Circulation of Jupiter's Polar Atmosphere from Cassini Images

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Summary. This paper presents a preliminary study of the motion of cloud features in Jupiter's North and South Polar Regions (latitudes 50° to 80° North and South).

1 Introduction

In this work we have used series of Jupiter images obtained by Cassinis ISS instrument [1] with the filters UV1 (258 nm), MT3 (889 nm, methane absorption band) and CB2 (750 nm, continuum band) during its fly-by of the planet in December 2000. The filter selection was performed in order to have vertical sensitivity, sounding the upper hazes and cloud layer in Jupiter's atmosphere [2]. We have used pairs of images separated by a minimum temporal interval of 10 hours to guaranty accurate velocity measurements. The images have been measured and processed using PLIA ("Planetary Laboratory Image Analysis"), a software developed by our team to process, navigate and measure planetary images [3]. Maps of the poles made from mosaics of polar projections, have been constructed to identify and track cloud features in successive image frames (Fig. 1).

2 Mean Zonal Wind Profile

We have used two different methods to retrieve the motions and the velocity (relative to System III) of cloud features in the polar area observed in the lower cloud (at about 500 mbar) as detected by the CB2 filter.

2.1 Cloud Tracking

A standard cloud tracking procedure has been performed identifying the same cloud element in pairs of images separated by 10 hours. As a control procedure, we have tracked some selected, prominent and stable features in more than

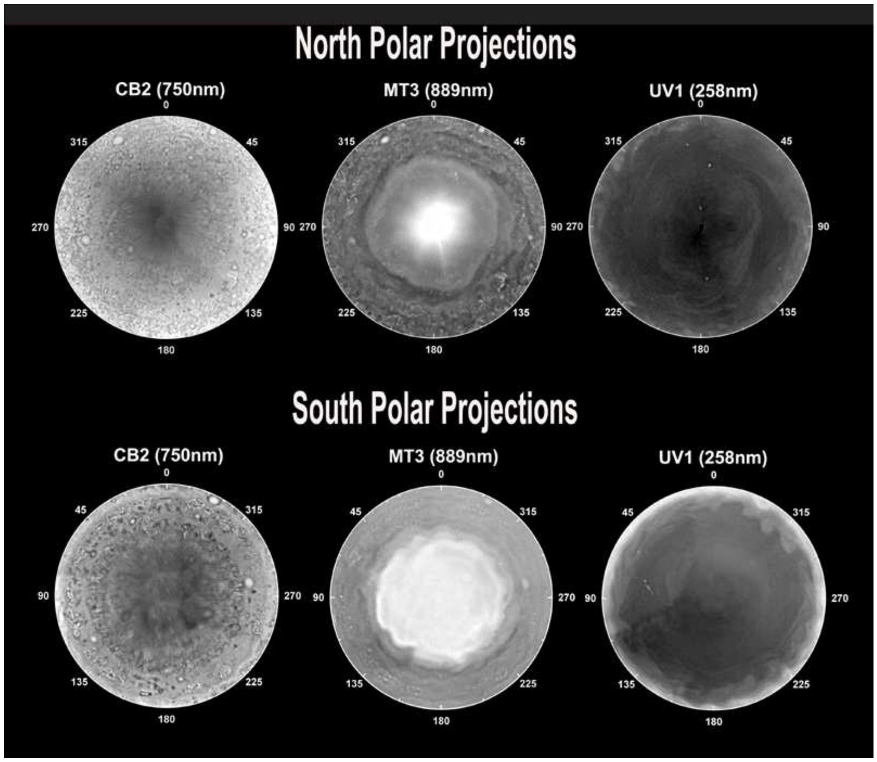

Fig. 1. Polar projections in the three filters that we have use to study the circulation of polar atmosphere of Jupiter.

30 images. In Figure 2 each individual measurement (cloud target) is shown by a single dot. In total we got about 300 individual features on each pole. The solid line represents the mean zonal wind that is obtained from a fit to the average values obtained from a binning of a set of values within latitude boxes. Our wind profile is compared to the data presented by Porco et al. [4] drawn by a dashed line. In general, there is a good agreement between both data sets.

