Cornell University
REMOTE SENSING PROGRAM
SCHOOL OF CIVIL AND ENVIRONMENTAL ENGINEERING
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E7.9-10.21.1

CR-158683

June 21, 1979

NASA Scientific and Technical
Information Facility
P.O. Box 8757
Baltimore-Washington International Airport
Maryland 21240

Subject: NASA Grant NGL 33-010-171

Gentlemen:

In accordance with the provisions of the subject grant, we are transmitting herewith two (2) copies of our 14th Semi-Annual Status Report, covering the period December 1, 1978 to May 31, 1979. In addition, three (3) copies of this report are being sent directly to the Technology Transfer Division, NASA Headquarters, Washington, D.C. 20546 (Attention: Mr. J.A. Vitale).

Sincerely yours,

Ta Liang

Ta Liang
Principal Investigator

TL/pw

cc: Mr. J.A. Vitale, NASA Headquarters
Mr. D.A. Douvarjo, NASA Headquarters
Deans T.E. Everhart and P.R. McIsaac
Mr. T.R. Rogers and Mr. F.J. Feocco
Director R.N. White

(E79-10211) REMOTE SENSING PROGRAM Semiannual Status Report, 1 Dec. 1978 - 31 May 1979 (Cornell Univ., Ithaca, N. Y.) 102 p HC A06/MF A01 CSCL 05B

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SEMI-ANNUAL STATUS REPORT

of the

NASA-sponsored

Cornell University Remote Sensing Program

December 1, 1978 - May 31, 1979

NASA Grant NGL 33-010-171

Principal Investigator: Ta Liang

Co-Investigators: Arthur J. McNair
Warren R. Philipson

Remote Sensing Program
Cornell University
Hollister Hall
Ithaca, New York 14853

June 1979

INTRODUCTION

The primary objective of the NASA-sponsored, Cornell University Remote Sensing Program is to promote the application of aircraft and satellite remote sensing, particularly, in New York State. In accordance with NASA guidelines, this is accomplished through conferences, seminars, instruction, newsletters, news releases, and most directly, through applied research projects. Each project must be, in some way, unique; essentially noncompetitive with commercial firms; and potentially, benefit- or action-producing. Relatively little emphasis is placed on technology transfer, per se.

The activities of the Remote Sensing Program staff, from December 1, 1978 to May 31, 1979, are reviewed in this Semi-Annual Status Report, the fourteenth to be submitted to NASA since the Program's inception in June 1972.

COMMUNICATION AND INSTRUCTION

Contacts and Cooperators

The Program staff spends many hours discussing remote sensing with representatives of various federal, state, regional, county and local agencies, public and private organizations, the academic community, and foreign countries.

During the past six months, members of the Program staff presented remote sensing research or orientation papers at the 45th Annual Meeting of the American Society of Photogrammetry, at a special Conference on Landsat Applications in New York State (30 state, county or university participants), and at a Cornell University review of Programs in Engineering (35 industrial representatives); and Program staff attended the 13th International Symposium on Remote Sensing of Environment in Michigan (Appendices E and F). In conjunction with the Program's Seminar in Remote Sensing, the staff hosted speakers from three private companies, one university, four U.S. government agencies, one Canadian government agency, and one international research agency in Italy (Appendix F). In addition, during the past year, one member of the Program staff presided over the Central New York Region of the American Society of Photogrammetry, which includes some 200 professionals and students. Another member, at the request of and funded by the U.S. Agency for International Development, travelled to Thailand and the Philippines to assess the potentials of remote sensing programs in these countries.

Along with receiving project cooperators from the Taylor Wine Company and the N.Y.S. Agricultural Experiment Station, Program staff provided remote sensing consultations or orientation sessions for visitors from the N.Y.S. Department of Environmental Conservation, the Southern Tier East Regional Planning and Development Board, N.Y., the Environmental Management Council and Soil and Water Conservation District of Cayuga County, N.Y., Land Care, Inc., of Boonville, N.Y., the State University of New York at Buffalo, N.Y., Ulster County Community College, N.Y., and the Soviet Union. Many new and continuing dialogs were also held via the mail and telephone, particularly in the course of developing new remote sensing projects (Appendix D).

Newsletters

By highlighting remote sensing activities at Cornell while reporting other items of interest, the Program's "Cornell Remote Sensing Newsletter" continues to serve as an important link to and beyond the Cornell community (Appendix H). The number of Newsletter recipients has grown steadily to more than 500 individuals or groups in over 40 states and 20 countries (Appendix G).

Seminars

The Program's weekly Seminar in Remote Sensing, a one-credit hour course in the School of Civil and Environmental Engineering, returned after a fall semester hiatus. In bringing experts from government, industry and other institutions to Cornell to discuss a wide range of remote sensing topics, the Seminar attracted audiences of from 50 to 70, with a course registration of 27 graduate and 26 undergraduate students from 13 Cornell divisions (Appendix F).

Courses, Special Studies and Workshops

Cornell's curriculum in Aerial Photographic Studies and Remote Sensing, and the possibilities for research through special topics courses, professional master's design projects and M.S. or Ph.D. theses, have been reviewed in earlier Semi-Annual Status Reports. During the spring semester, 1979, for example, over 100 students were enrolled in formal courses in this area, and ongoing graduate thesis investigations included: a remote sensing analysis of lateritic engineering materials for Thailand (Pichit Jamnongpipatkul, Ph.D. candidate); detection and categorization of inactive surface mines with small scale remotely sensed data (Jan Berger, M.S. candidate); Landsat analysis of flooding in the western plains of Venezuela (Rafael Avila, M.S. candidate); and mineral exploration in the western Adirondacks, N.Y. (Caren Rubin, MEC candidate). Other topics being considered for remote sensing thesis research include arid regions (William Teng, Ph.D. candidate), tropical crops (Elaine Aderhold, M.S. candidate), and coastal environments (William Hafker, M.S. candidate).

Typical of the Program staff's extracurricular instructional activities during the past six months are an invited paper, "Remote Sensing for the User," presented at a Conference on Landsat Applications in New York State; and an overview of the Remote Sensing Program, presented to industrial representatives from some 35 companies (Appendix F).

DATA AND FACILITIES

As described in earlier reports, staff research and instruction have been enhanced through continued acquisition of a wide range of remotely sensed, aircraft and satellite data, and through extension of capabilities for their analysis and interpretation. These data, along with Program facilities and equipment, are made available at no cost to cooperators, students and other interested users.

With assistance from the NASA Office of University Affairs, the Program has received Landsat, Skylab, high altitude and low altitude coverage of sites in the Northeast, and new high altitude aircraft missions were scheduled for the summer, 1979. The U.S. Environmental Protection Agency has also overflown Program-selected sites at no cost to the Program; and imageries have been obtained from the U.S.A.F. Rome Air Development Center, the U.S. Geological Survey, the U.S. Department of Agriculture, the St. Lawrence Seaway Development Corporation, the National Air Photo Library of Canada, the Tri-State Regional Planning Commission, the National Archives, Eastman Kodak Company and several commercial mapping firms.

The Program maintains or has access to a spectroradiometer and selected image analysis equipment (i.e., zoom and non-zoom stereoscopes, density slicer, color-additive viewer, Zoom Transfer Scope, densitometer, stereoplotters, and other photogrammetric and photographic instruments). The Program also maintains a series of computer routines for analyzing multispectral digital data. These routines have received increased usage in Program-sponsored, spinoff and thesis investigations with Landsat and aircraft scanner data.

PROJECTS COMPLETED

During the six-month period, December 1, 1978 to May 31, 1979, the Cornell Remote Sensing Program staff completed three applied research projects:

1. Developing In Situ Flood Estimators with Landsat Imagery.

2. Preliminary Analysis of Vineyard Yield Assessment.

3. Evaluating Landslide and Erosion Susceptibility.

The projects are summarized here, and pertinent material on each is included in an appendix.

1. Developing In Situ Flood Estimators with Landsat Imagery.

In a feasibility study conducted cooperatively with the N.Y.S. Board of Hudson River-Black River Regulating District, Landsat imagery was used as the primary source of information on the extent of flooding in the Black River Basin of northern New York State (Appendix A). Landsat images depicting flood conditions during several flood seasons were analyzed to identify flood prone areas and to develop an empirical relationship between areas of flooding and river discharge measurements. Successful refinement of this relationship will allow real-time estimation of the extent of flooding to be made on the basis of in situ discharge measurements. (A follow-up investigation with the Black River Regulating District has been proposed and tentatively accepted for funding by the Office of Water Research and Technology, U.S.D.I.)

2. Preliminary Analysis of Vineyard Yield Assessment.

The Program staff is working with the Taylor Wine Company, Inc., and the N.Y.S. Agricultural Experiment Station in examining the extent to which remotely sensed data might provide useful information for assessing vineyard-related problems. The first phase of the investigation, an evaluation of vineyard drainage, was completed and described in the Program's 7th Semi-Annual Status Report (Dec. 1975). The second phase of the investigation, an airphoto assessment of plant vigor, was completed and described in the Program's 9th Semi-Annual Status Report (Dec. 1976). For the current phase of the investigation, the staff examined relationships between vineyard yield and those morphologic and spectral characteristics of the vines that could be measured through aerial photographic and airborne multispectral scanner data (Appendix B).

