AGRICULTURE, FORESTRY, RANGE RESOURCES

John Hanson Room

Chairman, W. J. Crea, Jr., (MSC)

Co-chairman, H. L. Mathews, (GSFC)

Paper A 1

IDENTIFICATION OF IRRIGATED WINTER WHEAT FROM ERTS-1 IMAGERY

Donald L. Williams, Stanley A. Morain, Bonnie Barker and Jerry C. Coiner, *Department of Geography and Meteorology, Center for Research, Inc., The University of Kansas, Lawrence, Kansas 66044*

ABSTRACT

Continuing interpretation of ERTS-1 imagery of the test area in Finney County, Kansas, has revealed that winter wheat can be successfully identified. This successful identification is based on human recognition of tonal signatures on MSS images. Several different but highly successful interpretation strategies have been employed. These strategies involve the use of both spectral and temporal inputs.

The first approaches were based on the construction of decision matrices (scattergrams) which compared two or more images of different bands and/or dates. These matrices successfully segregated wheat from all other crops and field conditions. However, they also demonstrated that, given a tone measurement vector of sufficient length, each field became unique. Analysis of these decision matrices resulted in the conclusion that wheat identification could be made as easily and as accurately by observing the temporal sequence of tones on images of a single band (MSS-5).

The advantages of construction of this temporal sequence are: (1) the strategy may be easily implemented by anyone familiar with the area under interpretation, (2) accuracy improves as additional images are added to the temporal sequence, and (3) a normal pattern for the changes in a given field may be established as a function of the crop calendar. The consequence of this normal temporal sequence is to facilitate the detection of anomalous response (results of disease, etc.) in each field.

E7.3 10104

SEMI-AUTOMATIC CROP INVENTORY FROM SEQUENTIAL ERTS-1 IMAGERY

Claude W. Johnson and Virginia B. Coleman, *Department of Geography, University of California, Riverside, CA 92502*

ABSTRACT

The detection of a newly introduced crop in the Imperial Valley (California) by sequential ERTS-1 imagery is proving that individual crop types can be identified by remote sensing techniques. The identification of specific crops and subsequent regional inventory can be performed using a simplified semi-automatic system. The system depends on both: (1) the ability to detect individual field conditions from ERTS-1; and, (2) the ability to relate sequential field conditions to the regional crop calendar. The system is somewhat unique from several other types of crop identification systems by the fact that the color infrared response of the agricultural vegetation is not a prime identification factor.

This current study utilizes the multi-spectral response of the agricultural crop to indicate only the presence or absence of a crop within each field. The fields which show the absence of a growing crop are further identified (by moisture response in the image) to be either fallow, freshly plowed, or recently irrigated which would indicate that seed has been recently sown in the field.

The sequence of field conditions through six ERTS cycles will, in most instances, provide sufficient variation to indicate the crop type when compared to the regional crop calendar for the same time period. A recent example in the Imperial Valley illustrates how a newly introduced crop was detected from ERTS-1.

On the August 26, 1972 ERTS-1 image of the Imperial Valley eight fields totaling 900 acres located in the northeast region of the Valley showed fallow field conditions. Inspection of the next five ERTS-1 images showed a progression of growing crops in these field as indicated by a red color infrared response. On December 12, the ERTS-1 image revealed a most distinctive orange-yellow color for these fields. No where else in the Valley could a similar color be found. Inspection of the crop calendar and field record reports for the time period showed that a new crop of Alicia Grass (a variety of Bermuda Grass) was planted in August and harvested in late December. Ground inspection of the fields were in fact planted to Alicia Grass.

A computer system is being designed to consider the varying field conditions in relationship to the crop calendar as well as such other identification factors of field size, regionalization of crop rotation types, and crop rotation practices. The system will evaluate the sequential conditions of each of the 8,864 agricultural fields in the Imperial Valley and provide a summary of the total acreages of each crop within the total 465,000 farmable acres.

Paper A 3

E7.3 10105

CROP IDENTIFICATION USING ERTS IMAGERY

Maurice L. Horton and James L. Heilman, *Plant Science Department and Remote Sensing Institute, South Dakota State University, Brookings, South Dakota*

ABSTRACT

Digital analysis of August 15 ERTS-1 imagery for southeastern South Dakota was performed to determine the feasibility of conducting crop surveys from satellites. Selected areas of bands 4, 5, 6, and 7 positive transparencies were converted to digital form utilizing Signal Analysis and Dissemination Equipment (SADE). The optical transmission values were printed out in a spatial format. Visual analysis of the printouts indicated that cultivated areas were readily distinguished from noncultivated areas in all four bands. Bare soil was easily recognized in all four bands. Corn and soybeans, the two major crops in the area, were treated as separate classes rather than as a single class called row crops. Bands 6 and 7 provided good results in distinguishing between corn and soybeans.

