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Characterisation of haze, cloud and surface with VIMS onboard Cassini

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Abstract

We have used a model of atmosphere properties, coupled with radiative transfer solver to analyse observations of Titan made by VIMS about haze, clouds and surface. The model is validated with the DISR observations : we use the haze and cloud properties retrieved from observations made during Huygens descent [1] to model the intensity as observed by VIMS at locations close to Huygens landing site. We then use this model to characterise the haze and cloud layer near the pole. We also use this model to give quantitative information about the surface albedo.

Haze and cloud in the north polar region

We then focus our analysis on two aspects. First, we analyse the haze and cloud layer in the northern polar region and their evolution with time around the equinox. The north polar cloud was covering all the region northward to 62°N at the end of 2006 and gradually disappeared between 2007 and 2009 [2]. In this work, we make a quantitative analysis of the images (Figure 1) and we retrieve the opacity of the haze and cloud layers. We then are able to monitor the cloud break-up. We also show that after the cloud break-up, a ring of diffuse mist remains around 60°N (Figure 2).

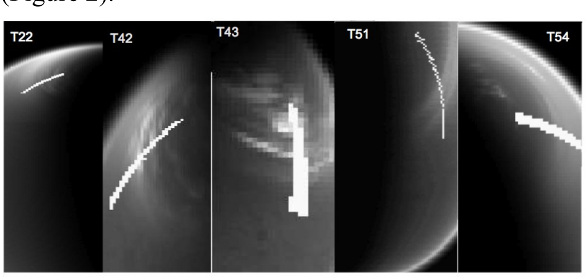

Figure 1: Pictures of Titan extracted of the observation analyzed in this work.

This ring, observed here in the near IR, could be similar the dark ring observed in 1980 by Voyager in visible [3]. By comparison, we show that Voyager may also have detected the north polar cloud.

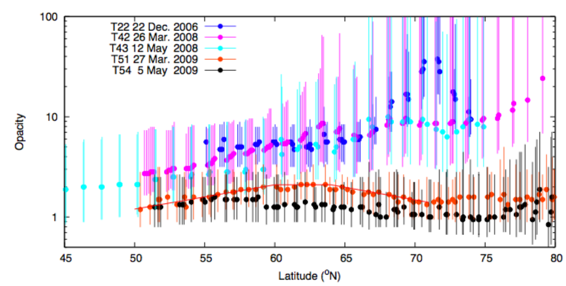

Figure 2: Opacity of the condensate layer as a function of latitude for several dates. The cloud layer gradually vanishes with time, and it finally yields a maximum of opacity between 60 and 65°N, then producing a circumpolar ring.

Surface albedo

We also use this model, educated with the properties retrieved with DISR [1], to reproduce the intensity observed by VIMS. After a phase of comparison where we are able to retrieve exactly the surface albedo at the Huygens landing site ([1][4]), we are able to retrieve the absolute surface albedo, in several methane windows, at other place on the planet.

We then use the model to produce map of absolute surface albedo in a latitude band around tropics and equator (Figure 3). We also show how we may extrapolate DISR result beyond 1.6 µm with a model accounting for the physics of particle scattering. We then are able to retrieve information about surface albedo at 2.0 and 5.0 µm.

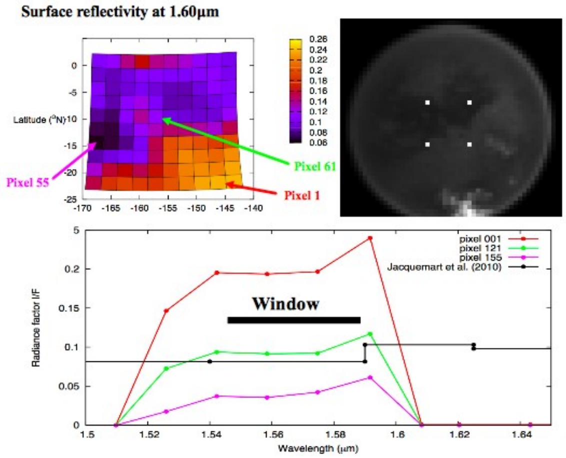

Figure 3: (up and left) Map of Titan surface at 1.60 µm retrieved from analysis. (up and right) Image of Titan showing the surface structure and the square zone which is analyzed. (bottom) the surface albedo retrieved for three selected pixels, and compared to the surface albedo retrieved with DISR [3,4].

References

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