

HST OBSERVATIONS OF NORTH POLAR DUST STORMS IN LATE SUMMER ON MARS. S.W.Lee¹, P.B. James², and M.J. Wolff³, ¹LASP, Campus Box 392, Univ. Colorado, Boulder, CO 80309; email: lee@lasp.colorado.edu, ²Dept. Physics & Astronomy, Univ. Toledo, Toledo, OH 43606, email: pbj@physics.utoledo.edu, ³Space Science Institute, 2039 Pheasant Creek, Augusta, GA 30907, email: wolff@colorado.edu.

The Martian polar regions play an integral role in the current climate of the planet. Polar processes also play important roles in the dust cycle; enhanced deposition of atmospheric dust is thought to take place as dust grains act as nucleation sites for CO₂ and H₂O condensation, perhaps leading to significant sedimentary deposits [1]. The presence of dust will alter the albedo of surface condensates, and greatly impacts the polar radiation budget and the rate of sublimation once spring returns [2]; subsequent transport of dust out of the region contributes significantly to the atmospheric dust loading and therefore to the atmospheric temperatures [3]. It is clear that understanding the seasonal behavior of dust in the polar regions is essential to understanding the current climate on Mars.

In late-1990, the Hubble Space Telescope (HST) began a long-term program of Mars observations; by late-1997, HST had accumulated observations over portions of four consecutive Martian years. During that time, HST has provided unique observations of the seasonal behavior of both polar caps, and has given clear evidence of a surprising level of dust activity in the north polar region. In fact, over the course of roughly monthly HST observations between September 1996 and October 1997 (covering an L_S range of about 10° to 190°), dust activity was detected over the north polar cap in the majority of the observations. [4] has reported on north polar dust storms seen by HST during early northern spring, the time during which the north polar hood (a blanket of clouds which obscures the polar region through much of the autumn and winter) dissipates and the seasonal polar cap recedes. This presentation will discuss observations during the period between late northern summer and early autumn, the time during which the north polar hood reforms and the seasonal cap begins condensing onto the surface.

Figure 1 shows a polar map constructed from HST WFPC2 images obtained during early northern summer (L_S ~ 98°); this shows the extent of the residual north polar cap at this time. Figure 2 shows a series of polar maps obtained between L_S 163° and 186° (late summer through early autumn). The obscuration of the residual polar cap by the polar hood is evident, as is the presence of large dust storms in most of the maps. Dust is particularly obvious in the L_S 172°, 183°, and 186° maps. In this last view, the dust cloud appears to obscure most of the polar region northward of about 60° latitude. Details of the polar dust activity during this time period will be discussed in this presentation.

These 1997 HST observations will form the basis for ongoing observations of the polar regions by Mars Global Surveyor and the upcoming Mars Climate Orbiter missions. The combined data should provide a detailed look at the behavior of dust in the north polar region over at least three consecutive Martian years, allowing the extent and interannual variability of this dust activity to be investigated.

Acknowledgements: This work was supported by General Observer grants GO-02379.03-87A and GO-07792.01-96A from the Space Telescope Science Institute.

References

- [1] Pollack, J. B. et al. (1979) *JGR* 84, 2929-2945.
- [2] Paige, D. A. and Ingersoll, A. P. (1985) *Science*, 228, 1160-1168.
- [3] Clancy, R. T. et al. (1996) *Icarus*, 122, 36-62.
- [4] James, P. B. et al. (1999) *Icarus*, 138, 64-73.

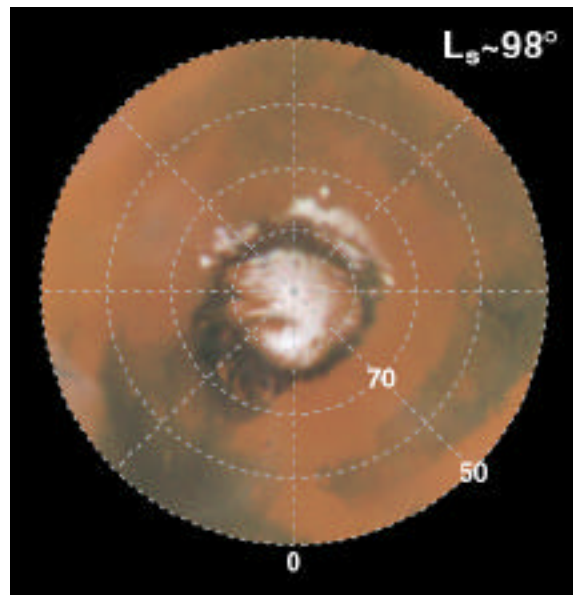


Figure 1: Polar stereographic map of the Martian north polar region, produced from HST WFPC2 images obtained in March 1997. Three individual images (red = 673 nm; green = 502 nm; blue = 410 nm) were map-projected and composited. A Minnaert correction has been applied ($k=0.95$), and data at emission and incidence angles greater than 80° have been eliminated. This represents the appearance of the residual north polar cap during early summer.

