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Compositional mapping of Titan's surface using Cassini VIMS and RADAR data

Anezina Solomonidou^{1,2,3}, Athena Coustenis², Alice Le Gall⁴, Rosaly Lopes⁵, Michael Malaska⁵, Bernard Schmidt⁶, Kenneth Lawrence⁵, Charles Elachi¹, Ashley Schoenfeld⁷, Christophe Sotin⁸, Stephen Wall¹, Yannis Markonis³, and Christos Matsoukas⁹

¹California Institute of Technology (Caltech), Los Angeles, United States of America (anezina.solomonidou@jpl.nasa.gov)

²LESIA-Observatoire de Paris, CNRS, UPMC Univ., Paris 06, Univ. Paris-Diderot, Meudon, France

³Faculty of Environmental Sciences, Czech University of Life Sciences Prague, Suchbátka, Praha, Czech Republic

⁴LATMOS/IPSL, UVSQ Université Paris-Saclay, Sorbonne Université, CNRS, Guyancourt, France

⁵Jet Propulsion Laboratory, California Institute of Technology, Pasadena, California, USA

⁶Institut de Planétologie et d'Astrophysique de Grenoble, Université Grenoble Alpes, CNRS, Grenoble, France

⁷Department of Earth, Planetary, and Space Sciences, University of California, Los Angeles, CA, USA

⁸Laboratoire Planétologie et Géodynamique, LPGNantes, CNRS UMR 6112, Université de Nantes, Nantes, France

⁹KTH-Royal Institute of Technology, Stockholm, Sweden

The investigation of Titan's surface chemical composition is of great importance for the understanding of the atmosphere-surface-interior system of the moon. The Cassini cameras and especially the Visual and infrared Mapping Spectrometer has provided a sequence of spectra showing the diversity of Titan's surface spectrum from flybys performed during the 13 years of Cassini's operation. In the 0.8-5.2 μm range, this 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. Nevertheless, atmospheric scattering and absorption need to be clearly evaluated before we can extract the surface properties. In various studies (Solomonidou et al., 2014; 2016; 2018; 2019; 2020a, 2020b; Lopes et al., 2016; Malaska et al., 2016; 2020), we used radiative transfer modeling in order to evaluate the atmospheric scattering and absorption and securely extract the surface albedo of multiple Titan areas including the major geomorphological units. We also investigated the morphological and microwave characteristics of these features using Cassini RADAR data in their SAR and radiometry mode. Here, we present a global map for Titan's surface showing the chemical composition constraints for the various units. The results show that Titan's surface composition, at the depths detected by VIMS, has significant latitudinal dependence, with its equator being dominated by organic materials from the atmosphere and a very dark unknown material, while higher latitudes contain more water ice. The albedo differences and similarities among the various geomorphological units give insights on the geological processes affecting Titan's surface and, by implication, its interior. We discuss our results in terms of origin and evolution theories.

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