The 2010 perihelic opposition of Jupiter observed from Barbados

Damian A. Peach

The year 2010 was expected to be a memorable time for Jupiter enthusiasts. After years of being placed low in the sky for northern hemisphere observers, the giant planet would finally move north of the celestial equator. Better still, the opposition of 2010 presented observers with Jupiter at its largest apparent angular diameter since the opposition of 1963. This gave an opportunity that was too good to be missed, so I arranged to stay on the tropical island of Barbados in hope of obtaining many excellent images, as had been possible there on previous visits.[1]

Plan of action

Finding a suitable place to stay proved straightforward. Previously I rented a villa located on the southeastern shores of the island belonging to Mr Eric Norris and his wife Louise, an English couple who have lived permanently on the island for the past several years. They were friendly and very helpful which took much of the usual trouble away from arranging things.

Eric's strong background in the construction trade also proved extremely useful. Before my arrival he offered to construct a large windbreak to help protect the telescope from the ever-present easterly trade winds. This proved to be invaluable, and made the demanding work of high resolution imaging considerably less frustrating than it could have been.

As in 2009 I travelled out in September, this time from September 8 to 29 to coincide with Jupiter's opposition, which occurred on September 21. This would give a long period of coverage which is especially useful to follow small scale changes within the dynamic Jovian atmosphere.

Early in the apparition a new camera came onto the market. Point Grey Express released a new firewire-based CCD camera using the new Sony ICX618 CCD chip. This chip has significantly better sensitivity to light, especially in the red and IR parts of the spectrum, and offers faster frame rates. Tests by other observers confirmed the improved speed and sensitivity, and fortunately I was able to borrow one from fellow observer Ian Sharp. This was to be the camera used throughout the expedition.

Barbados arrival – eventually

The flight out on September 8 was almost perfect. A timely departure, and relaxing flight in Virgin business class was one of the most enjoyable I can recall – until about twenty minutes prior to landing.

Gazing out of the window on approach to Barbados it became clear the weather was rapidly deteriorating. The Captain announced that due to severe weather conditions at Grantley Adams Airport, we would have to divert north and land on St Lucia until the weather improved. Very dark clouds were visible out of the window and the

Images

Above: Jupiter on 2010 Sept 12 under near perfect conditions (see text). A wealth of detail is visible across the planet and its satellites.

Left: Portrait of the author by M. Georgiou.

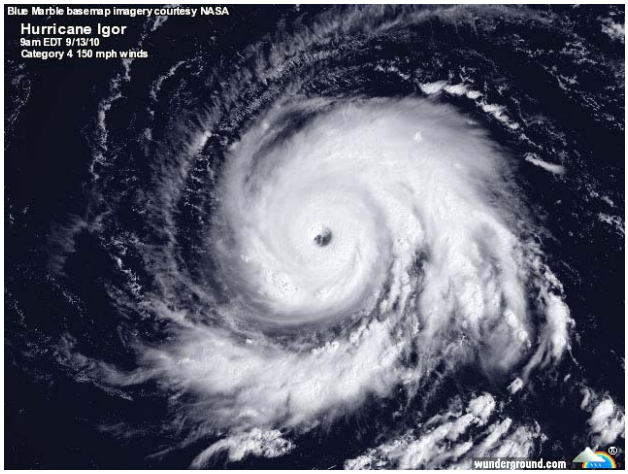

Figure 3. Satellite image of Hurricane Igor during the middle period of the trip about 600 miles north east of Barbados. This was the strongest Atlantic hurricane since 2007. *NASA/NOAA/GOES*

sound of the rain lashing against the fuselage coupled with the very bumpy conditions was quite disconcerting. Then without warning the left wing was struck by lightning, making a loud cracking noise and lighting up the cabin. At this point I began to wonder if I would ever see solid ground again...

Fortunately the weather improved and we soon landed at St Lucia, where we sat on the runway for around 90 minutes while it was decided what to do next. Some passengers were going to Antigua via Barbados so it was decided the plane would fly further north to Antigua, everyone would disembark, the flight was cancelled and we would have to join the return UK flight to Gatwick via Barbados! Hearts sank at this point, as it quickly became clear it would be some hours before we reached our destination.

Antigua's V.C. Bird Airport was a total shambles and was not prepared to deal with the diverted passengers; staff didn't seem to have a clue as to what was going on. Finally we re-boarded the plane shortly after sunset. The plane itself was parked about ¼ mile from the terminal building which made for an exhausting walk for some already exhausted passengers. The only relief was a splendid view of Venus blazing above the runway with Mars close by as we walked to the plane.

And so the plane departed for the short 40-minute flight back to Barbados where we landed smoothly – albeit more than eight hours late. Vast puddles of water across the air strip revealed the kind of weather that had been battering the island earlier in the day. All the equipment was reclaimed safely, and I met Eric on arrival for the short drive to the villa. Skies were overcast, so after a late evening meal, I retired to bed exhausted.

