CASSINI ISS OBSERVATIONS OF TITAN: THE TITAN-20 FLYBY. J. Perry[1], E. P. Turtle[2], A. S. McEwen[1], and D. D. Dawson[1]. [1]Lunar and Planetary Lab., Univ. of Arizona, 1541 E. University Blvd, Tucson, AZ, 85721. [2]John Hopkins Univ. Applied Physics Lab., 11100 John Hopkins Rd., Laurel, MD, 20723; perry@pirl.lpl.arizona.edu

Introduction: Since shortly before entering Saturn orbit, the Cassini Spacecraft and its comprehensive suite of instruments, have been mapping the surface of Titan at near-infrared and microwave wavelengths [1,2]. The Imaging Science Sub-system (ISS) and the Visible and Infrared Mapping Spectrometer (VIMS) have steadily improved their global view of the surface of Titan as well as providing detailed observations of several regions [3, 4]. The 21st targeted Titan flyby (T20, October 25, 2006) provided an opportunity to image a complex boundary between bright and dark terrain on the trailing hemisphere, providing the first detailed look at this region of Titan. Data from T20 also revealed several unique features in this region.

Observation: The ISS REGMAPNA101 observation from T20 was a 25-frame mosaic consisting of images taken using filters at 938-nanometers (CB3) and 619-nanometers (MT1). CB3-filter images take advantage of a window in the absorption spectrum of atmospheric methane to observe the surface [1]. MT1-filter images do not sense the surface, but do sense the lower atmosphere, and thus have similar photometric properties as images taken using the CB3 filter. Thus, MT1 images, when ratioed with the corresponding CB3 images, can provide an ad-hoc photometric function, improving contrast and visibility of surface features close to the terminator [5].

The images from the REGMAPNA101 observation were taken from distances ranging from 41,200 km to 90,302 km and pixel scales ranging from 468 to 1050 meters per pixel. The region examined is centered at 25º S, 317.1º W, and covers approximately 1750 by 2000 km. To improve visibility of surface features, in addition to ratioing each summed CB3 image with a corresponding MT1 image, each frame was sharpened moderately to enhance bright-dark albedo contacts [5]. The processed mosaic can be seen in Figure 1. A color-coded unit map based on this mosaic is presented in Figure 2.

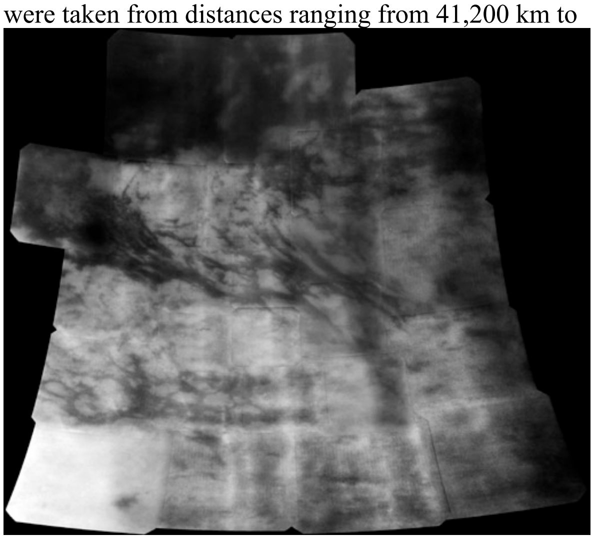

Figure 1: Mosaic of 25 ISS images from the T20 flyby. Processing preliminary when abstract was written.

Surface Units: Based on the brightness and morphology of albedo features, surface features in the T20 observations can roughly be divided into five albedo units: bright terrain, dark terrain, mid-latitude dark streaks, mid-latitude dark spots, and bright streaks.

Bright terrain: In the T20 observations, bright terrain is characterized by mottled, bright albedo material generally lying south of 27º S with isolated regions of bright material (termed "faculae") to the north. The brightness values of the bright terrain in this region (after ratioing CB3 and MT1 images), with the exception of the lower left corner, are similar to those seen north of a dark region named Fensal during 2005 by ISS. That region was observed by RADAR during T3 (February 15, 2005) and was interpreted as a plains unit consisting of water ice [6]. The lower left corner consists of the brightest material seen in this region, and marks the easternmost extent of a mid-latitude bright region known as Tsegihi, a region sampled further to the west by RADAR SAR on T7 (September 7, 2005).

Dark Terrain: Dark material dominates north of approximately 14º S along the upper fifth of the mosaic as well as on the far left. The dark material in this region is part of an area known as Senkyo (see [3] for a labeled map). Comparisons between this region and similar equatorial dark terrain regions observed by both ISS and RADAR would suggest that this dark terrain is an extension of the equatorial longitudinal dune seas observed by RADAR [7]. The margins between bright and dark terrain, particularly in the region marked "C" in Figure 2 would seem to support this interpretation. At "C", numerous northwest-southeast trending bright features, or "faculae", are observed to the southwest of a large region of bright material. These elongated faculae are interpreted as hills poking up above the surrounding dunes. The bright features would appear elongated as the dunes diverge around the hills and leave a sand-free wake on their downwind-side. The dunes would then be aligned in the same direction as the faculae, because the local winds, and thus the longitudinal dunes, are diverted around the large bright region, and topographic obstacle, north of "C".

