**REPRODUCING METEOROLOGICAL OBSERVATIONS AT THE MARS PHOENIX LANDER SITE USING THE NASA AMES GCM V.2.1.** S. M. Nelli[1], N. O. Renno[1], W. C. Feldman[2], J. R. Murphy[3] and M. A. Kahre[4], [1]Atmospheric, Oceanic, & Space Sciences Department, University of Michigan, 2455 Hayward St., Ann Arbor, MI, 48109 (snelli@umich.edu), [2]Planetary Science Institute, Tucson, AZ, [3]Astronomy Department, New Mexico State University, Las Cruces, NM, [4]NASA Ames Research Center, Moffett Field, CA.

**Introduction:** Mars Phoenix landed in late May, 2008 on the northern plains of Mars (68.218830 N , 234.250778 E) [1]. The mission began in late Spring ($L_s$~77˚) and ended in mid-Summer ($L_s$~148˚), lasting for 151 sols [2]. *In situ* measurements by the lander characterized the local atmospheric conditions (i.e. temperature, pressure, wind speeds and direction, opacity of dust and water ice, and the detection of surface water ice frost) [3,4].

Phoenix measured a steady decline in near surface atmospheric pressures over the course of the mission. Atmospheric pressure fell from ~8.5 mbars at the beginning of the mission to ~7.4 mbars near the end of the lander's life. Atmospheric temperatures were measured with daytime highs ~245 K and nighttime lows ~190 K. Late in the mission, water ice clouds and surface frosts, along with dust devils were imaged with the Surface Stereo Imager [3,4] and opacities were measured with the weather station lidar [4,5].

Using the NASA Ames General Circulation Model (GCM) v2.1, we reproduce atmospheric conditions at the Mars Phoenix Lander site in an effort to explain the measured atmospheric phenomena (water ice clouds, ground frosts, dust devils, etc.). We attempt to answer why many of these features occur late in the mission, but not during the early sols after landing [4].

**NASA Ames GCMv2.1:** The NASA Ames Mars General Circulation Model (GCM version 2.1) is a finite difference numerical grid point model of Mars' atmosphere. Current model geophysical processes include the treatment of the radiative transfer equation using a correlated-k approach [6]. $CO_2$ condensation/sublimation are accounted for, and MOLA topography [7] is smoothed to the required model resolution. Aerosol transport and the atmospheric thermodynamic equations are solved on a 5˚ latitude by 6˚ longitude Arakawa C grid by the model's dynamical core [8]. Dust opacity in the model is prescribed by ingesting the first year of MGS TES 9 µm dust opacity data into the model (a nominally dusty year) [9]. A surface water ice source [10] with approximate area to the measured North Polar cap is seasonally exposed at northerly model latitudes to produce a representative water cycle [9] (Figure 1a). Using a moment scheme based on work by *Rodin* [11] and *Montmessin et al*. [12], a simplified microphysical treatment for cloud formation is incorporated into the GCM. Clouds are radiatively inactive.

**Results:** The Ames GCM produces a water cycle (Figure 1b) representative of the newly adjusted TES measurements for water vapor [*Mike Smith*, Private Communication; 13]. The GCM also forms an aphelion cloud belt and polar hoods at the appropriate season and latitude (not shown here). Figure 2 illustrates that the GCM predicts the seasonal pressure drop at the lander site extremely well. The simulated surface pressure is within 1% of the measured values during the first 30 sols of the mission, but thereafter better matches the observations. The measured Phoenix surface pressure values are plotted once daily [4], while the GCM simulated Phoenix-location pressure values are plotted at six hour intervals (3am, 9am, 3pm, 9pm).

Near-surface temperatures at the Phoenix Lander site are presented in Figure 3. The red and blue '+' symbols represent the daily maximum and minimum temperatures measured by the lander weather station [4]. The maximum height at which these measurements can be made is 1 meter . The black stars are the simulated Phoenix-location temperatures at a height of ~5 meters sampled at six hour intervals. The measured temperatures exhibit a greater diurnal range than the simulated 5-meter temperatures, as expected for a daytime convectively unstable surface layer. One-dimensional (vertical) radiative-convective simulations indicate that 5-meter temperatures are ~5 K colder than 1-meter temperatures during the daytime, and are ~2 K warmer at night, consistent with the differences between the observed temperatures and simulated 5-meter temperatures.

