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The Spectral Nature of Titan's Major Geomorphological Units

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We investigate the surface of Titan using spectro-imaging near-infrared data from the Visual and Infrared Mapping Spectrometer (VIMS). We use a radiative transfer code to determine the contributions of atmospheric haze to the Titan spectrum and retrieve the surface albedo [1;2]. We focus here on the major geological units identified in [3;4;5;6] from Synthetic Aperture Radar (SAR) data: mountains, plains, labyrinths, impact craters, dune fields, and alluvial fans. We find that all the different regions classified as being the same geomorphological unit in SAR show a very similar spectral response after the VIMS data analysis, thus suggesting a good correlation in the classification between SAR and VIMS. Exceptions are the undifferentiated plains, which present two different types of spectral responses. The Huygens landing site appears to be compositionally similar to one type of plains unit (variable plains), suggesting similar formation mechanisms. Within the VIMS data, we have identified 3 main types of albedo values (high, medium, low). By matching the extracted albedos with candidate materials for Titan's surface (using the GhoSST database [7]), we find that all regions of interest fall into one of three main compositional groups of major candidate constituents: water ice-like material, tholin-like material, or an unknown, very dark material. More specifically, we find that part of Titan's surface appears to be dominated by a tholin-like material and/or a very dark unknown (most likely organic) material, and that some fraction of the surface is covered by atmospheric/organic deposits. Material with a spectral response similar to water ice is also present at a number of regions as major constituent at latitudes higher than 30ºN and 30ºS. The surface albedo differences and similarities among the various geomorphological units constrain the implications for the geological processes that govern Titan's surface and interior (e.g. aeolian, fluvial, sedimentary, lacustrine, cryovolcanic, tectonic). Our results show that Titan's surface composition has a significant latitudinal dependence [8].

[1] Solomonidou, A., et al.: JGR, 119, 1729-1747, 2014; [2] Hirtzig, M., et al.: Icarus, 226, 470-486, 2013; [3] Lopes, R.M.C., et al.: Icarus, 205, 540-558, 2010; [4] Lopes, R.M.C., et al.: Icarus, 270, 162-182, 2016; [5] Malaska, M., et al.: Icarus, 270, 130-161, 2016; [6] Radebaugh, J., et al.: Geological Society, London, Special Publications, 440, 2016; [7] GhoSST database (http://ghosst.osug.fr); [8] Solomonidou, A., et al.: JGR-Planets, in review.