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SEMI-ANNUAL PROGRESS REPORT NO. 1

November 1, 1973 - April 30, 1974

APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS

NASA Grant: NGL-25-001-054

Submitted to

Office of University Affairs
Headquarters
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
Washington, D.C.

Submitted by

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April 30, 1974

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APPLICATION OF REMOTE SENSING TO STATE AND REGIONAL PROBLEMS

I. INTRODUCTION

The primary purpose of the Remote Sensing Applications Program is for various members of the university community to participate in activities that improve the effective communication between the scientific community engaged in remote sensing research and development and the potential users of modern remote sensing technology. The state-of-the-art remote sensing capability is significantly beyond the present-day applications of the potential user group. The program serves to accelerate the use of state-of-the-art remote sensing capabilities which will help to insure resonable pay-off from and better usage of space, high altitude, and other remote sensing capabilities largely evolved by the NASA program.

Activities of this program are assisting the state of Mississippi in recognizing and solving its environmental, resource, and socio-economic problems through inventory, analysis, and monitoring by appropriate remote sensing systems.

In order to achieve this purpose, the participants in this program and collaborating departments are interacting with state and federal agencies, councils of government, counties, and urban groups in the following ways:

1. Identifying and updating state and local problems which remote sensing can help solve.
2. Assisting potential users to learn how better to use remote sensing where it is appropriate to the solution of specified problems.
3. Conducting remote sensing applications programs to bring remote sensing technology to bear upon the solution of selected high priority problems. (Three projects are currently underway and progress in them is reported in a later section of this report).
4. Identifying additional research needs to which remote sensing technology may be applied and establishing priorities for meeting these needs.
5. Stimulating, guiding, and aiding the faculty and students at MSU and others in the state of Mississippi to utilize information from the NASA Earth Resources Satellite and Aircraft Programs in research and public service activities. This program is augmented by the program of the Land Use Center of the Cooperative Extension Service at MSU.
6. Provide a center of expertise and an operational laboratory for short-course training (a schedule of the first is presented below), assistance to departments and agencies in utilizing appropriate remote sensing technology in solving their problems (a list of assistance is given below), and making certain specialized equipment available to users.

Program participants consist of interested faculty researchers in the multifaceted aspects of the application of remote sensing techniques to problems in Mississippi, the region, the nation, and the world. The program participants are organized so as to help foster the growth and improved effectiveness of the group and strive toward accomplishing the purposes of the program.

C. W. Bouchillon, Director of the Institute for Environmental Studies, is serving as Program Coordinator. Other key personnel in the program include: W. F. Miller, Associate Professor of Forestry; Timothy Cannon, Research Associate in Forestry; C. A. Taylor and Harlow Landphair, Professors of Landscape Architecture; Frank Whisler, Professor of Agronomy Soils; and V. L. Zitta, Assistant Professor of Civil Engineering.

II. PROJECT PROGRESS REPORTS

A. Bark Beetle Project - Copiah County

Objective

The objective of this study is to provide information to the Mississippi Forestry Commission on the location of high-risk pine stands; that is, those stands which have a high risk of bark beetle attack due to high stand density and/or internal water stress.

Accomplishments

A total of two days have been spent in Copiah County with the County Forester and the Commission's Bark Beetle Coordinator.

Infestation spots ranging from 5 or 6 trees to areas 15 acres in extent were visited and examined. A data collection form is attached.

The Commission will re-fly the county during the first week in May, and a crew from the University will accompany the Beetle Coordinator to each new reported infestation following the flight.

The following resource information and data has been compiled:

1. Climatological data, 1969 to date
    a. Monthly precipitation
    b. Average yearly precipitation
    c. 5 year average precipitation
    d. Length of growing season
    e. Average yearly temperature
    f. Wind direction and speed
    g. Soil water deficit calculations using Zahner's formula
2. Broad soil association map of the county
3. Geological association map
4. Infestation spots

Contacts with other departments or agencies include the Department of Entomology, Mississippi State University where Dr. Evan Nebeker, Forest Entomologist, is working on a bark beetle project in Copiah County. Personnel from the

Alexandria, Louisiana, branch of the Southern Forest Experiment Station have been in communication with Mississippi State in order to ascertain our procedures; they will shortly undertake a similar project on the ground. No remote sensing is planned for their project.

Current Status

An attempt is being made to utilize existing imagery to map pine stands of high density. The imagery is from NASA Mission 054, color infrared at a scale of 1:120,000, winter season. A preliminary topographic analysis is also underway. It is anticipated that if NASA overflights are not forthcoming, the project will have to be modified to rely on the high altitude, winter imagery.

