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A chemical composition map for Titan's surface

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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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