

Determining the Thermal Inertia and Ice Depth in Martian Polar Regions

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The polar regions of Mars present an interesting problem when producing thermal models for the surface of Mars. For a long time models were produced assuming uniform thermal properties as a function of depth, a natural assumption in the absence of extra information. What has become clear recently is that properties are certainly not uniform with depth. Adding also to the complexity are the changes in emissivity and albedo with seasonal frost and strange processes during the spring.

Ground ice has long been expected in the polar regions of Mars (Leighton and Murray 1966), and has recently been detected (Boynton et al 2001). Ground ice changes the thermal properties of the ground at depth but close to the surface. The top, dry (or ice-free) layer will have a thermal inertia that is much less than a buried, ice-rich layer. The effect of ground ice has been discussed before by (Paige and Scherbenski 2003) as a possible reason for seasonal thermal anomalies. Estimates of depth to ground ice in polar regions is of the order of the skin depth (or few) of the diurnal thermal wave based on the atmospheric water content (Mellon et al. 2004). Ground ice this shallow is close enough to affect the surface temperatures observed remotely.

I show here the results of some models to illustrate how depth to ground ice and dry-layer thermal inertia can be determined from temperature observations. The temperature observations used come from the Thermal Emission Spectrometer (TES) onboard the Mars Global Surveyor (MGS). I also show the effect of this ground ice on the apparent thermal inertia. Effects of ground ice explain irregularities in recent thermal inertia maps that appear more like orbit tracks than anything geological (Putzig et al. 2005).