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Title: A Scheme for the Uniform Mapping and Monitoring of Earth Resources and Environmental Complexes Using ERTS-1 Imagery

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Objectives

To develop, test and specify a practical procedure and system for the uniform mapping and monitoring of natural ecosystems and environmental complexes from space-acquired imagery.

With primary emphasis on ERTS-1 imagery, but supported by appropriate aircraft photography as necessary, our objective furthermore is to accomplish the following:

1. Develop and test in a few selected areas of the western United States a standard format for an ecological and land use legend for making natural resource inventories on a simulated global basis.
2. Based on these same limited geographic areas, identify the potentialities and limitations of the legend concept for the recognition and annotation of ecological analogues and environmental complexes.

An additional objective is to determine the optimum combination of space imagery, aerial photography, ground data, human data analysis and automatic data analysis for estimating crop yield in the rice growing areas of California and Louisiana.

Major Accomplishments

Natural Vegetation Analogue Studies

1. Experimental color reconstitutions were made on the I^2S color additive viewer. We are seeking to determine a standard technique that will be used for all color reconstitutions both intra- and interregionally. Variables considered were band, filter and lamp intensity.

2. With additional testing, some modification of our legend classes has been necessary. We have added one primary class to handle the permanent, culturally modified vegetations of forest and range lands. These are the long-lived, essentially permanent, introduced vegetations such as planted forests and seeded ranges. To maintain the logic of the primary classes, this new class was inserted between the Natural Vegetation and the Agricultural classes as follows:

100 - Barren Lands
200 - Water Resources
300 - Natural Vegetation
400 - Cultural Vegetation
500 - Agricultural Crop and Idle Lands
600 - Urban and Industrial Land
900 - Obscured Land

The tertiary classes under 400 are the same as those under class 300. Three classes were added at tertiary level under Aeolian Barrens. On the suggestion of some water resources people we modified classes 240 to 270 as follows:

240 - Lagoons and Bayous
250 - Estuaries
260 - Coves and Bays
270 - Oceans, Seas and Gulfs

To simplify nomenclature we renamed the following 320 classes but their criteria for identification remain the same:

324 - Halophytic Shrub
326 - Sclerophyllous Scrub
327 - Macrophyllous Shrub

A new class, 328 - Microphyllous, Dwarf Shrub, was added to provide for certain of the arctic vegetational analogues. In the 330 - Savanna-like and 340 - Forest Types we have settled on the tertiary level classes as follows:

330 - Savanna-like Types

- 331 - Tall Shrub-scrub — Over low herb
- 332 - Broad-leaved Tree — Over low herb
- 333 - Coniferous Tree — Over low herb
- 334 - Mixed Tree — Over low herb

- 335 - Broad-leaved Tree — Over low shrub
- 336 - Coniferous Tree — Over low shrub
- 337 - Mixed Tree — Over low shrub
- 339 - Undifferentiated complexes of Savanna-like Types

340 - Forest and Woodland Types

- 341 - Needleleaf Forests and Woodlands
- 342 - Broadleaved (Hardwood) Forest and Woodlands
- 343 - Needleleaf-Broadleaf Mixed Forests and Woodlands

- 349 - Undifferentiated complexes of Forest and Woodland Types

3. We performed two classifications each on two test areas from the digital tape obtained from NDPF. We used carefully selected problem areas in the vicinity of Honey Lake in California--on the northern edge of our Sierra-Lahontan test site. The purposes of this classification were: (1) to determine at what legend level we could identify vegetational analogues from the digital data, (2) to look for vegetation types that could not be seen nor discriminated in the photographic black-and-white or color reconstituted data, and (3) to provide a more accurate determination of the multispectral