Initial results of the GCM's water ice clouds and surface frost deposition appear to correlate well with the lander's observations. These results and an analysis of the physical mechanisms driving these processes will be forthcoming at the conference. We will present results at the conference with simulations containing greater temporal resolution (output 16 times a day). This should reduce some of the differences seen in the temperature and pressure fields.

**References:**

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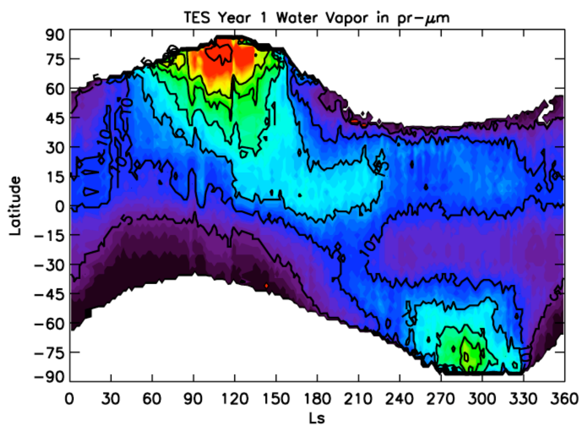


**Figure 1a:** MGS TES column water vapor. Contours are 5, 10, 15, 20, 25, 30, 50 precipitable microns (pr-µm).

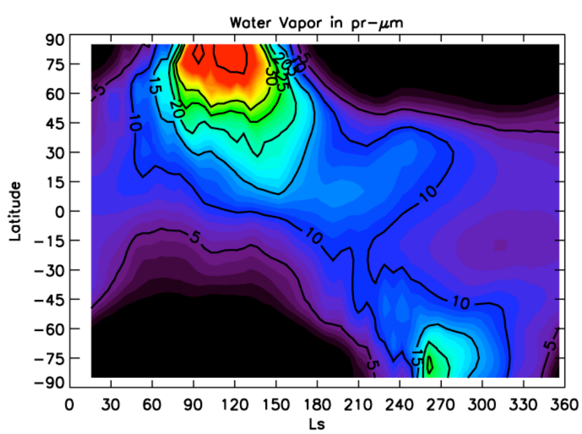


**Figure 1b:** Ames GCM column water vapor. Contours are 5, 10, 15, 20, 25, 30, 50 pr-µm.

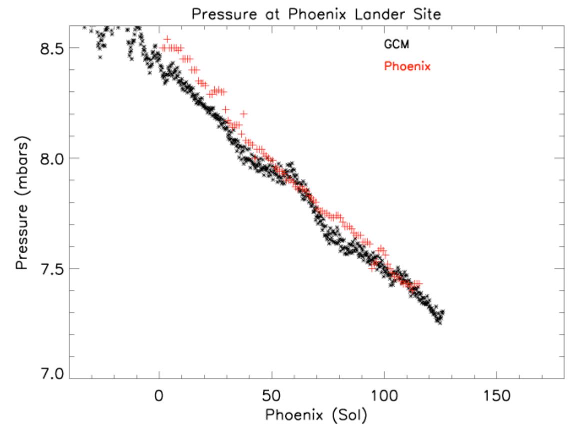


**Figure 2:** Pressure in mbars at the Phoenix Lander site. Red crosses are the measured data and the black stars are from the GCM.

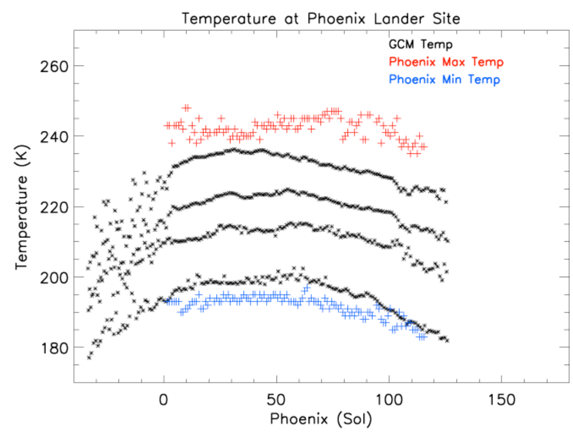


**Figure 3:** Temperature in Kelvin at the Phoenix Lander site. The red crosses are the daily highs measured by Phoenix, and the blue crosses are the daily lows. The black stars are the GCM simulated temperatures at a location ~5 meters above the surface. GCM temperatures were only sampled at low temporal resolution (4 times daily at 3am, 9am, 3pm, 9pm), therefore, the GCM temperatures shown here do not represent the daily high and low.