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Imaging of Titan in the infrared with Cassini/VIMS : Toward homogeneous surface maps

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The Visual and Infrared Imaging Spectrometer (VIMS) onboard Cassini has acquired a near global coverage of Titan in 352 wavelengths from 0.3 to 5.1 microns at a medium spatial resolution (10-20 km/pixels). Few percents of the surface have been observed with a resolution better than 5 km/pixel. The surface can be observed in seven narrow "windows" where the atmospheric methane does not absorb. This data set has allowed the cartography and spectral study of a wide range of surface morphological features, such as mountains, channels, dunes, impact craters, lakes, or cryovolcanic areas. However, the integration of the global data set into fully homogeneous global maps is hampered by the coupled effect of surface and atmosphere, which is all the more problematic than the geometry of observation covers a wide range of incidence, emergence and phase angle. Our objective is to find an empirical way to correct the mosaics from this coupled effect. We first study the 5 μm surface window, which is the less affected by the additive component of the signal due to the scattering by the particles in the haze layer. Seams at this wavelength result only from differences of absorption at 5 μm of the atmospheric species and the surface phase function, which are both multiplicative components. Then, we investigate different empirical corrections for the other methane windows (1.08, 1.27, 1.59, 2.03, 2.69, 2.78 microns) by using the 5 μm window as a reference. These windows contain both an additive component due to the scattering of the particles in the atmosphere, and a multiplicative component due to the absorption by aerosols and gas, and the surface phase function. We found in particular that the effect of the atmosphere in these methane windows can be significantly lowered by subtracting the bottom of their wings, which account mainly for the flux reflected by the aerosols in the upper layers of the atmosphere. This is consistent with the first order outputs of a radiative transfer model developed by Rodriguez et al. (2009)