Although the data and results have certain important limitations, they point to the potential for developing remote sensing as a tool for predicting yield. Follow-up studies are being planned.

3. Evaluating Landslide and Erosion Susceptibility.

At the request of the Director of the Planning Board of Albany County, N.Y., the Program staff completed an assessment of active and potential landsliding and erosion in a region of known land stability problems in the county (Appendix C). Derived from multi-date and multi-scale photographs, and soils and geologic reports, the information will be used by the Albany County Planning Board in its review of the many subdivision and development proposals that are received regularly. The information will thus provide critical input to controlling the development of potentially hazardous or erosive areas.

PROJECTS IN PROGRESS

Program-Sponsored

As of June 1, 1979, the Program staff was conducting two projects under the NASA grant: (1) An Assessment of Sand and Gravel Mining, and (2) A Landsat Analysis of Snow Distribution. The objectives, cooperators, users, expected benefits and actions, and status of these projects are described, as follow:

1. An Assessment of Sand and Gravel Mining.

-cooperators/users:	Planning Dept. of Fulton County, N.Y.; Town of Mayfield, N.Y.
-benefits/actions:	Zoning to be based on airphoto interpreted information
-expected completion date:	August 1979

In order to allow for compatible zoning adjacent to the existing sand and gravel mining operations in the Town of Mayfield, N.Y., the Fulton County Planning Department requested the Program to provide information regarding the extent of sand and gravel deposits in the town. Medium and small scale (NASA high altitude aircraft) photography are being used as the primary source of information.

2. A Landsat Analysis of Snow Distribution.

-cooperator/user:	N.Y.S. Office of Parks and Recreation
-benefits/actions:	More reliable data for planning recreational facilities; development of a remote sensing technique for estimating snow occurrence
-expected completion date:	Pilot study--December 1979

At the request of the N.Y.S. Office of Parks and Recreation, the Program staff is examining techniques for estimating the distribution of snow on the basis of Landsat and ground station measurements. This project is a repeated attempt to complete a study begun in 1975, but terminated because of the lack of applicable Landsat and other satellite data.

In general, if an effective methodology can be developed in the pilot study, the Office of Parks and Recreation would implement a statewide project, publishing the results--temporal and spatial distribution of snow--as a state planning document.

Spinoff Projects

During the past six months, the Program staff has been involved in a remote sensing analysis of some 40 chemical waste landfills in the Niagara Falls area of New York. Funded by the N.Y. Department of Health, this work follows the Program-sponsored assessment of Love Canal (13th Semi-Annual Status Report, Dec. 1978), as well as earlier leachate detection studies which were funded jointly by NASA and EPA.

As noted, the Program has also received tentative grant approval for a follow-up investigation of flood modeling with Landsat. This 12-month study would begin in October 1979 and be funded by the Office of Water Research and Technology, U.S.D.I.

FUTURE PROJECTS

The Program staff is continually soliciting and receiving proposals for new remote sensing, applied research projects (Appendix D). As described, criteria for project acceptance are that the project must be, in some way, unique; that project acceptance would not compete unduly with private companies or consultants; and that, if completed successfully, the project would produce tangible benefits or actions by defined users.

Among topics that are under current consideration are:

1. With the *St. Lawrence-Eastern Ontario Commission, N.Y.*--defining river currents as inputs to oil spill response modeling (Appendix D).

2. With the *St. Lawrence-Eastern Ontario Commission, N.Y.*--determine near-shore river/lake bottom types (Appendix D).

3. With the *New York State Office of Parks and Recreation*--develop approaches for identifying and characterizing beaches for a coastal zone management program.

Depending on user interest, personnel and available funds, any of these as well as other projects may be undertaken.

PROGRAM STAFF

The Program staff includes Prof. Ta Liang, principal investigator, Prof. Arthur J. McNair and Dr. Warren R. Philipson, co-investigators, Mr. Thomas L. Erb, research specialist, Mr. Jan P. Berger, graduate research assistant, Mr. John G. Hagedorn, computer data analyst, and Ms. Pat Webster, secretary. Prof. Donald J. Belcher and Dr. Ernest E. Hardy are general consultants to the Program, and for specific projects, assistance has been provided by many Cornell and non-Cornell personnel. Students who have contributed significantly to the Program staff effort over the past six months include William R. Hafker, Jay N. McLeester and William L. Teng.

LIST OF APPENDICES

APPENDIX A

DEVELOPING IN SITU FLOOD ESTIMATORS USING MULTI-DATE LANDSAT IMAGERY

STATE OF NEW YORK

BOARD OF HUDSON RIVER-BLACK RIVER REGULATING DISTRICT

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Walter Estabrook
Assistant Chief Engineer

March 21, 1979

Dr. Warren R. Philipson
Office of Water Research and Technology
Department of the Interior
Cornell University
Ithaca, New York 14853

Dear Dr. Philipson:

We are in receipt of your research proposal for the development of a relationship between Black River discharge measurements and the extent of river basin flooding. The discharge measurements are as recorded at the U.S.G.S. station maintained in Watertown, New York (58 year period of record). The flooding occurs at an annual or more frequent interval period in the 40± square mile basin - Carthage to Lyons Falls area.

The preliminary study using Landsat satellite data covering 9 and 18 day interval scenes together with discharge measurements taken for specific high water periods provided a cost analysis basis for damage estimates. However, if your research project is funded for another year, weather cooperating, a more reliable model should be developed.

The District, as a cooperator, and a direct beneficiary of the demonstration feasibility study, would use this refined empirical model in its flood assessment at various river stages. Comparable results should be applicable to other similar river basins, not upon the same basis, but derived by like methodology.

We appreciate your fine cooperation in this matter. The staff of the District has followed with interest the evolution of experimental operation of Landsat Satellite applications in relation to snow cover monitoring and run-off forecasting. However, your project appears to have a more practical approach to a current problem in this drainage area.

We shall be happy to continue to furnish stream gauge information with related crest flood elevation data at any specific time frame you request.

Thank you for your cooperation.

Sincerely,

K. H. Mayhew

K. H. Mayhew
~~Chief Engineer~~

KHM:FTM

DEVELOPING IN SITU FLOOD ESTIMATORS USING MULTI-DATE LANDSAT IMAGERY

J.N. McLeester and W.R. Philipson

Remote Sensing Program
Cornell University
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Paper presented at the 45th Annual Meeting
of the American Society of Photogrammetry
19-23 March 1979, Washington, D.C.

DEVELOPING IN SITU FLOOD ESTIMATORS
USING MULTI-DATE LANDSAT IMAGERY

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Remote Sensing Program
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BIOGRAPHICAL SKETCHES

Jay N. McLeester is a senior in Civil and Environmental Engineering at Cornell. A research assistant with the Remote Sensing Program, he won the American Society of Photogrammetry/Bausch & Lomb Photogrammetric Award for the best paper by a college student, 1977, and was awarded the Legislative Council for Photogrammetry scholarship for 1978.

Warren R. Philipson received his B.C.E., M.S. in Civil Engineering, and Ph.D. in Soil Science (Agronomy) from Cornell. Since 1965, he has taught, conducted research and participated in remote sensing projects in various parts of the world. A senior research associate in Civil and Environmental Engineering, he co-directs the Remote Sensing Program.

ABSTRACT

Landsat satellite imagery is being used as the primary source of information on flooding in the Black River Basin of northern New York State. Landsat images (Band 7) depicting flood conditions during several flood seasons since 1973 were obtained for analysis. Visual interpretation of these images is providing the basis for quantitatively relating in situ measurements of river discharge with the total area and geographic locations of inundation. This, in turn, will provide real-time estimation of flood losses over the entire river basin. This practical and inexpensive approach can provide sufficiently reliable information, and is applicable in other similar river basins.

INTRODUCTION

Approximately 65 kilometers of the Black River in northern New York State floods annually, inundating farm land and breaching local roadways. Ground surveys of the actual areas flooded are incomplete and thus inadequate for estimating agricultural and other losses. Previous studies have demonstrated that Landsat satellite data can be used effectively for delineating areas of river flooding (e.g., Deutsch and Ruggles, 1974; Rhode et al., 1976; Sollers et al., 1978). This study was undertaken to determine whether a correlation could be established between in situ measurements of river discharge and Landsat-derived measurements of river flooding. Such a relationship would allow the total area and specific locations of river flooding to be estimated in real time. These estimates would be of significant value for assessing damage and planning flood control.

METHODS AND MATERIALS

Study Area

The study area involves a highly flood-prone reach of the Black River in Lewis County, New York (Figs. 1 and 2). It extends approximately 65 kilometers from Lyon Falls to Carthage, being depicted on six 1:24,000 scale, U.S. Geological Survey topographic maps (Brantingham, 1966; Glenfield, 1966; Lowville, 1966; W. Lowville, 1943; Carthage, 1943; and Croghan, 1966). This area is known locally as "Black River Flats," as the net change in river elevation for the entire reach amounts to only three meters. The local vegetation is absent or without foliage through most of the spring flood season, allowing generally unobstructed overhead monitoring of flood waters.

