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Seasonal temperature variations observed by Cassini-VIMS on Saturn's satellites

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We report about temperature maps of Mimas, Enceladus, Tethys, Dione and Rhea derived from Cassini/VIMS data. Observations taken during the entire duration of the Cassini mission (2004-2014) were processed. Since equinox occurred in 2009, this dataset includes both pre and post equinox viewing geometries. VIMS data taken at spatial resolution of 20-40 km/pixel allow us to study the correlation of the temperature at regional scale resolution with solar illumination conditions, geological features and seasons.
The retrieval of the temperature from IR reflectance data is based on the comparison with laboratory measurements (Clark et al., Icarus 218, 831, 2012): when a sample of pure crystalline water ice particles is cooled, the 3.6 μm peak moves towards shorter wavelengths, from about 3.65 μm at T=123 K to about 3.55 μm at T=88 K. Mastrapa et al. (ApJ 701, 104, 2009) have measured a similar trend also in the imaginary part (k) of the refractive index of water ice when a sample is cooled from T=140 K to 20 K.
Being Saturn's satellites surfaces dominated by water ice (Filacchione et al., Icarus 220, 1064, 2012), the measurement of the wavelength at which the 3.6 μm reflectance peak occurs can be considered as a good temperature marker. This method was already applied to Saturn rings VIMS mosaics to retrieve ring particles temperature (Filacchione et al., Icarus 241, 45, 2014).
By using geometry projection techniques applied to VIMS data, we have mapped temperature variations as a function of LST and season on the regular satellites surfaces. Pre and post-equinox temperature maps built at the same LST allow us to follow seasonal variations across summer and winter hemispheres. Moreover, temperature variations seen across satellites surfaces appear correlated with geological features, leading-trailing asymmetries, local color patterns and equatorial radiation lenses.