Paper A 4

IDENTIFICATION OF LARGE MASSES OF CITRUS FRUIT AND RICE FIELDS IN EASTERN SPAIN

Fernando López de Sagredo and Francisco G. Salinas, *Superior Technical School of Agricultural Engineering Politechnical University of Madrid*

ABSTRACT

Referring to the production of citrus fruit, the region of Eastern Spain is the most important. To reach our aim, we include the area covering from the North of the province of Castellon to the Mar Menor, in the province of Murcia.

The photographs received from the ERTS-1, with the help of other flights that are in our hands, allow us the identification of masses of citrus and rice fields.

We shall also try to make a map of cultivation of the area, object of our study.

Paper A 5

ENGINEERING ANALYSIS OF ERTS DATA FOR SOUTHEAST ASIAN AGRICULTURE

Mr. H. L. Heydt, *General Electric Co.* and Prof. A. J. McNair, *Cornell University, Ithaca, N.Y.*

ABSTRACT

Rice is a major world food. This investigation focuses on rice in the Philippines. Our objectives are: (1) to extract reliable signatures for rice from ERTS imagery, (2) to use the signatures to extract from the imagery the locations and areas where rice is grown, and (3) to determine what measurements on the imagery will enable assessment of the condition of the crops, i.e., maturity, moisture, stress, etc.

The University of the Philippines and the International Rice Research Institute are providing regular, frequent and detailed ground truth information for this program. There are at least two growth cycles per year for Philippine rice, spanning the wet and dry seasons. Rice is characterized by rapid observable variations with time.

A combination of man and sophisticated machine is used in the imagery analysis to locate the test sites and to extract spectral, spatial and temporal signatures. These signatures are correlated with ground truth information. The intent is to perform the engineering aspects of the data extraction in order to provide signatures and extraction techniques which can be useful to agricultural specialists for a variety of future research and operational tasks.

Results to date, covering a few test sites and imagery from two ERTS passes at the end of the 1972 wet season, include signatures for rice fields in different degrees of flooding and harvesting.

AN INTERREGIONAL ANALYSIS OF NATURAL VEGETATION ANALOGUES USING ERTS-1 IMAGERY

Charles E. Poulton and Robin I. Welch, *Earth Satellite Corporation, 2150 Shattuck Avenue, Berkeley, California 94704*

ABSTRACT

Our research objective is to determine if ecological analogues in natural vegetation and key food crops have sufficiently analogous signatures to be interregionally and potentially globally identifiable from ERTS-1 imagery. Space imagery has made it possible and practical to inventory and monitor vegetational resources in the global context. Full realization of this potentiality requires three things in addition to the imaging capability. First is a vegetational resources classification concept that is logical and that can be maintained across political or jurisdictional boundaries. Second is the determination of interregionally and eventually globally applicable vegetational signatures that are usable in this context. Thirdly is the determination of image interpretation procedures essential to the recognition and measurement of vegetational analogues by use of the interactive system of space and aircraft imagery. In this second ERTS-1 Seminar, we are reporting a few preliminary results that relate particularly to requirements one and two above.

One of our analogues is the world-important food crop, rice. Definitive work on this analogue will start with the 1973 growing season; but from ERTS-1 imagery in July and September of 1972, we have already determined that rice does have a highly unique ERTS-1 signature in the color reconstituted mode and that we can in fact detect some within-field variations in image that should be crop yield or production related.

We have an operational legend system that meets the requirements of items one and two above and shows the potential for being globally applicable. This legend is presented in abstracted form and illustrations of its application are presented at various levels of generalization. From among the legend units, a series of natural vegetation analogues have been identified for study between our two interregional test sites. We have confirmed the advantages of interpreting the ERTS in stereo wherever side-lap permits.

The following is our assessment of benefit. From preliminary work with the rice identification problem, we feel that use of ERTS imagery together with aircraft subsampling will lead to efficiencies attributable to the space imagery in estimating acreage and production of this key world food crop.

The capability to provide a uniform synoptic treatment of vegetational resources irrespective of ownerships, agency jurisdiction, and political boundaries, brings within our grasp the capability to institute a nation-wide system of uniform ecological inventory of our total vegetational resource base. Because of ERTS, this now is nearing feasibility.

Paper A 7

NATURAL VEGETATION INVENTORY: AN ABSTRACT OF A PRESENTATION TO THE AGRICULTURE/FORESTRY/RANGE RESOURCES SESSION

Barry J. Schrumpf, *Oregon State University, Corvallis, Oregon*

ABSTRACT

Our investigation has been designed to employ several of the unique aspects of the ERTS-1 system in the production of natural vegetation resource statistics and maps.

We have prepared a vegetation classification for a 3200 square mile test site with Tucson, Arizona, in the northwest corner and Willcox Playa, Arizona, in the northeast. Considerable diversity is present including Sonoran and Chihuahuan desert shrub-, grassland-, Arizona chaparral-, juniper-oak woodland-, and conifer forest vegetation types. In total, 29 types have been recognized.

