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Processing of Landsat Imagery for Dissemination Purposes

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Progress Report 8/18/75 - 5/1/76

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16. Abstract  Recent tests with digitally enhanced Landsat imagery indicate that far greater information content can be obtained in photographic form than is possible with conventional imagery. Meaningful distinctions between MSS bands 4 and 5 can thus be achieved and items such as dormant vegetation can be uniquely recorded in color image form.			
17. Key Words (Selected by Author(s)) spectral band enhancement, contrast improvement, photographic processing, digital processing.		18. Distribution Statement	
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Figure 2. Technical Report Standard Title Page

## Progress Report

- a. Title - Processing of Landsat Imagery for Dissemination Purposes
- b. GSFC I.D. No. 23650
- c. Problem areas

Problems are basically the same as previously reported August 18, 1975. Problems indicated in the 1 April 76 report on experiment No. 23960 (Overall Evaluation of Landsat (ERTS) Follow-on Imagery for Cartographic Application) are also pertinent. As indicated in these reports, the critical problem is the determination of when and how to convert Landsat signals from digital to analog form. Until NASA/Goddard completes the requested testing of enhanced processing through their EBR, this problem cannot be solved.

- d. Accomplishments

As previously reported, photographic enhancement of conventional Landsat imagery is being explored. The principal accomplishment during this period is in color treatment. Tests show that the conventional combining of bands 4, 5, and 7 into a color composite is not optimum. For both photographic and lithographic color treatments, further objective tests must be evaluated by competent user representatives before standards for Landsat photographic products are established.

Experimental reprinting of Upper Chesapeake Bay (copy attached to EC-34-Landsat), although lithographic, provided insight to the photographic processes as well. The experiment clearly shows that Landsat imagery as now produced in conventional form by Goddard and the EROS Data Center is not optimum. The Upper Chesapeake Bay imagery was digitally enhanced (precision processed by IBM) and results in far greater information content than could be obtained from the conventional imagery. In this case, the differences between bands 4 and 5 (which were lost in conventional processing) were enhanced to the point that dormant vegetation is recorded as green in color composites. A chart based on the responses and treatment applied to Upper Chesapeake Bay, in simplified form, is enclosed as figure 1. It is noted that some color composites produced by Goddard show response similar to that achieved by IBM precision processing but at a somewhat reduced level of information content. The EROS Data Center, JPL, and others using digital resampling procedures are obtaining enhancements similar to that of IBM. A memorandum summarizing such activities as they relate to cartography, EC-32-Landsat, has been prepared.

e. Significant results

The only significant result to report during this period is the differentiation between bands 4 and 5 achieved through enhancement. Depiction of dormant vegetation on the Upper Chesapeake Bay image map in tones of green is an example of a significant difference between bands 4 and 5 which can be achieved through proper enhancement.

f. Publications and reports

See section f of progress report of 1 April 1976, of experiment No. 23960, "Overall Evaluation of Landsat (ERTS) Follow-on Imagery for Cartographic Application."

g. Recommendations

In addition to previous recommendations, it is now recommended that image enhancement be further investigated and, where justified, applied to the standard processing of Landsat imagery which is distributed to the public in photographic form.

h. Not applicable

i. Not applicable

j. Not applicable

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Simplified Diagram of the Development of Color Composites based on Subtractive Application of Green, Red, and Near IR Response (Positive Record, 3-bands)

Object Type	Cleared Area (Highly reflective)			Urban Areas			M A T E R			Vegetation (IR reflective)			Dormant Vegetation		
	Green 0.5 - 0.6 μm	Red 0.6 - 0.7 μm	Near IR 0.7 - 1.1 μm	Green 0.5 - 0.6 μm	Red 0.6 - 0.7 μm	Near IR 0.7 - 1.1 μm	Green 0.5 - 0.6 μm	Red 0.6 - 0.7 μm	Near IR 0.7 - 1.1 μm	Green 0.5 - 0.6 μm	Red 0.6 - 0.7 μm	Near IR 0.7 - 1.1 μm	Green 0.5 - 0.6 μm	Red 0.6 - 0.7 μm	Near IR 0.7 - 1.1 μm
Spectral band (wavelength)	Green	Red	Near IR	Green	Red	Near IR	Green	Red	Near IR	Green	Red	Near IR	Green	Red	Near IR
	0.5 - 0.6 μm	0.6 - 0.7 μm	0.7 - 1.1 μm	0.5 - 0.6 μm	0.6 - 0.7 μm	0.7 - 1.1 μm	0.5 - 0.6 μm	0.6 - 0.7 μm	0.7 - 1.1 μm	0.5 - 0.6 μm	0.6 - 0.7 μm	0.7 - 1.1 μm	0.5 - 0.6 μm	0.6 - 0.7 μm	0.7 - 1.1 μm
	high	high	high	high	high	low	high	high	low	low	low	low	low	high	low
Response (relative)	high	high	high	high	high	low	high	high	low	low	low	low	low	high	low
Color application	white	-	-	white	-	-	white	-	-	yellow	-	-	yellow	-	yellow
	yellow (-blue)	-	-	white	-	-	white	-	-	yellow	-	-	yellow	-	yellow
	magenta (-green)	white	-	white	white	-	white	magenta	-	magenta	-	magenta	-	white	white
Color, to observer, of the three bands combined	white	white	white	cyan	cyan	cyan	black	black	red	red	red	red	red	green	green
	white	white	white	cyan	cyan	cyan	black	black	red	red	red	red	red	green	green
	white	white	white	cyan	cyan	cyan	black	black	red	red	red	red	red	green	green

Figure 1

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