Pecora file

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IN REPLY REFER TO POC 6-30

June 17, 1983

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Dr. Hugh H. Kieffer
U.S. Geological Survey
2255 North Gemini Drive
Flagstaff, AZ 86001

Dear Dr. Kieffer:

On behalf of the planning and program committee, it is my pleasure to invite you to present a paper on Landsat-4 Data Quality Analysis at the eighth William T. Pecora Memorial Symposium, which will focus on the theme of "Satellite Remote Sensing Advancements for the Eighties." Pecora VIII will be held October 4-7, 1983, in Sioux Falls, South Dakota, under the combined sponsorship of the National Oceanic and Atmospheric Administration, the National Aeronautics and Space Administration, and the United States Geological Survey.

This symposium is expected to be of major international significance, as it will provide both performance and policy summaries of United States, French, and other satellite remote sensing systems.

The enclosed Preliminary Program indicates the topics for which papers are desired. Please respond to this invitation by July 15, with the final title of your paper and a brief abstract (about 100-200 words). You will be provided with detailed information on paper guidelines and schedules as soon as possible. For Pecora VIII, the registration fee applies to all participants, including speakers.

Thank you for your consideration.

Sincerely

Allen H. Watkins
Chief, EROS Data Center

enclosed

Enclosure

Thematic Mapper: Detailed Radiometric and Geometric Characteristics

Hugh Kieffer
U.S. Geological Survey
Flagstaff, AZ 86001

Those radiometric characteristics of the Landsat 4 Thematic Mapper (TM) that can be established without absolute calibration or spectral data have been examined. Subscenes of radiometrically raw data (B-data) were examined on an individual detector basis; areas of uniform radiance were used to characterize subtle radiometric differences and noise problems. A variety of anomalies have been discovered with magnitude of a few digital levels or less; the only problem not addressable by ground processing is irregular width of the digital levels. Essentially all of this non-ideal performance is incorporated in the fully processed (P-type) images, but disguised by the geometric resampling procedure. The overall performance of the Thematic Mapper is a great improvement over previous Landsat scanners.

The effective resolution in radiance is degraded by about a factor of two by irregular width of the digital levels. Several detectors have a change of gain with a period of several scans, the largest effect is about 4%. These detectors appear to switch between two reponse levels during scan direction reversal; there is no apparent periodicity to these changes. This can cause small apparent differences between forward and reverse scans for portions of an image. The high-frequency noise level of each detector was characterized by the standard deviation of the first derivative in the sample direction across a flat field. Coherent sinusoidal noise patterns were determined using one-dimensional Fourier transforms. A "stitching" pattern in Band 1 has a period of 13.8 samples with a peak-to-peak amplitude ranging from 1 to 5 DN. Noise with a period of 3.24 samples is pronounced for most detectors in band 1, to a lesser extent in bands 2, 3 and 4, and below background noise levels in bands 5, 6 and 7.

The geometric fidelity of the GSFC filmwriter used for Thematic Mapper (TM) images was assessed by measurement with accuracy better than three micrometers of a test grid. A set of 55 control points with known UTM coordinates was measured on a digital display of part of band 5 of the TM image of the Washington, D.C. area and fitted to the control points. The standard error of the fit of the TM image to the control is 37 meters, or 1.3 pixels, with no consistent distortion. These tests indicate that the geometric fidelity of TM images is likely to be higher than the ability of film recorders to reproduce the images.