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High resolution mapping of Titan with VIMS

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Abstract

We report on the results of Titan flybys for which the Visual and Infrared Mapping Spectrometer (VIMS) was prime at closest approach and obtained high resolution (1 km/pixel) images of Titan's surface. The observations include the Huygens landing site and lakes at 1 km/pixel resolution. The images are compared to the DISR images and to the radar images. It emphasizes the facts (1) that resolution is required for geological interpretation of the features observed at Titan's surface and (2) that the radar and VIMS data sets provide complementary information.

1. Introduction

During the nominal mission and the extended mission (Cassini Equinox Mission), the VIMS was able to take some high-resolution images of Titan's surface when Cassini was at closest approach from Titan. Two modes can be chosen: a noodle mode which provides long narrow strips acquired with a short integration time [1,2] or an image mode using the spacecraft pointing capabilities for motion compensation [3,4]. In this abstract, examples of the later are given.

2. Tortola Facula

The VIMS image (fig. 1) was taken during the first close flyby of Titan by Cassini named TA. At the time of the implementation, Titan was still the largest unknown territory to be explored and we had no idea of what we were going to find at the surface [3]. We chose to use the spacecraft for motion compensation and to target an area on Titan (Fig. 1). We discovered a bright area, now known as Tortola Facula, which appears brighter than the surrounding area at all wavelengths.

This area was later observed by the radar (Fig. 1). It shows very clearly the dunes which are merely seen in the optical image. The dunes are diverted by the radar bright topographic obstruction [5] which correlates very well with the optically bright area.

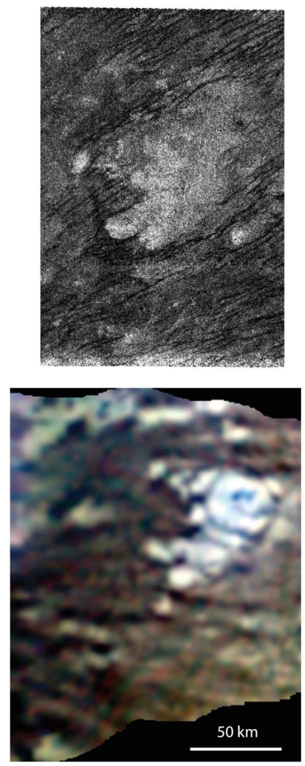

Figure 1: Tortola Facula observed by radar at T43 (top) and by the VIMS at TA (bottom)

One possible origin for this relief is that erosion has been operating leaving some topographic highs. The fact that it is bright in radar indicates that the roughness at a few centimeters is higher than the surrounding terrains, which suggests some kind of porosity. The infrared spectra do not suggest that the surface is made of water ice. Although the radar and optical images correlate very well, the shape looks different. The origin of such reliefs, before erosion processes operated, is still under investigation.

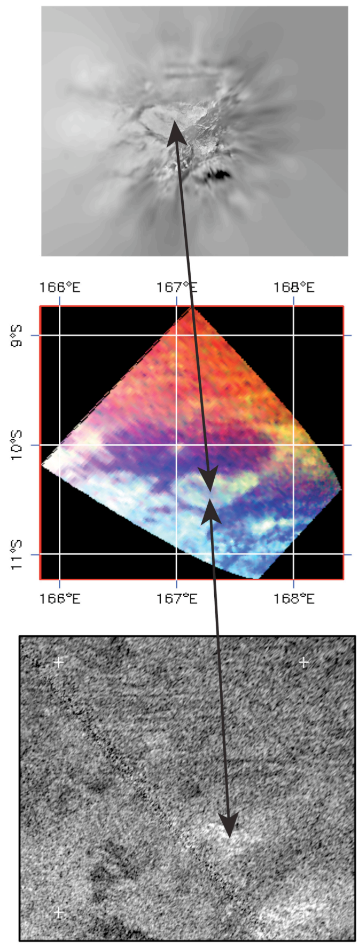

Figure 2: The Huygens landing site area seen by Huygens/DISR (top), Cassini/VIMS (middle), and Cassini SAR (bottom).

3. The Huygens landing site

The Huygens landing site was first imaged by the Huygens probe during its descent in Titan's atmosphere in January 2005 (Fig. 2). It was then imaged by the SAR in February 2008 and finally by the VIMS in November 2008 (Fig. 2)

First there is a very good correlation between the Huygens image taken at 50 km from the surface and the VIMS image taken at 2,000 km from the surface. The bright plateau indicated by the arrow helps in comparing the images. The situation seems somehow similar to that for Tortola Facula suggesting a topographic high (plateau) surrounded by plains. In the South, the plains are covered with ice pebbles as observed by Huygens. The northern plains are dune fields. This area is the eastern tip of the Adiri plateau which is a bright equatorial plateau. This area is carved by rivers as demonstrated by the Huygens images taken at 6 km from the surface with a resolution of 20 m/pixel. Although erosion plays a key role in the small scale morphology of those plateaus, the question of their initial formation has not yet been resolved.

The comparison between the VIMS image and the spectra obtained by the DLIS (Downward Looking Infrared Spectrometer) provides a ground truth for the VIMS spectra. It allows us to determine the albedo of the surface in the range 800 to 1600 nm.

4. Conclusions

The VIMS has taken high resolution images of Titan's surface which show details not seen in the radar images. The SAR outlines the dunes very nicely whereas the optical images are more sensitive to small contrasts in albedo properties related to composition variations and (or) topographic variations.

References

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