TABLE I

DEFINITION OF THE GRID POINTS USED BY DISORT TO GENERATE THE ADR-AC LUTS. FOR EACH OF THE GRID POINTS, DISORT IS RUN IN ORDER TO ESTIMATE $I/F$. THE CRISM_LambertAlb SYSTEM LATER USES THE ADR-AC LUT FOR EACH WAVELENGTH BAND TOGETHER WITH MULTIDIMENSIONAL INTERPOLATION TO ESTIMATE THE LAMBERT ALBEDO($A_L$) FROM THE MEASURED $I/F$ VALUE AND THE ESTIMATED VALUES OF THE OTHER DATA AXES (THE PHOTOMETRIC ANGLES: EMI, PHI, INC; THE AEROSOL OPACITIES: $\tau_{\rm dust}$, $\tau_{\rm ice}$; AND THE SURFACE PRESSURE, THE SURFACE TEMPERATURE, AND THE SOLAR IRRADIANCE). THREE OF THE DATA AXES FOR THE GRID DEFINITION ARE ONLY USED WHEN EITHER THE SPECTRAL BAND IS A $CO_2$ GAS BAND OR A THERMAL BAND

| **Variable** | **# of grid points for data axis** | **Min. value** | **Max. value** | **Spacing** |
|---|---|---|---|---|
| *The six grid axes that are common to all CRISM multispectral bands* | | | | |
| Cos(EMI) | 7 | 0.10 | 1.00 | 0.15 |
| PHI (deg) (azimuthal angle) | 11 | 0.00 | 180.00 | 18.00 |
| Cos(INC) | 7 | 0.10 | 1.00 | 0.15 |
| $A_L$ | 11 | 0.00 | 0.60 | 0.06 |
| $\tau_{dust}$(9.3 μm) | 9 | 0.01 | 0.71 | 0.0875 |
| $\tau_{ice}$(12.1 μm) | 7 | 0.00 | 0.50 | 0.0833 |
| *Extra DISORT grid axis used only for $CO_2$ gas bands: These gas bands are at: 1.21, 1.43, 1.66, 1.88, 1.97-2.17, 2.60, 2.70, and 3.00 μm* | | | | |
| Surf Press.(mbar) | 3 | 1.00 | 8.00 | 3.50 |
| *Extra DISORT grid axis used only for thermal bands (3.12-3.92 μm):* | | | | |
| Surf. Temp.(K) | 3 | 180.00 | 300.00 | 60 |
| *Extra DISORT grid axis used only for thermal bands (3.12-3.92 μm): The limits for two example thermal bands are shown (3.12 μm and 3.92 μm).* | | | | |
| Solar Irradiance in $W/m^2/\mu m$ @3.12 μm | 3 | 0.1113 | 0.1855 | 0.0371 |
| Solar Irrad. in $W/m^2/\mu m$ @3.92 μm | 3 | 0.0526 | 0.0877 | 0.0175 |

TABLE II

VITAL NUMBERS FOR THE ATMOSPHERIC MODEL USED BY DISORT IN ORDER TO COMPUTE THE ADR-AC LUTS. FOR THE ATMOSPHERIC EQUATION OF STATE, WE USE A REPRESENTATIVE TEMPERATURE PROFILE FROM THE MGS-TES DATABASE AND SIMPLY INTEGRATE THE HYDROSTATIC STRUCTURE EQUATION. GIVEN THE NEGLIGIBLE CONTRIBUTION FROM ATMOSPHERIC THERMAL EMISSION AND THE MINIMAL SENSITIVITY OF THE MOLECULAR ABSORPTION TO THE EXPECTED EXCURSIONS IN ATMOSPHERIC TEMPERATURES, OUR USE OF A REPRESENTATIVE PROFILE IS QUITE ADEQUATE. WE ALSO USED THE LAMBERTIAN PHASE FUNCTION (i.e., INSTEAD OF A HAPKE PHASE FUNCTION) FOR THE SURFACE PHOTOMETRY. FOR THE $CO_2$ GAS BANDS, WE ALSO EMPLOY THE CORRELATED-k TECHNIQUE (FOR A GENERAL DESCRIPTION, SEE [55])

| *Number of DISORT moments* | *Number of DISORT streams* | *Number of atmospheric layers* |
|---|---|---|
| 64 | 32 | 10 |

| *Heights of boundaries between layers (km)* | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 50.0 | 40.0 | 30.0 | 25.0 | 20.0 | 15.0 | 10.0 | 5.0 | 2.5 | 1.0 | 0.0 |

currently being used for the CRISM multispectral retrieval of Lambert albedos. The grid point spacing and atmospheric layer spacing can be adjusted in future deliveries in order to give more accuracy or higher speed, but these settings have thus far been adequate for both accuracy and speed.

In Fig. 3, we show a portion of the internal structure of the ADR-AC LUT#2007.

This LUT was computed for the deep atmospheric $CO_2$ gas band at 2.007 $\mu$m. Note the straight-line dependence on semilog plots. This indicates that if we use exponential interpolation in the surface-pressure variable, the nonlinear dependence of $I/F$ upon surface pressure can be adequately sampled by only three grid points for the pressure data axis. The exponential pressure scale heights of $I/F$, which we denote as $p_{{\rm sh};I/F}$, range from ~5 to ~12 mbars for different values of the dust and ice optical depths. Although we do not show the dependences of $I/F$ on the other 5–7 data axes here, the majority of the parameter spaces for the other axes are dominated by nearly linear dependences. Because these dependences are not strictly linear, and occasionally nonmonotonic, we sample most of the other 5–7 data axes with more than three grid points. The plots in Fig. 3 also demonstrate that differences in ice and dust aerosol optical depths do have quite an effect on the coefficients to the exponential dependence of $I/F$ on surface pressure. The use of multidimensional ADR-AC LUTs[19] allows much faster computation than forward calls, and more accuracy than limited analytical or empirical models. This combination of speed and

[19]The ADR AC LUTs have sizes: 13.1 MB for each of the thermal bands, 4.4 MB for each of the $CO_2$ gas bands, and 1.5 MB for the each of the normal bands. The sizes of these LUTs have been minimized to the extent possible, in order to optimize both the speed and the usage of memory.

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