METEOROLOGICAL RESULTS FROM THE MARS PATHFINDER LANDER: AN OVERVIEW. **J.R. Murphy[1,2], G.W. Wilson[3,2] A. Seiff[1,2], J.T. Schofield[4], J. Magalhaes[1,2], S. Larsen[6], R.M. Haberle[2], D. Crisp[4], J. Barnes[5]** . [1]San Jose State University Foundation, San Jose CA; [2]NASA Ames Research Center, MS 245-3, Moffett Field, CA 94035-1000, (murphy@canali.arc.nasa.gov); [3]Arizona State University, Tempa AZ; [4] Jet Propulsion Laboratory, Pasadena, CA; [5]Oregon State University, Corvallis OR; [6]RISOE, Denmark.

The Mars Pathfinder Lander obtained a significant meteorological data set during its 83 sols of operation on the martian surface. This meteorology (MET) data, which had at worst a sampling rate of 0.25 Hz during data collection intervals, included measurements of atmospheric pressure, atmospheric temperature at three elevations (0.25, 0.5, and 1 meter) along the MET mast, and thermal signals from which wind speed and direction are obtainable. In this presentation we describe the data collected and some of the preliminary interpretations of this data set.

The intent of the initial data sampling strategy was to characterize the diurnal variations of the measured quantities, as well as to characterize high frequency fluctuations at as many times of day as data downlink capacity allowed for. Characterization of diurnal variations was determined from three-minute sampling time intervals (0.25 Hz) spaced every ~28 minutes during the sol, nominally providing for fifty-one such intervals each sol. Interspersed with these three-minute intervals were fifteen-minute to sixty-minute intervals of continuous sampling (1.0 or 0.25 Hz) which, during the initial 10 sols, were intended to sample each hour of the day. This collection scheme was employed during the initial 30 sols of the mission (the Primary Mission). As an enhancement, the time period from ~6 AM Local Time (LT) on sol 25 through ~6 AM LT on sol 26 was a continuous sampling interval at 0.25 HZ. This data session, referred to as a 'Presidential' MET session, consists of an unprecedented 22,263 measurements of each variable during that one sol time period. [Four additional Presidential met sessions were obtained during the mission, beginning and ending at 9 AM LT: sols 32-33, 38-39, 55-56, and 68-69.]

Subsequent to sol 30, the mission entered its Extended phase. During this portion of the mission, full diurnal coverage was only obtained during the Presidentail MET session sols noted above. The sampling strategy for sols 31 through 50 consisted of near continuous sampling (at 0.25, 0.5, or 1 HZ, depending on available downlink volume) from ~9 AM LT until no later than 3 PM LT, with the sampling rate changing at various points during the sol. Subsequent to sol 50, sampling each sol began at ~ 9 AM LT and continued, at a fixed sampling frequency (0.25, 0.5, or 1 HZ), through the final downlink of the sol (~2:30 PM on the most opportune sols).

MET data was collected on 76 of the eighty-three sols of the mission. Sols devoid of data were engendered by the planned lack of a downlink that sol, and spacecraft resets which halted spacecraft activities

From the data collected, a variety of meteorological phenomena have been identified and analyzed, ranging in extent from the quantification of heat transfer between the local atmosphere and surface, passage at the site of small scale vortices, to characterization of the global-scale thermal tide.

On at least 20 occasions, a short period, large magnitude (> 10 microbar) reduction and subsequent recovery of the measured surface pressure occurred. In conjunction with these pressure reductions are thermal variations resulting in local peak temperatures coincident with the pressure minimum. Additionally, these pressure minima are associated with rapid changes in wind direction, and with an indication of increased wind speed (wind speeds are not yet well determined). These variations suggest the passage of small-scale vortices, possibly "dust devils", which have previously been inferred from Viking lander meteorology data. No direct data exists which correlates these Pathfinder (or for that matter, Viking lander) meteorological features with enhanced dust at the lander site (i.e. the passage of a dust column). However, indirect engineering information from the spacecraft's solar panel's do indicate that in association with one vortex passage (sol 62), power generation was slightly reduced. This might be an indication of reduced insolation due to suspended dust above the solar panel.

Diurnal variations of measured pressure provide information about atmospheric thermotidal variations. Daily expansion and contraction of the atmosphere due to its heating and cooling cycle force net column mass divergence and convergence which are measured by periodic variations in the measured pressure. The amplitudes of the diurnal and semidiurnal (two maxima and minima per sol) pressure variations measured by Pathfinder are in general agreement with VL1 amplitudes measured at the same season (and a nearby location). This similarity is consistent with the similar atmospheric dust opacities measured during middle to late northern summer at the two lander sites. The suspended dust, via its aborption of solar radiations and absorption and emission at infrared wavelengths, results in enhanced atmospheric temperature fluctuations which drive the thermal tidal response. Deeply distributed dust preferentially enhances the semidiurnal tide.

The 83 sols of the Pathfinder mission included the date (~sol 20; Ls ~ 152) of the annual minimum surface pressure at the lander site. Occurrence of this minumim, engendered by deposition on to and sublimation from the seasonal carbon dioxide polar ice caps, was anticipated based upon results from the Viking mission and the proximity of the Viking 1 and Pathfinder landers. The seasonal date of the measured Pathfinder minimum pressure lags that measured at VL1 by several sols.

The first-of-their-kind near surface temperature profile measurements (and wind profile measurememnst provided by camera images of the three mast-mounted wind socks) provide information regarding the exchange of heat and momentum across the atmosphere-surface interface. Daytime vertical temperature gradients between the bottom (0.25 m) and top (1.0 m) thermocouples exceed the adiabatic lapse rate (5 K km^{-1}) by a factor of > 1000. This thermally unstable environment is characterized by rapid [10's of seconds], large amplitude [10-20 K] temperature fluctuations. These large temperature fluctuations are caused by forced descent of air parcels in the environment of the near-surface super adiabatic lapse rate. Spectral (numerical) characterization of these thermal fluctuations provide insight into the atmospheric vertical sensible heat flux. Quantification of this process is provided in much greater detail by Wilson et al. at this 1998 LPSC.

The latter stages of the mission saw the apparent passage of travelling weather systems at the lander site. These systems are likely eastward travelling baroclinic waves, as observed at VL1 to have initiated at the same season (Ls ~180^{o}), and as predicted by numerical models. One such wave is inferred to have passed by late on sol 81 or early on sol 82 (the lack of full diurnal coverage during that portion of the mission precludes a more precise timing).