Plans

Early in May, the Forestry Commission plane will be utilized to obtain low level, 35 mm imagery of selected infestation spots. Stand and topographic analysis will be made, and direction of infestation will be predicted. These spots will be flown late in the summer to check the validity of prediction.

B. Location of State Park - Natchez State Park Study

Summary

The Natchez State Park Locational Study is estimated 20% complete, with August being the target date for the Preliminary Report.

After getting off to a slow start in late February, the pieces of the project have begun falling into place. The basic organization is now 80% complete, the data gathering is 15% complete and the analysis os 20% complete.

The most significant developments in the project are as follows: First, we were delighted to find that accurate data can be acquired from photographic materials at a scale of 1:25,000, and the decision to work with a small pilot area first is allowing us to develop techniques that will speed up the overall process.

Organization

The general organization of the project is estimated 80% complete. This includes the layout and basic format the research is going to take, involving the personnel of the State Park Commission and officials from Adams County, Natchez and the Natchez Chamber of Commerce. Each organization is committed to the concept of the study and have agreed to work with the research team.

One general problem encountered in organizing the public interest groups has been a running controversy over what a state park at Natchez should be. Over the past years a great deal of pressure has been put on the State to develop a site known as Natchez Under the Hill rather than a large regional type park in the county. It now appears that the approach we are taking to site selection on this project has the potential to quell the argument.

Remaining organizational matters that will be completed in May involve a thorough inventory of other public organizations and plan making bodies involved in the study area. For example, the Soil Conservation Service, Forest Service, Planning and Development District and County Extension Service. Our hope here is to be sure we consider all possible overlap in planning functions that may affect land use.

Data Inventory

The data inventory was begun in late March and has been rather slow moving compared to early "guesstimates". The major problem has been the speed of data interpretation working from materials at scales of 1:250,000 and 1:62:500. However, we are finding that photos of 1:250,000, and maps at 1:62:500 provide the accuracy needed. Now, it is a matter of developing some skill and few photographic techniques for bringing data to compatible scales. Just as a rough guess I would say that over the last 6 weeks our speed has improved about 150%, and we anticipate even more improvement.

Now that the handling and scaling of the data seems to have smoothed out, we intend to begin work on the machinery to check ground truth in late May.

Data Handling and Analysis

This area is also progressing well. Roughly, we estimate that work in this area is 20% complete. The soft ware system for handling the required data base is complete and running

under the watchful eyes of Dr. Brad Carter.

One very real advantage realized already in using the computer is the ability of the machine to re-scale the data. This ability to work from data at any scale and print it at 1:62,500 is a major time saver.

The next step in this area is to complete the modeling and evaluation phase. This is already in progress and slated for completion in June.

To facilitate this step we have concentrated our data gathering efforts on a smaller section of the study area designated as a pilot area. We believe that working with the smaller site now will allow us to make our mistakes early and save time in the long run. So far, this has proved to be the case with the data gathering operation.

Research Objectives - May - July 1974

May: Complete the data base on the designated pilot study and refine the evaluation models to be used in site selection.

A concentrated effort will also be made to collect and collate all related public agency work that may have an effect on park location and construction.

June: Major concentration will be on completing the data base for the entire study area. It is hoped that this will include most of the updating of base maps and field verification of the photogrammetric materials.

July: Early July will be spent working directly with the involved public agencies going over the data maps and evaluation models to be sure there are no apparent physical or political contradictions. The latter part of the month will be spent in compiling the preliminary findings into usable form.

C. Waste Source Location and Stream Channel Geometry

Objective

It has been proposed in this study to use remote sensing techniques to reduce the level of effort in obtaining basic stream channel hydrologic characteristics and waste source location for input into mathematical models for water quality assessment and waste load allocation. As a continuing effort, it was proposed that remote sensing techniques have the possibility of being used in the monitoring of in-stream water quality, to insure that the requirements of the waste allocations are met.

Accomplishments

The major part of the research effort has been directed towards a thorough search of the literature to determine if hydrologic characteristics of stream channels have been obtained from remote imagery at low flow conditions. In addition, a search has been made to determine if waste outfalls have been located and under what conditions from remote imagery.

Hydrologic Data

The hydrologic data required for input into mathematical models are channel length, depth and velocity. The literature indicates that channel length, L, top width, W, and slope, S_o, are readily obtained from remote imagery. Relative depths up to a maximum of 150 feet have been obtained from imagery, but accurate quantitative measurement of bottom depth has not been demonstrated. Velocity determinations require the placing of a photographically reproducable dye tracer or surface floats, neither of which are desirable.

