YEARLY COMPARISONS OF THE MARS NORTH POLAR CAP: 1999, 2001, AND 2003 MOC OBSERVATIONS. J. L. Benson and P. B. James, Ritter Astrophysical Research Center, Dept. of Physics and Astronomy, Univ. of Toledo, Toledo, OH 43606 (jbenson@physics.utoledo.edu; pbj@physics.utoledo.edu)

Introduction: The seasonal cycle of the martian north polar cap has been studied since the time of William Herschel, who published the first quantitative observations of the seasonal recession of the polar caps in 1784 [1]. Ground-based observations made after Herschel were summarized by Slipher in 1962 [2]. More recent ground-based observations of the north polar cap have been done by Iwasaki et al. [3, 4, 5, 6]. Mariner 9 [7] and Viking [8, 9] also made north polar observations. Cantor et al. used Hubble Space Telescope observations between 1990 and 1997 to determine several north polar recessions and Lambert albedos of the cap [10].

Mars Global Surveyor went into orbit around Mars in September 1997. The wide-angle cameras on the Mars Orbiter Camera (MOC) acquire images of the entire planet every day at a resolution of ~ 7.5 km/pixel in both red (575 nm – 625 nm) and blue (400 nm – 450 nm) bandpasses (WAR and WAB). Some polar cap observations were acquired during the aerobraking (AB) and science phasing (SPO) of MGS before systematic mapping began in March, 1999 at L_S = 110°.

More than two complete Martian years have now been monitored by MGS/MOC, including three summer seasons in the northern hemisphere. Data pertaining to the spring / summer recessions of the north cap during the first year of mapping has been reported previously [11]. The north polar recession in 2000 was very similar to previously observed recessions. The MOC observations confirmed an almost linear cap regression from L_S = 340° until L_S = 60°.

Using WAR images, we have studied the subsequent spring recession of the north seasonal polar cap and also made albedo measurements of the residual cap. We look for interannual variability between this and previous years observed by MOC. This comparison is especially interesting because an extensive planet encircling dust storm occurred in early northern fall of the second Martian year while there was no such large storm in the first year. Therefore, it may be possible to determine the effects of dust on the condensation and sublimation of the carbon dioxide in the cap.

Seasonal North Cap: The late winter and early spring portions of the north cap recession have been phases for which the largest interannual variability has been reported. The extent of the surface cap boundary in late winter has been controversial. Also, a halt in cap regression in early to mid-spring has been reported [3, 8]; that is, the boundary of the cap remains fixed at a latitude of about 65º for several weeks before the recession resumes. A global dust storm during the condensation phase of the north cap is one mechanism suggested to be responsible for this variability. However, it is difficult to separate interannual effects from longitudinal asymmetries in the cap due to the gradual change in the longitudes on Mars seen from a location on Earth.

We have determined the regression curves for the 2000-2001 and 2002-2003 recessions of the north polar cap (Figure 1); a planet encircling dust storm occurred in early fall in the second year. The regression curves from the two years are very similar, however, there are small differences between L_S=10º and L_S=50º. There is no sign of a halt in cap regression in either year.

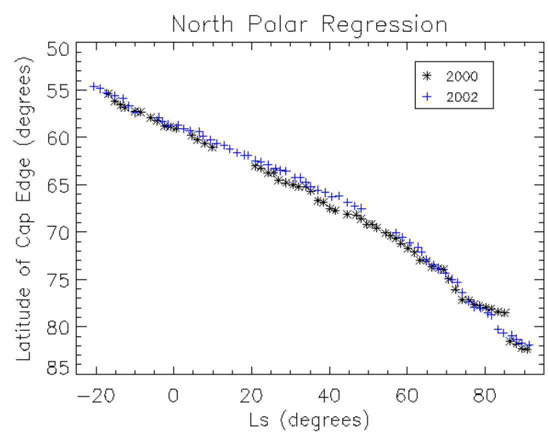

Figure 1: Regression of the north polar cap in 2000 (*) and 2002 (+). The latitude of the cap edge on a sterographic projection is ploted versus areocentric solar longitude. Recessions are similar, however, there are slight variations between L_S=10º and L_S=50º.

Residual North Cap: Mars Global Surveyor mapping began at L_S = 110º in 1999. Detailed comparisons of the caps in different years are complicated by frequent dust storms that may obscure the surface cap; fallout from these storms on the surface cap may also affect the apparent albedo for longer periods.

In Figure 2, the average Lambert albedo of the center (geographic pole) of the RNPC is plotted against L_S

for 1999 (*) and 2003 (Δ). Due to a change in sensitivity of the MOC WA Red Camera during the fall of 2001, those data are not included here, however, James and Cantor have reported these results [12]. The general behaviors of the albedo in this central region of the cap seem to be similar in the two years. The main exceptions are two data points from 1999 near L_S = 135°. There is a gap in the MOC WA red mapping subsequent to these events due to the Geodesy Campaign; so the question of the duration of this suppression is not answered by the red images alone, and additional investigation using the blue filter mapping images, which continued through the period, will be needed. The decrease after $L_S > 160°$ is probably due to the fact that the Lambert approximation fails at the large incidence angles in late summer.

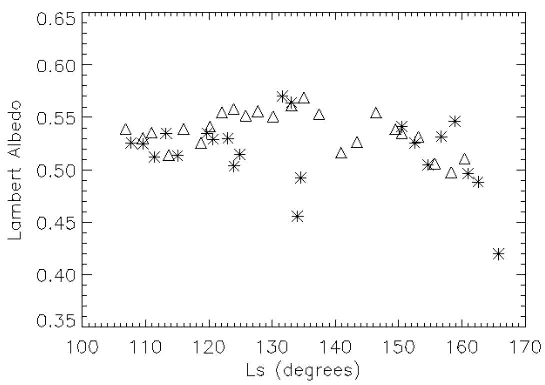

Figure 2: Average Lambert albedo for a 30 × 30 pixel^2 region around the geographic north pole as a function of L_S for 1999 (*) and for 2003 (Δ).

Acknowledgements: The authors were supported by grants from the Mars Data Analysis Program.

References: [1] Herschel, W. (1784) *Phil. Trans.*, 24, 233-273. [2] Slipher, E. C. (1962) *The Photographic Story of Mars*, Northland Press. [3] Iwasaki, K. et al. (1979) *JGR*, 84, 8311-8316. [4] Iwasaki, K. et al. (1982) *JGR*, 87, 10265-10269. [5] Iwasaki, K. et al. (1984) *PASJ*, 36, 347-356. [6] Iwasaki, K. et al. (1999) *Icarus*, 138, 20-24. [7] Soderblom, L. A. (1973) *JGR*, 78, 4197-4210. [8] James, P. B. (1979) *JGR*, 84, 8332-8334. [9] James, P. B. (1982) *Icarus*, 32, 565-569. [10] Cantor, B. A. et al. (1998) *Icarus*, 136, 175-191. [11] James, P. B. and Cantor, B. A. (2001) *Icarus*, 154, 131-144. [12] James, P. B. and Cantor, B. A. (2001) *BAAS XXXIII*, Abstract #19.16.