WATER VAPOR BEHAVIOR IN THE NORTH POLAR REGION OF MARS AS SEEN BY MGS TES. L. K. Tamppari[1], M. D. Smith[2], D. S. Bass[1], and A. S. Hale[1]. [1]Jet Propulsion Laboratory/California Institute of Technology, 4300 Oak Grove Dr., M/S 264-623, Pasadena, CA 91109, [2]NASA Goddard Space Flight Center, Mail Code 693, Greenbelt, MD 20771.

Introduction: The behavior of water vapor in the Martian atmosphere is important for understanding the overall Martian climate system, which is characterized by three main cycles: water, dust, and CO2. Understanding the water vapor behavior through time in the north-polar region, the location of the main source of water vapor on the planet today, will lend insight to the atmospheric dynamics that control the transport of water, including transport to different parts of the planet. In addition, the Phoenix Mars Scout mission is planning to carry several experiments that will observe water vapor in the Martian atmosphere: a solid state imager which will determine the upward looking column abundance of vapor, a Thermal and Evolved Gas Analyzer which will quantify the amount of water in the atmosphere, and a humidity sensor on the robotic arm that will measure the humidity regularly. Because of these capabilites, observations of water vapor from previous spacecraft are important as background information and context for Phoenix as well as important for modeling studies. In particular, we will display and discuss three Mars years of spring and summer observations of the north polar region.

Data Sets: The water vapor amounts discussed utilize the data from the MGS TES instrument. It is an infrared interferometer/spectrometer operating in the spectral range 6-50μm [1]. In particular, the water vapor is retrieved using 5 bands spanning 28-42 µm.

The MGS spacecraft is in a sun-synchronous, nearly polar orbit [1]. The spacecraft orbits Mars 12 times every 1-sol period covering the globe with equally spaced strips once a day. The data are taken around the local time of 1400 hours and 0200 hours. Here, we use the daytime (~1400 hour) data.

Mapping of atmospheric quantities: The water vapor mapped here, using MGS TES observations, span nearly three Mars spring/summer seasons, from $L_s \approx 104$ in Mars year 24 (1999-2000) to $L_s \approx 180$ in Mars year 26 (2002-2003; Mars years definitions per [2]). L_s is defined as the areocentric longitude of the sun, with L_s=0 starting at northern spring equinox and stepping through the seasons to L_s=359, just before the subsequent northern spring equinox. The data examined cover 60-90°N latitude during the Mars northern spring and summer times (L_s=0-180). Because of the low surface temperature in these northern latitudes, which decreases the signal to noise, the data examined here are retrieved only over a surface of T>220K.

To produce seasonal maps, we average the optical depths and the vapor in boxes of 2º latitude by 4º longitude by 5º in L_s (Figure 1). We chose this combination of parameters to maximize the areal coverage while minimizing the time step from map to map, and to allow averaging of many retrievals together, minimizing the uncertainties in each bin. The mathematical mean is computed for each bin using the total number of points that fell into that lat/lon/Ls bin. The typical number of points in any one bin is 10-20. The color scale ranges from 0-100 pr µm. The dynamic range of the scale bar was chosen to "stretch" the signal and bring out variations within the maps. In actuality, the largest value in a given map is often larger than the maximum shown and, in those cases, is colored to the maximum color on the scale bar. In particular, there are instances when the column abundance of water in a given bin is >200 pr µm. The black area in the maps contains no data. The black area surrounding the northpole is due to surface temperature cutoff of T_s >220K. This area decreases and subsequently increases, following the retreat and growth of the seasonal polar cap.

Maps for all years and seasons will be shown and discussed at the conference.

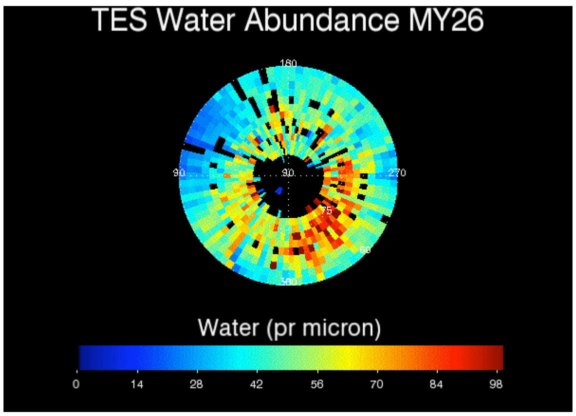

Figure 1. TES water vapor map for MY26, L_s=95-110. The color bar ranges from 0=100 pr µm.

Conclusions:

The water vapor has been mapped in the north polar region during northern spring and summer for three Mars Years, beginning Ls=105 in MY24 (Mars Year definitions per Clancy et al., 2000), using the

Mars Global Surveyor Thermal Emission Spectrometer [3]. Specific conclusions are:

1) Water vapor varies significantly interannually and varies spatially within a season.

2) Water vapor first increases above 50 pr µm near L_s=75 and decreases below 50 pr µm again near L_s=130-125. In between times, there are many locations in which the column abundance is >50 pr µm, even approaching 200 pr µm. This increase/decrease pattern is repeatable year to year.

Because these observations show the spatial and seasonal changes in water vapor over 3 Mars years, they will provide a useful background for Phoenix measurements and guide observational planning. The Phoenix mission will be 90 sols long, occurring between L_s=~76-125.

References: [1] Christensen, P. R., et al., *JGR* **97**, 1992. [2] Clancy, R. T., et al. *JGR* **105**, 2000. [3] Tamppari, L. K., *et al.*, submitted to *Plan. and Sp. Sci.*, 2005.