To determine the velocity, V, and the depth, D, of a stream from measurements of length, L, top width, W, and slope, S_o, the following relations have been developed for uniform flow conditions in a wide shallow channel:

$$V = \left[\frac{n \, W^{0.667}}{1.49 \, S_o^{0.5}} \right]^{-0.6} Q^{0.4} \qquad (1)$$

$$D = \left[\frac{n}{1.49 \, S_o^{0.5} \, W} \right]^{0.6} Q^{0.6} \qquad (2)$$

where n is the Manning roughness coefficient.

Waste Source Location

Waste treatment facilities are readily available on U. S. Geological Survey maps. It has been demonstrated that some facilities are omitted from maps when there is a long dealy between the time photographs are taken, ground surveillance

completed and the final map published. Recent imagery is being used to update locations of known treatment facilities on USGS maps.

The location of the outfall from waste treatment facilities is not explicitly defined on USGS mpas. Preliminary results shown that waste outfall structures are most easily located on large scale photographs taken in the absence of foilage under low streamflow conditions. Land scars, manholes, and instream structures are the most readily identifiable evidence of an outfall from a treatment facility.

Instream Monitoring of Water Quality

From the literature, the greatest promise for using remote imagery is for the detection of solids. It has been shown that plumes of high solids concentration are detectable, but to quantify the type and amount of solids requires ground truth sampling. Natural sediments tend to give reflectance properties similar to organics.

Future Directions

A continuing effort will be made to review current literature which is applicable to the determination of hydrologic properties of stream channels under low flow conditions. The theoretical relation of length, top width and slope will be expanded and verified by correlation of data obtained from existing and future imagery with planned water quality surveys in the Tupelo and Clarksdale areas.

Recent pancromatic imagery will continue to be used to update USGS maps to locate waste treatment facilities and outfalls constructed since publication of the maps.

III. DESCRIPTION OF SHORT COURSE

A short course which will serve to illustrate the use of remote sensing information to various state agency type problems has been announced for May 21-24, 1974. A copy of the material describing the course and the agencies to which it was sent is included as Appendix A.

IV. LIST OF SPECIAL ASSISTANCE OFFERED

A. D. Beck, Golden Triangle Planning and Development District, Examine MSFC flood imagery to determine archeological and ecological impacts of TVA proposed line in Lowndes County, 3/22/74

B. L. Autry, Weyerhaeuser Corporation, Examination of sites for large nursery operation; MSFC imagery, 4/4/74

C. J. Breland, Weyerhaeuser Corporation, Mapping of impoundment levels for Tennessee-Tombigbee Waterway on Weyerhaeuser lands, Tennessee-Tombigbee project maps, 4/9/74

D. G. Hurst, Department of Wildlife and Fisheries, Introduction to remote sensing and game habitat identification for Wildlife Techniques course, use of various NASA imagery, 4/9/74

E. D. Beck, Golden Triangle Planning and Development District, Information on relative ecology of two areas involved in land transfer, USFS and Sturgis Lumber Company, 4/16/74

V. PLANS FOR ADDITIONAL EFFORTS

A. Repeat of Short Course because of high interest and demand.

B. Expansion into Tennessee-Tombigbee area with project.

C. Interaction with Mississippi Research and Development Center on Land Use Study and Applications (ERTS B Program).

APPENDIX A

Remote Sensing Workshop

REMOTE SENSING WORKSHOP
May 21-24, 1974
Mississippi State University

The Use of Remotely Sensed Data in Land Capability Classification

The purpose of this workshop is to provide a working knowledge of the fundamentals of remote sensing which apply to terrain analysis. These fundamentals should provide the participant with the information necessary for operational evaluation of land capability.

What is terrain analysis? Terrain analysis, as related to photointerpretation, is the identification of landform (geomorphic characteristics), topographic expression, and stream drainage pattern and density. Interpretation of these factors will yield a great deal of information concerning the nature of the geologic substrate. Since there is a strong correlation between geologic substrate and soil associations, grouping of similar soils on landscape units of similar topographic expression leads to definition of land capability units. These units will have similar capabilities that can be utilized in interpretations of land use suitability for forest crops, agronomic crops, game management, urban and industrial sites, and general planning activities. The basic purpose of terrain analysis and capability classification is to provide the information necessary to assign land uses which maximize environmental enhancement, and minimize environmental degradation.

