

Cassini/VIMS Spectra and Time-Evolution of Precipitation-Associated Surface Brightenings on Titan

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Abstract's Abstract

Large areas of Titan's surface brightened at all wavelengths as seen from *Cassini/VIMS* for several months. The brightenings occurred after a large storm and rainfall event, and may relate to volatile refreezing due to evaporative cooling.

Abstract

By incorporating latent heat cooling, Graves [1] showed that falling precipitation could reach Titan's surface. *Cassini* Imaging Science Subsystem (ISS) observations of surface darkenings associated with cloudburst events confirmed surface rains empirically [2, 3, 4]. In this presentation we will show observations from the *Cassini* Visual and Infrared Mapping Spectrometer (VIMS) instrument showing surface brightenings across large swaths of Titan in the wake of these storms. The brightenings were also observed by ISS (see talk by Turtle et al.).

The surface changes occurred in the wake of a storm seen by ISS on 2010 September 27 [2] which caused local darkening inferred to result from surface wetting by precipitated volatiles (Figure 2i). VIMS sees that the same areas that ISS had seen darkened later appeared brighter than their pre-rainfall state for a few months (Figure 2a,b,c). The brightening occurred at all wavelengths seen by VIMS from 0.9 to 5.2 microns. The spectrum of the changed areas does not match that of any other spectral units on Titan, including that of recently-discovered evaporites [5].

The brightened areas (Figure 2e,f) avoid mountain ranges and sand dune terrains, as mapped from RADAR and VIMS data (Figure 2d, g, h).

The general time-evolution pattern that we see – dark for weeks after cloudburst, lighter for months, then fade to original brightness – is seen in each of our four study areas. The timescale involved with return to the original spectrum may be too rapid to be accounted for by changes in chemistry of the preexisting surface. Hazefall

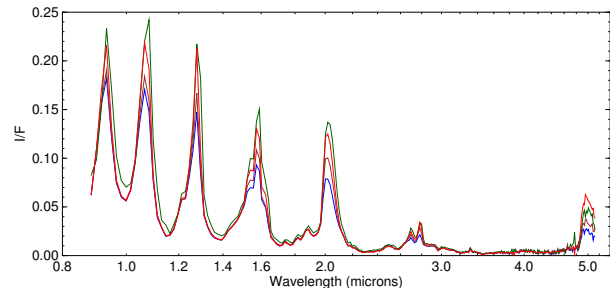


Figure 1: Comparison spectra with identical incidence and emission angles (but a significantly different phase angle for the Xanadu observation) for the change in Hetpet Regio. In blue is the area pre-alteration, in dark red the altered spectrum, in green Xanadu, and in light red Tui Regio.

also could not bury the surface fast enough to explain the vchanges. Hence our present best-fit physical scenario involves pure methane hail that gets melted by the warm surface, but subsequently refreezes after evaporative cooling. The methane-icy surface then would represent the brightening that we see, and gets sublimed away over the course of the ensuing months. A similar scenario was first proposed by Tokano [6] for Titan lakes.