Direct interpretation of natural vegetation types from satellite imagery is limited; however, vegetation may frequently be inferred from associated evidence. Some terrain features are the more salient characteristics of ERTS images; these features can be directly interpreted and delineated on the ERTS imagery, and additionally correlated with vegetation types. Significant terrain feature-vegetation relationships have been identified, and those terrain features have been delineated directly on ERTS imagery. Comparisons of macrorelief interpretations on ERTS imagery are currently being made using low sun angle monoscopic versus high sun angle stereoscopic techniques. This evaluation should provide an additional measure of the importance of providing stereo coverage from an orbiting satellite.

Application of this work is primarily in the production of vegetation inventories. Natural vegetation maps provide an index to the biological potential of land and thereby provide the means for incorporating applied ecology in land management. We are attempting to further the contribution of satellite data to this application by relating multidate images to plant phenological changes.

VEGETATIVE AND GEOLOGIC MAPPING OF THE WESTERN SEWARD PENINSULA, ALASKA, BASED ON ERTS-1 IMAGERY

James H. Anderson, Lewis Shapiro and Albert E. Belon, *University of Alaska, Fairbanks, Alaska 99701*

ABSTRACT

ERTS-1 scene 1009 - 22095 (Western Seward Peninsula, Alaska) has been studied, partly as a training exercise, to evaluate whether direct visual examination of individual and custom color-composite prints can provide new information on the vegetation and geology of this relatively well known area of Alaska.

The vegetation analysis reveals seven major vegetation types, only four of which are described on existing vegetation maps. In addition the ERTS analysis provides greater detail than the existing maps on the areal distribution of vegetation types.

The geologic analysis demonstrates that most of the major rock units and geomorphic boundaries shown on the available geologic maps could also be identified on the ERTS data. Several major high-angle faults were observed, but the zones of thrust faults which dominate the structure of the area are much less obvious. All of the previously mapped granitic intrusive rocks in the area were identifiable on the images; however, a radial drainage pattern about 7 km in diameter, probably indicative of a buried intrusive, was recognized for the first time on the ERTS images. The known association of tin deposits with granitic rocks on the Seward Peninsula suggests that the area of this pattern be investigated further.

ERTS-1 EVALUATIONS OF NATURAL RESOURCES MANAGEMENT APPLICATIONS IN THE GREAT BASIN

Paul T. Tueller, *Renewable Resources Center, University of Nevada, Reno, Nev.*

ABSTRACT

The relatively cloud free weather in the Great Basin has allowed the acc ulation of several dates of excellent ERTS-1 imagery. Mountains, valleys, playas, stream courses, canyons, alluvial fans and other landforms are readily delineated on ERTS-1 imagery particularly with MSS-5. Each of the bands has been found to be useful for identifying and studying one or more natural resource features. For example, crested wheatgrass seedings were most easily identified and measured on MSS-7. Color enhancements simulating CIR were useful for depicting meadow and phreatophytic vegetation along water bodies, stream courses and elsewhere.

A lack of sequential ERTS-1 coverage during the growing season has precluded an evaluation of vegetation phenology changes. However, significant phenology comparisons have been made with U-2 data and offer promise of usefullness in making resource management decisions. Wildfire scars, both recent and old, have been identified. Work is underway to inventory and monitor these wildfire areas by age and successional status. Inventories have been completed on crested wheatgrass seedings over the entire State of Nevada and inventories of playa surfaces, water surfaces, phreatophytic vegetation, snow cover and other features is continuing. Most of this data is unavailable from conventional sources and would not be available without the possibility of rapid inventory on ERTS-1 imagery.

Vegetation ecotones are being delineated. The Pinyon/Juniper/northern desert shrub ecotone has been identified with some success. Other ecotones are being studied. Mountain ranges with heavy concentrations of mountain brush communities are readily identified when color enhanced and will be easily delineated on color composites when such data becomes available. Corrections have been made in existing vegetation maps and a new map is being prepared on an ERTS-1 photo mosaic of Nevada.

Paper A 10

EVALUATION OF ERTS-1 IMAGERY IN MAPPING AND MANAGING SOIL AND RANGE RESOURCES IN THE SAND HILLS REGION OF NEBRASKA (MMC #020)

Paul M. Seevers and James V. Drew, *Department of Agronomy, University of Nebraska, Lincoln, Nebraska 68503*

ABSTRACT

Analysis of initial ERTS-1 imagery indicates that satellite-acquired data is of significant value in managing soil, rangeland and water resources in the 19,300 square miles comprising the Sand Hills region of Nebraska.

High altitude multispectral and color-infrared photography obtained during early June, 1972 in the Sandhills revealed characteristic and repetitive relationships between natural vegetation and multispectral reflectance. Comparison of reflectance from plant communities with soil mapping units defined in the field resulted in the delineation of soil mapping units classified in the following subgroups: Typic Ustipsamments, Entic Haplustolls, Aquic Haplustolls and Typic Haplaquolls.

