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A Principal Component Analysis of global images of Jupiter obtained by Cassini ISS

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Abstract

The Cassini spacecraft flybied Jupiter in December 2000. The Imaging Science Subsystem (ISS) cameras acquired a large number of images at different spatial resolution in several filters sensitive to different altitudes and to cloud color. We have used these images to build high-resolution multi-wavelength nearly full maps of the planet in cylindrical and polar projections. The images have been analyzed by means of a principal component analysis technique (PCA) which looks for spatial covariances in different filtered images and proposes a new set of images (Principal Components, PC) which contains most of the spatial variability. The goal of this research is triple since we: 1) explore correlations between the ammonia cloud layer observed in most filters and the upper hazes observed in methane band images and UV, 2) we explore the spatial distribution of chromophores similarly to previous studies using HST images [1, 2]; 3) we look for image combinations that could be useful for cloud features sharpening. Furthermore, we study a global characterization of reletive altimetry of clouds and hazes from synthetic indexes between images with different contributions from the methane absorption bands (CB1, CB2, CB3, MT1, MT2, MT3)..

1. Data

We have build cylindrical projection images from images obtained with the wide filters: BL1, GRN and narrow filters: CB1, CB2, CB3, MT1, MT2, MT3 and UV. Images were navigated and projected in cylindrical coordinates using the software PLIA [3]. Limb-darkening of individual images were corrected using a Lambert function for most filters and a Minnaert function for the UV images. Examples of these cylindrical projections appear on Figure 1.

2. PCA

A PCA analysis of the 9 maps shows that most of the variability is explained by 4 components (see Figure 2). The first component contains 76.7% of the spatial variability and represents the lower cloud, the second component contains 13.7% of the spatial variability and correlates well with the MT3 images. The third component represents a 6% of the information in the 9 images and contains most of the information associated with color. A fourth component accounts for another 2.5% of the information (see Figure 2). The next 5 principal components contain less than 1% of the original information and account for small navigation errors in the different images and differential rotation of some cloud features.

3. Outlook

We plan to systematically explore different combinations of the original images and principal components to provide a physical interpretation to each of the PCAs. Relevant questions are if combining different images we can obtain sharper views of the deep clouds (normally studied from CB2 or CB3 images) or the upper hazes (typically studied from the MT3 or UV images alone).

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References

[1] Simon-Miller A. et al. An HST study of Jovian chromophores. Icarus 149, pp. 94-106, 2001.

[2] Strycker, P.D. et al. Jovian chromophores characteristics from multispectral HST images. Icarus 215, pp. 552-583, 2011.

[3] Hueso, R. et al. The Planetary Laboratory for Image Analysis (PLIA). Advances in Space Research 46, pp. 1120-1138, 2010.

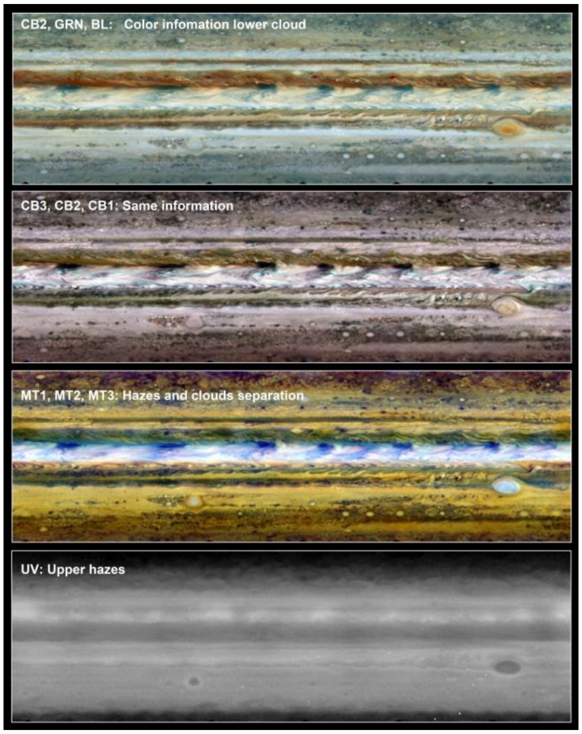

Figure 1: Cylindrical map projections from 9 sets of filtered images. The spatial resolution of the maps is 0.1º per pixel while the original data had a spatial resolution at sub-spacecraft point of about 0.35º in longitude. Color composites are shown here with contrast stretch.

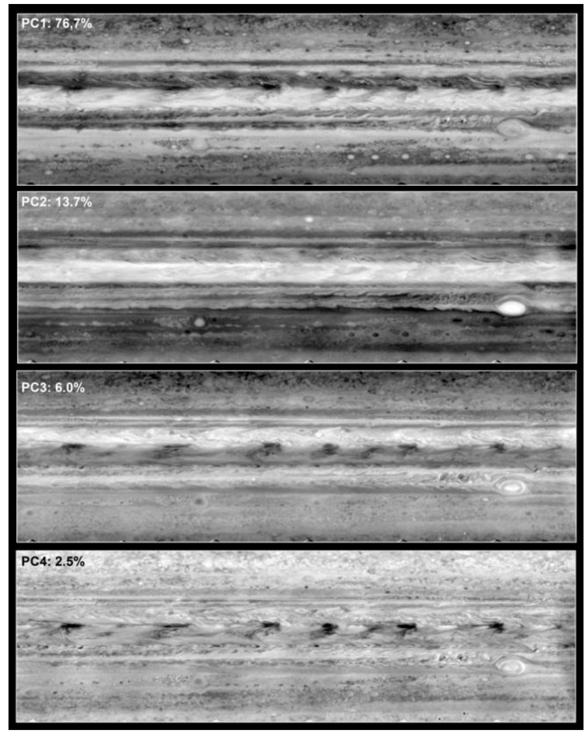

Figure 2: First four principal components for a 9 images analysis and amount of information associated to each component. The first PC represents a good map of the lower cloud. The second PC is obtained by adding MT2 and MT3 while subtracting the UV image with appropriate weights. The other image filters have a small contribution to the second PC. The third PC correlates well with the distribution of red hues on RGB images of the planet. A close view to PC3 and PC4 seem to indicate that two color agents are required to explain the color variability on RGB images of the planet.

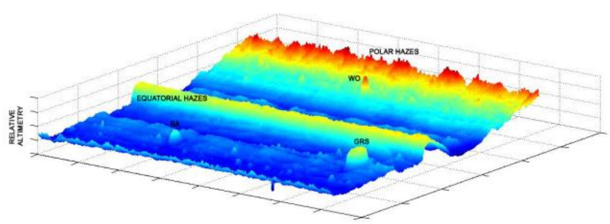

Figure 3: Test of the relative altimetry from MT3 and UV images.