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DETERMINE THE UTILITY OF ERTS-1 IMAGERY IN THE PREPARATION OF HYDROLOGIC  
ATLASES OF ARID LAND WATERSHEDS

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Type II Progress Report for Period 1 July 1972-31 December 1972

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68

Type II Progress Report  
ERTS-A

- a. Title: Determine the Utility of ERTS-1 Imagery in the Preparation of Hydrologic Atlases of Arid Land Watersheds

ERTS-1 Proposal no: SR 234

- b. GSFC ID No. of P.I.: IN 397

c. Problems that are impeding the progress of the investigation: The principal investigator has been assigned to the Department of Interior, Resource and Land Information (RALI) Program. Therefore, he will have less time to spend on the ERTS investigation so the scope will have to be reduced. Nonetheless, it is expected that the objectives of the investigation can be met and that the final report can be prepared by about July 1, 1973.

- d. Accomplishments during the reporting period and plans for next reporting period: 1. Progress for the period 1 November 1972 to 31 December 1972.

ERTS-1 imagery taken in August and October for all four test sites was previewed for quality on a light table and cataloged. Preliminary analyses were begun on the ERTS-1 transparencies using a hand lens and a 10 power binocular microscope on both 70-mm and 9x9-inch products. Some of the 70-mm data were viewed using an I<sup>2</sup>S multispectral color-additive viewer. The high altitude (U-2) color-IR photography of the Utah and Wyoming test sites was examined with a zoom stereoscope and a 10 power binocular microscope.

Base maps of the four test sites with a scale of 1:250,000 were ordered on which vegetation and geomorphic data from both the spacecraft and aircraft imagery will be plotted. Larger scale (1:24,000 and 1:62,500) maps were ordered for 3 areas on which some detailed vegetation mapping will be done from the U-2 photography. One frame of ERTS-1 color composite imagery was ordered from NASA for each of the four test sites. Image descriptors were identified for eleven frames of ERTS-1 imagery. A vegetation map was obtained from the Bureau of Land Management (BLM) for the upper Rio Puerco, New Mexico test site.

2. Summary of progress for the period 1 July 1972 to 31 December 1972.

Reconnaissance and spot checking pertinent to existing maps was done on the Willow Creek, Montana; Eastern part of the Wind River basin, Wyoming; and the Saleratus and Brown's washes, Utah test sites. Vegetation maps and ground cover data were obtained from the BLM for all four test sites. Channel cross sections, which relate to annual flow from watersheds, were measured on the Wyoming test site, and some supplemental ground cover measurements were also made on that site. These same data were obtained prior to this year on the other three test sites.

ERTS-1 multispectral scanner (MSS) data was received for one date each in August and October, 1972 for each of the four test sites. Return Beam Vidicon (RBV) data taken in early August 1972 was received for all test sites. NASA's Ames Research Center furnished excellent quality, high altitude, approximately 1:120,000 scale color-IR photography taken July 14, 1972 of the Utah and Wyoming test sites. All of these data

have been cataloged and given a "first look" and preliminary analyses have been started on the Montana, Utah, and Wyoming test sites.

3. Plans for next reporting period.

Vegetation and geomorphic data will be transferred from the high altitude, U-2 photography, to 1:24,000 and 1:62,500 scale base maps for two areas within the Utah test site and one area within the Wyoming test site. A Kern PG-2 stereo-plotter will be used to transfer the data from the photographs to the base maps, then a Salzman projector will be used to reduce the scale of the tracings to 1:250,000 for comparison with data traced from ERTS-1 imagery using a zoom transfer scope.

e. Discussion of significant scientific results and their relationship to practical applications: The analyses completed to date dealt with detection and identification of features and patterns to establish familiarity with both the ERTS-1 and U-2 imagery. This background familiarity will be necessary in further analyses (mapping) which deals with the delineation of and discrimination among vegetation, relief, and drainage types.

1. ERTS-1 light table and microscope analyses of black and white transparencies.

The 9x9 positive transparencies show more contrast than 70 mm positive transparencies. The 9x9 imagery can be magnified about 8 times before the image becomes excessively grainy. It appears that about 500 feet of relief is needed in an area to delineate drainage divides and define hill-slopes and bottomlands.

Imagery from the MSS has better contrast and resolution than the data from the RBV system. Spectral band 7 (0.8-1.1 microns) from the MSS is the best band for viewing land form-water complexes with a single product. MSS band 5 (0.6-0.7 microns) supplements band 7 significantly because vegetation patterns are best defined with band 5.

2. ERTS-1 color additive viewing.

The following discussion applies to color additive viewing using an I<sup>2</sup>S Mini-Addcol viewer of MSS band 4 with a green filter and bands 5 and 7 with a red filter.

The first frame examined was no. 1031-17311 which was obtained by the ERTS-1 satellite over east-central Utah on 23 August 1972. The color-additive view improved separation of vegetation types especially in areas where there was moderate to strong infrared (IR) reflectance from two or more vegetation types. As an example, in the upper-center part of the frame, at higher elevations, strong IR reflectance from aspen trees and oak brush results in a red tone; the adjacent but lower zone of pinyon and juniper trees was pink, and the zone below that, of scattered juniper grading into saltbush, was gray-green. The San Rafael Desert appears as a wind-blown area with longitudinal dunes in the west-central part of frame 1031-17311. In the color-additive view the area was orange-tan colored, which is probably caused by the reddish-brown sandy soil sparsely covered with desert shrubs. This sandy area can easily be discriminated from the barren light-red colored Navajo Sandstone, which outcrops at the Green River gorge along the east side of the San Rafael Desert. The Navajo Sandstone appears pinkish-gray in the color additive view.