Standard interpretations of these mapping units permitted identification of subirrigated range sites as well as complexes of choppy sands and sands range sites, units composing approximately 85% of the Sandhills rangeland. These range sites form the basic units necessary for the interpretation of range condition classes used in forage management. Analysis of ERTS-1 imagery acquired during August, September and October, 1972 indicated potential for the identification of gross differences in forage density and range condition within given range sites identified on early season aerial photography.

Because of the susceptibility of soils in the Sandhills to erosion by wind, intensive range management is required when plant cover is destroyed by overgrazing or fire. Imagery from ERTS-1 was effective in determining the location and extent of range fires within the region. On March 6, 1972 a major range fire destroyed grazing forage, cattle, bridges, fences and equipment with an estimated value of $1,000,000. Acreage measurements of the burned area made from ERTS-1 imagery obtained on August 17, 1972 were superior to estimates previously available.

Multispectral data from ERTS-1 also provides a means of monitoring the expansion of center-pivot irrigation systems within the Sand Hills region as well as assessing the management of irrigated cropland. Successful irrigation systems are dependent on landscape and soil characteristics that may be determined from ERTS-1 imagery of the Sandhills.

Differences in multispectral reflectance among lakes within the Sand Hills region are related to differences in water quality. Assessment of ERTS-1 imagery will provide an evaluation of water quality for irrigation, livestock or recreation in more than 1000 natural lakes within the region.

Paper A 11

MONITORING CALIFORNIA'S FORAGE RESOURCE USING ERTS-1 AND SUPPORTING AIRCRAFT DATA

David M. Carneggie, *Forestry Remote Sensing Laboratory, University of California, Berkeley, California 94720*

ABSTRACT

Throughout the western United States, large livestock operators, livestock associations, county farm advisors, state statistical reporting services and federal land resource managers have expressed the need for improved techniques for regional monitoring of the forage resources associated with rangelands and wildlife habitats. These techniques should yield more accurate and timely information regarding the distribution and availability of forage, the health or condition of forage, the duration of the green-feed period and the amount produced. This information is essential for determining: (a) the animal carrying capacity for the range; (b) the time when grazing animals can be grazed and the time when they would be removed from the range to minimize damage to forage plants; (c) the location and condition of alternative sources of forage once it has been fully utilized in any given range environment; and (d) the fire hazard created by unutilized forage.

This paper discusses how the analysis of ERTS-1 and supporting aircraft data can provide a wildland manager with the information needed to evaluate the condition and productivity of annual and perennial rangelands in California. The analysis technqiues presented will demonstrate how the ERTS-1 imagery obtained at 18-day intervals can monitor the progressive development of forage plants throughout the state in response to sufficient rainfall to initiate plant growth and development. Moreover, change detection techniques will be demonstrated which illustrate how the ERTS data can be used to detect and to monitor the drawdown and depletion of surface water reservoirs and the progressive drying of forage plants. Finally, a simple model will be presented which requires ERTS-1 data to evaluate forage conditions statewide and predict availability and amount of forage produced in the varied range environments of California.

E7.3 10114

TESTING THE USEFULNESS OF ERTS-1 IMAGERY FOR INVENTORYING WILDLAND RESOURCES IN NORTHERN CALIFORNIA

Donald T. Lauer and Paul F. Krumpe, *Forestry Remote Sensing Laboratory, University of California, Berkeley, California 94720*

ABSTRACT

The 2.5 million acre Feather River headwaters area in northern California is the keystone watershed for the California Water Project, one of the most extensive and ambitious water resource developments ever attempted. Consequently, accurate and timely information on the quantity, quality and distribution of timber, forage, water and recreational resources is of immediate importance to each public agency and private group managing this vast, but inaccessible, wildland area.

Preliminary results are presented which stress both the applications of ERTS-1 imagery within the Feather River region and the benefits derived from these applications. These results relate to (1) evaluating the feasibility of mapping vegetation/terrain resources with the aid of ERTS-1 imagery, (2) evaluating the cost/effectiveness of resource mapping using various types of data, including ERTS-1 and aircraft imagery, (3) developing suitable aids for training image interpreters (4) testing quantitatively selected ERTS-1 images for detailed wildland resource information, (5) comparing – in terms of accuracy of boundary placement, accuracy of type identification and degree of interpretation efficiency – information derived from ERTS-1 imagery with that derived from conventional and/or high flight photography, (6) comparing ERTS-1 and high flight interpretation results with existing regional mapping capabilities that employ conventional techniques, and (7) evaluating the interpretability of multiband-multidate ERTS-1 image color composites.

Several types of color composite imagery have been analyzed, including those made by diazo overlay, optical projection, direct photo reproduction (multiple exposure), and electronic display (direct from ERTS-1 digital tapes). Emphasis in the results reported has been placed on documenting levels of accuracy, degree of timeliness, and costs associated with utilizing ERTS-1 imagery for inventorying wildland vegetation/terrain resources.

