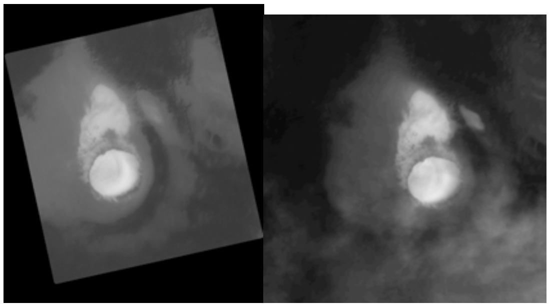
ALBEDO VARIATIONS ON THE MARTIAN NORTHERN POLAR CAP AS SEEN BY MGS. A.S. Hale D. S. Bass, and L. K. Tamppari[3], [1]NASA Jet Propulsion Laboratory (MS 264-235, 4800 Oak Grove Drive, Pasadena, CA 91109 amy.s.hale@jpl.nasa.gov), [2]NASA Jet Propulsion Laboratory (MS T1722, 4800 Oak Grove Drive, Pasadena, CA 91109 deborah.s.bass@jpl.nasa.gov), [3]NASA Jet Propulsion Laboratory (MS 301-422, 4800 Oak Grove Drive, Pasadena, CA 91109 leslie.k.tamppari@jpl.nasa.gov [1]

Introduction The Viking Orbiters determined that the surface of Mars' northern residual cap is water ice. Many researchers have related observed atmospheric water vapor abundances to seasonal exchange between reservoirs such as the polar caps, but the extent to which the exchange between the surface and the atmosphere remains uncertain. Early studies of the ice coverage and albedo of the northern residual Martian polar cap using Mariner 9 and Viking images reported that there were substantial internannual differences in ice deposition on the polar cap [1], a result that suggested a highly variable Martian climate. However, some of the data used in these studies were obtained at differing values of heliocentric solar longitude (L_s). Reevaluation of this dataset in [2] indicated that the residual cap undergoes seasonal brightening throughout the summer, and indicated that this process repeats from year to year. In this study we continue this work with data acquired with Mars Global Surveyor's Mars Orbiter Camera (MOC) and Thermal Emission Spectrometer (TES) instruments.

We use MOC Wide Angel (WA) red filter images of the cap obtained at different values of L_s and different Martian years, and TES albedo data of the north polar region. Previous work in this study has concentrated on MOC images of the cap edge and frost covered outliers [3]; in this phase we systematically investigate images from the cap center (defined for our purposes to be the area northward of 80 degrees latitude) in order to assess any latitudinal trends in seasonal brightening. We have examined data from both instruments from mapping year 1 and 2, though we have ignored MOC data acquired between September 2000 and May 2001, as the MOC camera experienced a state change between those dates that make albedo comparisons with data taken at other times problematic (Cantor, private communication).

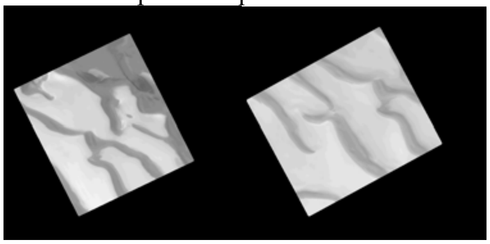
Result 1: MOC: Previous work [3] examined brightening of cap edge areas of approximately 40% throughout the northern summer, with the greatest increase occurring in early summer. This result is in agreement with that obtained by [1] for Viking and Mariner 9 data. The region shown in **Figure 1** shows this brightening [3].



a. b.

. **Figure 1:** MOC images showing the crater at approx. 77 degrees north and 270 degrees west. The left image (a) shows L_s = 108; the image on the right (b) shows L_s =161. An approximate 40% brightening is seen.

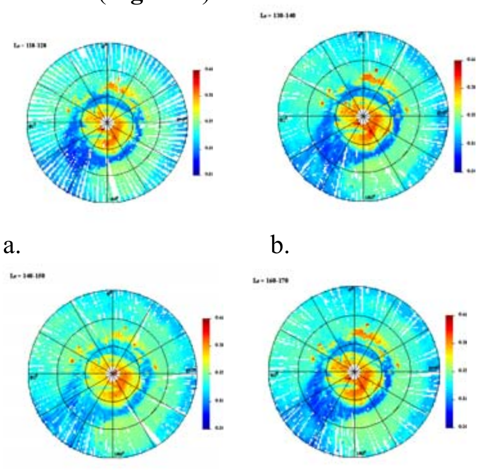
In contrast, examination of center cap images to date shows a different trend; center cap images appear to remain at the same albedo as the summer progresses. For example, the region shown in **Figure 2** shows a decrease in brightness of approximately 2.5 % between L_s = 121 and L_s = 155. This change is not within the MOC detectability limits (Malin and Edgett 2001), and so we conclude that this region has experienced no detectable albedo change. This result is in disagreement with that obtained by [1] for Viking and Mariner 9 data that suggested cap edge albedo was controlled by cap center albedo; the reasons for discrepancy are still being explored and will be discussed in our presentation. In all comparisons, the DN values of same pixels of the calibrated processed ISIS level 2 cubes were compared in qview.



a. b.

Figure 2: MOC images showing the area at approx. 86 degrees north and 141 degrees west. The left image (a) shows L_s = 121, the right one (b) L_s=155. No brightening within reliable detection limits is seen for the same areas

Result 2: TES: The story of north polar water ice frost appears to be even more complex when other datasets are examined. We generated TES lambert albedo maps for the northern polar region; maps were binned in 2 by 2 degrees of latitude and longitude, and 10 degrees of L_s. The spatial resolution of the TES instrument is much less than that of MOC (approximately 3 km per pixel), but larger regional trends can still be seen (**Figure 3**).



a. b.

c. d.

Figure 3: TES lambert albedo data showing the Martian north polar region. The plot on the top left (a) shows L_s 110-120; the plot on the top right (b.) L_s =120-130. The bottom left image (c) shows L_s 140-150, and image d shows L_s = 160-170 The latitude range shown is from 60 to 90 degrees north. All data from second mapping year.

The TES data show a complex picture, with the cap region appearing to brighten early in the summer, then decrease in albedo later in the season, and then brighten again as the summer ends. This is consistent with behavior documented previously [4]. Work is ongoing correlating TES pixels with areas observed by MOC, as is analysis of how the regional view of TES and the localized view of MOC agree and disagree, and we will present the results in our presentation.

Conclusions: The results reported here describe far more complexity in water ice albedo variability than had previously been appreciated. It is clear that the entire cap may not be treated as a monolithic body, but rather, individual locations show a variety of influences. One possibility is that topographic effects may have an effect; water cycle processes may also have a latitudinal dependence. In other research not presented here we are also investigating is the role of atmospheric effects on surface albedo. Clearly, whatever processes are affecting the cap albedo may have latitudinal dependence, and may have important implications for the Martian water cycle. We will present results regarding the full TES albedo data set, as well as other sites observed by MOC. Additionally we will present out interpretation of regional and local process interaction.

References: [1] Bass D. S et al. (2000) *Icarus, 144,* 382-396. [2] Cantor B. et al. (2002) *JGR., 107*. [3] Hale et al. (2003) 34th LPSC Abstract # 1422. [4] Kieffer and Titus (2001) *Icarus, 154,* 162-180.