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

Here we present the first maps of the thermal properties of the south 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 north 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 Aug. 24, 1977 to Sept. 23, 1977 (L_s = 321.58 to 338.07, Julian Date=2443380 to 2443410). This period corresponded to the late summer season in the south, when the seasonal polar cap had retreated to close to its residual configuration, and the second global dust storm of 1977 had largely subsided. The IRTM observations were constrained to exclude observations obtained at slant ranges of less then 6500 km and greater than 33000 km, and emission angles of greater than 78.463 degrees. The remaining observations were then grouped into 3238 geographic regions with boundaries defined by squares with sides of 1.0° 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 3.5K for 83% of the regions. Regions that contained the residual CO_2 frost cap could not be fit by the model. 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:

- Dust Deposits: The south polar region is the site of a major low thermal inertia region. The low inertias imply the presence of an extensive deposit of exposed dust which covers the south polar layered deposits[3,4]. The unique location of this deposit may provide clues to the processes responsible for the formation of the northern hemisphere low thermal inertia regions and the layered deposits at both poles.
- Surface Heat Balance: The derived surface albedos are in good agreement with the measured IRTM albedos at -60° latitude, but are not in good agreement near the south pole. Near polar surface temperatures during this season are almost 12K colder than would be predicted for the observed albedos. Because of the low thermal inertias near the poles, the surface cooling that is observed during this season must either be due to a significant alteration of the surface radiation environment by the south polar atmosphere, or by the presence of cold subsurface materials in thermal contact with the surface. Preliminary experimentation with one-dimensional radiative convective models indicates that dust in the south polar atmosphere is capable of producing latitudinally dependant changes in the surface heat balance that mimic the observed cooling, but the magnitude of the dust cooling effect does not appear to be as large as the observations require. Experimentation with thermal models that assume the presence of high thermal inertia material below the diurnal skin depth also fail to reproduce the observed surface cooling during this season. Another possibility is that the low surface temperatures are due to the presence of sublimating subsurface CO_2 frost deposits. Conventional wisdom dictates that solid CO_2 on Mars is not stable below dark soil layers because it will be progressively sublimated by heat conducted from the warmer overlying soil[5]. Nonetheless, the possible presence of a large subsurface reservoir of solid CO_2 underneath a thin, opaque, insulating layer of dust needs to be seriously reconsidered in light of these new results.

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2. Keegan, K. D. and D. A. Paige *this volume* (1991).
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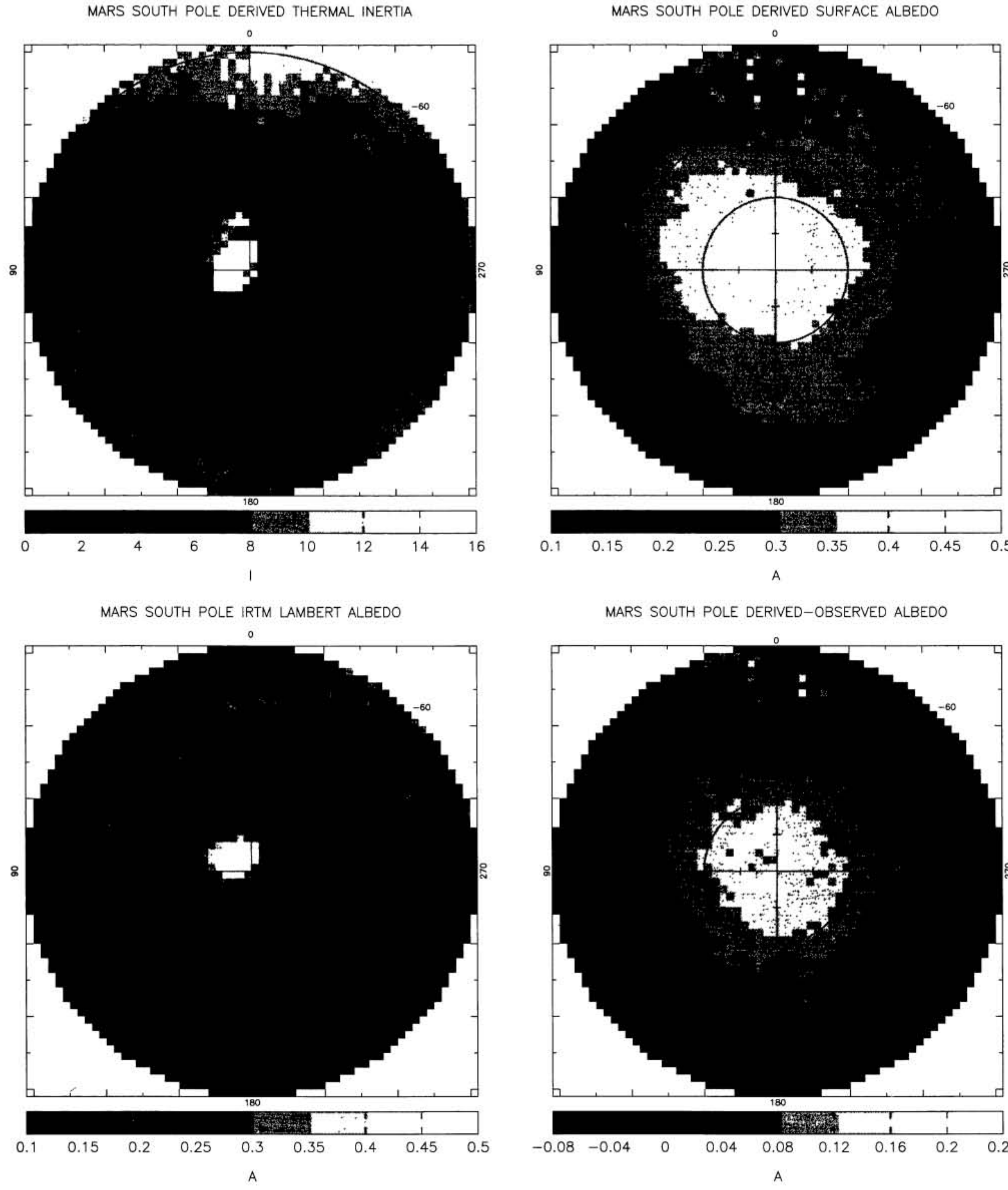

Figures 1-4. Thermal inertia and albedo maps of the south polar region of Mars from Viking IRTM observations. Top left: Derived thermal inertia in units of $\times 10^{-3}$ cal cm^{-2} sec $^{-1/2}$. Top right: Derived surface albedo. Bottom left: Measured IRTM Lambert albedo. Bottom right: The difference 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.)