EPSC Abstracts
Vol. 13, EPSC-DPS2019-**PREVIEW**, 2019
EPSC-DPS Joint Meeting 2019

EPSC
EPSC-DPS Joint Meeting 2019
15–20 September 2019 | Geneva, Switzerland

The Great Red Spot in 2019 and its unusual interaction with retrograding vortices

Clyde Foster (1), John Rogers (2), Shinji Mizumoto (3), Andy Casely (4), and Marco Vedovato (5)

(1) Astronomical Society of Southern Africa; (2) British Astronomical Association, London, UK; (3) ALPO-Japan; (4) Independent scholar, Australia; (5) JUPOS team, Italy. **<clyde@icon.co.za>**

Abstract

Early in the 2019 jovian apparition, ring-like structures on the southern edge of the South Equatorial Belt (SEBs) were recorded by various amateur planetary imagers. Due to the retrograding jet at this latitude, the rings were progressively drawn towards, and into, the Great Red Spot Hollow (GRSH). This resulted in deformation and ultimate dispersal of the rings, with interaction taking place with the Great Red Spot (GRS) as well as the South Equatorial Belt (SEB) immediately following the GRS. These interactions were apparently repsonsible for the repeated detachment of red 'blades' from the GRS. Concurrently, an elaborate structure developed on the SEBs following the GRS, with dark material being drawn from this structure around the GRS, This paper presents the development of the SEBs rings and their subsequent interaction with the GRS and surrounding region, based largely on observations by the first author.

1. Introduction

Since 2014, the GRS has been smaller than at any time in the last two centuries, and has had a dark red colour that was hardly ever seen except when the SEB was whitened. For several years it has also been largely undisturbed by retrograding rings (vortices) travelling westward along the SEBs; these have been generally sparse in the last few years.

The first author has monitored the planet Jupiter from his location in Centurion, Gauteng, South Africa for the last 5 years. Primary equipment has consisted of a Celestron 14" Edge HD Schmidt-Cassegrain telescope combined with various planetary imaging cameras. Monochrome imaging using various filters has been the primary technique employed.

The state of the GRS and SEB over this period has been documented by J.H.R. in BAA Jupiter Section reports (https://www.britastro.org/node/17157), and by S.M. in compilations of maps on ALPO-Japan (http://alpo-j.asahikawa-med.ac.jp/Latest/j_Cylindrical_Maps/j_Cylindrical_Maps.htm). After solar conjunction in 2018, good-quality ground-based imaging began in 2019 Jan. Meanwhile, the Juno spacecraft camera obtained views of the GRS at perijoves 17 (Dec.21), 18 (Feb.12) and 19 (April 6), especially at PJ18 when Juno flew very close to the GRS.

2. SEBs retrograding rings and their interaction with the GRS in 2019

Early in the 2019 apparition, amateur ground-based images started to capture an interesting structure along the SEBs edge. Oval or ring-like structures had formed and these were being carried in a retrograding direction due to the jet stream at this latitude. This renewal of the typical SEBs jet activity occurred across large sectors of longitude. It was maintained at least from February to May and appeared to be generated by the turbulent region following the GRS. Due to this retrograde motion, some of the rings were carried into the GRS Hollow, resulting in deformation of the rings, and interaction with both the GRS itself as well as the SEB immediately following the GRS.

During this period, various amateur imagers were able to capture red streaks or "blades" apparently sweeping off the west end of the GRS. They were also seen in JunoCam images at PJ17, 18 and 19 (see Figure). In view of their red colour and their brightness in methane-band images, they appeared to be material detaching from the GRS.

Maps of amateur images showed that each of three successive 'blades' was formed within a few days after a retrograding ring entered the GRSH, suggesting that these vortices were disrupting the periphery of the GRS. The red fragments last for more than a week, extending westward within the SEB(S). Their reddish colour is often difficult to distinguish from the brown of the belt but they can be identified as methane-bright.

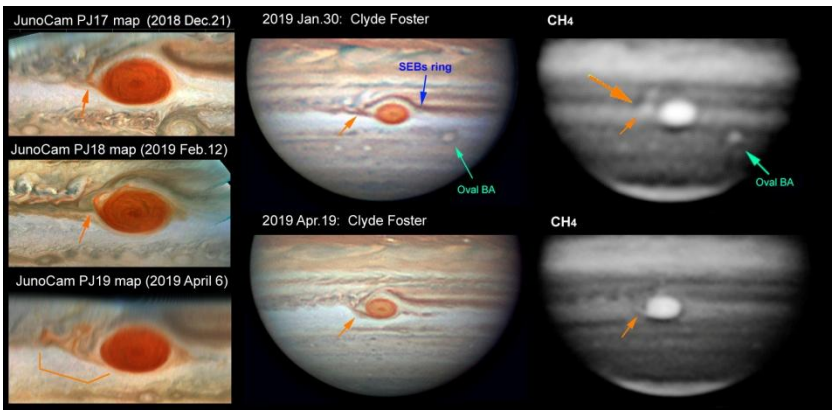

Figure: *Left:* Cylindrical maps from JunoCam images of the GRS. (*Credit:* NASA/SwRI/MSSS/ Gerald Eichstädt / John Rogers.)
Right: Examples of images by C.F. All show red 'blades' (orange arrows).

In early April, another pair of retrograding rings was observed approaching the GRSH. Amateur images and map animations were able to monitor the distortion of the rings as well as their movement along the edge of the hollow, whilst interaction with the GRS itself was also observed. Indeed they triggered the emergence of a pair of red blades from the GRS (April 17-20). However, the interaction became more complex. A dark hook-like structure developed on the southern edge of the SEB immediately following the GRS. (This was reminiscent of the South Tropical Disturbance (STrD) that was passing the GRS in early 2018, although it did not have the circulation pattern of a true STrD.)

Some of the dark material in the hook-like structure was captured by the prograde jet that flows past the south edge of the GRS, forming a very dark grey ring around the GRS, and was distributed into the South Tropical zone preceding the GRS. This was a dynamic stream with multiple concentrations and extensions. Further observations of this stream, and comparison with the 2018 STrD, will be reported.

3. Discussion

Similar red 'blades' have occasionally been reported in the past, and may have been under-reported because they are only detectable with high resolution. Nevertheless, it is possible that this behaviour has only recently become common. In the Voyager 1 movie in 1979, SEBs retrograding rings were swinging round the GRS with vigorous interactions but not usually causing obvious disruption of the GRS itself as at present. In publicly posted maps from the Hubble Space Telescope, no such feature was recorded in 2014, 2015 or 2016; but the paired maps of 2017 Feb.2 showed a similar red 'blade', and showed its dynamics over 10 hours. The GRS periphery has also appeared 'ragged' in subsequent Hubble and JunoCam images, although the recent 'blades' appear more substantial. We suggest that the small size of the GRS has made it susceptible to disruption by incoming vortices in a way that did not commonly occur previously.

Acknowledgements

We are grateful to the other amateur observers whose images enabled continuous coverage of these events. We also acknowledge the NASA JunoCam team for the JunoCam imagery.