Scene Selection

A computer listing of available Landsat imagery of the study area was obtained from the U.S. Geological Survey, EROS Data Center. In addition, data on river discharge and flooding since the launch of Landsat-1, in July 1972, were acquired from the New York State Board of Hudson River-Black River Regulating District (Table 1). Nine Landsat scenes (i.e., nine dates) were selected for analysis on the basis of favorable cloud cover conditions and the immediate history of river discharge for those dates of coverage.

Positive, 70mm, 1:3,369,000 scale transparencies of band 7 (near-infrared, 0.8 to 1.1 micrometers) multispectral scanner images were obtained of the scenes judged to be most useful. Band 7 images were chosen because of the relatively high spectral contrast between water and most surroundings in the near-infrared region.

Image Analysis and Information Extraction

The 70mm images were enlarged photographically and 3x4 inch projection plates were created. A lantern projector and rear-view projection screen were then used to obtain a final enlargement to 1:84,000, approximately 40 times the scale of the original image. The projected images of flood conditions were traced directly onto matte acetate, with a non-flood scene used to delineate the river channel. Flood boundary determination was based upon visually detectable changes in image densities between flood and non-flood scenes. Areas, such as swamps, which have continually low infrared reflectance would not be classified as flooded or flood stressed unless the area was encompassed by a more prominent flood boundary.

A general knowledge of flood susceptibility was obtained from the acetate sheets by overlaying various combinations of dates. For area measurement, however, flood boundaries were enlarged to 1:24,000 scale, U.S. Geological Survey map overlays, using a Zoom Transfer Scope. The area of flooding depicted on each overlay was measured with a polar planimeter, and the total area of inundation was tablulated for each date.

A "best estimate" curve was developed to relate the area of flooding in the most critical portion of the river basin (Lowville Quadrangle) to discharge measurements recorded at a single river gage station, some 30 kilometers downstream (Watertown). The construction of the curve is reviewed in Figure 3.

In general, the discharge measurements were adjusted to allow for: (1) the one-day delay between flooding in the area of interest and the time the corresponding discharge reaches the gage station, and (2) the effects of a reservoir ("Stillwater") which is used to reduce downstream discharges during flood periods. Further, because Landsat scenes obtained after peak discharges may show areas of standing water which are not directly related to the discharge reported for that scene date, all areas of standing water which were not connected directly to the river were subtracted from the total area of flooding for that scene. (The occurrence of standing water which might be present after a higher flood stage has passed can be reduced by applying images acquired during periods of increasing river discharge, i.e., rising waters, but such coverage was not available.)

These data were used to construct an envelope in the manner described in Figure 3, where the envelope is defined by the limiting points b and c. The best estimate curve was then located within the envelope by assuming the following: (1) if the time delay between the observed discharge and the previous peak discharge were one to seven days, the best estimate would be a point on line b-c less than 20% of the distance from c; (2) if the delay were 8 to 15 days, the best estimate would be 20% to 50% of the distance; and (3) if the delay exceeded 15 days, the best estimate would be closer to b than to c. These assumptions were based upon previous reports of the approximate number of days that flood effects remain detectable on infrared imagery (e.g., Sollers et al., 1978), and the rate of decrease in river discharge from the previous peak to the time of observation. A smooth curve was fitted to the nine points.

To test one method for using river discharge measurements to estimate flooding at any location, the specific locations of inundation were determined for each date from the 1:24,000 scale map overlays, using a 0.5-by-0.5 kilometer grid system referenced to UTM coordinates. For each 0.5-by-0.5 kilometer grid cell, the percentage of inundation was estimated using a 5-by-5 data take-off subgrid. These values were tabulated and adjusted to levels of discharge using the best estimate curve, in order that flooding in any cell could be related to river discharge measurements.

RESULTS AND DISCUSSION

The location of the Black River in New York State is shown in Figure 1, and flood conditions interpreted from selected Landsat images (Table 1) are shown, for a portion of the river, in Figure 2. Some improvement in the determination of flood boundaries might accompany the use of color composites, other color or photographic enhancement technique, or digital data, and this possibility will be explored.

As described, the Landsat interpreted flood boundaries for nine dates (scenes) were enlarged to 1:24,000 scale U.S. Geological Survey topographic map overlays, where the river channels were found to agree generally within 100 meters. The total areas of inundation, measured from the 1:24,000 scale map overlays and subsequently adjusted, are listed in Table 1. No adequate ground surveys of flooded areas were conducted during the period of obtained coverage, but when compared to a survey conducted in 1970 (Waller and Ayer, 1975), the total areas of inundation were found to agree within 10%. In general, areas of inundation corresponding to higher discharges were found to be in closer agreement than those corresponding to lower discharges.

The best estimate curve relating river discharge (at Watertown) to the area of flooding in the most critical portion of the river basin (Lowville Quadrangle) is illustrated in Figure 4. Although subject to error, the curve is within an envelope which allows a range of areas for a single value of discharge. As described, this lack of specificity is caused by the inability to eliminate all possible effects of higher flood levels from images obtained after peak discharges. Refinement of the curve will accompany additional data; especially if two or three images are recorded just prior to peak discharges, when measured areas of inundation can be more directly related to specific discharge values.

One portion of the Lowville Quadrangle, which was gridded into 0.5-by-0.5 kilometer cells, is shown in Figure 5. The estimated percentages of inundation in each cell, corresponding to a range of river discharges, are reported in Table 2. These estimates will also improve as the best estimate curve is refined.

In conclusion, it is felt that Landsat data can provide valuable information on flooding in the Black River Basin of New York as well as in other similar river basins. Visual methods for extracting flood boundary information are practical and inexpensive. They appear to be sufficiently reliable for developing empirical models which use river discharge measurements to estimate the extent of river flooding on a real-time basis.

ACKNOWLEDGMENTS

This study is being conducted with the support of NASA Grant NGL 33-010-171, and with the cooperation of Kenneth H. Mayhew, Chief Engineer of the New York State Board of Hudson River-Black River Regulating District. The authors would also like to thank Ta Liang, Professor In Charge of the Cornell Remote Sensing Program, for reviewing this manuscript.

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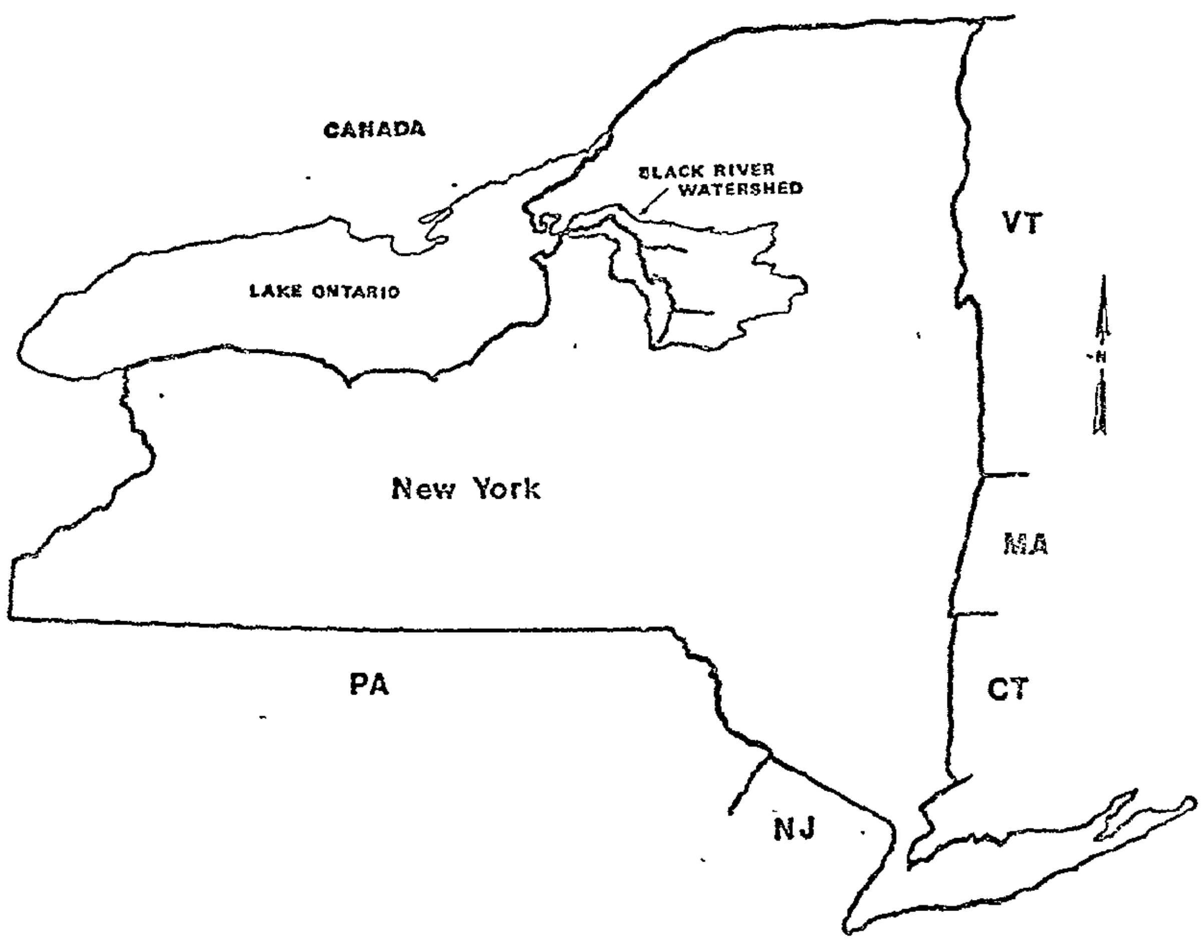

Figure 1a. Location of Black River watershed in New York State.

