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Potentially active regions on Titan: New processing of Cassini/VIMS data

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The Cassini Visual and Infrared Mapping Spectrometer (VIMS) obtained data of Titan's surface from flybys performed during the last seven years. In the 0.8-5.2 μm range, these spectro-imaging data showed that the surface consists of a multivariable geological terrain hosting complex geological processes. The data from the seven narrow methane spectral "windows" centered at 0.93, 1.08, 1.27, 1.59, 2.03, 2.8 and 5 μm provide some information on the lower atmospheric context and the surface parameters that we want to determine. Atmospheric scattering and absorption need to be clearly evaluated before we can extract the surface properties. We apply here a statistical method [1, 2] and a radiative transfer method [3, 1] on three potentially "active" regions on Titan, i.e. regions possibly subject to change over time (in brightness and/or in color etc) [4]: Tui Regio (20°S, 130°W) [5], a 1,500-km long flow-like figure, Hotei Regio (26°S, 78°W) [6], a 700-km wide volcanic-like terrain, and Sotra Facula (15°S, 42°W) [7], a 235-km in diameter area. With our method of Principal Component Analysis (PCA) we have managed to isolate specific regions of distinct and diverse chemical composition. We have tested this method on the previously studied Sinlap crater [8], delimitating compositional heterogeneous areas compatible with the published conclusions by Le Mouélic et al. (2008). Our follow-up method focuses on retrieving the surface albedo of the three areas and of the surrounding terrains with different spectral response by applying a radiative transfer (RT) code. We have used as input most of the Cassini HASI and DISR measurements, as well as new methane absorption coefficients [9], which are important to evaluate the atmospheric contribution and to allow us to better constrain the real surface alterations, by comparing the spectra of these regions. By superposing these results onto the PCA maps, we can correlate composition and morphology. As a test case, we used our RT code to verify the varying brightness of Hotei Regio reported by other investigators based on models lacking proper simulation of the atmospheric absorption [10]. Even though we have used exactly the same dataset, we did not detect any significant surface albedo variations over time; this led us to revise the definition of "active" regions: even if these regions have not visually changed over the course of the Cassini mission, the determination of the chemical composition and the correlation with the morphological structures [11] observed in these areas do not rule out that past and/or ongoing cryovolcanic processes are still a possible interpretation.

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