United States Department of the Interior

GEOLOGICAL SURVEY
EROS Data Center
Sioux Falls, South Dakota 57198

March 31, 1983

Memorandum

To: Technical Officer

From: Principal Investigator AN 31

Subject: Second Quarterly Report; Landsat 4 Investigations of Thematic Mapper and Multispectral Scanner Applications (PCN902-91548; S-10757-C)

1) Problems

The major problem encountered this quarter occurred in analysis of the Washington D.C., MSS scene (840/0915/40X0). Resampling to 25 meter pixels to match the TM data revealed a Northeast to Southwest striping. This "wood grain" effect as noted by other researchers was accentuated by resampling to the small size pixels. Three methods of resampling were tried (25 meter cubic convolution, 25 meter bilinear, and 50 meter cubic convolution with duplicating pixels) with unfavorable results in all cases. This problem places a restriction on TM vs. MSS comparisons. Several alternatives are being considered to by pass this problem.

A second problem is the reassessment of the data analysis plan due to the probability of no data collection for some test sites this spring.

2) Accomplishments

Initial findings from Landsat 4 Thematic Mapper and Multispectral Scanner Applications Project investigators at the EROS Data Center were presented at the Early Results Symposium held February 22-24, 1983, at the Goddard Space Flight Center, Greenbelt, Maryland. The initial findings were derived from thematic mapper (TM) and multispectral scanner (MSS) data collected on November 2, 1982, over the Washington, D.C. area.

An analysis of TM and MSS digital data was directed toward comparing TM and MSS data relationships between corresponding spectral bands and for investigating the potential usefulness of new Landsat spectral bands offered by TM for mapping land cover. Measures of relative variance for corresponding spectral bands of the two sensors were found to be higher for MSS data, promoting speculation for expecting higher classification performance with the TM spectral bands. The results of several statistical analyses suggest improved land cover information with TM data due to the addition of new spectral bands in the mid-infrared (mid-IR) wavelength region.

A test of image interpretability has shown strong preference for black-and-white images of the mid-IR bands over other individual spectral bands when making distinctions within a number of interpretation categories. Strong interpreter preferences were also noted for a standard color-infrared composite image as well as a color composite image consisting of a visible, near-IR, and mid-IR spectral bands.

3) Significant Results

Some early results of evaluating new-available thematic mapper data are documented. The results are derived from preliminary efforts of evaluating TM and concurrent MSS data of the Washington, D.C. area that was acquired by Landsat 4 on November 2, 1982.

In general, the results of several digital data analyses suggest the potential for TM data to provide improved land cover information due to the addition of new spectral regions as data channels. The mid-IR bands (5 and/or 7) may be especially useful because of (a) the large range of variability for digital values in five separate land cover categories and (b) low correlations with other spectral bands for vegetated land cover categories and water. The mid-IR bands may also play a role in increasing the dimensionality of data space that has been transformed into its principal components. Correlations with the blue band (1) suggest its utility for water studies.

The coefficients of variation (CV) for major land cover categories were shown to be generally greater for MSS data channels than for corresponding TM channels. This could contribute to better classification performance from traditional Goussian-based multispectral classification rules. The larger CV's for MSS data noted herein may be the result of an observed artifact in all the MSS data of Landsat 4.

The large variability noted for the digital values in band 5 and 7 has likely contributed to the results of image interpretation. Interpretations of black-and-white images of the six reflective TM bands indicated a strong preference for bands 5 and 7 for making the distinctions in most of the interpretation categories that were addressed.

Results of interpreting the six color composites showed strong overall interpreter preference for the standard color-infrared composite. However, the results also make a strong case for a color composite containing a visible, near-IR and mid-IR spectral region when making distinctions involving vegetation considerations.

Finally, two types of data transformations were demonstrated. A transformation from each red, green, blue color space into hue, intensity, and saturation space has the potential for offering enhanced interpretability for TM color composite images. A perspective view transformation could be useful for presenting registered layers of spatial data in an oblique-view format.

4) Publications

Lauer, D. T., and Waltz, F. A., 1983, Landsat 4 Investigations of Thematic Mapper and Multispectral Applications, in Landsat 4 Scientific Characterization Early Results Symposium, NASA Goddard Space Flight Center, Greenbelt, Maryland. (abstract)

Thormodsgard, J. M., 1983, Geodetic Accuracy of Landsat 4 Multispectral Scanner and Thematic Mapper Data, in Landsat 4 Scientific Characterization Early Results Symposium, NASA Goddard Space Flight Center, Greenbelt, Maryland. (abstract)

Sadowski, F. G., Sturdevant, J. A., Anderson, W. H., Seevers, P. M., Feuquay, J. W., Balick, L. K., Waltz, F. A., and Lauer, D. T., 1983, Early Results of Investigations into Landsat 4 Thematic Mapper and Multispectral Scanner Applications, in Proceedings of Landsat 4 Scientific Characterization Early Results Symposium, NASA Goddard Space Flight Center, Greenbelt, Maryland.

Thormodsgard, J. M., and DeVries, D. J., Geodetic Accuracy of Landsat 4 Multispectral Scanner and Thematic Mapper Data, in Proceedings of Landsat Early Results Symposium, NASA Goddard Space Flight Center, Greenbelt, Maryland.

5) Recommendations

Resources should be expended to minimize the wood grain effect in MSS data. A document should be produced outlining the effect of the antenna failure and shuttle delays on the collection and processing of TM data for AN experimenters.

6) Data Utility

Definite data utility problems exist in the MSS scanner (wood grain) when oversampling is used. However, as MSS data are normally used a simple warning as to the possible effects on classification would be sufficient. In general, the TM scenes we have examined are of high radiometric quality although the dead sensors are of some concern.

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