EPSC Abstracts
Vol. 6, EPSC-DPS2011-571-1, 2011
EPSC-DPS Joint Meeting 2011

Meteorology of Jupiter's Equatorial Hotspots and Plumes from *Cassini* Imagery

D. S. Choi (1), A. P. Showman (1), and A. R. Vasavada (2)
(1) Department of Planetary Sciences, University of Arizona, Tucson, AZ, USA (dchoi@lpl.arizona.edu) (2) Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA, USA

Abstract

We report preliminary results regarding the meteorology of Jupiter's equatorial hotspots and plumes using *Cassini* imagery. *Cassini* obtained an extensive imaging data set of Jupiter's equatorial region during its approach of the planet in late 2000. The 3-month observational baseline enabled the detailed analysis of meteorological features within these latitudes. We conducted a census of the infrared hotspots and equatorial plumes observed during the campaign by compiling a record of their sizes and locations. We also documented unique meteorological events that occur within these latitudes, such as hotspot generation and merger. Additional analysis tools, such as periodograms and automated feature tracking, will allow us to examine flow patterns and their connection with equatorial wavenumber modes.

1. Introduction

The equatorial latitudes of Jupiter exhibit unique meteorological features. A quasi-periodic series of dark patches represent areas of reduced cloud opacity and strong emission in the 5-micron infrared window. These "hot spots" are sources of emission from as deep as 8 bars, and have been the focus of numerous ground-based and spacecraft observation campaigns [1, 2, 3]. Interspersed between hotspots are equatorial plumes: bright, white cloud streaks with lengths of up to 20,000 km that are embedded within the super-rotating prograde equatorial jet stream.

Because of their quasi-periodic structure, location just off of the equator, and westward propagation, numerous studies [4, 5, 6] have advocated that equatorially trapped Rossby waves are primarily responsible for generating these features. A few components of the theory, such as the downwelling branch of the trapped Rossby wave causing cloud clearings, effectively explain observations. However, some aspects regarding plume generation encounter difficulty with observations [7]. In addition, details about the nonlinearity of the equatorial wave dynamics (relevant because of observed hotspot merger events [3]) remain unconstrained due to a paucity of observational information relating to hotspot morphology and wind patterns during key interaction events.

For this study, we begin to address these outstanding questions concerning hotspot meteorology by utilizing an extensive data set from *Cassini* taken with its Imaging Science Subsystem during the spacecraft's approach of Jupiter. The spacecraft acquired global, multispectral mosaics of the planet at intervals of one or two Jovian rotations for nearly 3 months. We use images observed with a near-infrared continuum filter (CB2, 750 nm) to maximize feature contrast and minimize Rayleigh scattering and gaseous absorption for optimum dynamical and morphological study.

2. Preliminary Results

Figure 1 charts the locations and sizes of hotspots and plumes throughout approach. The overall configuration of hotspots and plumes is relatively stable, with no significant deviation in propagation speed. However, several examples of hotspot generation, growth, dissipation, merger, and separation are apparent in Figure 1, and analysis is ongoing. Plumes also experience similar generation and dissipation events, though their relationship with hotspot events is currently unknown.

Analysis of the imagery with automated feature tracking software is also currently in progress; these results will be compared against periodograms to determine any correlation in flow pattern with hotspot wavenumber. We will also investigate whether previously observed flow patterns near hotspots [8, 9] are typical across a broad set of hotspots or unique to particular features because they are controlled by other external factors. We will also address the stability of local flow patterns in the vicinity of hotspots and plumes throughout the 3-month observation period.

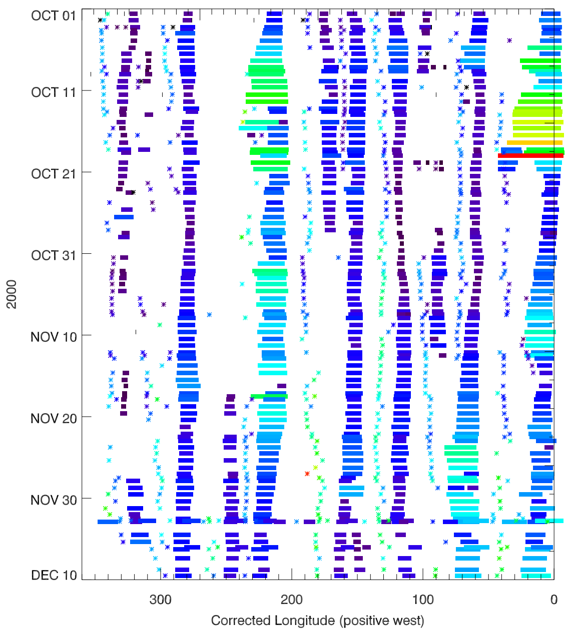

Figure 1: Locations of hotspots (rectangles) and plumes (asterisks) in a coordinate frame that moves at the average hotspot propagation speed ($\sim$35 m s^{-1} eastward) throughout the nearly 3-month period of the *Cassini* imaging campaign during Jupiter approach. Asterisk location denotes the center of the plume. Sizes of rectangles represent hotspot size on a 1:1 scale, whereas plume size is only represented with color using the same scale as the rectangles for the hotspots.

Acknowledgements

This work was supported by NASA JDAP Grant #NNX09AD98G.

References

[1] Orton, G. S., et al. (1998) *Journal of Geophysical Research*, *103*: 22791–22814.

[2] Ortiz, J. L., et al. (1998) *Journal of Geophysical Research*, *103*: 23051–23069.

[3] Arregi, J., et al. (2006) *Journal of Geophysical Research (Planets)*, *111*: E09010.

[4] Allison, M. (1990) *Icarus*, *83*: 282–307.

[5] Showman, A. P. and Dowling, T. E. (2000) *Science*, *289*: 1737–1740.

[6] Friedson, A. J. (2005) *Icarus*, *177*: 1–17.

[7] Showman, A. P. and de Pater, I. (2005) *Icarus*, *174*: 192–204.

[8] Vasavada, A. R., et al. (1998) *Icarus*, *135*: 265–275.

[9] García-Melendo, E., et al. (2011) *Icarus*, *211*: 1242–1257.