E7.3 10115

INTERPRETATION OF ERTS-MSS IMAGES OF A SAVANNA AREA IN EASTERN COLOMBIA

G.W.W. Elbersen, *Soils Section of the Centro Interamericano de Fotointerpretacion Apdo. Nal 762/2 Bogotá D.E. Colombia*

ABSTRACT

Using conventional photointerpretation techniques on images of the green, red and infra-red MSS channels of a savanna area in Eastern Colombia the following landscape units, approximate equivalents of units of an existing soil map of a similar adjacent area, where delineated:

Of the Recent Alluvium:

The Floodplain

Of the High Plains

The Level Well Drained High Plain
The Level Poorly Drained High Plain
The Dissected High Plain
The Colluvial Alluvial Valleys
The "Esteros" (divided into those with and without forest)

Of the Aeolian Plain

The Dunes

Furthermore the following features were identified:

Patterns of grass burns in various stages of regrowth
Vegetative differences within the flood plains of the major rivers - (scrub woodland versus savanna woodland)
Outcrops of remnants of lateritic crusts
"Bright spots" within eroded areas for which existing aerial photo coverage has not given a solution so far.

Comparison with sample interpretations of existing 60.000 aerial photography shows a correlation which rates from good to reasonable taking into account the generalizations due to scale.

The preliminary conclusion is that ERTS-MSS material if used in combination with samples of conventional aerial photography can serve as a bases for soil surveys which are in between generalized and schematic for the area under consideration.

Paper A 14

DELINEATIONS OF MAJOR SOIL ASSOCIATIONS USING ERTS-1 IMAGERY

W. L. Parks, *Professor of Soil Science, University of Tennessee, Knoxville, Tennessee 37916*

ABSTRACT

The delineation of a major soil association in the loess region of Obion County has been accomplished using ERTS-1 imagery. Channel 7 provides the clearest differentiation. The separation of other smaller soil associations in an intensive row crop agricultural area is somewhat more difficult. Soil differentiation has been accomplished visually as well as electronically using a scanning microdensitometer. Lower altitude aircraft imagery permits a more refined soil association identification and where imagery is of sufficient scale, even individual soils may be identified.

Paper A 15

EVALUATION OF REMOTE SENSING IN CONTROL OF PINK COTTON BOLLWORM

Virginia B. Coleman, *Department of Plant Sciences, University of California, Riverside, California 92502*

ABSTRACT

The purpose of our project is to identify and map cotton fields in the southern deserts of California. Cotton in the Imperial, Coachella, and Palo Verde Valleys is heavily infested by the pink cotton bollworm which affects both the quantity and quality of the cotton produced. The California State Department of Agriculture, therefore, has regulated the growing season of cotton by establishing planting and plowdown dates. These procedures ensure that the larvae, whose diapause or resting period occurs during the winter months, will have no plant material on which to feed thus inhibiting spring moth emergence.

There are approximately 800,000 acres of cotton in California and they are mapped yearly by ground survey teams. A more practical means of accomplishing that objective seemed necessary and satellite data from ERTS-1 was considered a viable alternative.

The underflight data from the U-2 aircraft has shown that we can detect the differences between a growing, a defoliated, and a plowed down field providing that we know where the fields are. The ERTS-1 multispectral scanner (MSS) data are being analyzed using an I^2S (International Imaging Systems) optical color combiner to determine which combinations of dates and colors will identify cotton fields and thus provide the data needed to produce maps of the fields for the forthcoming cotton season.

Paper A 16

DETECTION AND MONITORING OF FOREST INSECT INFESTATION IN THE SIERRA NEVADA MOUNTAINS OF CALIFORNIA

Ralph C. Hall, *Natural Resources Management Corporation, Berkeley, California 94704*

ABSTRACT

Preliminary analysis of ERTS–1 imagery in a rugged mountain area in the Sierra Nevada Mountains of California indicates some promising possibilities of detecting two types of insect infestations as our primary objective and secondary detecting and mapping other features such as timber or untimbered areas; timber stand density; principal stream courses, mountain meadows, lakes, massive rock outcrop and domes, riparian vegetation, grazing land and possible glaciers. We have used and found exceedingly useful NASA underflight RC-10 imagery.

Paper A 17

IMPACT OF ERTS IMAGES ON SURVEYS OF FOREST INSECT INFESTATIONS IN COOK INLET BASIN, ALASKA

James H. Anderson*, F. Philip Weber**, John M. Miller*, Enzo Becia†, and Roy C. Beckwith††

ABSTRACT

Aerial surveys conducted during the past three summers by the U.S. Forest Service have identified a severe spruce beetle (Dendroctonus obesus (Mann.)) infestation to a 200,000 acre region west of Cook Inlet near the Tyonek Indian Reservation, and additional acreages identified on the Kenai Peninsula in the Kenai Moose Range and adjacent state and private lands. Estimates have been made of two billion board feet of white spruce killed or damaged by the spruce beetle; however, the large areal extent of the spreading infestation presents a difficult task for maintaining surveillance of the extent of the affected trees.