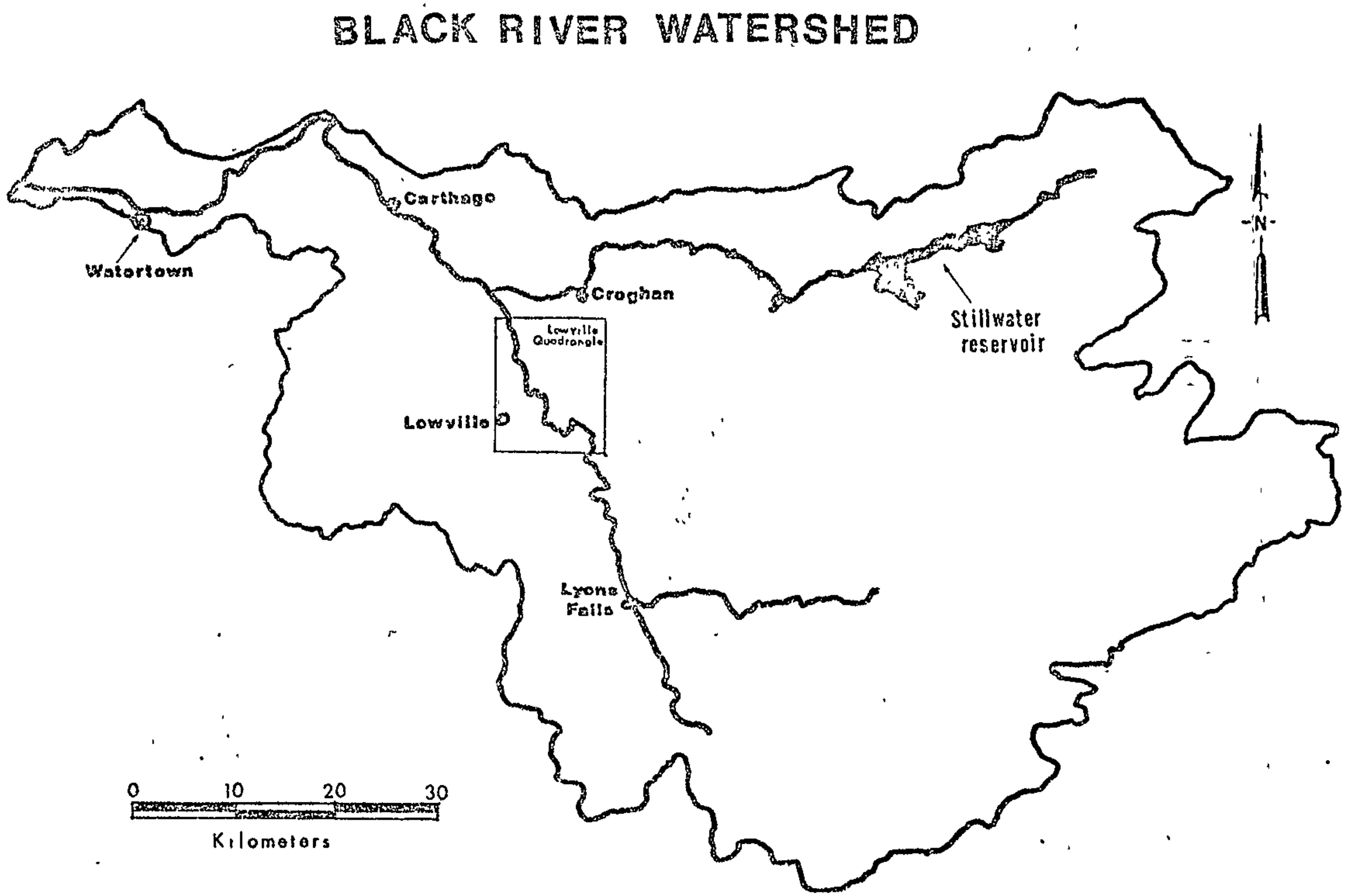

Figure 1b. Black River watershed and location of Lowville Quadrangle.

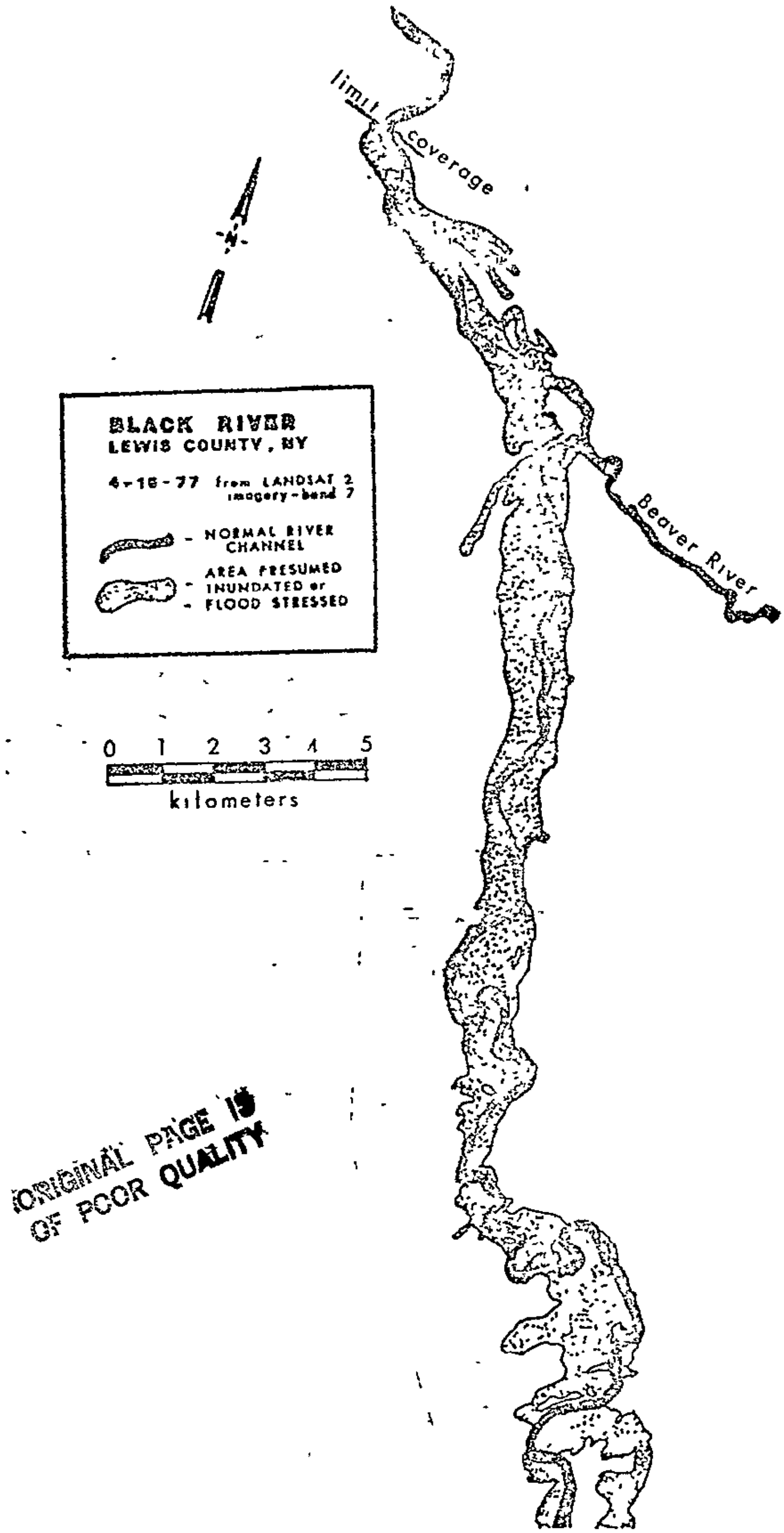

Figure 2a. Landsat-interpreted flooding of a portion of the Black River, N.Y., on April 15, 1977.

