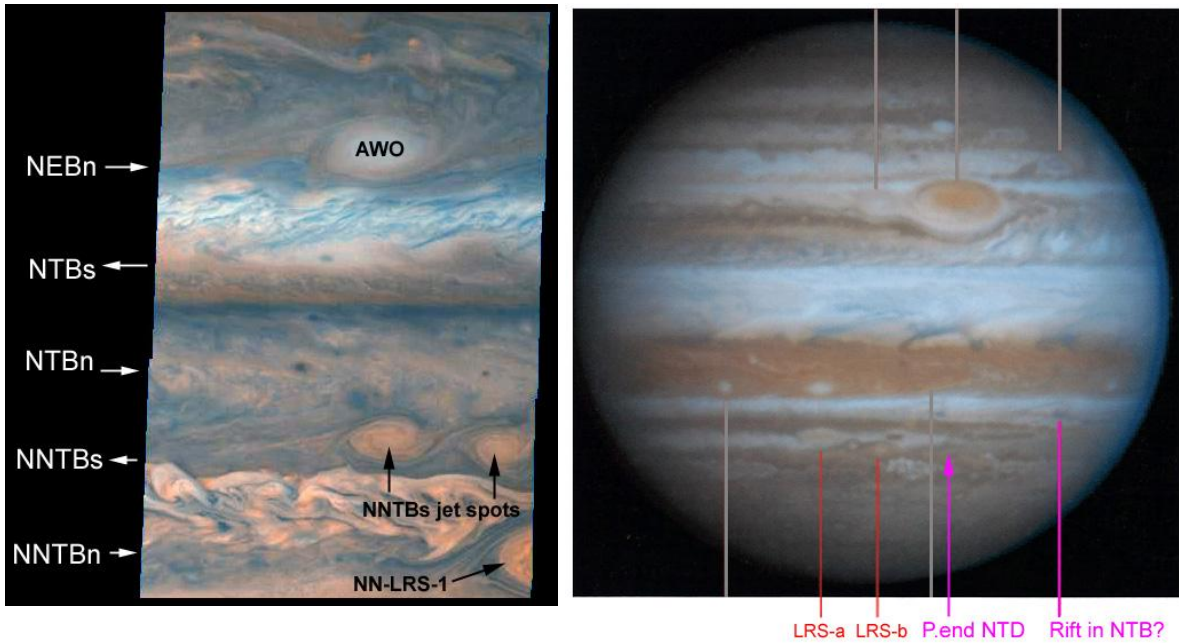


Fig.5 (left): Image from the Galileo Orbiter, 1997 April (RGB image normalised and colour-enhanced by JHR). This was within the incipient NTD but does not show any obvious anomalies.

Fig.6 (right): Image from HST, 1997 May 4, showing the p. end of the NTD, with two reddish spots on NTBn and NNTBs p. it. (I have not yet retrieved the original image; this was a copy labelled for our report in JBAA.) Rifts may be present on the f. side but not clearly resolved.

NTD of 1997:

The Galileo Orbiter took closeup images in 1997 April, within the boundaries of the incipient NTD (Fig.5), and although the very dark straight line of the NTB was notable, there were no rifts, and the whole aspect was much the same in the Cassini images in 2000. So this snapshot did not capture the dynamic features of the NTD. The p. end was imaged by HST on 1997 May 4 (Fig.6), and a possible rift is visible, although the resolution is limited.

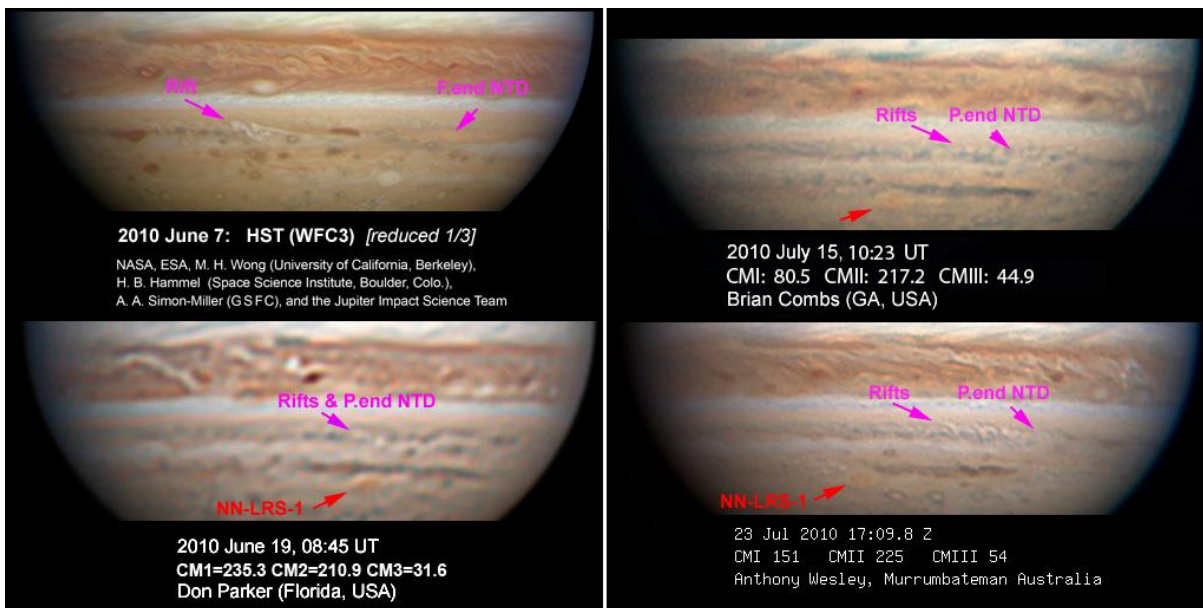


Fig.7. The NTD in 2010: f. end (from HST) and p. end (from amateurs).

NTD of 2009-10:

The 2009 NTD is still prominent in 2010, and v-hi-res amateur images show that there is still persistent rifting at the p. end of the NTD (Fig.7). HST has also imaged the NTD on 2010 June 7 (Fig.7, top), and showed a beautiful little rift within it. The p. end of the NTD was not included in this image, but was included in the global sets of images taken on 2009 Sep.18, and when those images are publicly available they should reveal the dynamics of these rifts.

Conclusion:

Rifts are present alongside the p. end of the NTD whenever it is imaged at sufficient resolution, fulfilling the prediction of our model.

References:

- [1] Adamoli G. & Rogers JH, 'Jupiter's North Temperate Region in 2009: The nature of the North Temperate Disturbance.' <http://www.britastro.org/jupiter/2009report08.htm>.
- [2] Rogers JH & Young PJ (1977) 'Earth based and Pioneer observations of Jupiter.' JBAAs 87, 240-251.