Unsettled weather

During the first two days the weather was much the same as the conditions that had delayed the flight. Thunderstorms, cloud and rain persisted, and not until the third day did the weather settle down into a more normal condition and I was finally able to set up the telescope.

The first night of actual observations proved quite successful. A transit of Ganymede and its shadow was observed under good, although not superb seeing. The following night yielded some excellent seeing conditions with the Great Red Spot well placed on the disk. The high altitude of Jupiter in the sky during this trip (75° when at the meridian) made for some long nights.

It seemed that the weather would settle down for the rest of the trip, however Hurricane Igor quickly intensified to become a major Category 4/5 hurricane. Though the storm's path took it well north of the Windward Islands, high cloud flowing out from Igor reduced transparency to rather average levels. The surface winds were also light and variable for several days resulting in variable quality of seeing and some oppressive night time conditions. At its worst, it reached 29°C with fairly heavy dew. Despite these problems, image quality remained good, though rarely excellent during this time. Showers and thunderstorms were also a daily occurrence.

Just as Igor moved away northward on course for Bermuda, a low-level trough formed in its wake bringing overcast skies and torrential rain. Two or three days were lost. Though no observations were possible, the weather did make for some impressive night time thunderstorms and lightning displays.

The final week arrived with the weather patterns finally returning to normal. Excellent transparency and seeing prevailed almost every night until the end of the trip. During this period I decided also to take time to obtain images of Uranus

Figure 4 *(below)*. Jupiter on 2010 Sept 15. Some rarely seen detail was recorded on this occasion, with exceptionally clear views of complex folded filamentary regions (FFRs) in the Northern Polar Region, and small anti-cyclonic rings in the NTZ. An enlargement inset shows these features more clearly.

Figure 5a,b. Ganymede on 2010 Sept 18 & 29, showing two opposite hemispheres. Note the clearly identifiable surface features such as the brilliant ray craters Osiris and Tros.

and Neptune, to see if any details of note were visible. These planets were also very well placed in the sky, and Uranus was only 1° away from Jupiter making it very easy to locate.

Results

Despite the challenging conditions the trip proved a great success. Of twenty-one possible nights, five were lost due to poor weather. Around 900GB of data were collected. Many fine Jupiter images were obtained giving a similar level of coverage to that achieved on previous trips. In terms of image quality, the large angular size of Jupiter, combined with its high altitude in the sky and the new more sensitive Flea3 camera yielded probably the best results to date. A full online image gallery may be found at **http://www.damianpeach.com/barbados10.htm.**

Features usually only within the remit of the HST, such as ring like structures in the North Temperate Regions, and complex Folded Filamentary Regions (FFRs) in far northern latitudes, were clearly recorded. The Great Red Spot (GRS) displayed interesting and complex internal cloud structure with its periphery resolved into a rough edge giving the distinct impression of a churning storm.

The Galilean moons became fascinating targets, especially Ganymede. A whole range of features was recorded, all easily identified on the reference maps available from *Voyager* imagery. Two transits of Ganymede occurred and these were especially interesting to see. Io also put on a good show, with its bright equator and darker polar region easily seen.

Though Jupiter was the main object of study, nearby Uranus presented a fascinating target. Focusing was convenient as it was possible to focus on Jupiter and then move over to Uranus. The tiny 3.7 arcsecond disk appeared reasonably large and bright – very reminiscent of a distant Mars. It appeared very sharp under the excellent seeing conditions but featureless on the live feed from the camera. I decided to employ a long pass red light filter as features on these planets are often more contrasty at IR wavelengths. Several sequences were taken during the final week in hope of detecting some features. As it turned out very little was seen on the planet, aside from some dusky shading.

Neptune was also high in the sky by mid-evening. At magnitude 7.8 it is much harder to find than Uranus but was obvious once located. This proved to be rather more interesting as bright and dark patches were readily apparent in the result. I deliberately avoided processing the data strongly on these distant objects so as to avoid imparting artefacts into the results. It certainly shows that these distant planets are worth scrutiny with large amateur telescopes.

During the typical four to five hour sessions at the telescope, as with past trips, I always took time out to observe visually. This time however it was a special treat with Jupiter so high in the sky. I typically settled on a power of ×413 and usually spent around fifteen minutes taking in the view when the planet was near the meridian.

Figure 6. Uranus on 2010 Sept 27. Periods of near-perfect seeing allowed for some exceptionally clear views with both Uranus and Neptune (Figure 8) high in the sky.

One of the most memorable views occurred on Sept 28 during the final week, with the planet near the meridian. The on-screen feed showed the seeing to be near perfect so I eagerly exchanged camera for eyepiece. With the planet above so high in the sky the familiar fringing caused by atmospheric dispersion was absent. The brilliant white spot Z was near the meridian. The tiniest details were held steadily in view with a wealth of colours across the planet. Tiny ovals in far northern latitudes, to faint delicate wisps of detail across the Equatorial Zone were all rendered wonderfully. Most spectacular of all was the North Equatorial Belt (NEB.) This displayed a range of red/brown shades with delicate meandering rifts. The image in Figure 7 viewed on the monitor from several feet away gives some idea of the view.