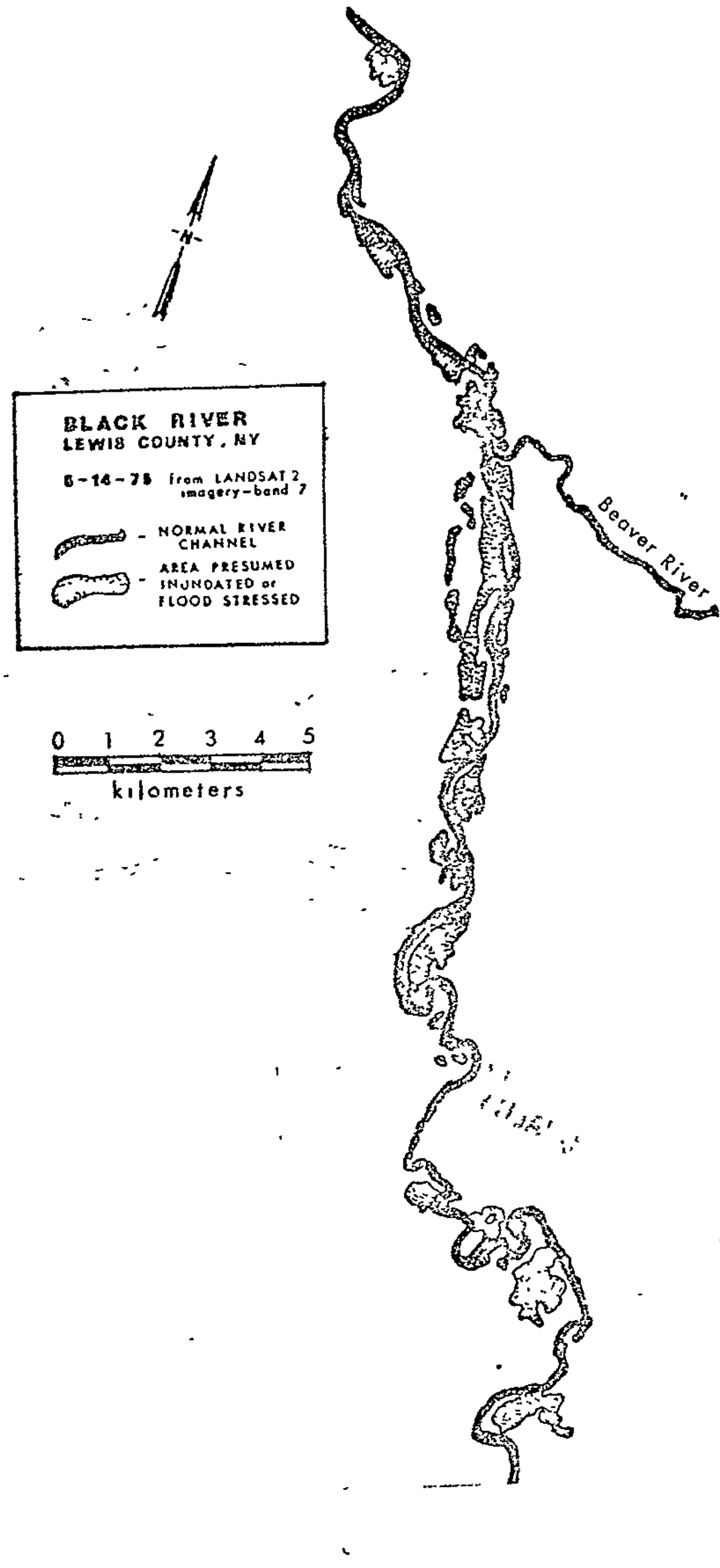

Figure 2b. Landsat-interpreted flooding on May 14, 1975, showing several areas of isolated standing water.

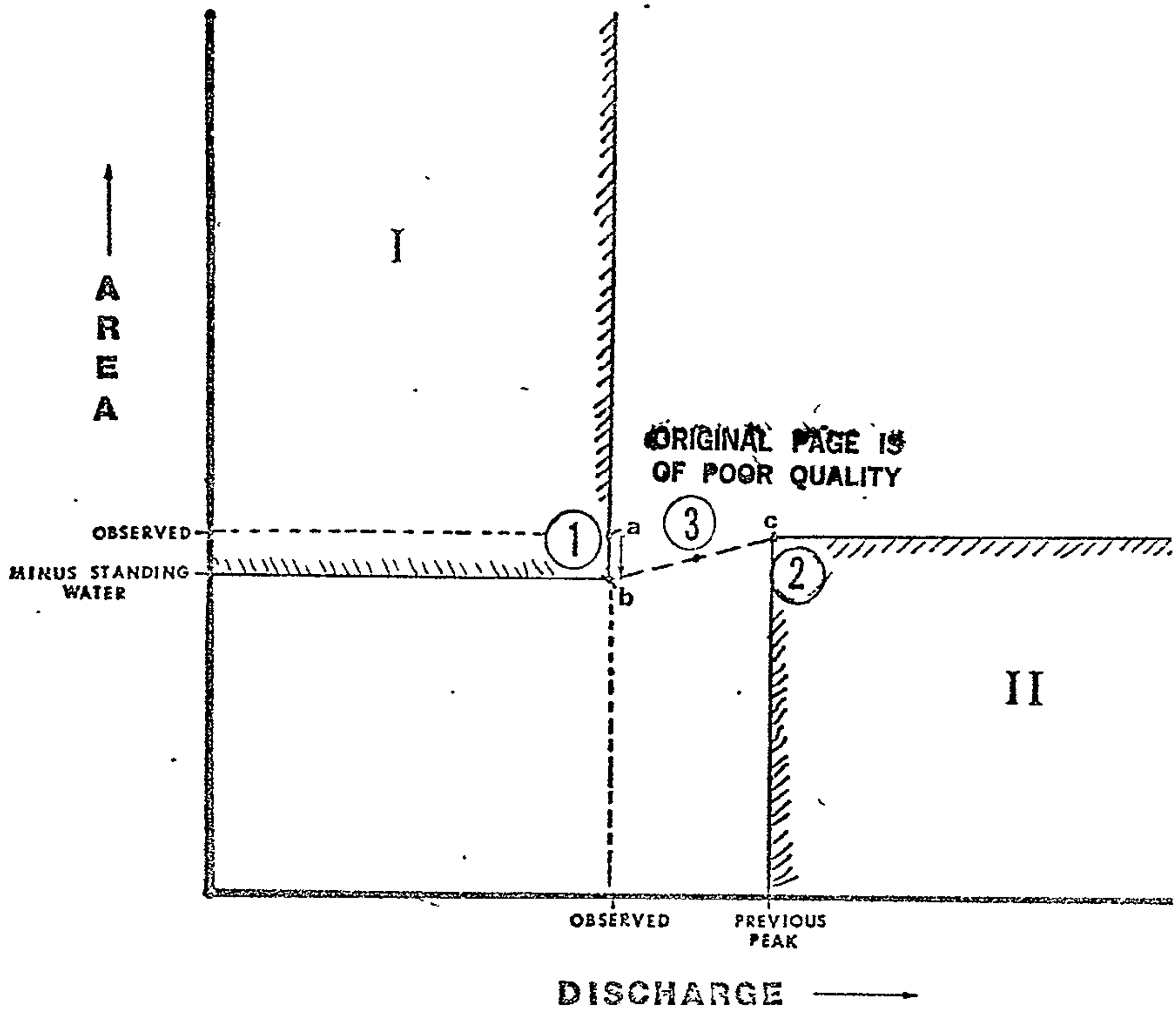

Figure 3. Development of curve for relating area of inundation to river discharge in Black River Basin, N.Y.

1. The area interpreted as inundated from a Landsat scene is plotted versus the discharge (adjusted for delay) for that date (Point a). As needed, the area is adjusted downwards by subtracting any isolated areas of standing water (Point b). The adjusted area is the maximum possible area of inundation that can be produced by the observed or a lesser discharge. This generally eliminates region I from consideration.

2. The total unadjusted area interpreted as inundated is the smallest area of inundation that could have been produced by the previous peak discharge or any higher discharge (Point c). This generally eliminates region II from consideration.

3. The best estimate point is located along the line from "b" to "c," allowing for (1) the time delay between the observed discharge and the previous peak discharge, and (2) the rate of decrease in river discharge.

