THERMAL AND ALBEDO MAPPING OF THE NORTH POLAR REGION OF MARS; K. D. Keegan, J. E. Bachman and D. A. Paige, Dept. of Earth and Space Sciences, UCLA, Los Angeles, CA 90024.

Here we present the first maps of the thermal properties of the north polar region of Mars. The thermal properties of the midlatitude regions from -60° to +60° latitude have been mapped in previous studies[1]. The maps presented here, plus those of the south polar region contained in an accompanying abstract[2], complete the mapping of the entire planet.

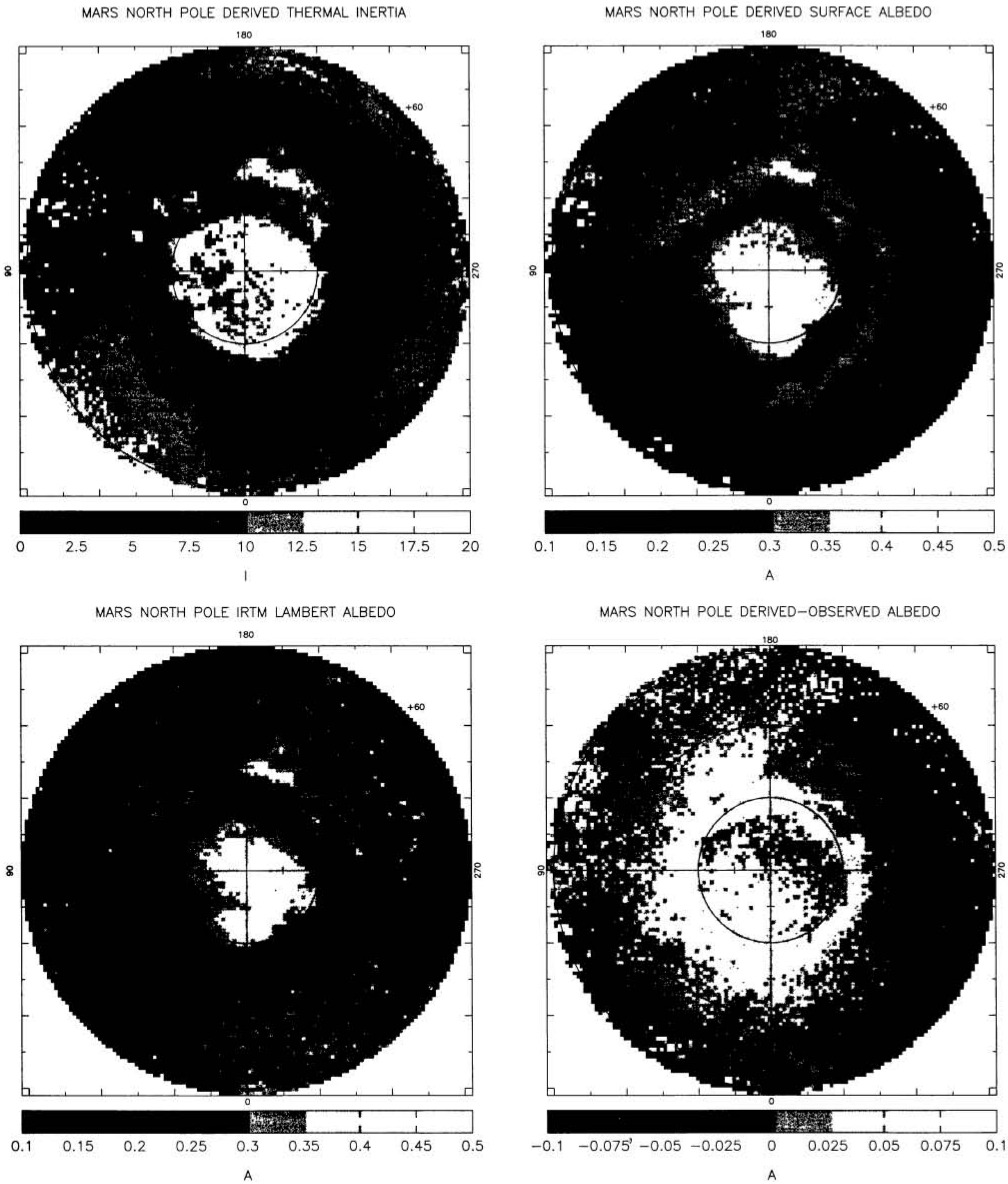
The maps were derived from Viking Infrared Thermal Mapper (IRTM) 20μ channel brightness temperature observations obtained between June 10, 1978 to Sept. 30, 1978 (L_s = 98.39 to 121.25, Julian Date = 2443670 to 2443720). This period corresponded to the early summer season in the north, when the north residual water ice cap was exposed, and polar surface temperatures were near their maximum. The IRTM observations were constrained to exclude observations obtained at slant ranges of less then 3500 km and greater than 22000 km, and emission angles of greater than 78.463° . The remaining observations were then grouped into 12267 geographic regions with boundaries defined by squares with sides of 0.5° of latitude on a polar conic projection. If a given region contained 6 or more observations, then the exact latitudes, local times and seasons of each of the points in a region were compared with the results of an extensive series of thermal model calculations, and best fit thermal inertias and surface albedos were determined for the region using multi-linear interpolation in five dimensions. The thermal model assumed homogeneous thermal properties with depth and no atmospheric contributions to the surface heat balance. Standard deviations of the model fits were less than 2.5K for 85% of the regions. Regions that contained large thermal and albedo contrasts, such as those on the boundaries of the residual water ice cap had higher standard deviations. Figures 1-4 show the resulting maps of apparent thermal inertia, derived surface albedo, average IRTM measured solar channel lambert albedo, and the difference between the derived and measured albedos from the pole to +60° latitude.

