TABLE III
MEAN PRESSURE

Mars year, Lander	Mean Pressure (mbar)
Year 1, VL1	7.936
Year 2, VL1	7.942
Year 1, VL2	8.663
Ave = *p*(VL)	8.180

TABLE IV
AMPLITUDE OF FIRST FIVE HARMONIC TERMS OF PRESSURE CYCLE, AVERAGED OVER THE FIRST TWO MARS YEARS FOR VIKING LANDER 1 AND THE FIRST MARS YEAR FOR VIKING LANDER 2

a_1(mbar)	a_2(mbar)	a_3(mbar)	a_4(mbar)	a_5(mbar)
0.704	0.582	0.108	0.062	0.015

TABLE V
PHASE OF FIRST FIVE HARMONIC TERMS OF PRESSURE CYCLE, AVERAGED OVER THE FIRST TWO MARS YEARS FOR VIKING LANDER 1 AND THE FIRST MARS YEAR FOR VIKING LANDER 2

	φ_1	φ_2	φ_3	φ_4	φ_5
In Degrees	92.31°	-130.80°	-69.76°	-10.00°	49.55°
In radians	1.611 rad	-2.283 rad	-1.217 rad	-0.175 rad	0.865 rad

A. Algorithmic Pressure Climatology

The surface pressure on Mars varies seasonally (cf. [56]), and we must encapsulate that variation in an analytical "algorithmic" expression. This algorithmic climatology for surface pressure used by CRISM_LambertAlb is based upon an average of measurements of the two Viking landers over two Mars years without great dust storms (Viking Lander 1 for two Mars years and Viking Lander 2 for one Mars year, see [56]). The technique adopted by the CRISM team for averaging of the data from the two landers is detailed in the succeeding discussions and is similar to unpublished techniques used by the MGS-TES team. The pressure cycle over the course of a Mars year has characteristically two large and broad peaks, roughly preceding the winter solstice for each of the polar caps, after which CO_2 condensation on the caps begins in earnest. The Mars-year averaging is done for each of the five harmonic amplitudes and phases, and the averages are shown in Tables III, IV, and V. This pressure climatology as a function of solar longitude or Julian day is then offset to correspond to a MOLA altitude of 0 km. The "algorithmic" Viking-based climatological pressure equation used for CRISM multispectral retrieval of Lambert albedos is

$$p_{\mathrm{surf}}(f, z=0\ \mathrm{km}) = p_{\mathrm{surf,ave}}(z=0\ \mathrm{km}) \times (1 + (1/p(\mathrm{VL})) \times \sum_k [a_k \sin(2\pi k f + \varphi_k)]. \quad (1)$$

In this equation, $p_{\mathrm{surf,ave}}(z = 0\ \mathrm{km})$ corresponds to the average surface pressure over a martian year for a surface that is at a MOLA altitude of $z = 0$ km, and $p_{\mathrm{surf}}(f, z = 0\ \mathrm{km})$ is the time dependence of this surface pressure. The values of the amplitudes a_k and the phases φ_k are the averages in Tables IV and V, the phases being given in radians. Seasonal time is expressed as f in terms of fraction of a martian year in seconds, not in L_s (i.e., f varies from 0 to 1). Note that L_s is not linear in time, so we use calendar date (or spacecraft clock time). In the aforementioned equation, f is equal to zero at $L_s = 330.2°$, as in [56]. Relevant calendar dates for $L_s = 330.2°$ include Nov. 26, 2005 (Julian Date 2453701) and Oct. 14, 2007 (Julian date 2454388).

The average for the three mean pressures is 8.180 mbar, but this is for the mean elevation of the Viking landers. The value of $p_{\mathrm{surf,ave}}(z = 0\ \mathrm{km}) = 5.477$ mbar that is in our formulation is determined by adjusting the $p(\mathrm{VL}) = 8.180$ mbar mean value for the elevation of the Viking landers.

The pressure at other altitudes is computed from an exponential dependence with a given scale height H

$$p_{\mathrm{surf}}(f, z) = p_{\mathrm{surf}}(f, z = 0\ \mathrm{km}) \exp(-z/H) \quad (2)$$

where the scale height depends on the temperature of the lower atmosphere: $H = RT/g$.

The gas constant is R, the gravitational acceleration is g, and the lower atmospheric temperature is T (in kelvin). For Mars, $H = (T/19.5)$ km, which for most daytime nonpolar conditions is roughly 10 km. The temperature of the lower atmosphere for a given location and time is determined from the MGS-TES climatology described earlier.

Using (1), we have calibrated for atmospheric conditions at the locations of the Viking landers 25–30 Earth years ago. This should allow somewhat accurate pressure determination at most locations on the planet, if we only know the altitude and the temperature of the lower atmosphere. This goes beyond what can be accomplished with the $3° \times 7.5°$ (in latitude and longitude) spatial resolution and 5° (in L_s) temporal resolution that we have made available in the ADR-CL LUT. The surface pressures in the ADR-CL LUT are also based upon Viking climatology, but the ADR CL uses a different definition of scale height than the one used in the algorithmic climatology here and is sampled at a much lower spatial resolution than the MOLA grid. The pressure climatology in the ADR CL is a rather crude estimate since it uses a constant 10 km for the scale height, and the climatology values are simply averages over the entire climatology bin from whatever observations happen to fall in that bin (which can be from very different altitudes than the multispectral pixel of interest). The differences between the two climatologies are usually less than 20% and often better than this. The largest systematic differences between the ADR-CL LUT climatology and the algorithmic climatology are observed in the Hellas basin, where the differences are greater than 1.5 mbars. A comparison is currently being performed between (a) the algorithmic pressure climatology, which is based in a large part on data from the Viking Landers, and (b) the pressures retrieved directly from CRISM data; this will be a topic in a future paper.

By inspection of Fig. 3 with the exponential dependence of I/F on surface pressure of a certain I/F scale height $p_{\mathrm{sh};I/F}$ and by some calculus, a +1.5-mbar error in pressure, for a $p_{\mathrm{sh};I/F} = 7.5$ mbar, will have a −20% effect on the measured I/F. Therefore, if we want 5% photometry in the gas