References

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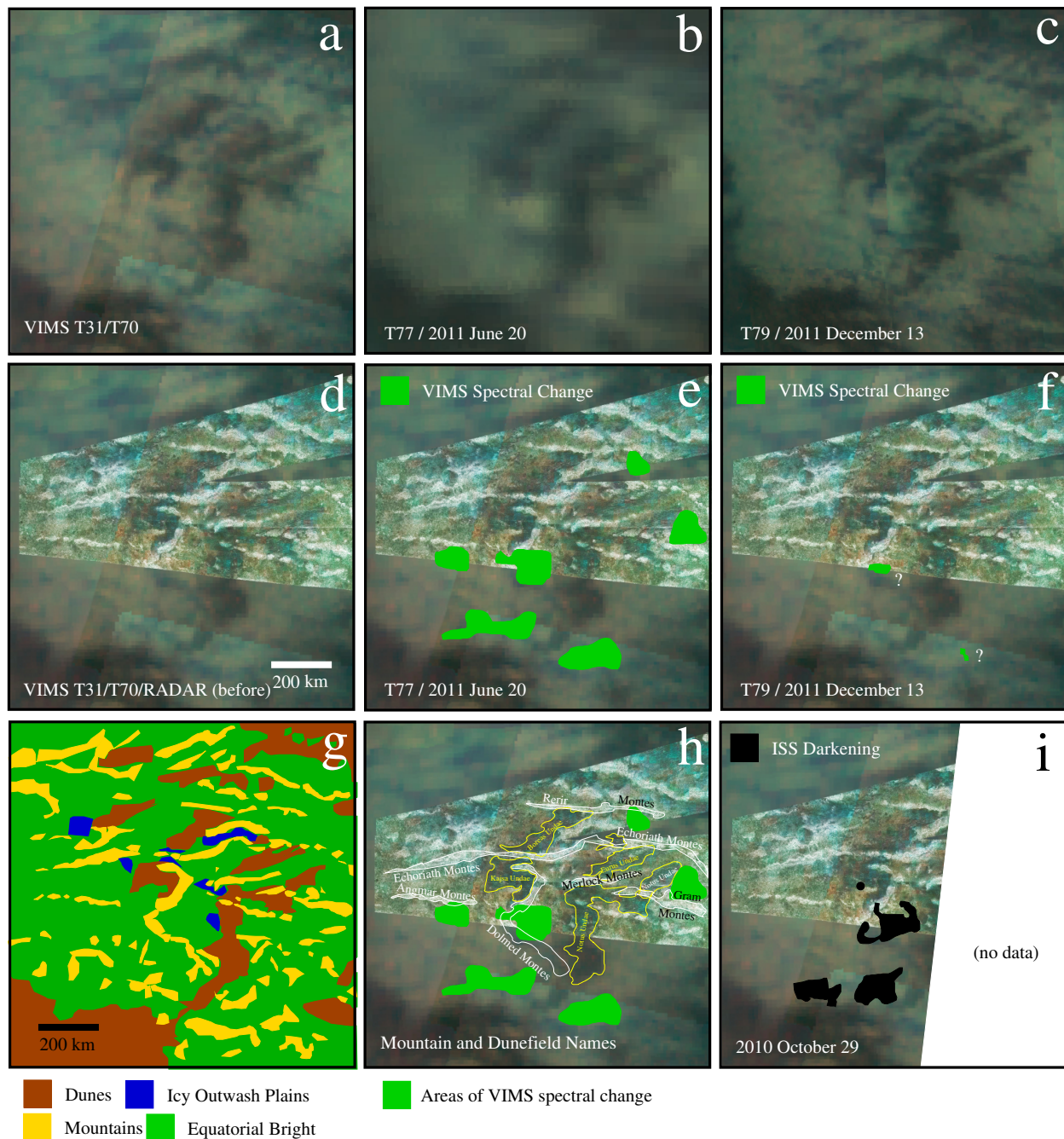


Figure 2: These nine views detail the changes that we see within Adiri, centered about 800 km west of the *Huygens* landing site. (a) VIMS view of the study area with R=5 μm , G=2 μm , and B=1.3 μm (after [7]) before the changes occurred, combination of T31 (2007 May 28) and T70 (2010 June 21) views. (b) VIMS view at relatively coarse resolution on T77 (2011 June 20). (c) Fine-resolution VIMS view on T79 (2011 December 13). (d) Area of overlap with RADAR from T8 and T61. (e) Map of areas VIMS sees as changed between T77 and T70. The altered surfaces do not occur in mountain ranges, and instead preferentially occur in more radar-smooth areas near and between mountains. (f) Map of remaining bright areas as of T79. (g) Unit map of the Adiri study area, based on RADAR where available and VIMS elsewhere. (h) Named mountain ranges and dune fields, with VIMS change areas for reference. Outlined in yellow are the dune fields, Boreas Undae, Kajsa Undae, Notus Undae, and Eurus Undae. The mountain ranges outlined in white are Echoriath Montes, Angmar Montes, Dolmed Montes, Rerir Montes, Merlock Montes, and Gram Montes. (i) Map of areas seen by ISS as darkened by rainfall as of 2010 October 29.