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A COMPARISON OF LOWTRAN-7 CORRECTED AIRBORNE VISIBLE/INFRARED IMAGING SPECTROMETER (AVIRIS) DATA WITH GROUND SPECTRAL MEASUREMENTS

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1. Introduction

Atmospheric correction of imaging spectroscopy data is required for quantitative analysis. Different models have been proposed for atmospheric correction of these data, refer to (*Bosch et al.1990 and Conel et al. 1987*) for discussion of LOWTRAN atmospheric correction model and other models. LOWTRAN-7 is a low-resolution model and computer code for predicting atmospheric transmittance and background radiance from 0 to 50,00 cm^{-1} which was developed by the Air Force Geophysics Laboratory. The AVIRIS data (*Portor et al. 1987*) used here are radiometrically calibrated and include the 09/28/1989 Providence Fan flight line segment 07, California. It includes a dark gravel surface defined as a calibration site by the Geologic Remote Sensing Field Experiment (GRSFE) (*Arvidson et al. 1989*). Several ground measurements of portable spectrometer DAEDALUS AA440 Spectrafax were taken during the GRSFE July, 1989 field campaign. Comparisons of the LOWTRAN-7 corrected AVIRIS data with the ground spectrometer measurement were made in this study.

2. LOWTRAN-7 atmospheric correction of AVIRIS data

Eight pixels of the dark target were chosen from the AVIRIS image. "Noisy" data from AVIRIS bands (1-5, 32-33, 108-117, 153-174, 216-224) were removed. The median value of eight pixel DNs of each band was calculated to represent the data at that band. Medians were used because the median is a more robust estimator of central value than means. The input parameters for the LOWTRAN-7 were mid-latitude summer profile, radiance mode, multiple scattering, surface albedo 0.1, desert aerosols, ground altitude 0.863 km which was read from a topographic map, and local climatological data at the time of the AVIRIS flight (Table 1).

Table 1. Local Weather Data
(Data from Metromonitoring Services F.C.W.O.S. Daggett, CA)

Air Temp. (°C)	Relative Humidity (%)	Wind Speed (m/sec)	Visibility (km)
34.4	16	9.26	56.3

The equation used to calculate the reflectance is

$$\rho = \frac{0.1}{Lg}(Lo\text{-}Lps)$$

where Lo =observed radiance, i.e. AVIRIS radiance data

L_{ps} = observed radiance due to path scattering
L_g =observed radiance due to ground-reflected radiation
ρ = ground reflectance

assuming horizontally homogeneous atmosphere and flat surface (*Bosch et al.1990*).

3. Calibrating DAEDALUS data

The DAEDALUS instrument measures radiances in 280 channels between 0.45 and 2.4 micrometers. The spectral resolution of the channels varies from 0.01 micrometers in the visible to ~ 0.04 micrometers in the infrared. The raw DAEDALUS data of the dark target is from the GRSFE CD-ROM. Reflectance values are derived by ratioing the measurement of a sample to that of a pressed and bonded halon standard viewed at the same angle. The median values of several measurements were used to estimate the reflectances of the dark surface. The "noisy" data were removed before interpolating the data to AVIRIS wavelength center using the cubic spline technique.

4. Results and conclusion

The LOWTRAN-7 corrected AVIRIS spectral data and calibrated DAEDALUS spectral data were plotted against wavelength (Fig.1). In general, the differences between two spectra are larger after 1.3 μm wavelength than before that. The histogram of the differences between DAEDALUS data and LOWTRAN-7 corrected data (AVIRIS_LT) is shown in Fig.2. From the histogram, most bands of the two data sets agree within 6.0% reflectance. At some bands the data deviated more than 6.0% reflectance. In most bands, DAEDALUS reflectances are higher than LOWTRAN-7 corrected AVIRIS reflectances. Table 2 shows the statistics of the differences between two spectra. The differences between the data sets may be due partly to different seasons of data acquisition.

Table 2.Statistics of the Differences

Minimum	-6.1971402
Maximum	9.0017633
Points	152
Mean	2.3132297
Median	2.2561876
Std Deviation	2.54485100

5. Acknowledgement

The authors would like to thank Dr. Tom Farr for identifying the pixels of the dark target on the AVIRIS image. *Metromonitoring Services* is acknowledged for providing the weather data.

6. References

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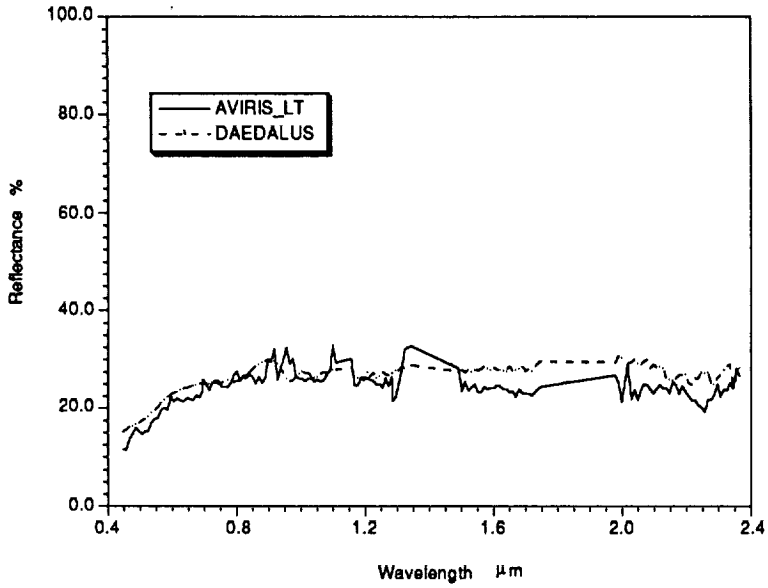

Fig.1. Lowtran-7 corrected AVIRIS data (solid line) vs. ground Daedalus measurement (dashed line) at the GRSFE dark target (Pumping Station near Kelso, CA)

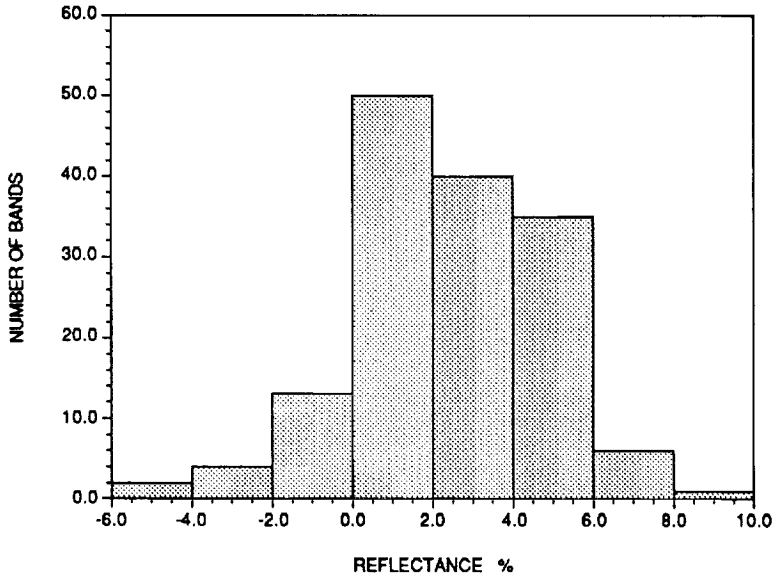

FIG. 2. The histogram of differences between DAEDALUS and AVIRIS_LT data