It was difficult to get more than two bands in registration with the viewer used, and it was discovered that good definition of vegetation, relief, and water bodies could be obtained using just bands 5 and 7 with red filters.

The Fort Peck Reservoir area in northeastern Montana on frame 1085-17285, 16 October 1972, was another area that was viewed with the color-additive viewer. Because most of the vegetation was dormant, the only notable improvement on the viewer was the appearance of a reddish tone from coniferous trees in the Missouri River breaks adjacent to Fort Peck Reservoir. The sparse to moderately dense forest in the breaks is not apparent on the single band black and white images. On the black and white single bands of frame 1085-17285 the light gray bottomland areas are easily discerned from the medium to dark gray upland areas. These shades of gray correspond to soil colors on the bottomlands and uplands in addition to the fact that vegetation is denser on the uplands. Grassy meadows (floodwater spreading areas) are easily discerned on the bottomlands. Water filled reservoirs that are greater than about a quarter of a mile across can be identified.

The multispectral color-additive viewing did not appear to improve relief or drainage channel detail beyond what can be discerned with MSS band 7 alone in black and white for either the Montana or Utah frame.

3. U-2 false-color infrared imagery of Utah and Wyoming test sites was provided by the Ames Research Center (flight number 72-113) on July 14, 1972.

The RC-10 false color infrared photographs of the Utah test site are virtually cloud free, and they are of excellent quality. On the Wyoming test site many areas of interest are at least partially covered by clouds. Most analyses to date have been on the Utah test site.

The RC-10 transparencies of the Utah test site have been examined under as much as 15 power magnification without serious loss of contrast or excessive fuzziness. Vehicles can be detected on the highway near Green River, Utah with 8 power magnification.

Much of the desert land on the Utah test area has a sparse to moderate shrub cover. On the San Rafael Desert, the contrast between the soil background and the shrubs is so low that textural differences between different shrub communities cannot be discriminated, even under 15 power magnification. Within the pinyon-juniper woodland, however, it is possible to discriminate tree crowns in both sparse and dense stands.

At Cedar Mountain, Utah (U-2 photo no. 3063) it is possible to identify several plant communities and vegetation-conversion practices on the 1:120,000 scale photographs. These include natural pinyon-juniper stands; former pinyon-juniper stands that have been chained with debris removed and seeded to grass, and natural stands of big sagebrush. This may be contrasted to the ERTS-1 MSS imagery where only the tree and grass-shrub interface for the same location can be identified.

In the Bookcliffs area north of Green River, Utah, there is strong IR reflectance from the oakbrush and aspen, while the moderately dense pinyon pine is a gray-green color. Further analyses should lead to separation of the aspen from the oakbrush.

On the Utah photograph number 3031 near Dead Horse Point and on the Wyoming photograph number 3093 near Moneta, there are density contrasts that follow fencelines. The contrast was investigated at the Utah site about three months after the photograph was taken. Cattle were grazing on the side of the fence that appeared darker, but from the size of ungrazed parts of grasses it was apparent that there had been more cover on that side of the fence when the photograph was taken. This does indicate the responsiveness of small-scale photography to differences in the quantity of vegetation.

(Category 4A)

f and g. Nothing to report.

h. Changes in standing order forms: Except for coverage during May of 1973, requests for all imagery after October 1972 were cancelled because it was decided that the objectives of the investigation could be met with the data collected through October 1972.

The cancellation was made via our NASA technical monitor in November 1972.

i. ERTS image descriptor forms: Provided image descriptors for 11 images on two forms on 22 December 1972.

j. Nothing to report.

TECHNICAL REPORT STANDARD TITLE PAGE

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15. Supplementary Notes			
<p>16. Abstract The 9x9-inch transparencies from the ERTS-1 system seem to have better contrast in vegetation and drainage features than the 70-mm transparencies. The 9x9-inch imagery can be magnified about eight times before it becomes excessively grainy. Imagery in the 0.8- to 1.1-micron spectral band (7) appears to be the best single band product for viewing landform-water complexes. The 0.6- to 0.7-micron band (5) best defines vegetation patterns. Multispectral color-additive viewing would appear to improve the separation of vegetation types where the vegetation exhibits moderate to strong infrared reflectance. Multispectral viewing did not appear to improve relief or drainage channel detail.</p> <p>False-color aerial infrared photographs at a scale of 1:120,000 for the Utah test site are excellent quality and can be magnified as much as 15 times without serious loss of contrast or excessive fuzziness. In desert areas with sparse to moderate shrub cover, the contrast between the soil background and the plant cover is so low that texture cannot be seen, even under high magnification. In areas of higher rainfall during the summer it is possible to discriminate coniferous and deciduous trees, grass, and shrub communities and to identify different rangeland treatment practices.</p>			
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