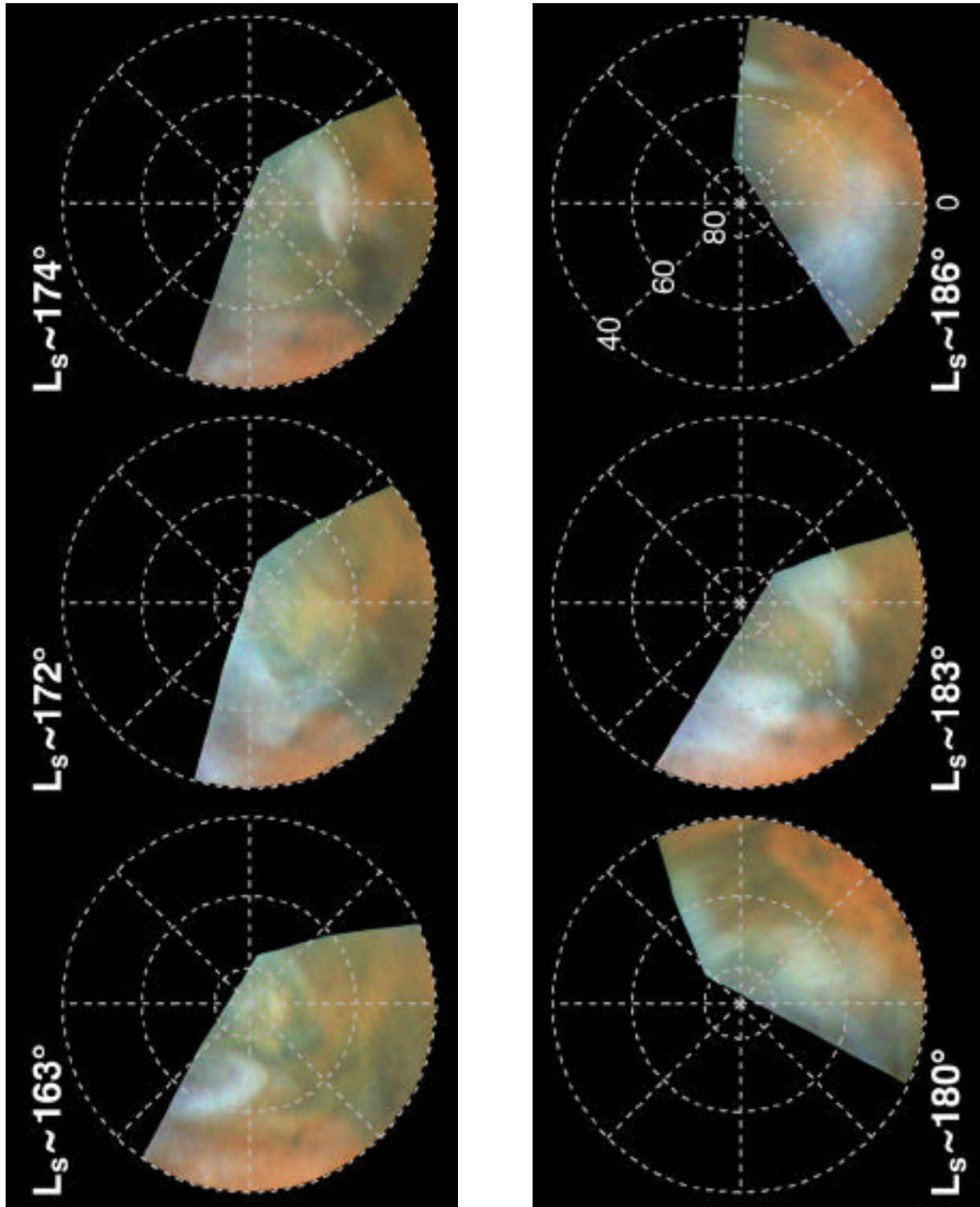


Figure 2: Polar stereographic maps of the Martian north polar region, showing polar dust storms and the development of the north polar hood. Maps were constructed as for Figure 1. The minimum latitude is 40°N; the latitude and longitude grid is labeled on the L_s 186° map. The HST images were obtained in August and September 1997.

Extensive dust activity is visible as “yellow clouds” over the polar region in most of the images, particularly for L_s 172°, 174°, 183°, and 186°.