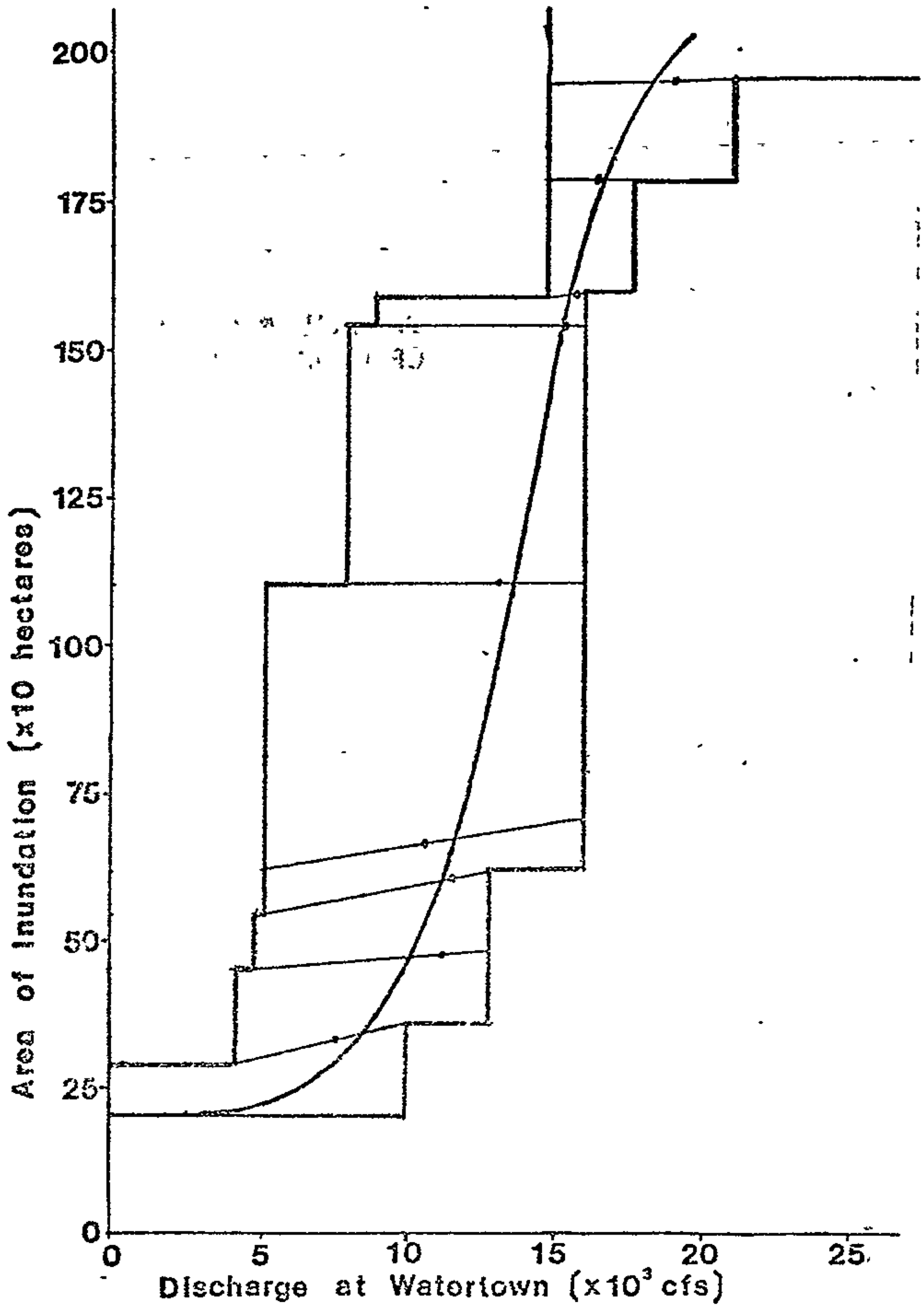

Figure 4. Area of inundation versus river discharge for the Lowville Quadrangle, New York.

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

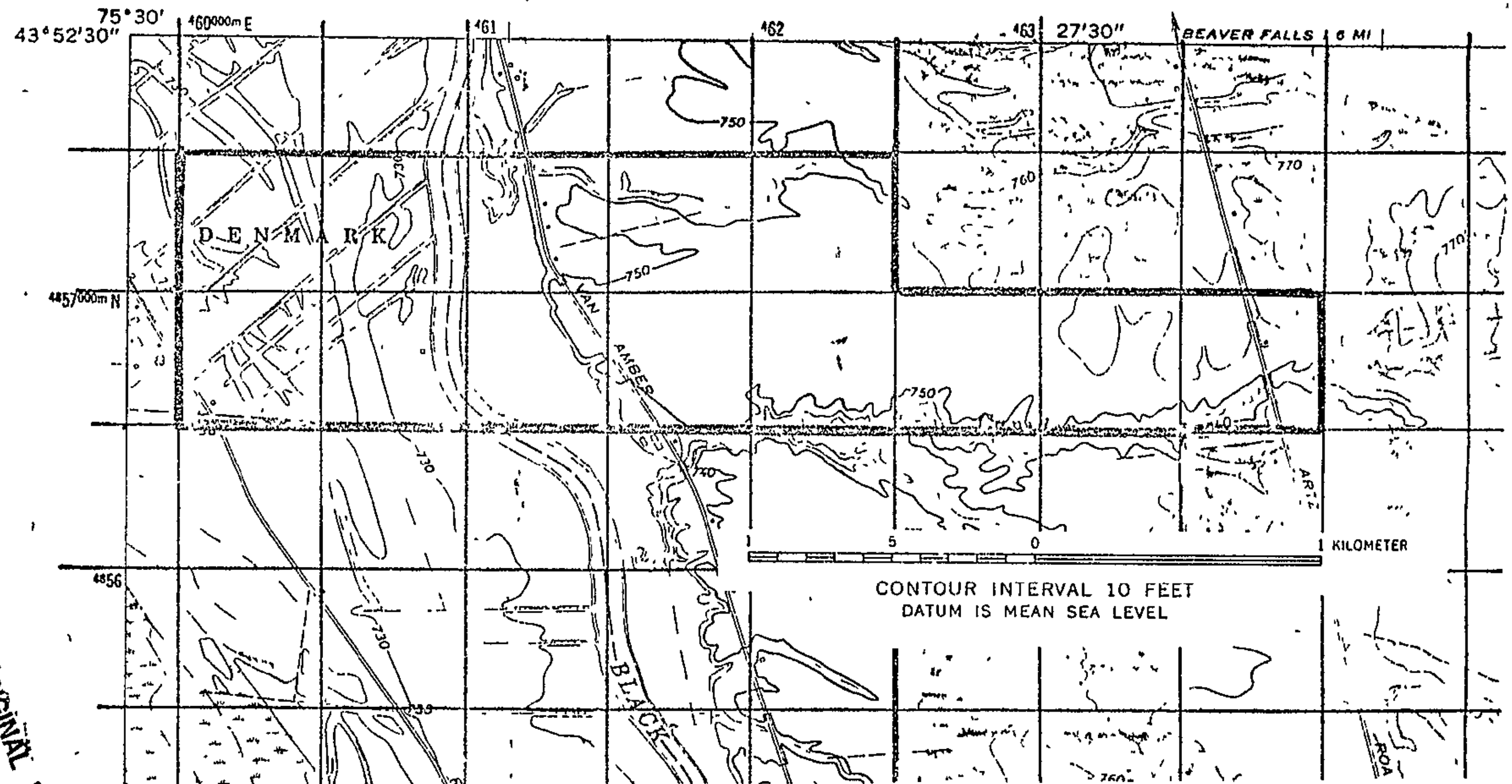

Figure 5. Portion of gridded Lowville Map (original 1:24,000 scale) with cells corresponding to those in Table 2 within outlined area.

Table 1. Discharge data and Landsat-interpreted inundation for selected dates, in Black River Basin, N.Y.

Date	Net Discharge 1/ Watertown (cfs)	Previous Peak 2/ Discharge (cfs)	Time Delay Between Peak Discharge 3/ and Image Date (days)	Inundation (hectares)
11-16-72	5,145	12,831	5	414*
4-9-73	8,842	16,037	5	2568*
6-2-73	4,131	9,940	10	181
5-14-75	4,711	17,760	23	1032
3-24-76	14,510	15,860	1	2311
4-29-76	7,810	24,260	27	1748
4-15-77	13,971	20,900	14	3541*
5-3-77	4,800	17,630	8	660
4-28-78	11,829	17,592	14	3120

1. "Net Discharge Watertown" = [Discharge at Watertown (day after image date)] - [Discharge at Croghan (on image date)]

2. "Previous Peak Discharge" = [Peak discharge at Watertown] - [Discharge at Croghan (on day before peak at Watertown)]

3. "Time Delay Between Peak Discharge and Image Date" = [Image date + 1 day] - [Peak discharge date]

* Observed inundation only, cloud cover obscured portions of study area.

Table 2. Estimated percentages of inundation at grids located in portion of Lowville Quadrangle for given discharges of the Black River at Watertown.

	Net Discharge at Watertown (cfs x 10^2)								
Cell number*	25	50	75	100	125	150	175	200	225
48570-4600	0	0	0	18	53	88	100	100	100
48570-4605	0	5	24	43	62	81	100	100	100
48570-4610	20	20	20	20	33	48	62	77	92
48570-4615	0	0	0	0	0	0	0	0	0
48570-4620	0	0	0	0	0	0	0	0	0
48565-4600	0	0	2	23	44	66	87	100	100
48565-4605	0	0	11	33	54	75	96	100	100
48565-4610	0	0	13	29	46	62	79	95	100
48565-4615	0	0	0	0	2	3	5	6	7
48565-4620	0	0	0	0	0	0	0	0	0
48565-4625	0	0	0	0	0	0	0	0	0
48565-4630	0	0	0	0	0	0	0	0	0
48565-4635	0	0	0	0	0	0	0	0	0
Total (hectares)	5	6	17	41	73	105	132	144	149

*Cells in this table correspond to those outlined in Figure 5. Numbers are based on UTM coordinates of southwestern corner of cell.

APPENDIX B

PRELIMINARY ANALYSIS OF VINEYARD YIELD ASSESSMENT

PRELIMINARY ANALYSIS OF VINEYARD YIELD ASSESSMENT WITH REMOTELY SENSED DATA

Remote Sensing Program
Cornell University
Hollister Hall
Ithaca, New York 14853

May 1979

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PREFACE

This study was supported by NASA Grant NGL 33-010-171, and conducted in cooperation with the Taylor Wine Company, Inc., Hammondsport, N.Y. Warren R. Philipson directed the analysis; Jay N. McLeester selected the fields for study and made the photogrammetric measurements; and John G. Hagedorn performed the computer data analysis tasks. Consultations were provided by Nelson J. Shaulis and Robert M. Pool of the N.Y.S. Agricultural Experiment Station, Geneva, N.Y.