Mid-latitude Dark Linear Features ("virgae"): Within the bright terrain, there is a region of dark material, roughly aligned east-west centered around 35º S. Many of the boundaries within this feature appear roughly linear, suggesting tectonic control of the distribution of bright and dark material. Structures, such as the virgae seen near "A" and others like Shiwanni Virgae and Bacab Virgae seen at similar latitudes, may represent extensional terrain, with bright horsts and grabens filled in with dark material.

Bright Streaks: Several bright streaks, roughly aligned north-south (or northwest-southeast) are visible at mid-latitudes, near the location marked "A" in Figure 2. These bright streaks were also observed by VIMS during the T20 flyby and were interpreted as mountain chains based on possible topographic shading observed at longer, near-infrared wavelengths [8]. While topographic shading is not apparent at 938 nm, it should be noted that the bright material and the "virgae" these streaks are superimposed on is mottled, and dark material can be seen along parts of the eastern margins of these streaks, suggesting that some of the apparent shading observed by VIMS is due to albedo variations, not topography.

Mid-latitude Dark Spots: The bright terrain seen on T20 is mottled with numerous dark spots, most likely representing local areas of dark particulates, as seen in the rest of the dark terrain region [7], or small, mountainous areas assocated with dark, hydrocarbon channels [9]. Two rather unique dark features were observed in the lower left portion of the mosaic, labeled "B" in the unit map, and shown in Figure 3. The dark spot in Figure 3A contains some of the darkest material observed at this latitude range, and has a ciliated margin, particularly along its southeastern edge, perhaps representing channels flowing in or out of this feature. The feature in Figure 3B has a kidney-bean shaped outline with an interior only slightly darker than its surroundings, but unlike the spot in Figure 3A, has a more distinct margin, similar to Ontario Lacus in the south polar region [5]. These features are located within an area in which mid-latitude cloud streaks have been preferentially observed [10, 11], suggesting a possible connection between these surface features and the observed clouds. One possibility is that some of these dark spots are lacustrine features, though there is currently no evidence for liquids at these locations.

Conclusion: Many of the types of features observed during the T20 flyby are typical of those seen elsewhere on Titan over the last 2.5 years [e.g. 1]. However, the complex interplay between bright and dark material has provided additional data on the roles of materials on the surface of Titan, which may help in understanding their composition. Co-analysis with RADAR, particularly in the upper right portion of the mosaic (labeled "D" in Figure 2), may also provide further insights into this fascinating region on Titan.

References: [1] Porco, C. C. et al. (2005) *Nature*, *434*, 159-168. [2] Elachi, C. et al. (2005) *Science, 308*, 970-974. [3] Turtle, E. P. et al. (2007) *LPS XXXVIII*, this volume. [4] Barnes, J. W. et al. (2007) *Icarus, 186*, 242-258. [5] Perry, J. E. et al. (2005) *LPS XXXVI,* Abstract #2312. [6] Stofan E. R. et al. (2006) *Icarus, 185,* 443-456. [7] Lorenz, R. D. et al. (2006) *Science*, *312*, 724-727. [8] VIMS public image release: Titan's Sierras. 12 December 2005. http://photojournal.jpl.nasa.gov/catalog/PIA09032. [9] Barnes, J. W. et al. (2007) *LPS XXXVIII*, this volume. [10] Roe, H. G. et al. (2005) *Science, 310*, 477-479. [11] Griffith, C. A. et al. (2005) *Science, 310*, 474-477.

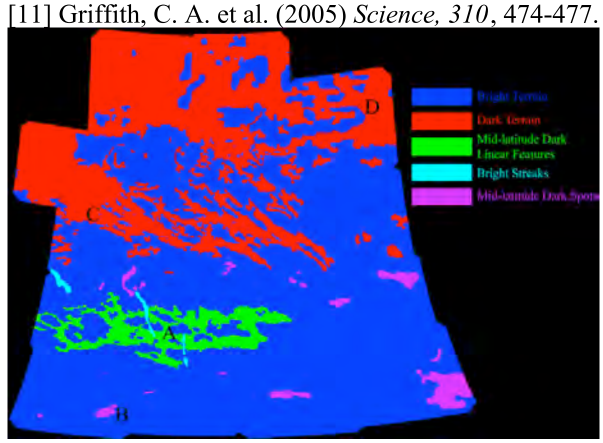

Figure 2: Map based on albedo and morphology as seen during T20. The units represented include: bright terrain (blue), dark terrain (red), mid-latitude dark linear features ("virgae"; green), bright streaks (cyan), and mid-latitude dark spots (purple).

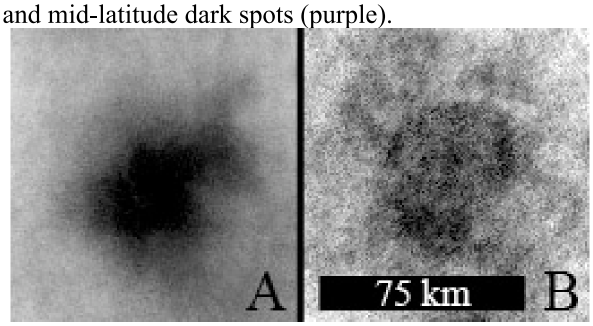

Figure 3: Close-up of two mid-latitude dark spots from T20. From N1540497931_1.