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Titan's Surface from the Cassini RADAR SAR and radiometry data

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The Cassini Titan Radar Mapper has proven to be of crucial importance for the investigation of Titan's surface. Synthetic Aperture RADAR (SAR) and radiometry of three Titan flybys (TA: October 2004; T3: February 2005; T7: September 2005; T8: October 2005) are reviewed in this paper with emphasis on the correlation and comparison of surface features and physical characteristics.

SAR and radiometry are two of the operational modes of the K_u-band (13.78 Ghz, $g\lambda$= 2.17 cm) Cassini Titan Radar Mapper. The radiometry data are acquired during the SAR active mode using 5 antenna beams. The observations are then modeled to derive brightness temperature measurements and form surface maps covering the same areal extent of the SAR swath to allow the comparison of radiometry and SAR surface features.

The correlation between SAR and radiometry is limited by the low radiometry footprint resolution at closest approach, preventing detection and correlation of surface features smaller than 6 km azimuth resolution. There is also a large-scale variability in calibration among the five radiometer beams caused by sidelobes that must be accounted for to obtain relative brightness variations. However, a general comparison of surface characteristics among swaths is informative.

An inverse correlation between SAR-bright and radiometric cold regions, SAR-dark and radiometric warm regions has been observed extensively in association with di-

verse geological features, which suggests that the correlation is not caused by a specific geologic process but characterizes the constituent material and surface properties of the features.

The observed variations in radar backscatter are a combined effect of surface roughness, topographic variation, and dielectric properties of unusual materials (mix of hydrocarbons or tholins, water ice, water-ammonia ice). Also, volume scattering might play an important role and contribute to the high backscatter return, especially in the presence of absorbing-porous materials on the surface. The correlation of SAR-bright and radiometric cold regions suggest volume scattering due to broken low-loss water ice, terrain rough on the size scale of the radiometer wavelength, or higher dielectric constant materials. Choosing amongst these three is possible only if the same area is covered in dual polarization, allowing the polarization dependency of the brightness to be determined.