Techniques have been implemented using November 1972 ERTS-1 imagery of the Cook Inlet Basin to stratify damage to White spruce into three levels – healthy, newly killed, and old killed. The three step analysis was performed on the ERTS imagery. A color composite was created using color recombining of the bulk 70-mm transparencies, an optimum color composite was chosen for display and interpretation at 28 times enlargement on a Variscan scanner, and scene radiance differences were analyzed from microdensitometer scans.

As of now we have been able to map the pure spruce stands as being different from the mixed spruce – hardwood stands, and we have been able to map the extent of old killed spruce stands. Work is continuing with other ERTS scenes taken earlier in the growing season where snow was not a problem for the purpose of further stratification of damage in spruce.

*University of Alaska, Fairbanks, Alaska 99701

**USDA Pacific SW Forestry Experiment Station, Box 245, Berkeley, California 94701

†Alaska Department of Natural Resources, Division of Lands, 323 E 4th Avenue, Anchorage, Alaska 99501

††USFS, Institute of Northern Forestry, Fairbanks, Alaska 99701

Paper A 18

ERTS-1 IMAGERY AND HIGH FLIGHT PHOTOGRAPHS AS AIDS TO FIRE HAZARD APPRAISAL AT THE NASA SAN PABLO RESERVOIR TEST SITE

Robert N. Colwell, *Associate Director, Space Sciences Laboratory, University of California, Berkeley, California 94720*

ABSTRACT

Great alarm currently is being expressed by several congressmen and also by disaster-preparedness officials from many federal, state and municipal government agencies relative to the "greatest fire hazard of the century" which currently is developing on and near the NASA San Pablo Reservoir Test Site in California.

The fire hazard has developed because of two recent and highly unusual climatic factors, both of which have been carefully monitored with ERTS-1 imagery and also with "high flight" photography concurrently obtained from an altitude of 65,000 feet by NASA's high performance aircraft. (1) A 9-day period of freezing weather in mid-December, 1972, which killed an estimated 90 percent of the frost-susceptible eucalyptus trees which exist as plantations covering more than 1,200 hectares (3,000 acres), mostly on ridgetops, scattered throughout the Oakland-Berkeley hills. The normally green foliage of these trees is now brown and highly inflammable. (2) A 1972-73 rainy season which, although still in progress, already has been proclaimed to be "the wettest in history". In consequence, a record volume of annual grass vegetation (mainly wild oats) currently is being produced on rangelands and park lands which are intermingled with the eucalyptus forests and which will turn dry and become highly inflammable next summer.

This paper will illustrate the many ways in which sequential ERTS-1 images and high flight photographs have been employed as aids to fire hazard appraisal within this study area. Based on information acquired to date, costs of fire hazard reduction in the Oakland-Berkeley area alone are being officially estimated at "from $4 million upwards" and federal and state disaster-aid loans are being sought. Hence the acquiring of timely, accurate, relevant information is of great importance in this instance.

Paper A 19

PHENOLOGY SATELLITE EXPERIMENT

Bernard E. Dethier, *Cornell University, Ithaca, New York*

ABSTRACT

The detection of a phenological event (the brown wave-vegetation senescence) for specific forest and crop types using ERTS-1 imagery is described. Data handling techniques included computer analysis and photo-interpretation procedures. Computer analysis of ERTS-1 multispectral scanner analog tapes in all bands was used to give the relative changes of spectral reflectance with time of forests and specified crops. These data were obtained for a number of the study's twenty-four sites located within four north-south corridors across the United States.

Analysis of ground observation photography and ERTS-1 imagery for sites in the Appalachian Corridor and Mississippi Valley Corridor indicates that the recession of vegetation development can be detected very well. Tentative conclusions are that specific phenological events such as crop maturity or leaf fall can be mapped for specific sites and possibly for entire regions.

Preliminary analysis based on a number of samples in mixed deciduous hardwood stands indicate that as senescence proceeds both the rate of change and differences in color among species can be detected. This will permit timber surveys by species over large areas, the determination of conditions of wildlife habitats, and aid in forest fire hazard evaluation.

The roles of the State Agricultural Experiment Station and the cooperative state extension agent and specialist in disseminating methods of applying ERTS data to agricultural, forestry and wildlife management practices are also discussed.

Paper A 20

E7.3 10122

VEGETATION MAPPING IN THE HOUSTON AREA WITH ERTS-1 DATA

G. R. Heath and H. D. Parker, *Lockheed Electronics Company, Inc., Houston Aerospace Systems Division, Houston, Texas*

ABSTRACT

ERTS-1 data acquired over the Houston Area has been analyzed for applications to vegetation mapping. In the field of forestry, the Sam Houston National Forest (Texas) was chosen as a test site, (Scene ID 1037-16244) and conventional imagery interpretation as well as computer processing methods were used to make classification maps of timber species, condition and land-use. The results were compared with timber stand maps obtained from aircraft imagery and checked in the field. The preliminary investigations show that conventional interpretation techniques indicated an accuracy in classification of 63%. The computer aided interpretations made by a clustering technique gave 83% accuracy.

