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A Look Toward the Surface: Radiative Transfer Modelling in Titan's Atmosphere Using Cassini/VIMS data

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Saturn's moon Titan possesses a thick and opaque atmosphere, strongly absorbing and scattering in the infrared due to the presence of molecular gases (mostly N_2 and CH_4) and of a thick organic haze. Despite the presence of this atmosphere, the Cassini Visual and Infrared Mapping Spectrometer (VIMS) instrument is able to acquire images of Titan's surface in atmospheric transmission windows centered at 0.93, 1.08, 1.27, 1.59, 2.01, 2.7-2.8 and 5 μm in the infrared [1]. These imaging capabilities already contributed to reveal and investigate the geological diversity of Titan's surface [2,3,4], but the interpretation of the data in terms of surface composition is often limited due to the heavy processing required to disentangle atmospheric to surface contributions. In this context, we are developing an accurate and fast radiative transfer model and inversion scheme for Titan in order to massively invert the Titan VIMS dataset (125 flybys, tens of thousands of data cubes) and compute surface albedo maps to be used for geomorphological and compositional mapping studies using Cassini/VIMS data. The present model operates in plane-parallel approximation using the SHDOMPP solver [5], which mostly constrains our inversions to the equatorial regions of Titan, where the viewing geometry is suitable to the solver. Our inversion strategy in based on the calculation of reference Look-Up Tables (LUTs) [6] with the radiative transfer direct model [6-8], on which we perform a series of interpolations in order to retrieve the exact geometry of the data (incidence, emission and azimuth angles) and the associated haze opacity factor and surface albedo in order to match the input spectra. This methodology of inversion allows us to process VIMS cubes and mosaics of VIMS cubes in a couple of hours only (as compared to several days with classical approaches). We will apply this model to regional VIMS mosaics composed of several flybys, such as the T13-T17 mosaic.

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