2.2 Wind Profiles by 2D Correlation

Complementary, we have used an automatic 2-dimensional correlation technique to measure cloud motions on pairs of cylindrical maps. The software identifies the cloud brightness patterns in selected boxes of latitude-longitude, correlating both and measuring the relative shift of the features from one box in the map to the next. The method is faster than manual tracking but needs a carefully checking, controlling the motion of individual features. In Figure. 2 the points measured with this technique are represented as circles. In gen-

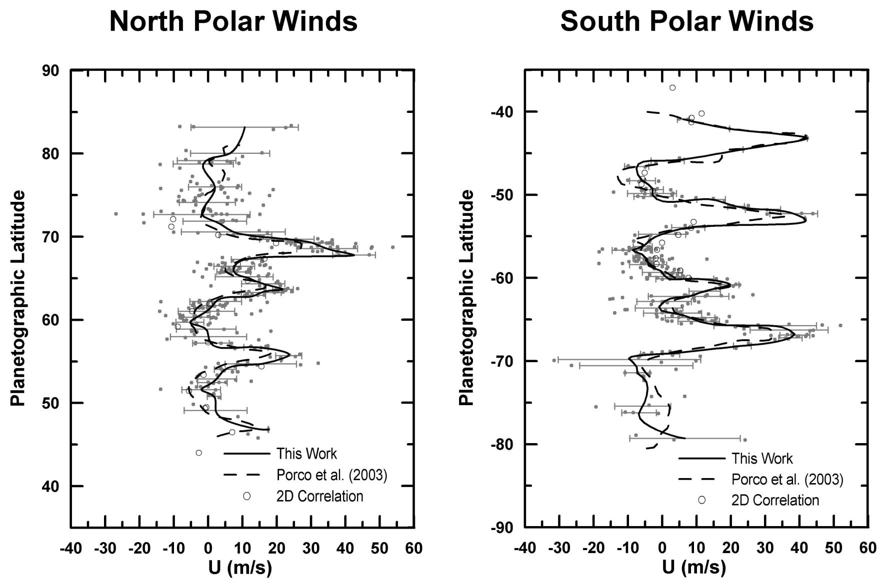

Fig. 2. Polar Wind Profiles: Comparison between differently obtained results

eral there is good agreement between the manual and automatic procedure, validating therefore this last methodology.

3 Circumpolar Waves

Images obtained with the UV1 and MT3 filters show different cloud morphology. The ultraviolet and methane band filters show the presence of extended polar regions, dark in UV1 (due to haze absorption) and bright in MT3 (due to high hazes reflectivity). They show undulating borders that form the circumpolar waves previously observed using Voyagers 1 and 2 images (in 1979), ground-based telescopes and the Hubble Space Telescope [5], [6]. These wave are therefore, permanent dynamical phenomena in the Jovian poles. In Table 1 we present the basic data measured for these waves. Fig. 3 shows a photometric cut over a planetary polar projection at the latitude of the wave system showing the albedo changes in the wave system.

4 Conclusions

We have presented measurements of motions in Jupiter's polar areas at different cloud levels using Cassini images. The jet structure seen in the lower cloud (in CB2) is not observed in the upper haze layers where a system of

Table 1. Circumpolar Wave Characteristics

Wave	Planetographic Latitude (°)	<c> (m/s)	ω (°/hr)	Wavenumber
MT3 Internal	-67±1	4.98±2.2	0.034±0.001	13
MT3 External	-63±1	9.1±3	0.055±0.002	14
UV1	-57±2	1.7±1	0.009±0.006	–

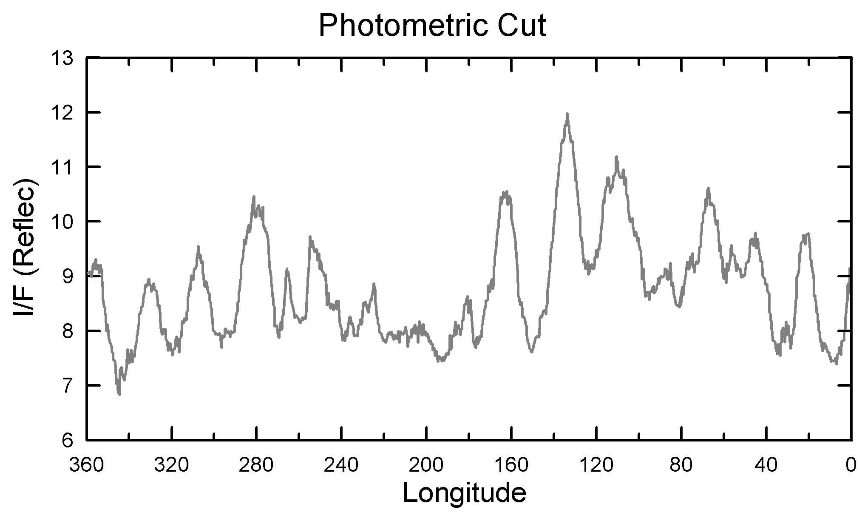

Fig. 3. Reflectivity across planetoghic latitude -67° from images taken in MT3.

permanent circumpolar waves surrounding an extended cap is observed. Future work will focus on retrieving the altitude location of these hazes, to get the vertical wind shear in the polar area, and perform dynamical simulations on the wave formation.

References

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