

**MAPPING THE EXPOSED WATER ICE AND CO<sub>2</sub> PERENIAL CAP AROUND THE SOUTH POLE OF MARS WITH THEMIS VISIBLE and INFRARED DATA.** S. Piqueux and P. R. Christensen, Arizona State University, (ASU, Department of Geological Science, Tempe, AZ, 85282, USA, sylvain.piqueux@asu.edu).

The inventory of the martian volatiles and their behavior has been a subject of debate since the early observations of Mars. Their influence on the past, present and future climate as well as their role in various surface processes makes the CO<sub>2</sub> and water inventories an issue of primary concern to many outstanding questions related to Mars. In particular, water is of first interest for its potential importance to biology and as a resource for future manned missions.

Here we treat the case of the exposed water ice around the South Pole. [1] has first discovered exposed water ice using THEMIS IR data on an isolated image taken during the late summer 2001 (Ls 334°). Water ice is identified from its brightness temperature obtained from THEMIS IR and VIS data. Bare soil composing the south polar layered deposits is typically characterized by an albedo of 0.2 and a brightness temperature larger than 190 K. The perennial CO<sub>2</sub> ice composing the south cap is easily recognized by the very cold temperature and high albedo (150 K and 0.6). Finally, the exposed water ice displays an intermediate temperature (185 ± 3 K) and albedo (0.3).

We have selected 2003 late summer IR and albedo images of the South polar areas obtained by THEMIS on board Mars Odyssey. Data acquired after the CROCUS date guarantee the absence of seasonal frost [2]. Using the brightness temperature and albedo criterions described above, we have mapped the polar cap, the bare dust and the exposed water ice at medium/high resolution (100 m per pixel). Figure 1 displays this map. The coverage is complete between the high latitudes and -87°N. The data on Figure 1 between the South pole and -87°N (inside the dotted circle) are solely based on albedo data from MOC wide angle images.

This map is in excellent agreement with [3] using the OMEGA spectrometer. THEMIS coverage is different (no data right next to the pole but repeated coverage elsewhere in the late summer) and THEMIS resolution is higher (100 m).

The polar cap is surrounded by a large body of exposed water ice covering approximately 36,000 km<sup>2</sup> between -90°N and -81°N. It is typically visible right next to perennial CO<sub>2</sub> forming a region of transition between the bare dust composing the South Polar Layered Deposits (SPLD) and the CO<sub>2</sub> ice. A large body of exposed water ice is also completely mapped for the first time between 315°E and 10°E at around -86°N. Few regions show significant differences with [3]. A previously unmapped patch of exposed water ice is observed at 315°E and -84°N. Around 240°E and -86°N, [3] mapped small amounts of exposed water ice which are not appearing on thermal data. In this region, during the summer, the terrains are much hotter than exposed water ice.

The albedo of the exposed water ice units matches perfectly the temperature units and therefore the compositional units of the polar regions. Although not sufficient for a rigorous mapping, albedo can be used for mapping the exposed water ice in the context of the South polar region. We have compared the distribution of the exposed water ice in 2003 based on the visible and thermal data with visible images of the South polar region taken in 1977 by the Viking orbiter

(~900 m per pixel, complete coverage of the polar latitudes in the late summer) and images taken in 1972 by the Mariner 9 spacecraft (~60 to 120 m per pixel, incomplete coverage but the large majority of the polar region is covered in the martian summer). The albedo units on the Viking and Mariner 9 images are identical to the one observed by THEMIS except for a small region centered at 302.5°E and -83.5°N. We conclude that at the resolution of those instruments, exposed water ice has mostly not been removed or deposited between 1972 and 2003.

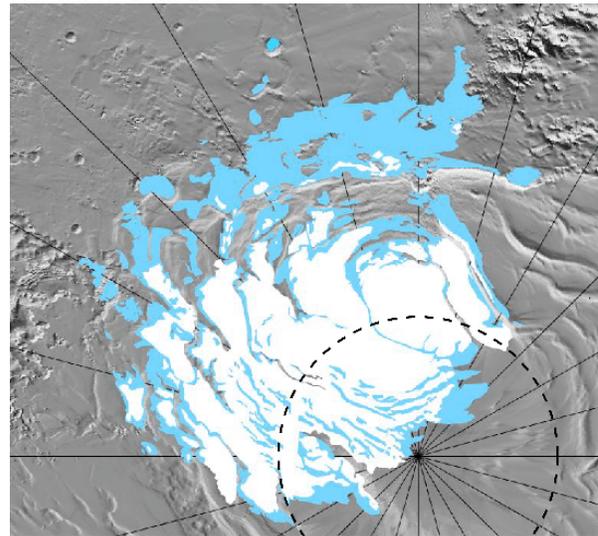


Figure 1: Distribution of the perennial CO<sub>2</sub> cap (white) and exposed water ice (blue) on top of a shaded relief map, next to the South pole. The dotted circle indicates the -87°N latitude inside which no THEMIS data is available.

We have compared the occurrence of small scale polygons on the SPLD and on the CO<sub>2</sub> seasonal cap with the exposed water ice. Small scale polygons are usually thought to be associated with surface and subsurface water ice [4], [5], [6], [7] through thermal cracking. A small population of polygons with common characteristics (classified as LPC in [6]) is clearly related to exposed water ice but the other families of polygons show no clear correlation with exposed water ice.

**References:** [1] Titus, T.N., et al. (2003) *Science*, **299**, 1048-1051, [2] Kieffer, H.H. et al. (2000) *JGR*, **105** (E04), 9653-9699 [3] Bibring, J.P. et al. (2004) *Science*, **428**, 627-630 [4] Mellon, M.T. (1997) *JGR*, **102**, 25,617-25628 [5] Mangold, N. et al. (2004) *JGR*, **109**, E08001 [6] Mangold, N. (2005) *Icarus*, **174**, 336-359 [7] van Gasselt, S. et al. (2005) *JGR*, **110**, E08002.