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MERGING LANDSAT-4 DIGITAL IMAGES WITH CARTOGRAPHIC DATA BASES

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SUMMARY

The Landsat-4 Mission provides scientists with an opportunity to assess the cartographic potential of satellite image data of improved geometric quality in digital formats. This presentation focuses on the geometric characteristics of Landsat-4 multispectral scanner (MSS) and thematic mapper (TM) data, and the possibilities for merging digital Landsat images with cartographic source material in both analog and digital formats.

When compared to characteristics of the previous Landsat missions, the improved pointing accuracy and attitude stability of the Landsat-4 platform offer significant advantages for mapping purposes. For example, in comparison to the earlier Landsat vehicles, the multimission modular spacecraft (MMS) of the Landsat-4 system is designed to meet a pointing accuracy specification of 0.01 degree (1σ) and an attitude stability of 10^{-6} deg/sec (1σ), which represent approximately 2 and 4 orders of magnitude improvement over the previous Landsat systems. Thus, from an altitude of 705 km, pointing should be to within about 120 m of the nadir and attitude should not vary by more than approximately 0.1 arc sec (or about 0.4 m ground distance) during the approximate 25 second time interval required to record a 185 X 185 km scene. Therefore, it should prove possible to merge Landsat-4 images with other cartographic data bases by utilizing relatively simple rectification procedures and a few well-distributed control points.

The merging of Landsat-4 image data in digital formats with other cartographic data requires consideration of the following items:

1. availability of control points in a standard (UTM) or local coordinate system;
2. procedures for converting analog data (e.g. topographic maps, film images) to digital formats;
3. procedures for rectification which will reformat (and resample) the various digital data sets to a uniform pixel

dimension in a common coordinate system;

4. procedures which will permit the various rectified data sets to be brought into exact registration.

Examples of merging digital elevation models (DEM's), and digitized maps, aerial photographs, and SIR-A images with Landsat-4 data are discussed. It is anticipated that Landsat-5 data will also prove to be of excellent geometric quality, facilitating integration with cartographic data bases.

AUTHOR BIOGRAPHICAL DATA

Roy A. Welch received his Ph.D. degree in photogrammetry, remote sensing and physical geography from the University of Glasgow in 1968. He was a photo-analyst with the U.S. Government from 1962 to 1964 and served as Manager, Earth Sciences Department, Itek Corporation from 1968 to 1969. In 1969, he accepted a National Research Council-National Academy of Sciences Postdoctoral Research Associateship in conjunction with the U.S. Geological Survey to evaluate factors influencing the quality of aerial and satellite imagery. Since 1971, he has been on the faculty, University of Georgia, where he is a Research Professor of Geography. Dr. Welch has published extensively on the cartographic quality of satellite image data, sensor system performance and remote sensing applications. He is the current President of the American Society of Photogrammetry.