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Amateur mapping of Jupiter's southern high latitudes to support JunoCam between Perijoves 12-15

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Abstract

Jupiter's polar regions are difficult to observe from Earth. Using amateur imagery, we were able to observe and map movements of folded filamentary regions (FFRs) and anticyclonic white ovals (AWOs) south of 60°S over the course of five months between March 30th and September 5th 2018, covering the time period of Juno's Perijoves 12-15. Maps have been created from ground-based images every 4-10 days to create an animated timeseries showing the evolution of these features. JunoCam imagery helps to verify the observed features, while the image sequence allows us to identify changes in position and morphology of FFRs and AWOs in between perijoves, and trace longer-lasting FFR regions from one perijove to the next. These observations are in the context of longer sequences of data tracing AWO drift patterns in relation to wind profiles at high latitudes.

1. Introduction

A fortuitous combination of circumstances in 2018 allowed amateur observations to contribute to the understanding of the south polar region of Jupiter. A series of Juno spacecraft passes around Jupiter's May 6th opposition observed similar regions in each pass, while Jupiter's South Pole was especially favourably tilted towards Earth.

Observing the high latitudes of Jupiter is challenging from Earth as Jupiter's poles tilt no more than 3.1° towards us. Juno's polar orbit has facilitated detailed observations of the polar regions for the first time, including the circumpolar cyclones and high-latitude hazes (1,2). One of the goals of the JunoCam mission is to understand how features at high latitudes evolve; however the 53 day orbit limits the ability of the spacecraft to observe feature dynamics at shorter timescales. Amateur imaging can help fill in the gaps, and has reached the stage where useful contributions can be made.

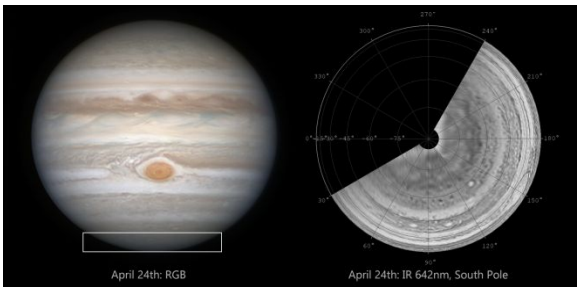

Figure 1: RGB and polar projected IR image of Jupiter, 24th April 2018. Region south of 60°S highlighted.

There have been crucial improvements in imaging and image processing technology that now allow many amateurs to reliably capture fine details previously only achievable by a very small number of observers in perfect conditions. With enough observers using telescopes of 300mm and larger apertures, mapping and time-series of high latitudes are now feasible. Importantly, Jupiter's South Pole reached its most favourable tilt towards Earth of 3.1° in April 2018, presenting the southern high latitudes at their most favourable for over a decade.

2. Observations

This apparition represented the best opportunity since Juno's arrival to study the polar regions from Earth, and make direct comparisons to JunoCam imagery. The sharpest amateur images are taken in near infrared wavebands between 640-800nm, often showing more structural detail than RGB colour images.

We present time-series data collected for AWOs in 2018, part of longer-term AWO tracking by the

JUPOS Team and J.R., and a high-resolution sequence of images to capture FFRs between March and September 2018. South polar maps at intervals of 4-10 days between April and September 2018 capture the changes in FFR morphology between perijoves, tracing the continuous motion and evolution of these features. Animating the sequence clearly shows the motions of the FFR features between perijoves. These will be placed into context of earlier ground-based and spacecraft observations, showing how amateur contributions can help build our understanding of polar regions.

3. Discussion

JunoCam has observed a broad train of pale FFRs ringing the planet from 65-75°S, interspersed with longer-lived circular AWOs. Our sequences show that the larger-scale morphological changes in FFRs occur over timescales of a few days to a week, with the core regions of the disturbances south of ~70°S retrograding in System III longitude, and shearing/dissipation of some parts of FFRs north of ~67°S where they get close to the prograding S6 jetstream. AWO behaviour provides further insight into the flow region south of 70°S, which does not appear to have strong jetstreams or stable features away from the circumpolar cyclones.

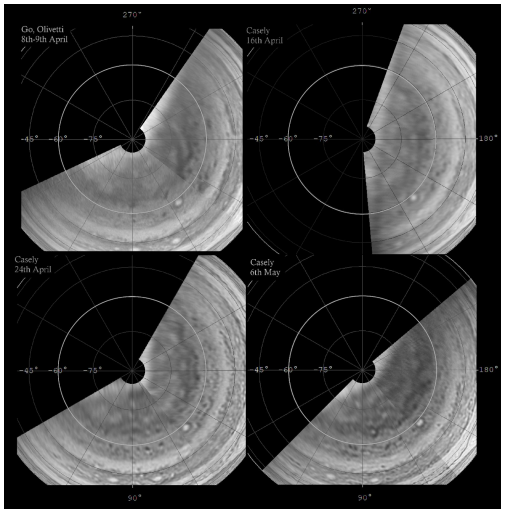

Figure 2: Four frames of the polar projection sequence showing changes to high latitude features (60°S highlighted) in April and May 2018. Images by A.C., Chris Go and Tiziano Olivetti.

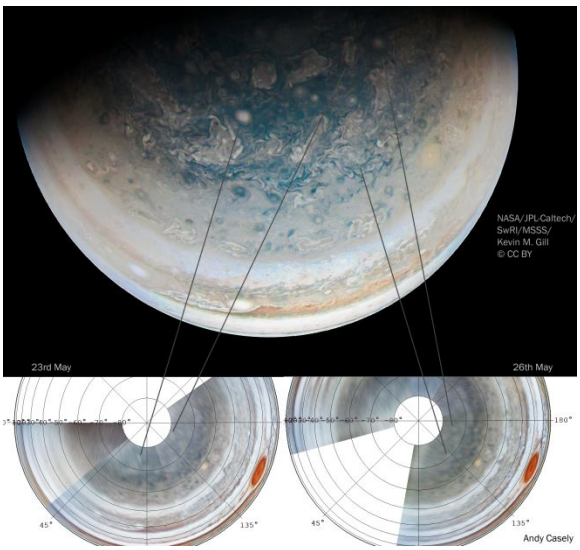

Figure 3: JunoCam PJ13 comparison to polar projected RGB images, 23rd-26th May 2018

4. Summary and Conclusions

Amateur planetary imaging and mapping is able to support professional science observations and contribute to our understanding of Jupiter's polar regions. We show observations that provide further understanding of the processes occurring in the high latitudes of Jupiter. Similar observations may be possible in 2019, but will be increasingly challenging from 2020 onwards as Jupiter's tilt becomes less favourable.

Acknowledgements

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References

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