WATER ICE GRAIN SIZES AND CO_2 ON THE TIGER STRIPES OF ENCELADUS FROM CASSINI/ VIMS OBSERVATIONS. G. B. Hansen and J. Romain, Department of Earth and Space Sciences, University of Washington, Box 351310, Seattle, WA 98195-1310 (ghansen@ess.washington.edu)

Introduction: We are working on a project to analyze the visible and infrared spectrum of the satellites of Saturn as observed by the Visual and Infrared Mapping Spectrometer (VIMS) on the Cassini orbiter. We plan to characterize the grain sizes and mixing and layering of water ice, and the characteristics of the non-ice components mixed with the ice.

The VIMS is an imaging spectrometer that generates cubes of up to 64x64 spatial coverage and 352 wavelengths (96 wavelengths 0.35-1.05 µm for VIMS-v and 256 wavelengths 0.8-5.2 µm for VIMS-ir) [1]. We have previously studied Phoebe, a distant satellite observed before Saturn orbit insertion, as an ice-poor end-member {2]. We now shift our attention to Enceladus as an ice-rich end-member. As before, we have done a critical calibration of the data set that involves careful correction of dark artifacts. We have calibrated all the data to mid-July 2005, including at least three Cassini close encounters with Enceladus. Of articular interest art the parallel quasi-linear valleys in the south polar region that are the source of the water geysers that feed the E-ring, called "tiger stripes".

Previously, ice grain sizes of 50-150 µm and evidence of both CO_2 and short-chain organics in the tiger stripes of Enceladus were reported by Brown *et al.* [3]. Grain radii of 5-40 µm increasing to near 100µm in the tiger stripes based on band-depth measurements are shown in [4]. We are modeling the spectra as pure water snow, which seems consistent with the infrared part of the spectrum. Previously [5], we have shown that the grain radius consistent with the Enceladus spectrum is 5 µm, and that the 3-µm region is modified by a layer of micron-sized particles, probably from the E-ring. Our first comprehensive modeling effort is presented here.

Observation: We have calibrated and modeled a small observation of the tiger stripes (the same used in [3]) from 14 July 2006, using only the IR part of the VIMS spectra. It was taken in high resolution mode with a spatial resolution of 6x12 km/pixel (Figure 1).

Modeling: For our model, we use precalculated bidirectional reflectances for pure water ice at grain radii from 1 µm to 1 mm (the same ones we have used for modeling the Galilean satellites [6]). These are resampled at the VIMS wavelengths and for the lighting geometries at each pixel, so we have a set of 10 grain radii at each location for the model. The lighting geometries are modified for surface roughness with an average slope of 10% [7]. A grain size map is shown in Figure 2.

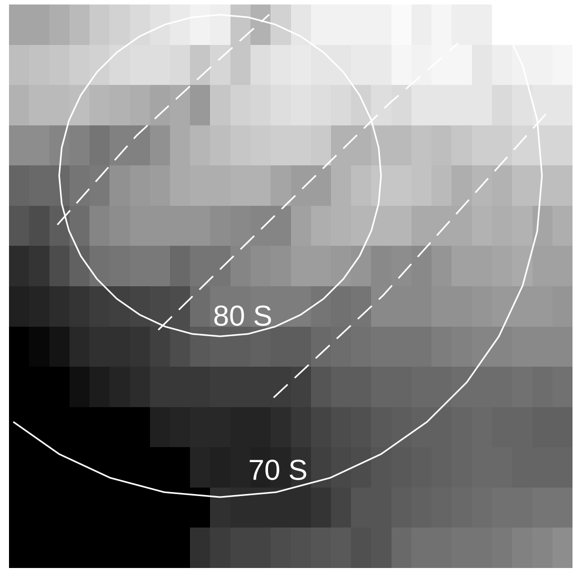


Figure 1. Enceladus tiger stripes observation from Cassini-VIMS taken on 14 July 2006. The tiger stripes imaged are marked by dashed lines.

The model has two parameters: the scaling for the ice and the water ice grain size. The grain sizes are monodisperse, representing a narrow distribution around the central grain size. The fits are not very good, implying that there is a broad distribution or mixed

