THERMAL EMISSION SPECTROMETER ESTIMATES OF THE MARS NORTH POLAR ICE TABLE DEPTH AND THERMAL INERTIA. T. N. Titus[1], G. E. Cushing[1], and T. H. Prettyman. [1]United States Geological Survey, Astrogeology Science Center, 2255 North Gemini Dr., Flagstaff, AZ (ttitus@usgs.gov), [2]Planetary Science Institute (1700 E. Ft. Lowell, Suite 106, Tucson, AZ 85719, prettyman@psi.edu).

Introduction: Because approximately 25-30% of the Mars atmosphere is cycled through the seasonal caps [1,2], the Mars polar energy balance must be determined if we are to understand the climate of Mars [3]. The Mars polar energy balance is composed of many energy sources and sinks, including solar insolation, latent heat of fusion, radiative losses to space, and thermal conduction and heat storage in the regolith. The thermal effects of the regolith on the energy balance are a function of the structure and composition of the top few meters of regolith. With the detection of a widespread water ice table in the polar regions of Mars [4,5], it is important to understand the thermal inertia and hydration states of both the polar ice table and the top layer of soil that covers the ice table in order to determine the heat capacity of the regolith and the impact on the net polar energy balance

TES Data and Thermal Model: This study compares spring and summertime TES Solar and Thermal Bolometer data to the top of the atmosphere temperatures generated by a two layer thermal model (i.e., KRC) [6]. The KRC thermal model has been successfully used to study the thermal inertia of the Martian regolith in a number of studies [7,8]. This study utilizes the diurnal cycle and the seasonal rise in temperature immediately following the complete sublimation of CO_2 ice from the surface. There are three free parameters: thermal inertia of the top layer, thickness of the top layer, and the thermal inertia of the lower layer. These three parameters, which are fit to TES data binned at 60 km resolution, are used to construct maps of the thickness of the top layer, and the thermal inertia of the top and bottom layers.

While the thickness of top soil covering the ice table can vary several centimeters over scales of less than 100 m [9], sixty kilometer resolution is sufficient to resolve most of the regional and global energy balance terms in this study.

Results: Figure 1 shows the distribution of the column density of the top layer (mostly desiccated soil). Figure 2 shows the distribution of the ice table index. Olympia Undae has a lower ice table index than its surroundings, consistent with the findings that Olympia Undae has a layer of desiccated sand on top of niveo-aeolian cemented dunes [10].

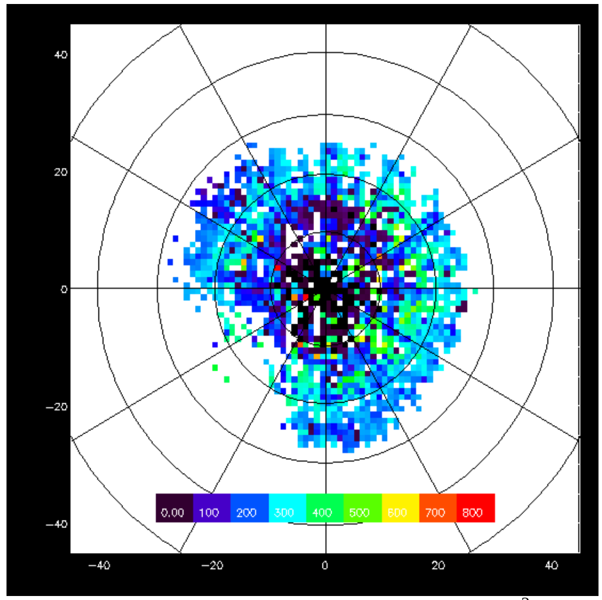

Figure 1: North polar ice table depth in kg/m^2. Latitude lines are spaced at every 10º, longitude lines are spaced every 30 º, with 0 º at the top.

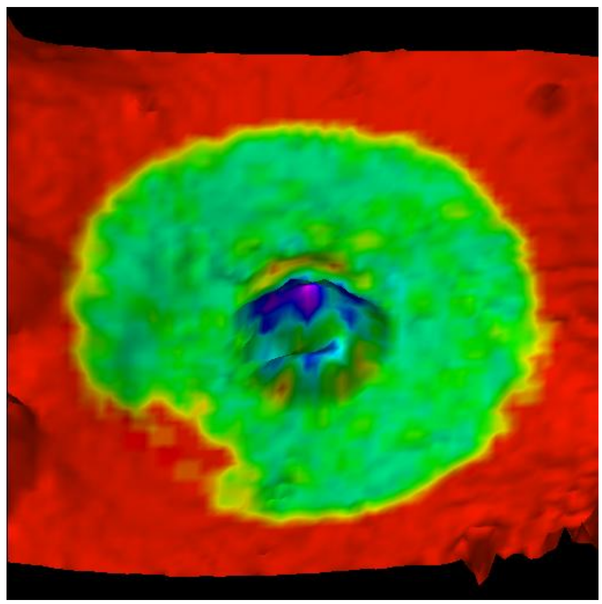

Figure 2: Ice Table Index overlaid on MOLA topography. Cooler colors (e.g., purple, blue) indicate exposed ice, while warm colors (e.g., red) indicate a lack of detectable ice in the near surface. Green represents near-surface ice that is not generally exposed.

Future Work: While the work presented in this abstract only addresses the northern hemisphere, future work will include the southern hemisphere as well as comparisons to neutron observations. In addition, we will combine neutron and TES observations to constrain and map ice table parameters and soil composition.

References: [1] Tillman et al. (1993) *JGR, 98*, 10963-71. [2] Kelly et al. (2006) *JGR, 111*, E03S07. [3] Titus et al. (2008) in *The Martian Surface*, edit J. Bell. [4] Boynton, W.V. et al. (2002*) Sci., 297*, 5578. [5] Feldman W. et al. (2002) *Sci., 297*, 5578. [6] Kieffer, H.H. (1977) *JGR, 82*, 4249-4291. [7] Titus, T. et al. (2003), *Sci*, *299*, 1048-1051. [8] Fergason R. et al., (2006) *JGR*, *111*, E12004. [9] Bandfield and W. C. Feldman (2008) *JGR*, *113*, E08001. [10] Feldman W. et al. (2008) *Icarus*, *196*, 422-432.