Ta Liang
Professor and
Principal Investigator

INTRODUCTION

Earlier work by staff of Cornell's Remote Sensing Program has shown the value of aerial photographic analyses for evaluating new vineyard site drainage conditions and for assessing the general health of vineyard plants. As a follow-up investigation, Cornell staff set out to examine relationships between vineyard crop yields and those morphologic or spectral characteristics of the vines that could be measured through remotely sensed data. It was believed that these relationships could provide insight into vineyard crop management practices and, at least to some extent, be applicable in predicting yield.

METHODS AND MATERIALS

Study Area and Data

At the request of the Cornell Remote Sensing Program, the National Aeronautics and Space Administration (NASA) acquired color infrared aerial photographic coverage and 11-channel multispectral scanner data over vineyards along the western side of the southern portion of Keuka Lake, in New York State (Fig. 1). The photographic and scanner data were acquired simultaneously at midday on 22 June and 26 August 1977; the thermal channel of the scanner was also operated during predawn hours on these two dates. Flight and data parameters are outlined in Table 1.

The photographic films were provided to the investigators by NASA as duplicate, positive transparencies. Selected portions of the multispectral scanner data were provided on computer-compatible magnetic tapes; the specific flight lines, or parts of flight lines, provided had been selected by the investigators from paper print output (visicorder) of the thermal channel.

The analysis focused on fields owned by the Taylor Wine Company, Inc., of Hammondsport, N.Y. Vineyard data made available for the study included detailed information on the vines in each field (e.g., variety, age, spacing), and yield as determined by the average weight of bins of each variety collected from each field section.

For this preliminary study, 16 field sections, planted to three varieties were included; six sections were devoted to Concord, five to Catawba, and five to Delaware. The selection of the specific field sections was based on the number, homogeneity and age of the vines in the sections, and the quality of both the June and August imagery of the sections.

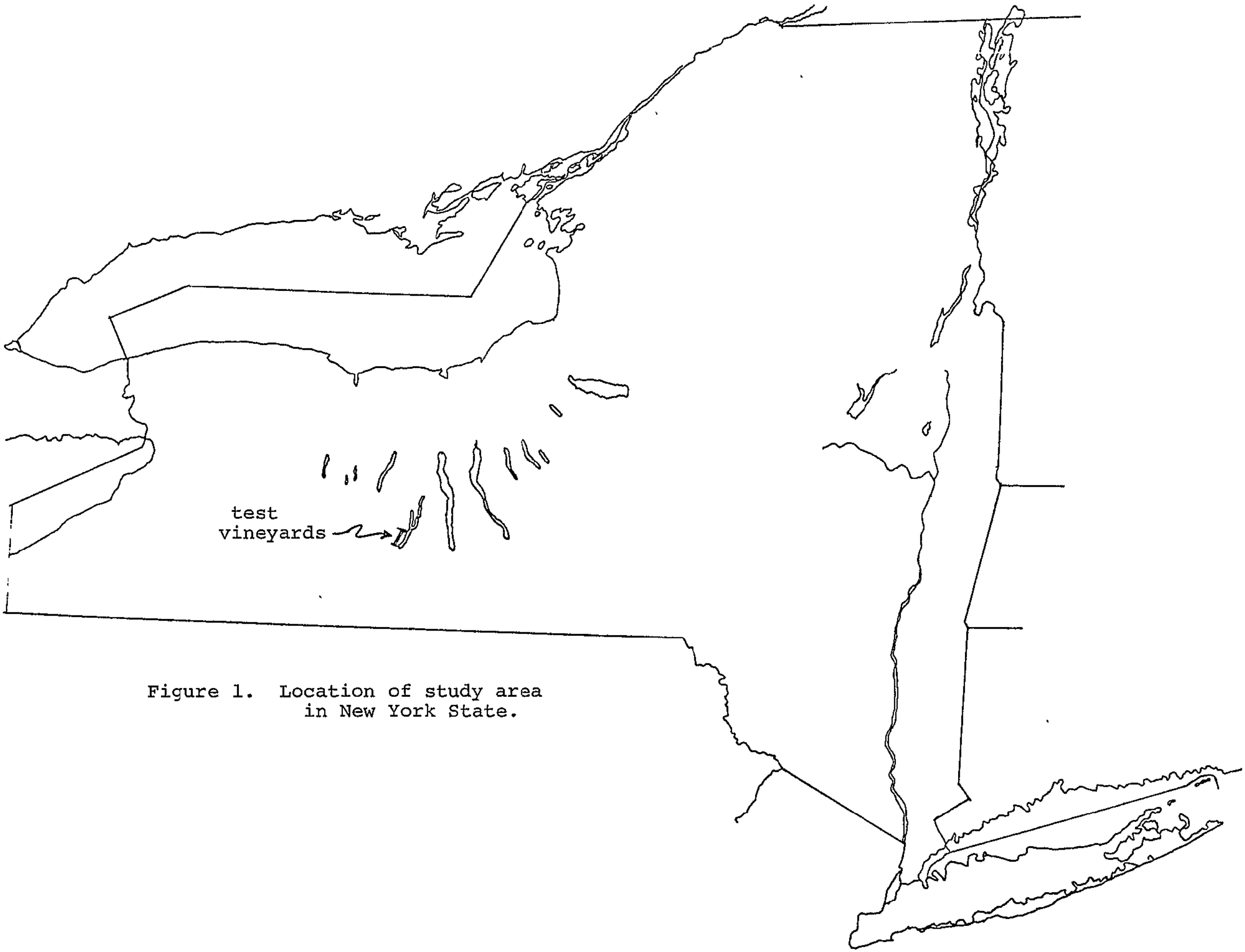


Figure 1. Location of study area in New York State.

Table 1. Remotely sensed data acquired for vineyard analysis.

SENSOR	NATURE OF DATA	FORM OF DATA
metric camera; 9 inch (23 cm) format; 6 inch (15 cm) lens	color infrared film, 2443; scales of 1:14,000 & 1:6,000	duplicate positive transparencies
multispectral scanner; instantaneous field-of-view of 2.5 milli-radians	scanner senses simultaneously in 11 channels (range in micrometers) 1) 0.411-0.438 2) 0.449-0.484 3) 0.490-0.532 4) 0.532-0.572 5) 0.572-0.611 6) 0.612-0.652 7) 0.653-0.692 8) 0.692-0.737 9) 0.762-0.856 10) 0.953-1.031 11) 8.0-14.0	visicorder prints of thermal channel; computer-compatible tapes of selected flight lines or of parts of lines

FLIGHT DATES: 22 June and 26 August 1977, daytime (all data) and predawn (Chan. 11 only).

FLIGHT ALTITUDES: nominally 3,000 and 7,000 ft. above mean terrain (915 and 2,130 meters).

Photographic Measurements

At the recommendation of Dr. Nelson J. Shaulis, Cornell Professor Emeritus of Pomology and Viticulture, two plant morphological factors were considered: the continuity of the vines in June and the width of the canopy in August. These were determined from the aerial photographs.

Canopy continuity was determined for each field section by using the June photographs to estimate the percentage of trellis that was covered by vines. The percentage for each field section was based on a sample of approximately three trellises for every twenty trellises, or approximately 15% of the total length of trellis in the section.

The percentages of canopy continuity were determined as follows:

1. The length of an entire trellis (row) was measured from the film, using a comparator (scale) viewed through the monoscopic mode of a zoom stereoscope.

2. In the same manner, the number and lengths of gaps in the vine canopy along the trellis were measured and summed.

3. The total length of gaps was adjusted (increased) to account for relief displacements (Appendix).

4. The proportion of continuous canopy was then calculated as the total trellis length minus the total length of gaps, divided by the total trellis length. This quantity was multiplied by 100 to obtain a percentage, and the values for a field section were averaged.

Canopy width in each field section was determined from the August photographs based on a sampling of approximately two sites per acre. Each sample site in each field section consisted of a portion of six adjacent trellises, approximately 13 meters in length.

The average canopy width at each sample location was determined in the following manner:

1. The scale of the photograph at the sample site location was computed by comparing the photographic distance between the first and sixth trellis with the reported ground distance.

2. The clear spacing between adjacent canopies was measured from the film using a bar comparator scale, viewed through the monoscopic mode of a zoom stereoscope. Different width bars, varying by 0.001 inch (0.025 mm), were "fitted" between the adjacent canopies and the widths recorded.

3. The average canopy spacing over the six trellises (i.e., 5 distances) was calculated and scaled to ground.

4. This average ground distance was subtracted from the average ground distance between the six trellises (i.e., avg. row spacing - avg. canopy separation) to arrive at an average canopy width.

The average canopy widths for all sample sites within each field section were averaged, and a correction factor was applied to account for photographic relief displacement (Appendix).