Thus far, the major results of this work can be summarized as follows:

- Surface Heat Balance: The derived surface albedos and measured IRTM surface albedos are generally in good agreement, which implies that the there are no major factors in the surface heat balance during this season that are not accounted for by the thermal model. The largest differences occur within low albedo, moderate thermal inertia regions close to the pole, where the thermal model would predict warmer temperatures than are observed for the measured albedos. This could be due to any of a number of factors, including the radiative effects of atmospheric aerosols, and the presence of higher inertia material at depths below one diurnal skin depth.
- Surface Water Ice: High albedo, high thermal inertia water ice deposits are widespread within the residual cap, and in outlying deposits at latitudes as low as +74° . The diurnal thermal inertias derived here are consistent with seasonal thermal inertias derived from measurements of the polar heat balance[3], which implies that these deposits are dense and coherent from the surface to great depths.
- Polar Dune Material: Regions containing low albedo polar dune material can not be distinguished from the surrounding polar planes units solely on the basis of thermal inertia. They generally have intermediate thermal inertias, which is consistent with transportation by the martian atmosphere under current climatic conditions. The inertias of the polar dune materials are distinctly lower than the low albedo material that extends northward from the Acidalia region at 45° longitude.
- Dust Deposits: In sharp contrast to our results in the south, there are no extensive regions of contiguous exposed low thermal inertia materials in the north polar region of Mars. If the north polar region is presently a major sink for material raised during global dust storms, then this material must be incorporated into the residual water ice deposits.

REFERENCES

1. Palluconi, F. D. and H. H. Kieffer, *Icarus* **45**, 415 (1981).
2. Paige, D. A. and K. D. Keegan, this volume (1991).
3. Paige, D. A. and A. P. Ingersoll, *Science* **228**, 1160 (1985).



Figures 1-4. Thermal inertia and albedo maps of the north polar region of Mars from Viking IRTM observations. Top left: Derived thermal inertia in units of $\times 10^{-3}$ cal cm^{-2} sec $^{-1/2}$. Top right: Derived surface albedo. Bottom left: Measured IRTM Lambert albedo. Bottom right: The difference between the derived surface albedo and the measured IRTM albedo. (data points with values outside the limits of the gray scales below each image were mapped to the highest or lowest gray scale values.)