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Cassini VIMS and RADAR investigation of Titan's equatorial regions: a case for changes in surface properties

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The Cassini-Huygens instruments revealed that Titan, Saturn's largest moon, has – in many aspects - a complex, dynamic and Earth-like surface [1;2;3]. Understanding the distribution and interplay of geologic processes on Titan is important for constraining models of its interior, surface-atmosphere interactions, and climate evolution. Data from the remote sensing instruments have shown the presence of diverse terrains, suggesting exogenic and endogenic processes, whose composition remains largely unknown. Interpreting surface features further requires precise knowledge of the contribution by the dense intervening atmosphere, especially the troposphere, which can be recovered from near-IR data such as those collected by Cassini's Visual and Infrared Mapping Spectrometer (VIMS) collects in the so-called "methane windows". In order to simulate the atmospheric contribution and extract surface information, a statistical tool (PCA) and a radiative transfer code are applied on certain regions of interest (i.e. possibly geologically varying and suggested in some cases to be cryovolcanic and/or evaporitic in origin) [4;5;7]. We also analyze RADAR despeckled SAR images in terms of morphology [6]. For comparison, we also look at undifferentiated plains and dune fields regions that are not expected to change with time. We find that Tui Regio and Sotra Patera change with time becoming darker and brighter respectively in terms of surface albedo while the plains and the suggested evaporitic areas in the equatorial regions do not present any significant change [5]. The surface brightening of Sotra supports a possible internal rather than exogenic origin. The unchanged surface behavior of the plains supports a sedimentary origin rather than cryovolcanic. Preliminary results on the chemical composition of the changed regions with time are also presented. We therefore suggest that temporal variations of surface albedo (in chemical composition and/or morphology) exist for some areas on Titan, but that their origin may differ from one region to the other. Such a variety of geologic processes and their relationship to the methane cycle make Titan particularly significant in Solar System studies.
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