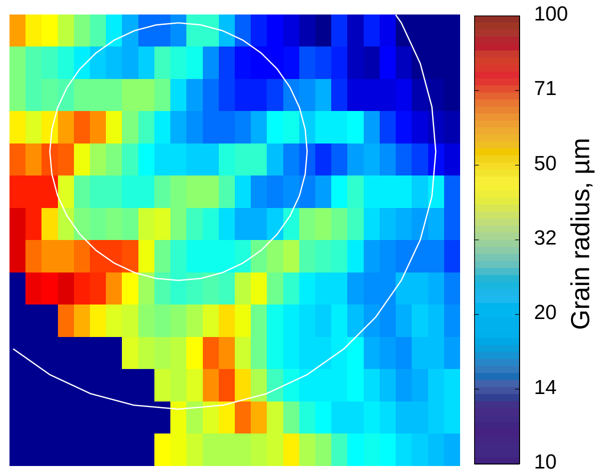
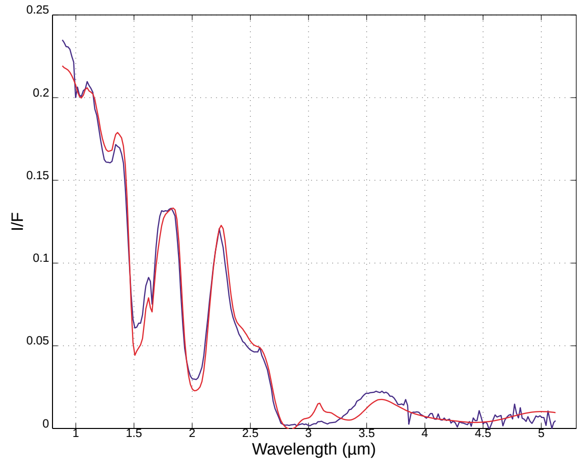


Figure 2. Model grain size map for the tiger stripes The grain radii are 30-50 µm in the stripes and 15-20 µm outside.



igure 3. Example model fit for one pixel in the nceladus observation. The VIMS data is in blue and he model data in red.

sizes in addition to the micron-sized layer. An example fit is shown in Figure 3.

CO_2 in the Tiger Stripes: About one hundred spectra were sampled from the tiger stripes and averaged, using the latest wavelengths for VIMS in the 4-µm region. The average is shown in Figure4(a), with a close-up of the long-wavelength region in Figure 4(b). there is a weak CO_2 band visible, much less than the 75% band found in [3] and no other bands are visible, probably caused by unstable darks.

Discussion: The water ice modeling will be modified to include the micron-sized layer plus mixed grain sizes in the main layer to better fit the observations. The other calibrated spectra for Enceladus will also be modeled and mapped and CO_2 band will be searched for elsewhere.

References: [1] Brown, R. H., *et al.* (2004), *Space Sci. Rev. 115*, 111–168. [2] Hansen, G. B., *et al.* (2009), *Lunar Planet. Sci. XXXX*, abs. 2227; Hansen, G. B., *et al.* (2009), *BAAS 41*, 1070–1071. [3] Brown, R. H., *et al.* (2006), *Science 311*, 1425–1428. [4] Jaumann, R., *et al.* (2009), *Icarus* (in press). [5] Hansen, G. B., *et al.* (2006), *Eos Trans. AGU 86*, Abstract #P11B-0124. [6] Hansen G. B., and T. B. McCord (2008), *BAAS 40*, 506–507. [7] Hapke, B. (1984), *Icarus 59*, 41–59.

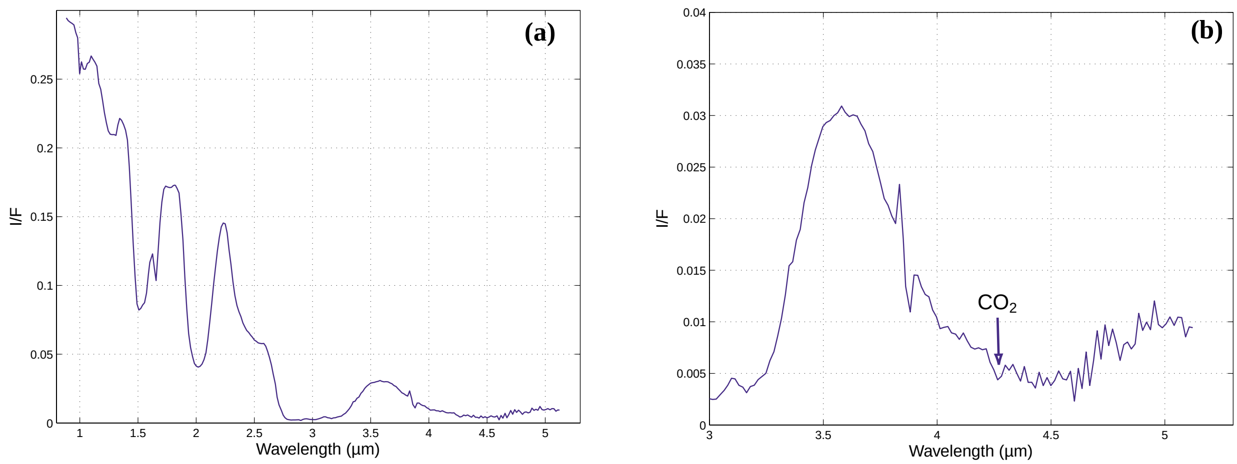


Figure 4. Average spectrum of the tiger stripes (a) and close-up of long-wave section showing ~20% CO_2 band.