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LABORATORY SPECTRA OF FIELD SAMPLES AS A CHECK ON TWO ATMOSPHERIC CORRECTION METHODS

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1. INTRODUCTION

Atmospheric correction is the first step toward quantitative analysis of imaging spectroscopy data. Two methods, MODTRAN model (Bosch et al., 1990) and the empirical line (Conel et al., 1987), were used to convert AVIRIS radiance values to reflectance values. A set of laboratory spectra of field samples corresponding to AVIRIS coverage was used to assess these methods. This will also serve to select bands for future quantitative analyses.

2. STUDY SITE AND DATA

The study site was Kelso Dune, California. It is covered by two segments, 01 and 02, of AVIRIS Kelso/Afton flight line flown on Sept. 28, 1989. The AVIRIS data are radiometrically calibrated. The input parameters for the MODTRAN model are the same as a previous LOWTRAN-7 study (Xu et al., 1992). The ground measurements used in the empirical line methods are DAEDALUS spectra taken during the Geologic Remote Sensing Field Experiment (GRSFE) (Arvidson et al., 1989) July, 1989 field campaign. The measurements were taken on a bright target located at the parking area on the road to the Dune and a dark gravel target located at the power station on the KelBaker road. Field samples which are mainly sand were also taken from different places on or near the Dune. The laboratory spectra were obtained by Brown University's RELAB facility using the same phase angle as AVIRIS.

3. METHODS

The MODTRAN model atmospheric correction method is the same as the LOWTRAN-7 method (Bosch et al., 1990) except the MODTRAN model is used instead of LOWTRAN-7 model. MODTRAN model maintains complete compatibility with LOWTRAN-7 but has higher resolution and a better band model than LOWTRAN-7. The DAEDALUS raw data were first calibrated (Xu et al., 1992) before they were used in the empirical line method (Conel et al., 1987). Pixel DN values of AVIRIS for bright and dark targets were also needed to calculate the gain and offset for each band in the empirical line method.

In order for different data set to be compared, all the data were convolved to AVIRIS wavelength.

4. RESULTS

Only the laboratory spectra of samples taken on the homogenous and less than 1% vegetation dune surface were used in this study, so that samples were representative of more than one pixel area and so that the corrected AVIRIS reflectance are close to laboratory reflectance values. Nine RELAB spectra were selected for comparison with atmospherically-corrected AVIRIS data. Among the nine cases, only the best case (sample X-93-20) and the worst case (sample X-93-1) are shown in Figure 1 and Figure 2 respectively. In general, the MODTRAN-corrected AVIRIS data are closer to the RELAB spectra than DAEDALUS-corrected AVIRIS data (Figure 1 and Figure 2). Moreover, statistics show that the means of the differences between MODTRAN-corrected AVIRIS data and RELAB spectra are smaller than the means of the differences between DAEDALUS ground measurement corrected AVIRIS data and RELAB spectra in both cases (Table 1,2,3,4). The big spikes of MODTRAN-corrected AVIRIS data in Figure 1 and Figure 2 are partially due to MODTRAN's over-estimation of water absorption in this study site. The big spike at around 800 to 900 nm of DAEDALUS-corrected AVIRIS data results from saturation in the electronics of DAEDALUS in the wavelength range 730 to 970 nm. The MODTRAN model gives poorly corrected reflectance values in the range 1300 to 1500 nm, 1750 to 1950 nm, and 2300 to 2400 nm. However, ground DAEDALUS measurements are better at some bands in those wavelength ranges.

Table 1. Statistics of the Differences between MODTRAN and RELAB for X-93-1

Minimum	0.009411
Maximum	26.299393
Points	159
Mean	6.8869764
Median	6.4395862
Std Deviation	5.3408877

Table 2. Statistics of the Differences between MODTRAN and RELAB for X-93-20

Minimum	0.027324
Maximum	17.657913
Points	159
Mean	2.6246841
Median	1.568169
Std Deviation	2.9924431

Table 3. Statistics of the Differences between DAEDALUS and RELAB for X-93-1

Minimum	0.219814
Maximum	66.139587
Points	159
Mean	16.245166
Median	11.820717
Std Deviation	14.138695

Table 4. Statistics of the Differences between DAEDALUS and RELAB for X-93-20

Minimum	0.9868810
Maximum	49.386105
Points	159
Mean	10.424899
Median	6.7065701
Std Deviation	10.513931

5. CONCLUSIONS

In this study, the MODTRAN-corrected AVIRIS data is generally better than ground DAEDALUS measurement corrected AVIRIS data. The ground DAEDALUS measurement is better in the water absorption wavelength ranges.