Computer-aided and conventional multispectral analysis techniques were applied to the problem of range vegetation type mapping in the gulf coast marsh, two species of salt marsh grasses were mapped. Aside from their importance for grazing and wildlife habitat, the separation of marshhay cordgrass (Spartina patens) and gulf cordgrass (Spartina spartinae) locations may be significant in coastal zone management since the natural boundary between the two species approximately marks a change in elevation as small as three inches above sea level. Preliminary results indicate the two types are separable in ERTS-1 MSS data. (Scene ID 1073-16251), both manually and automatically.

APPLICATION OF ERTS-1 DATA TO ANALYSIS OF AGRICULTURAL CROPS AND FORESTS IN MICHIGAN

Gene R. Safir and Wayne L. Myers, *Michigan Agricultrual Experiment Station, Michigan State University, East Lansing, Michigan,* and William A. Malila and James P. Morgenstern, *Environmental Research Institute of Michigan, Ann Arbor, Michigan*

ABSTRACT

The results reported are based on analysis of ERTS Frame 1033-15580 collected over southwestern Lower Michigan on August 25, 1972. Major agricultural crops such as corn and soybeans were approaching maturity at this date and forest canopies were dense.

Extensive ground truth information was gathered by detailed field study of test strips. This detailed information was supplemented over larger areas by interpretation of RB-57 and C-47 photography and MSS imagery. The U.S.D.A.–A.S.C.S. also cooperated by providing information on crops from their records.

Recognition processing of ERTS–1 MSS data was carried out on a digital computer. Fields and forest stands were selected as training sets and test areas. Aerial imagery was essential for locating the positions of these selected areas on ERTS digital tapes.

The recognition process was successful for each type of vegetation which had a dense green canopy such as forests, corn, soybeans, and alfalfa. Bare soil was also recognizable as a category. However, recognition of species was difficult in senescing or senescent vegetation. Since the accuracy of recognition depends on stage of growth, optimum times for collecting data will vary from one crop to the next.

Accurate computer recognition of crops from satellite data will be useful in operational surveys as the first stage in a multistage sampling process.

Paper A 22

CROP SPECIES RECOGNITION AND MENSURATION IN THE SACRAMENTO VALLEY

F. J. Thomson, *Environmental Research Institute of Michigan, Ann Arbor, Michigan*

ABSTRACT

An earlier paper, presented at the September 28 meeting at Goddard, dealt with agricultural recognition maps of a portion of the "San Francisco" frame (1003–18175). The recognition maps were generated by applying multispectral pattern recognition techniques to ERTS–MSS digital taped data. The earlier results have been improved and extended as a result of field studies to check the accuracy of the original recognition. The goal of the second recognition map prepared from these data was to delinate various crop species in a portion of the Sacramento Valley, and at the same time to determine how accurately each could be classified and measured from ERTS–1 data.

The new recognition map, a new and concise display of the old map, and classification and mensuration accuracy data will be presented and discussed. The mensuration accuracy, in particular, is affected by the presence of an edge effect one resolution wide surrounding nearly all fields. Points on the edge are misclassified because they contain a mixture of e.g., crop and bare soil. Using a processing technique to estimate the proportions of unresolved objects in this edge region, a much improved mensuration capability will be demonstrated.

Paper A 23

THE RESULTS OF AN AGRICULTURAL ANALYSIS OF THE ERTS-1 MSS DATA AT THE MANNED SPACECRAFT CENTER

Robert M. Bizzell, Lewis C. Wade, Harold L. Prior and Bobby Spiers*, *NASA-Manned Spacecraft Center, Houston, Texas 77058*

ABSTRACT

This report describes the initial analysis of the ERTS-1 multispectral scanner (MSS) data at the Manned Spacecraft Center (MSC), Houston, Texas. The primary data set utilized was the scene over Monterey Bay, California, on 25 July 1972, NASA ERTS ID No. 1002-18134. It was submitted to both computerized and image interpretative processing.

An area in the San Joaquin Valley was submitted to an intensive evaluation of the ability of the data to (1) discriminate between crop types and (2) to provide a reasonably accurate area measurement of agricultural features of interest.

The results indicate that the ERTS-1 MSS data is capable of providing the identifications and area extent of agricultural lands and field crop types. Later data sets of Hardin Co., Iowa, and Holt Co., Nebraska, have undergone preliminary analyses as a portion of a joint USDA/ASCS-NASA/MSC ERTS-1 data evaluation project. These preliminary results using the same techniques as those carried out on the Monterey data show an ability to discriminate major crops which are representative of different agricultural practices.

*USDA Representative at MSC.

Paper A 24

E7.3 10126

AGRICULTURAL APPLICATIONS OF ERTS-1 DATA

William C. Draeger, *Forestry Remote Sensing Laboratory, University of California, Berkeley, California 94720*

ABSTRACT

The Forestry Remote Sensing Laboratory at the University of California is conducting an experiment to evaluate the usefulness of ERTS-1 data in providing agricultural information on an operational basis for regional areas.