signature of selected vegetation analogues. This work was done in collaboration with Michael Hord of EarthSat, Washington, and Robin Mowlem of IBM. Based on modest ground familiarity the training sets were selected from the Band 5, gray-scale printout only. No comparisons with aerial photos of the test areas were possible at the time of selection. The classifications were field checked in the current reporting period. Results from one of the test areas far exceeded expectations in terms of the discrimination of minor vegetational variations. For example, one very good differentiation was obtained of a density variation in sagebrush where the other vegetational components were essentially the same. In other words, the ERTS system picked up a very minor difference in the environmental complex, or site, that was reflected in the density of sagebrush. Three different kinds of sagebrush types were differentiated and these in turn were separated from a grassland type dominated by bluebunch wheatgrass. A mixed shrub type consisting of approximately equal amounts of big sagebrush and bitterbrush, a type particularly important as mule deer range, was uniquely imaged and correctly classified. In part of the test area unclassified pixels were found to correctly represent rock outcrops even though a unique signature for this environmental complex was not provided. Some of these areas were as small as two to six pixel units. To date we have felt that the ERTS imagery would not provide the vegetational discrimination required for detailed management level decisions. We suspected we would do well to differentiate sagebrush from other shrub types, for example. If further work in the discrimination of ecological analogues and the testing of these signatures by application to other areas holds up, we will be forced to reverse our initial hypothesis where the data can be examined in digital form. This also encourages us to feel that with careful processing and sufficient enlargement more detailed definition of vegetational analogues may be possible from the photographic product.

4. Our second digital data test area did not yield such good results, but our ground check revealed that the reason was poor definition of training sets. In this area, south of Honey Lake, the vegetational mosaic is much more intricate and it appears that careful comparison of the gray-scale printout with large-scale aerial photography will be necessary to improve the training sets. In addition, designation of pure training sets in the data record may require specification of single or double lines and columns of pixel units in very irregular patterns. An alternative would be to locate near duplicate analogues elsewhere and extend their application to classify extremely intricate areas such as this.

5. During this report period we performed a field examination of the Sierra-Lahontan test site to observe spring phenology and to select specific training and calibration areas for each vegetational analogue. These were documented by ground photographs and field notes and will be individually documented by large-scale, aerial photography. This work is placing emphasis on the vegetational and environmental conditions that do have analogues between the two regions of our study.

<u>Rice Analogue Studies</u>

Photo interpretation has been continued as imagery was received of our various test sites. Color combined images have been made on an additive color viewer for preliminary determinations of the image features recognizable in relation to agricultural evaluation in the California rice test area.

No imagery has been received of the Louisiana rice test area. A field trip and aerial photographic mission was performed at the

Louisiana site with excellent results. Aerial photography was taken by the EarthSat staff on March 31, 1973 under clear skies and excellent visibility on the same morning that ERTS-1 passed over the test site. We look forward to receiving the ERTS-1 coverage of that overpass. Detailed test field maps have been made from the EarthSat aerial photography.

Each cooperating Louisiana farmer has been briefed on the requirements of this study and given a map of his area for reference. Excellent farmer cooperation is anticipated.

In the California rice study area arrangements have been made for the EarthSat staff to photograph the study areas based on a selection of specific study sites made in consultation with extension agronomists.

Because of severe springtime rains in Louisiana, planting of rice has been delayed in that test area. It is expected that delayed planting will have a harmful effect on rice production which should make for a very interesting study.

Rice planting in California is just beginning as of the end of this reporting period and is apparently occurring within the usual time periods.

Plans for Next Reporting Period

Maps will be made of the test fields from aerial photos taken by EarthSat in California and distributed to the cooperating farmers.

Photo interpretation will be performed to identify the status of crop planting and to correlate ERTS imagery of the Louisiana rice test site with our aerial photos. Because rice planting has been delayed in Louisiana, very few fields will have been planted.

Color composites will be made of the ERTS coverage of both California and Louisiana rice fields using an additive color viewer.

Field examine the Colorado Plateau Test Site, with same objectives as guided the Sierra-Lahontan field examination.

Make standard I^2S color reconstitutions of the best imagery accumulated to date of all test sites. Select two or three frames within each test area so intraregional variability can be determined as well as interregional. To the extent that good imagery permits, multidate images will also be used.

Begin the caract characterization of images for specified analogues both intra- and interregionally.

Complete the legend to quaternary level for the 330 - Savanna-like and the 340 - Forest and Woodland types.

Problems

As reported earlier, delay in receiving ERTS imagery causes photo interpretation of ERTS photos to be behind schedule. No serious problems have resulted from these delays in our rice study areas because very little planting has occurred and because we are able to obtain photos needed for rapid interpretation and follow-up field checking by our EarthSat flight operations.

Personnel

No change.

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