MAPPING GLOBAL ALBEDO PATTERNS ON TITAN A. McEwen[1], E. Turtle[1], J. Perry[1], S. Fussner[1], C. Porco[2], R. West[3], G. Collins[4], and the Cassini ISS Team. [1]LPL, University of Arizona, Tucson AZ 85721, mcewen@pirl.lpl.arizona.edu, [2]Space Science Inst., [3]JPL, [4]Wheaton College.

The Cassini Imaging Science Subsystem (ISS) images show striking albedo markings on the surface of Titan. In this presentation we describe the observation and processing strategy; interpretations are described in a companion abstract [1].

ISS began making systematic observations of Titan in April 2004 with a three-month-long approach sequence, during which the pixel scale improved from ~200 km to 35 km [2]. On July 2, 2004, shortly after Saturn orbit insertion, Cassini had a distant (339,000 km) encounter with Titan (referred to as "T0") during which images of the southern part of the sub-saturnian hemisphere and south-polar region were acquired at pixel scales of 2-3 km. The first close (1200 km) targeted flyby of Titan ("TA") occurred on 26 October 2004, followed by close passes with similar observation geometry on 13 December 2004 ("TB") and 15 February 2005 ("T3"). The best ISS filter to peer through Titan's photochemical haze to its surface is a narrow "continuum band" filter (CB3, 938 nm) centered in the best "methane window" available to ISS [3].

The smallest surface features we have been able to detect are ~5 pixels wide. Most of the photons detected by the ISS through the CB3 filter have been scattered by the atmospheric haze before ever reaching the surface, and at least 70-90% (depending on phase angle and haze properties) of the light that is reflected off the surface from the nadir point is widely scattered by atmospheric haze, spreading the signal over regions up to ~100 km. The ~10-30% surface reflection that passes through the atmosphere without scattering (or perhaps via strong forward scattering and relatively little smearing) returns a weak signal, and the Modulation Transfer Function of the Cassini ISS at the Nyquist frequency reduces the contrast over ~2 pixels by an additional factor of 0.15. As a result, with reasonable estimates of surface contrast, a single medium resolution (0.5 to 3 km/pixel) image with an overall signal-to-noise ratio of ~200:1 cannot reveal surface features on scales smaller than ~5 pixels. We often acquire several images at each position, to be combined on the ground to improve SNR. The effects of the haze on surface visibility can also be seen by comparison of images showing the same region viewed at different emission angles. The contrast is reduced approximately linearly with increasing emission angle, *e*, in degrees, although the path length is proportional to cos(*e*) [4].

A near-global mosaic of Titan (2-83 km/pixel) is shown (at reduced scale) in Figure 1, which reveals distinct patterns of relatively bright and dark areas. We summed multiple images to increase signal:noise and subtracted filtered images that approximate the surface signal scattered through the haze [5].

We interpret the surface brightness variations as being due to the presence of different surface materials (with variable albedo) rather than topographic shading, because (1) the phase angle is low in some images (14-16°), (2) such a large icy satellite probably has relatively low topographic relief [6], so any shadows or shading might not be detectable at resolutions of ≥1 km, and (3) the atmospheric scattering must reduce the contrast from topographic shading. We also see no evidence in preliminary looks for changes in the albedo patterns in TA-TB-T3 images, as might be expected if low-lying fog or mist is sometimes present.

Upcoming encounters this year on 31 March ("T4") and 16 April ("T5") will reveal further detail in the albedo patterns observed on Titan's sub-Saturn hemisphere. A high-resolution emission/phase sequence in T4 will cover the center portion of the Radar SAR swath from T3. We use longer exposure times and dwell times in T4 and T5 and concentrate the high-resolution images at very low emission angles, which should enable better detection of small-scale surface features.

[1] Turtle, E. et al., this workshop. [2] Porco, C. et al., *Nature*, in press. [3] Porco, C. et al., *Space Science Reviews* **115**, 363-497 (2004). [4] Fussner, S. et al., LPSC XXXVI, #2278 (2005). [5] Perry, J. et al., LPSC XXXVI #2312 (2005). [6] Perron, J.T., & de Pater, I. , *Geophys. Res. Letters* **31**, 2004.

Figure 1: ISS Map of Titan through TB.