Participants in this workshop will be offered the opportunity to utilize imagery from satellite, and high and low-level aircraft flights in the identification and interpretation of land capability. Attendance will be limited to 15 participants in order to give each member the individual instruction necessary for an understanding of the utility of aerial imagery. Prior training in remote sensing and photointerpretation is desirable, but not required as each agency or individual indicating a desire to participate will be sent instructional material prior to the workshop.

A tentative copy of the workshop schedule is attached for your consideration. If you find that your agency has an interest in this area, and an individual who might have an opportunity to make use of the information presented, you are invited to fill in and return the form printed below. In the event that all class spaces are not filled, please indicate whether you would like to send more than one participant.

There is no registration fee for the workshop. Partial support for the workshop is provided by the Office of University Affairs, National Aeronautics and Space Administration through Grant NGL-25-001-054.

Agency _____

We will _____ will not _____ send a participant to the Remote Sensing Workshop at Mississippi State University, May 21-24, 1974. If possible we would like to send _____ additional participants.

Agency Representative _____

Return to W. Frank Miller
Drawer FD
Mississippi State, MS 39762

RETURN BY MAY 1, 1974.

TENTATIVE PROGRAM - REMOTE SENSING WORKSHOP

Presented By
The Department of Forestry
Institute for Environmental Studies
Mississippi State University

In Cooperation With
Office of University Affairs
National Aeronautics and Space Administration
U.S. Geological Survey
EROS Program
and
Mississippi Agriculture & Forestry Experiment Station

May 21

10:00 a.m. - noon. Registration

1:00 p.m. - 1:15 p.m. Introduction. Frank Miller

1:15 p.m. - 2:15 0.m. Fundamentals of remote sensing. Hank Svehlak

2:15 p.m. - 3:00 p.m. Laboratory exercise; type of equipment, stereo-vision, and tests of acuity. Frank Miller, Tim Cannon

3:00 p.m. - 3:30 p.m. Break

3:30 p.m. - 5:00 p.m. General applications of remote sensing; the EROS Program; data acquisition. Hank Svehlak

May 22

8:30 a.m. - noon. Low-level flight over study area; laboratory exercise on care of photos, and preparation of photos for stereo-viewing.

1:30 p.m. - 4:30 p.m. Principles of photogrammetry. Frank Miller
Tim Cannon

6:00 p.m. Dinner and evening work session.

May 23

8:30 a.m. - 10:00 a.m. Principles of terrain analysis and capability classification. Frank Miller

10:00 a.m. - 10:15 a.m. Break

10:15 a.m. - 11:30 a.m. Laboratory exercise; preliminary identification of land forms and capability units.

12:30 p.m. - 5:30 p.m. Field exercise; examination of soil association geologic substrate and topography. Miller, Cannon, Hoover, Sader.

May 24

8:30 a.m. - 10:00 a.m. Final identification and mapping of land capability units. Miller, Cannon, Hoover, Sader.

10:00 a.m. - 10:30 a.m. Break

10:30 a.m. - 11:45 a.m. Interpretations based on soil associations. H.B. Vanderford

1:00 p.m. - 2:30 p.m. Seminar - Disciplinary and interdisciplinary operational use of data.

STAFF
REMOTE SENSING WORKSHOP

U.S. Geological Survey
EROS Experiments and Evaluation Office
Mississippi Test Facility
Bay St. Louis, MS 39520

Mr. Henry (Hank) Svehlak. General Electric Company. Remote Sensing Advisor to the EROS Experiments and Evaluation Office.

Mississippi State University
Agronomy Department

Dr. H.B. Vanderford. Professor of Agronomy and Soil Survey Leader, Mississippi Agriculture and Forestry Experiment Station.

Forestry Department

W. Frank Miller. Assoc. Professor. Remote Sensing Specialist for 5 NASA projects. Former Project Coordinator and Remote Sensing Investigator, "An Ecological Study of the Tennessee-Tombigbee Waterway."

Timothy K. Cannon. Research Associate, Remote Sensing Applications Program.

Steve Sader. Research Technician, Remote Sensing Applications Program.

Zoe Hoover. Graduate Student.

AGENCIES INVITED TO PARTICIPATE IN WORKSHOP

1. Mississippi Forestry Commission
2. Mississippi Park Commission
3. Game and Fish Commission
4. Office of State and Federal Programs
5. R and D Board
6. Air and Water Pollution Control Commission
7. Marshall Space Flight Center
8. A and I Board
9. Mississippi Geological Survey
10. Mississippi National Forest
11. Mississippi Highway Department
12. Agriculture and Commerce Department
13. Tennessee-Tombigbee Waterway Authority
14. Yazoo-Little Tallahatchie Watershed
15. U. S. Forestry Service