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Evolution of possibly active regions on Titan using Cassini/VIMS data analysis

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We present a study of Titan's complex geology with a focus on the satellite's surface regions that are showing spectral variations with time possibly linked to geological activity. We apply a statistical method, the Principal Component Analysis (PCA) [1] and a radiative transfer method (RT) [1,2] on three potentially 'active' regions on Titan, i.e. surface areas possibly subject to change over time (in brightness and/or in color etc.), namely Tui Regio (20°S, 130°W), a 1,500-km long flow-like figure, Hotei Regio (26°S, 78°W), a 700-km wide volcanic-like terrain, and Sotra Facula (15°S, 42°W), a 235-km in diameter area. With our PCA method we manage to isolate regions of distinct spectral response in all data available for our three study areas. Then, with our follow-up radiative transfer code we retrieve the surface albedo of the isolated regions with respect to the Huygens landing site albedo, which we use as a reference region and we compare them. Using this double procedure, we study the temporal surface variations of the three regions witnessing albedo changes with time for Tui Regio from 2005-2009 (darkening) and Sotra Facula from 2005-2006 (brightening) at all wavelengths. Hotei Regio has been suggested to present brightness variations over a two-year period (2004-2005) by Nelson et al. 2009 [3]. However, we find that the to-date available observations of that region present issues (geometry, resolution) that prevent an accurate application of our radiative transfer model to infer surface information with the desired accuracy. Therefore, we do not detect any significant surface albedo variations over time from 2004 and until 2009 given the uncertainties involved. The surface albedo variations, which we currently investigate in terms of chemical composition, and the volcanic-like features such as calderas, domes and lobate flows, which are present within the regions as shown by RADAR data analysis [e.g. 4], suggest that these features are compatible with internal phenomena such as cryovolcanism. Another study focusing on these areas suggests that Tui Regio and Hotei Regio could be paleolake clusters [5]. In the future, considering that the extracted surface albedos contain information on the chemical composition of the regions and their nature, we plan to better evaluate the temporal changes and to associate chemical composition inferences with morphological information to determine the nature of these regions.

References: [1] Solomonidou, A., et al.: in prep. [2] Hirtzig, M., et al.: submitted to Icarus. [3] Nelson, R., et al.: Icarus 199, 429-441, 2009. [4] Lopes, R.M.C., et al.: JGR, in press. [5] Moore, J.M., and Howard, A.D.: GRL 37, L22205, 2010.