Figure 8. Neptune on 2010 Sept 25.

Conclusions

As with past years, the results obtained during this trip were well beyond what could be achieved at home – though the margin in image quality against imagery obtained at home was less than in previous years due to the much improved altitude of the planet from the UK.

I feel that image resolution obtained during the finest nights of the trip must be at the limits of a 36cm aperture telescope. During the past couple of years the finest resolutions achieved using amateur instruments have tended to reach a ceiling at around 0.3 arcseconds, the limit of a 36cm aperture. Better techniques seem to have finally allowed the diffraction limit of large amateur telescopes to be fully exploited, after many years of improved imaging speeds and lower noise CCD sensors raising the bar. On average the quality achieved by planetary imagers worldwide, in typical seeing, has improved steadily, as imagers learn to minimise the effects of atmospheric dispersion and seeing by the careful use of filters and *Registax*. This is good news for longer-term study of Jupiter (and indeed all the planets) as it will allow the movements of the currents/jetstreams to be followed in even greater detail than previously possible.

I hope that the results obtained on Uranus and Neptune will prompt others to take some time away from more familiar targets to observe these distant planets. Uranus is becoming well placed from northern latitudes and longer-term study may well turn up some surprises on this neglected planet.

From 2011 onward things change considerably for Jupiter observers across Northern Europe and similar latitudes. Jupiter finally attains an altitude where very high resolution imaging will become possible from home when seeing conditions permit. This is an exciting prospect and I look forward to making the most of it. The 2011 apparition is perhaps the most favourable of the current opposition series as Jupiter is placed high in the sky on mornings in late summer – a time when excellent seeing is likely to occur. Perhaps UK-based imagery in the years to come will match the results obtained at Barbados in recent years.

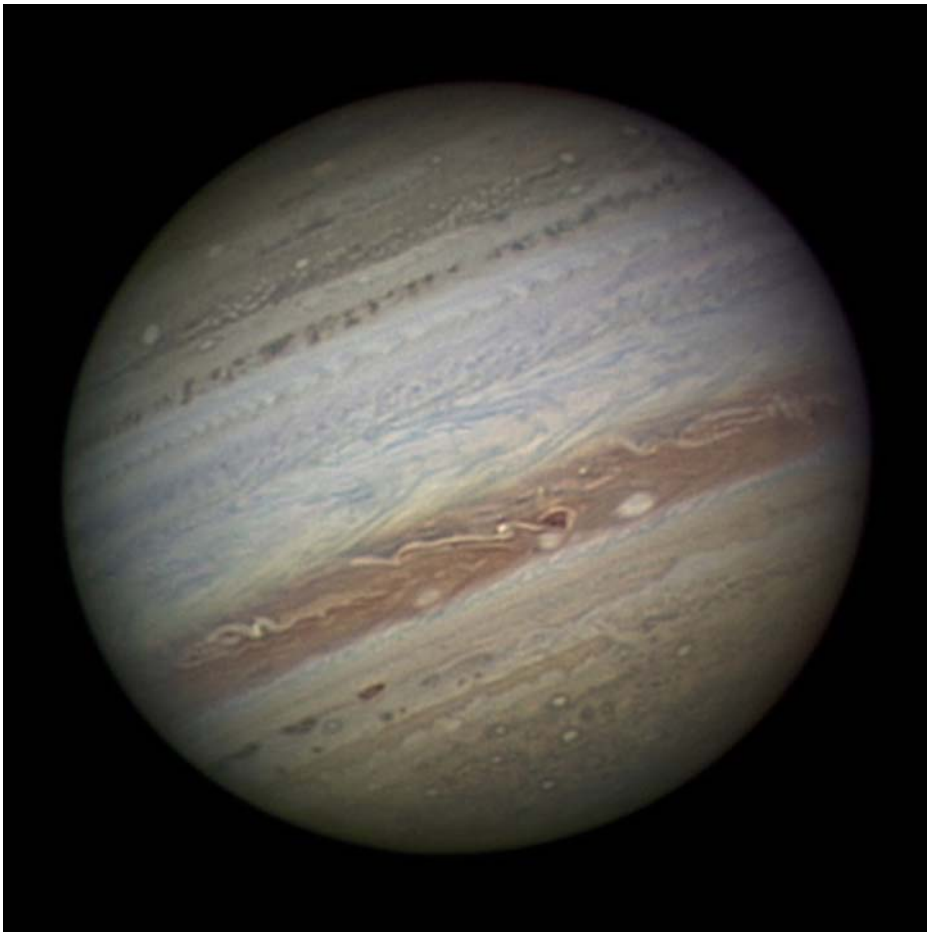

Figure 7. Jupiter on 2010 Sept 28. Shortly after this image was taken a memorable view of the planet was obtained visually at ×413, with the brilliant 'spot Z' dominating the view and intricate rifting throughout the NEB.

Address: c/o BAA, Burlington House, Piccadilly, London W1J 0DU. [dpeach_78@yahoo.co.uk]

Reference

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