In order to accurately determine the degree of detail which can be extracted from ERTS-1 data, and the optimum use of "subsampling" in the form of aerial photography and ground truth data for various agricultural-related tasks, the investigation is being carried out in a stepwise fashion beginning with gross land use delineation, progressing through a more detailed agricultural land classification, to very detailed crop inventory surveys. Emphasis is being placed on obtaining quantitative estimates of the accuracy of results, and where possible, a comparison with those obtained using conventional techniques. Investigations entail the use of both human interpreters and automatic classification and data handling techniques, and an evaluation of the optimum mix of human and machine techniques for each analysis problem.

Preliminary results of these investigations indicate several areas of application which appear promising. Stratifications of agricultural lands have been produced which have proved to be quite meaningful in terms of general crop type distribution. Such stratifications are useful in providing the basis for efficient subsampling using aircraft or ground data, or more detailed analysis of ERTS imagery, for specific crop inventories. The analysis of change in land allocation for agricultural purposes on a regional basis has been demonstrated to be readily accomplished using ERTS data as a primary input. Of particular significance is the progress which has been made in automated data handling and analysis of information extracted from the imagery, and in computer-based crop inventory techniques, wherein quite accurate and encouraging results have been obtained.

Paper A 25

E7.3 10127

IDENTIFICATION OF AGRICULTURAL CROPS BY COMPUTER PROCESSING OF ERTS MSS DATA

Marvin E. Bauer, *Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, Indiana 47907*

ABSTRACT

The wide area coverage of ERTS, linked with computer processing, offers a unique opportunity to improve upon the ground-based sampling methods now used to making acreage estimates. Eisgruber (LARS Information Note 030872) shows that annual social benefits of $23 million would result from reducing the corn, soybean and wheat production errors of estimate from 3% to 1%. Sequential coverage by ERTS should, by increasing the timeliness of estimates, produce additional social benefits.

As the first step in fulfilling these potentials and developing a crop production information system based on ERTS data, major crop species in three northern Illinois counties (Dekalb, Ogle and Lee) were accurately identified by computer processing of digital MSS data (ERTS frame 1017-16093, August 9, 1972). These counties have highly productive soils and are intensively cropped. Ground truth to support the investigation consisted of identification of the contents of over 500 fields. A small number of these were used for testing the accuracy of classifications.

Quantitative evaluation of crop species identification showed accurate identification of corn, soybeans and "other". Overall classification performances of 80% or greater were obtained for the several tests conducted. For example, training sets selected from areas 15 to 25 miles away from the area being classified could be used satisfactorily. Furthermore, training sets containing as few as three fields each of corn and soybeans performed as accurately as six and nine field sets and nearly as accurately as 12. Finally, comparisons of the proportion of points classified into corn, soybeans and "other" compared well with county estimates made by the USDA.

Additional analyses which will be completed and reported include: classifications utilizing temporal information, comparisons of estimates derived from different sampling methods, and evaluation of identification accuracies of classifications performed 50 to 100 miles from the origin of the training set.

E7.3 10128

IDENTIFICATION AND MAPPING OF SOILS, VEGETATION, AND WATER RESOURCES BY COMPUTER ANALYSIS OF ERTS MSS DATA

M. F. Baumgardner, S. J. Kristof, J. A. Henderson, LARS Staff, *Laboratory for Applications of Remote Sensing, Purdue University, West Lafayette, Indiana 47907*

ABSTRACT

A test site covering an area of 31,000 Km^2 was selected in West Texas to assess the utility of ERTS MSS digital data for mapping and monitoring the soil, vegetation, and water resources of the region. The ten county area, known as the Lubbock Regional Test Site, encompasses a variety of geologic, topographic, soils, agricultural and rangeland features.

Usable MSS data from portions of the test site have been analyzed from four different ERTS cycles. Using computer-implemented overlay techniques, ERTS MSS data obtained on three different dates over Lynn County, Texas have been analyzed. Temporal changes in vegetation and water supply in the playas were identified and mapped.

Six cooperating ground observers in each of the ten counties are obtaining pertinent soils and crop data at the time of each ERTS pass. Each observer records and reports data from each field along a 6-10 kilometer county road segment. These sixty ground observation segments are well distributed throughout the 10 counties.

Training sets for computer-implemented analysis of ERTS data are extracted from the ground observation data. Training sets from one county are used to classify ERTS data from other counties.

Surface features which have been easily identified include row crops, unimproved rangelands, improved rangelands, bare soils, winter wheat, playas, river and streams, towns and cities, reservoirs and gross geologic and soils features.

Preliminary results suggest that with these techniques, scientists should be able to identify drought conditions, crops damaged by hailstorms, areas of active wind erosion, and crop species. Each of these factors should contribute to better yield predictions and more efficient management of agricultural resources.