6. ACKNOWLEDGMENT

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7. REFERENCES

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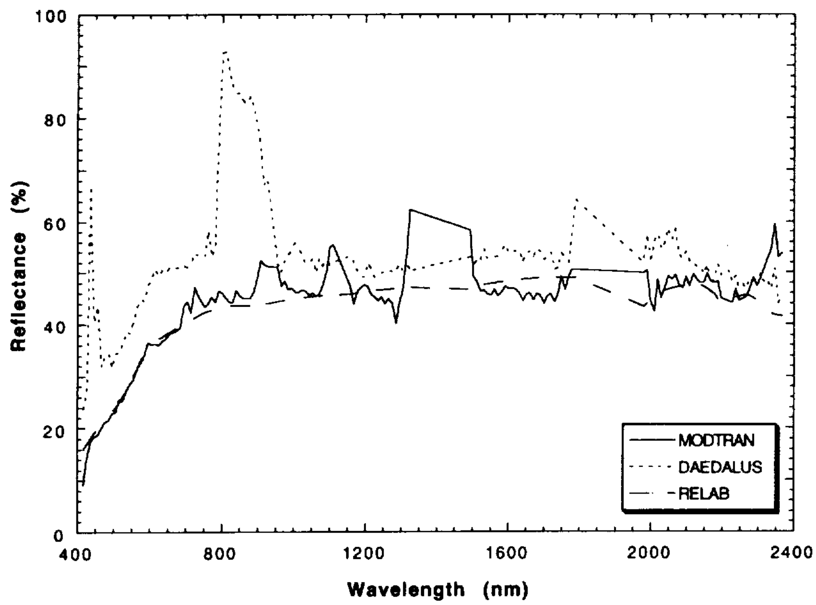

Figure 1. MODTRAN model corrected AVIRIS data (solid line) and ground DAEDALUS measurements corrected AVIRIS data (shorter dashed line) compared with RELAB reflectances of field sample X-93-20 (longer dashed line).

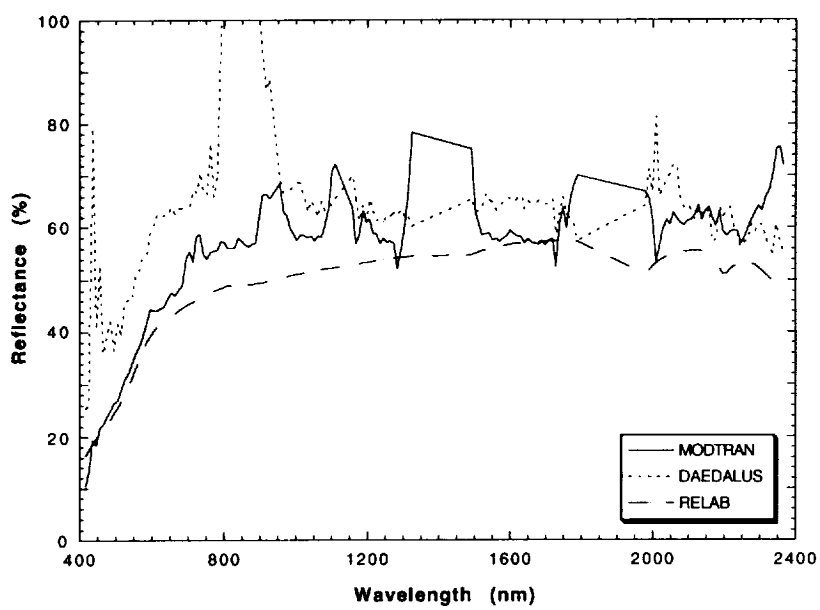

Figure 2. MODTRAN model corrected AVIRIS data (solid line) and ground DAEDALUS measurements corrected AVIRIS data (shorter dashed line) compared with RELAB reflectances of field sample X-93-1 (longer dashed line).