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GEOLOGICAL SURVEY
12201 SUNRISE VALLEY DRIVE
RESTON, VIRGINIA 22092

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Memorandum for the Record (EC-62-Landsat)

By: EROS Coordinator, Topographic Division

Subject: Landsat-3 Return Beam Vidicon (RBV) imagery

Enclosed is a copy of an early Landsat-3 RBV image of Cape Canaveral printed at 1:500,000 scale. The exposure setting was 5.6 milliseconds (ms) which resulted in some overexposure. With the shorter exposure times of 2.4 or 4 ms, which will generally be used, overall exposure should be more normal.

Figure 4.9 (April 1, 1977) of NASA's Data Users Handbook (1976 ed.) describes the annotations which appear on the image margin and the new Handbook (to be published by the USGS) will further document these annotations. One item of specific interest is the exposure reference (XC) which is located under the lower fiducial mark. There are five exposure (X) settings: A = 2.4 ms, B = 4 ms, C = 5.6 ms, D = 8 ms, and E = 12 ms. The XC means that the third exposure setting of 5.6 ms was used. Since the spacecraft covers about 6.5 m of ground distance per ms, image smear for this frame was theoretically about 36 m. This does not seem to appreciably degrade the image quality. Shorter exposure times will obviously decrease the smear so that somewhat higher quality may be expected.

The RBV generates 4,125 lines per image of 99 km and the analog signal will be sampled 5,375 times across the scene (again 99 km). Thus, a net pixel size of 18.4 by 24 m is formed as compared to 57 by 80 m for the MSS. However, the 3 to 1 ratio indicated by these figures is misleading since degradation due to the optics, image motion, and spreading of the phosphors on the image tube are all involved. These degradations are apparently quite small and the effective resolution of the Landsat-3 RBV, in terms of effective pixel response, is estimated between 25 and 35 m. Next fall when the digital processing system is in operation [Image Processing Facility/EROS Digital Image Processing System (IPF/EDIPS)], the RBV will be resampled at 19 m (square) pixels and the MSS at 57 m (square). Resampling creates some additional degradation but the RBV will have the advantage of being resampled at three times higher resolution (9 RBV pixels per 1 MSS pixel). The resolution differences between the systems may then approach the 3 to 1 ratio.

An enlargement from the negative for the enclosed print was made at 1:100,000 scale and it retained quality acceptable to the unaided human eye. Street patterns of 100 m spacing for the large subdivision being created west of Cape Canaveral are clearly visible on the enlargement and they can also be detected by magnification on the enclosed print. Informal contacts with NASA scientists indicate the RBV resolution is as good as that expected from the Thematic Mapper (TM) defined for Landsat-D.

Unfortunately the RBV images are not presently being cast on the Space Oblique Mercator (SOM) projection, as are the current MSS images, but rather retain the perspective geometry of a film camera. EC-61-Landsat indicated that RBV imagery would be cast on the same projection as the MSS, but this will only occur after the new digital system is introduced next fall. At that time, both MSS and RBV images will routinely be cast on the Hotine Oblique Mercator (HOM) projection which is a series of conventional oblique Mercator zones (see EC-50-Landsat) which approximates the geometry of the SOM projection. The geometric differences between the HOM and the SOM projections are very small and only of concern to those with elaborate and precise computer programs. The equations of the SOM will be published in the May 1978 issue of Photogrammetic Engineering and Remote Sensing and a Fortran IV computer program has been developed by the USGS. NASA plans to convert to the SOM within the next year or so.

EC-50-Landsat also referred to the IPF/EDIES use of ground control which will greatly increase the goemetric accuracy of Landsat imagery (both MSS and RBV). Unforturnately it will be well into 1979 before this part of the image processing system is implemented and even then it will only apply to certain parts of the United States.

Subject to weather forecasts, the RBV is turned on regularly over the 50 States and over foreign areas on a selective basis depending on ground receiver and tape recording capabilities. Landsat-3 RBV imagery, particularly when cast on the same map projection as the MSS, promises to make a significant contribution to the planimetric mapping of the Earth and to the analysis of the seasonal and long range temporal changes that involve land cover and land use. The RBV also demonstrates considerable water penetration capability, but this has not, to date, been quantified.

Alden P. Colvocoresses

Alden P. Colvocoresses, 1918-

Enclosure

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