

# Predictive maps for Juno perijoves and identification of significant features

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## Abstract

At each Juno perijove, JunoCam takes hi-res images of selected latitudes along the sub-spacecraft track, as determined by public voting. To inform this target election process, we use the continuous coverage of Jupiter's visible clouds by amateur imaging, and the tracking of features from those images by the JUPOS project, to identify the features which are expected to be visible at the upcoming perijove. We produce a predictive map for each perijove, and subsequently annotate the JunoCam images to locate the known jets and circulation. Up to perijove 5, this collaboration has contributed to hi-res imaging of several long-lived circulations in northern and southern hemispheres, of major new convective outbreaks in the North and South Equatorial Belts, and of the North Temperate Belt maturing after a cyclic outbreak.

## 1. Introduction

NASA's Juno orbiter performs a very close pass ('perijove', PJ) over Jupiter every 53 days. At each perijove the 'public outreach' camera, JunoCam, takes hi-res images of selected latitudes along the sub-spacecraft track, as determined by public voting [1,2]. Due to data volume limitations, only around 15 images can be returned on each perijove, including some which are reserved for scientific studies of the polar regions, and ~5-12 of lower latitudes. Amateur ground-based imaging is important in keeping track of visible features and predicting what will be available for imaging.

The NASA JunoCam team post regular maps made from recent amateur images on the JunoCam web site [<https://www.missionjuno.swri.edu/junocam>], with numerous 'points of interest' (POIs) nominated by members of the public, and about two weeks before each perijove, they post the most recent map with

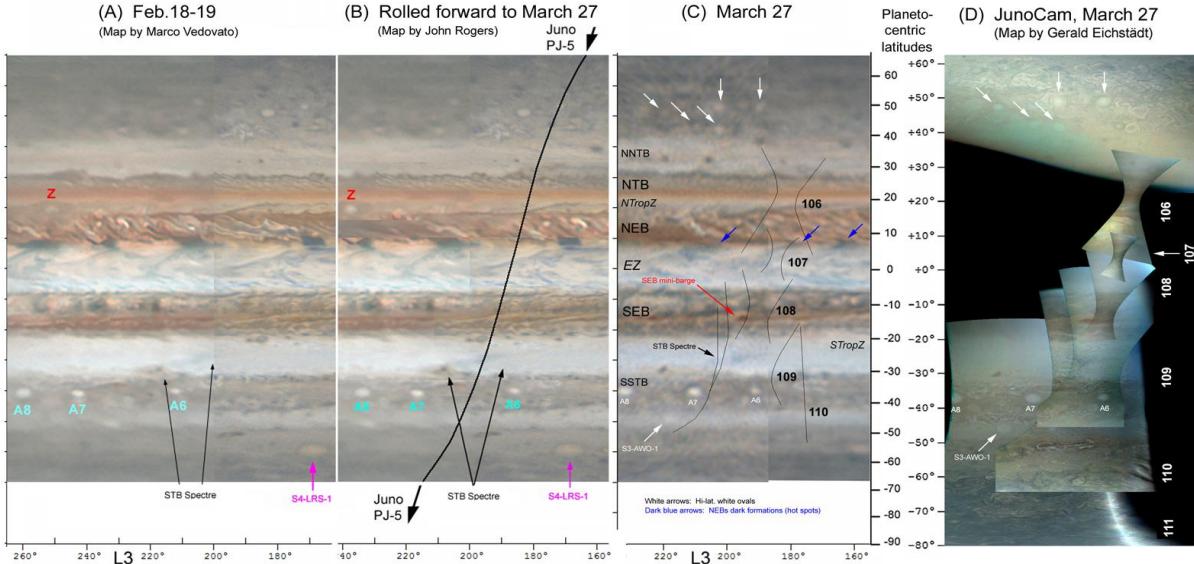
available POIs, and invite the public to vote on which will be imaged.

We complement this procedure by tracking all visible features, producing a predictive map on which known features of interest are identified for each perijove, and making recommendations for public voting.

## 2. Methods

Jupiter is almost continuously imaged by amateurs around the world, whose images are posted on several global databases, mainly PVOL2, ALPO-Japan, and JunoCam. The JUPOS project [<http://jupos.org>] analyses these images with the WinJUPOS software suite to produce maps of the planet every 10 days during the apparition, and to measure the positions of all visible 'spots' so that features can be tracked. In the 2015/16 apparition, 60981 measurements were made. From these, charts of longitude versus time were produced for spots in all latitude ranges. Our final report on the 2015/16 apparition [3] shows the level of detail obtained in the analysis and the consequent understanding of the atmospheric processes.

To inform the JunoCam target election procedure for each perijove, we take the best recent JUPOS map, and the latest JUPOS drift rates for major features in each latitude band, and 'roll forward' each latitude band (between ~9° and 43°, N and S), to produce a predictive map for the date of the next perijove. (We do not normally change L3 of features at higher or lower latitudes, because they are rapidly moving and/or changeable.) The predicted sub-Juno track is overlaid on this map so as to forecast what features of interest will be visible. These are matched to a subset of the nominated POIs (or new POIs), and recommendations for the public voting are posted on various forums accordingly.



**Figure 1.** (A) Map on Feb. 18-19, by the JUPOS team. The following observers contributed images for maps (A-C): D. Peach, C. Foster, J.-J. Poupeau, P. Maxson. (B) Predictive map for PJ5 on March 27, 'rolled forward' from the previous map, with some features of interest identified and the sub-Juno track overlaid. (C) Map from amateur images on March 27, by the JUPOS team, with locations of JunoCam images overlaid. (D) Map from JunoCam images on March 27 at PJ5, made by G.E.

### 3. Results

Figure 1 illustrates our mapping sequence for perijove 5. Up to PJ5, our recommendations have always been among the 'elected' targets.

After each perijove, with the JunoCam images processed and projected by the JunoCam team and by G.E., annotated versions of them are posted on the JunoCam web page [<https://www.missionjuno.swri.edu/junocam>] and BAA web page [[https://www.britastro.org/section\\_front/15](https://www.britastro.org/section_front/15)], identifying the features of interest and putting them in context of the known jets.

From PJ3 to PJ5, this collaboration has contributed to hi-res imaging of:

--Long-lived anticyclonic ovals at 41°N (NN-LRS-1) and 41°S (SS-AWOS);

--The North Temperate Belt, reviving over the months following a great outbreak which was discovered at the time of PJ2 [see separate abstract];

--A new convective outbreak in the South Equatorial Belt, imaged at PJ3 a month after it appeared, which could be compared with the normal convective region (at PJ4), and an undisturbed region (PJ5);

--In the South Temperate Belt, a two-year-old cyclonic circulation called the STB Spectre (PJ5).

High latitudes contain many ovals in the JunoCam images, and we can identify the long-lived ones and their motions, even up to 72°S. Future JunoCam images could enable us to correlate their variable drift rates with their changing local environments.

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### References

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