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Imaging Titan's potentially active regions with VIMS

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Abstract

Observations from the Cassini Visual and Infrared Mapping Spectrometer (VIMS) in 352 wavelengths show two anomalously bright and possibly geologically active regions on Titan, Tui Regio and Hotei Regio. Both features are imaged in narrow spectral windows centered at 0.93, 1.08, 1.27, 1.59, 2.03, 2.8 and 5 μm, through Titan's dense atmosphere. Despite the weak atmospheric methane absorption within the windows, the surficial imaging is still ambiguous due to haze scattering and particle absorption. In order to obtain relatively clear surface images without the interference of the atmospheric contribution, we use empirical methods of atmospheric effects correction and photometric analysis that produce constraints on the surficial chemical composition.

1. Introduction

Tui Regio is a 1,500 km wide flow-like region that appears to lack the erosion channels that Cassini observed in other highland regions on Titan, suggesting it may be geologically young [1] and the flow terrain could be deposits of cryovolcanic activity. Hotei Regio is a 700 km wide area that resembles a volcanic terrain [2]. Cassini/Radar observations confirmed that the area is a low basin surrounded by higher terrains with possible calderas, fault structures and extensive cryovolcanic flows [3]. Both regions are of high geological interest due to their spectral index in addition to their surficial structural expressions. The key aim of our study is to apply atmospheric and photometric corrections on the spectral images of both areas, in order to obtain more accurate data that will reinforce and validate the analysis of the chemical composition.

2. Empirical Methods

We are using three methods in order to acquire the optimal result from the data set. a/ At first we subtract the atmospheric component from the "window" images, where we expect the surface contribution to be predominant, though nevertheless hampered by the atmospheric interference [4]. We consider the centre of the methane window as the "surface" image, while the channel from the closest methane "wing" diagnoses best the "atmospheric" contribution. This accounts mainly for the flux reflected by the aerosols in the upper layers of the atmosphere. b/ On the resulting image we isolate areas of different spectral behaviors by using selections as shown in Principal Component Analysis (PCA) images (Fig. 1). c/ Eventually we constrain the chemical composition of these areas of interest by studying their contrast evolution with "differential spectroscopy". This method allows us to compensate for most of the atmospheric contributions while focusing on the real discrepancies in surface composition.

3. Results

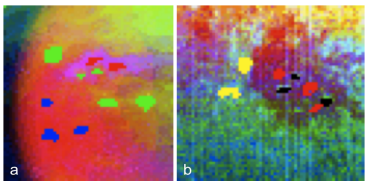

Figure 1: PCA on Tui Regio (a) and Hotei Regio (b). The isolated areas are selections of bright, dark and semi-dark areas (red, green, blue for Tui Regio - red, black, yellow for Hotei Regio respectively).

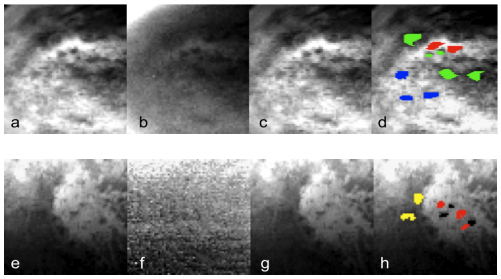

Figure 2: "Surface" (a & e) and "atmosphere" (b & f) references used to compute unaffected surface images (c & g). Figure 2d and 2h present the isolated areas using PCA color alterations as seen in figure 1(a) and (b).

4. Summary and Conclusions

We have used two empirical methods and one statistical method on VIMS data, in order to retrieve surface images without the atmospheric contribution at two specific areas. The results after applying the first empirical method showed that the effect and contribution of the atmosphere within the atmospheric methane windows could be reduced. Using the statistical method of Principal Component Analysis we found that the areas seen as bright in the original data and suggested as cryovolcanic in origin, present high I/F values, especially at long wavelength. On the contrary, the surrounded dark areas present low I/F values at all wavelengths. The diversity of I/F values suggests significant alterations in surface composition. Furthermore, through the analysis of contrast evolution at both Tui Regio and Hotei Regio, we will present comparisons between laboratory data of possible material candidates on Titan (ices, tholins and methane) with our inferred surface albedo that will reinforce the research of surficial components identification.

References

[1] Barnes, J.W., Radebaugh, J., Buratti, B.J., Sotin, C., Le Mouelic, S., Rodriguez, S., Turtle, E.P., Perry, L., Clark, R., Baines, K.H., Nicholson, D.: Cassini observations of flow-like features in western Tui Regio, Titan. Geophys. R. Lett., Vol. 33, L16204, 2006.

[2] Solomonidou, A., Coustenis, A., LeMouelic, S., Sotin, C., Bratsolis, E., Bampasidis, G., Kyriakopoulos, K., Moussas, X.: Potentially active regions on Titan with Cassini/VIMS and Radar data: Terrestrial analogues. Geophysical Research Abstracts Vol. 12, EGU2010-990-2, 2010.

[3] Soderblom, L. A., Brown, R. H., Soderblom, J. M., Barnes, J. W., Kirk, R. L., Sotin, C., Jaumann, R., Mackinnon, d.J., Mackowski, D. W., Baines, K. H., Buratti, B. J., Clark, R. N., Nicholson, P. D.: The geology of Hotei Regio, Titan: Correlation of Cassini VIMS and RADAR. Icarus, Vol. 204, pp. 610-618, 2009.

[4] Coustenis, A., Hirtzig, M., Gendron, E., Drossart, P., Lai, O., Combes, M., Negrao, A.: Maps of Titan's surface from 1 to 2.5 μm. Icarus, Vol. 177, pp. 89-105, 2005.