Special Issue
LIDQA Final Symposium:
LANDSAT IMAGE DATA QUALITY ANALYSIS

FOREWORD

This special issue of *Photogrammetric Engineering and Remote Sensing* is devoted to papers examining the quality and utility of data acquired by sensors on the Landsat-4 and -5 satellites, primarily the Thematic Mapper (TM). The TM is an Earth-imaging sensor first flown on Landsat-4, which was launched 16 July 1982. It has incorporated advancements in spectral, radiometric and geometric capabilities relative to the Multispectral Scanner (MSS) flown on previous Landsats and Landsats 4 & 5 (Engel and Weinstein, 1983). The high level of complexity of the sensing system, as well as the ground processing system required to meet the stringent performance requirements, precipitated the Landsat Image Data Quality Assessment (LIDQA) Program for verification and characterization of performance. Some 40 investigation teams of scientists and engineers from universities, government and private industry have participated in this 3-year effort. The radiometric and geometric performances of the Landsat-4 and -5 sensors have been analyzed and documented by this group. In addition, related work in information extraction techniques and applications of TM and MSS data, though not strictly data quality analyses, have been performed under the LIDQA program.

Early results from this program are concentrated in the proceedings of the February 1983 Landsat-4 Science Characterization Early Results Symposium (Barker, 1985), other LIDQA workshop documents (Barker, 1984) and a special Landsat-4 issue of IEEE Transactions on Geoscience and Remote Sensing (Salomonson, 1984). A paucity of TM data due to some premature hardware failures on Landsat-4 in early 1983 resulted in reduced activity in LIDQA analyses until the launch of Landsat-5 on March 1, 1984. It is the results of this final phase of the LIDQA program that are primarily reported in this special issue.

Nearly all of the papers in this issue were presented at the LIDQA Final Symposium in September 1985 cosponsored by the American Society of Photogrammetry and Remote Sensing (ASPRS) and held as part of the Fall ACSM/ASPRS Convention in Indianapolis, IN. The majority of these papers concentrate on the radiometry and geometry of Landsat-5 data and comparisons to Landsat-4 data. The performance of the new operational Thematic Mapper Image Processing System (TIPS) (Beyer, 1985), which replaced the interim Scrounge system (Fischel, 1984) in mid-1983 is at least partially verified. The TIPS system allows for incorporation of ground control points in the processing for precision geometric rectification of TM images, not possible with the Scrounge system. Other papers examine the information content of TM data and evaluate methodologies for extracting this information for land cover analysis.

Results of Landsat-5 sensors have continued to show the excellent radiometric and geometric quality of the TM. Because of the overall high radiometric quality of the TM data, many of the radiometric studies reported here (Kieffer *et al.*, Metzler and Malila, Desachy *et al.*, Murphy *et al.*, Fusco *et al.*, Singh, Poros, Malaret *et al.*, and Wrigley *et al.*) have concentrated on several systematic low-level radiometric effects of up to ± three digital numbers that are present in Landsat-5 TM data, as they were in Landsat-4 TM data. The paper by Duggin *et al.* attempts to quantify the overall level of noise in an image, including sensor, atmosphere and viewing geometry effects. The absolute radiometric accuracy of TM data was specified to be within 10 percent, but has yet to be verified; comparative studies between the Landsat-4 and -5 TM sensors have shown some anomalies at the 5-15 percent level (e.g., Metzler and Malila, Murphy *et al.*) and the calibration of the thermal band data from Lansat-5 does not agree with results from aircraft underflights and ground measurements by about 30 percent in gain (Schott and Volchok). Studies of the absolute radiometry of the TM are ongoing and a proposal is made (Kieffer and Wildey) for resolving some of the absolute radiometry questions using the moon as a source. One paper (Tilton *et al.*) addresses a low-level MSS radiometry problem, coherent noise, first observed on Landsat-4, and demonstrates that it has been significantly reduced on the Landsat-5 MSS.

The internal geometry of Landsat-5 TM data continues to be excellent as observed with Landsat-4 TM, though there are some indications as to subpixel between-focal-plane registration errors on Landsat-5 TM data as were observed on early Landsat-4 data (Wrigley *et al.*). Spatial resolution measures (Schowengerdt *et al.*, Malaret *et al.*) are consistent with expected sensor performance and a moderate degradation due to sampling, atmosphere and ground processing. Image rectification studies have shown TIPS-era systematic geometric performance to be as good as, if not better, than in the Scrounge-era and have pointed to some preference for the UTM projection in terms of the accuracy of the projection in the absence of ground control (Welch *et al.*, Bryant *et al.*).

The greater information content of TM data relative to MSS data (Malila), particularly that portion related to spatial resolution has been difficult to exploit using "standard" digital classification methodologies. Modified techniques, including pre-classification filtering and alterntive discriminant functions (Cushnie and Atkinson, Toll, Latty *et al.*) show promise and visual photointerpretation is still applicable (Benson and Degloria).

The high quality of the TM data provides the basis for anticipating a successful set of scientific analyses with investigators selected from those responding to the Thematic Mapper Research in the Earth Sciences Announcement of Opportunity (OSSA-3-84). These investigators will begin their work near the end of the summer of 1985. The excellent effort of characterizing the performance of the Landsat-4 and -5 sensors and resultant data quality by the LIDQA Investigators will facilitate the effective use of TM data by this group and other investigators. In addition, it forms a foundation for the continued development of spaceborn land observing systems that will enhance studies of the processes occurring on the Earth and the more effective utilization of its resources.

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Guest Editors

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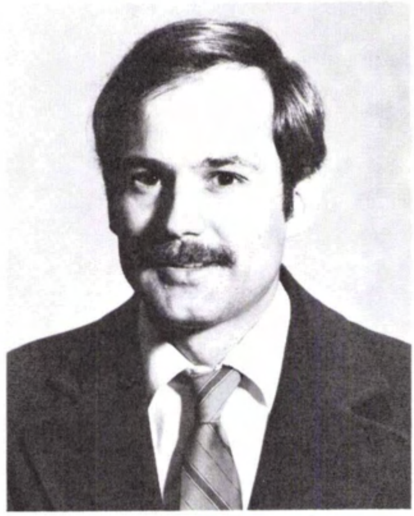
Guest Editors



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