Multispectral Scanner Data Analysis

Only the lower altitude scanner data were included in the present study. These data have a ground resolution of approximately 2.3-by-2.3 meters (7.5-by-7.5 ft.).

The 16 field sections were located through refinement of computer printout brightness maps. The average radiance value (digital count, 0 to 255) in each spectral region (channels 1 to 11) was then calculated for each section, and subsequently correlated with yield and related values for the section. Because the relative differences among sections were the principal quantities of interest, no attempt was made to calibrate the radiometric values or correct for atmospheric interactions.

RESULTS AND DISCUSSION

The results of this preliminary analysis are summarized in Table 2. Included are vine characteristics of the three varieties in the 16 field sections considered; multiple correlation coefficients between the varieties' 1977 yields and the averaged radiometric responses from the sections, as sensed in 11 spectral regions, on two 1977 flight dates; and multiple correlation coefficients between selected other factors of interest.

Three points are of importance in interpreting these results.

1. The number of field sections for any of the three varieties is too small to allow statistically valid statements.

2. The 1977 growing season followed a particularly harsh winter resulting in anomalously low yields (cf. 1976 yields, Table 2).

3. Yield values used in this analysis are based on average yields for the variety and may not be entirely accurate for the sections actually considered.

Even with these limitations, the results still provide a clear indication that further analysis is warranted and desirable. The high correlations between yield and the August spectral responses for Concord are notable, as are several other correlations. The negative relationship between yield and most factors is of interest and cannot be fully explained.

As a final note, it is emphasized that multiple or nonlinear correlations (regressions) have not been examined, nor have relationships between yield and spectral or temporal ratios. Follow-up studies and possibly new aerial missions over closely monitored vineyards are being planned.

Table 2. Characteristics of test vineyards and correlations between yield, spectral and morphological factors.

Variety	DELAWARE		CONCORD		CATAWBA	
No. Fields	5		6		5	
Yield, tons/acre[1]						
mean, 1977 (stan. dev.)	1.31 (0.36)		1.87 (0.37)		3.52 (0.74)	
mean, 1976 (stan. dev.)	2.51 (1.01)		5.09 (0.57)		3.97 (1.39)	
Vine Continuity, %						
mean, June 77 (stan. dev.)	80.9 (5.9)		87.9 (2.4)		84.5 (2.9)	
Canopy Width, feet						
mean, Aug 77 (stan. dev.)	2.48 (0.77)		4.05 (0.26)		3.85 (0.39)	
CORRELATED VARIABLES	R^2		R^2		R^2	
	6/77	8/77	6/77	8/77	6/77	8/77
Yield 1977						
vs. Chan 1	(-)[2].02	(-).63	X[3]	(-).81	(-).05	(-).22
Chan 2	(-).02	(-).64	X	(-).88	(-).06	(-).20
Chan 3	(-).01	(-).62	X	(-).91	(-).06	(-).20
Chan 4	X	(-).58	X	(-).93	(-).07	(-).24
Chan 5	(-).01	(-).65	X	(-).93	(-).07	(-).17
Chan 6	(-).01	(-).68	X	(-).91	(-).06	(-).11
Chan 7	(-).01	(-).68	X	(-).91	(-).04	(-).11
Chan 8	0.09	(-).51	X	(-).92	(-).03	(-).50
Chan 9	0.62	(-).40	0.01	(-).90	(-).02	(-).72
Chan 10	0.77	(-).45	0.02	(-).89	(-).01	(-).68
Chan 11	(-).15	(-).95	(-).34	(-).42	(-).12	(-).01
Continuity	0.31		(-).26		0.09	
Width		0.04		(-).03		(-).03
Yield 76	0.98		(-)0.66		0.20	
[Yield 76 / Yield 75]	0.80		(-)0.10		0.08	
Continuity vs. Width	X		0.02		(-)0.27	

Notes: [1] Non-metric units used to conform with vineyard records.
[2] Sign of R is given in parentheses.
[3] X denotes R^2 less than 0.010.

APPENDIX

PHOTOGRAMMETRIC CORRECTIONS APPLIED TO PHOTOGRAPHIC MEASUREMENTS

Relief displacement of vines on the photographs will tend to reduce the observed size of gaps between vines (affecting canopy continuity) and between rows (affecting canopy width).

Two vines are shown in the figure. It is assumed that foliage is primarily restricted to the upper portion of the vines, being a distance of z above ground. The gap between the two vines is D + G'.

From the aerial photograph, the observed gap between the two vines would be g in the photograph or G on the ground. Because the height of the aircraft above ground, H, is large compared to z, then G' is approximately equal to G. Photo-derived measurements of the gap between the two vines would thus be short by the distance D.

By similar triangles in the figure, f/r = h/D; where f = the focal length of aerial camera; r = the photo distance from the nadir point of the photograph to the image of the vine; h = the height of the vine foliage; and D = the ground distance obscured from overhead view. Solving for D,

$$D = hr/f$$

If the aerial photograph was taken vertically (i.e., no tilt), the distance r may be measured from the center of the photograph.

Canopy Continuity

The correction factor that was added to each gap between vines in a row is:

$$D' = 3r'(\cos \phi)/f$$

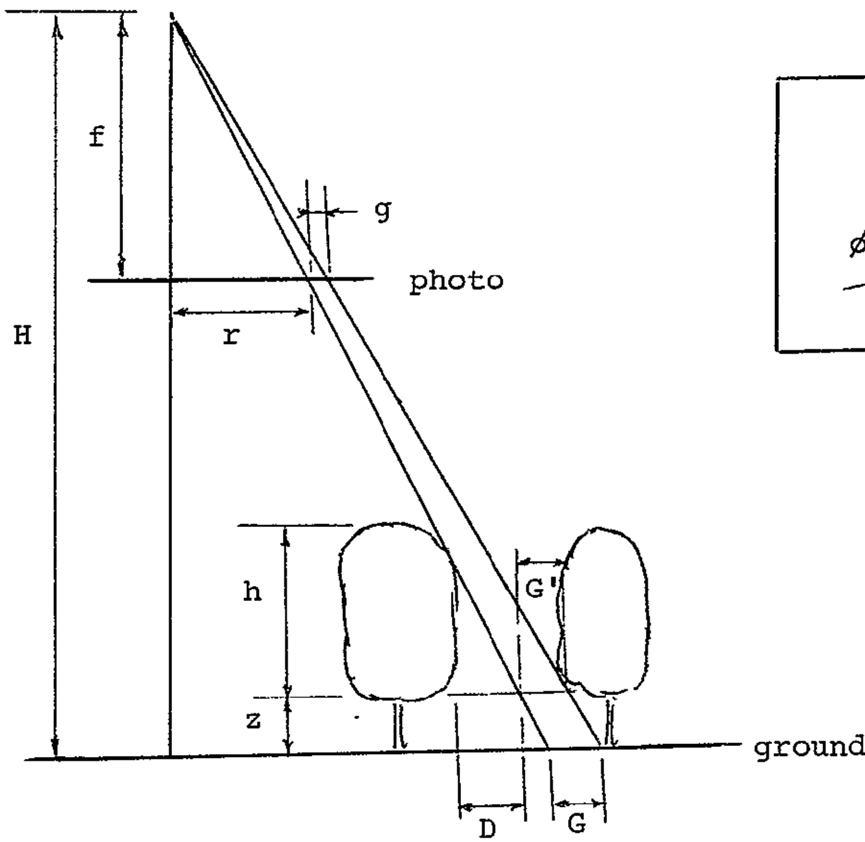
where: 3 feet is the assumed average height of the foliage, h; r' is the photo distance between the center of the photograph and the center of the field section being considered; ϕ is the angle between the radial line r' and the trellis (row) orientation; and f = focal length. If the camera had been pointed perpendicular to the rows (ϕ = 90 degrees), there would be no correction (cos ϕ = 0 and D' = 0).

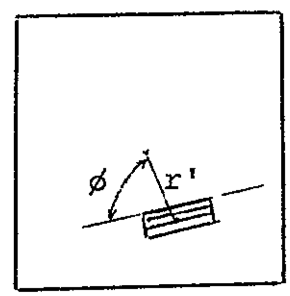
Canopy Width

The correction factor that was subtracted from the final measurement of canopy width for each field section is:

$$D' = 3r'(\sin \phi)/f$$

where the variables are defined above. The effect of this correction is to increase the observed gap between rows and thereby decrease the measured canopy width. In general, if the camera had been pointed parallel to the trellises (rows), there would be no correction (ø = 0 degrees; sin ø = 0; and D' = 0).





APPENDIX C

EVALUATING LANDSLIDE AND EROSION SUSCEPTIBILITY
IN ALBANY COUNTY, N.Y.

LANDSLIDE AND EROSION SUSCEPTIBILITY WITHIN THE NORMANS KILL DRAINAGE BASIN, ALBANY COUNTY, NEW YORK

Remote Sensing Program
Cornell University
Hollister Hall
Ithaca, New York 14853

May 1979

PREFACE

This study was performed by Jan P. Berger under the direction of Ta Liang and Warren R. Philipson. The work was requested by Lawrence Smith, Director of the Planning Board of Albany County, N.Y., and supported by NASA Grant NGL 33-010-171. This report is accompanied by four map overlays.

INTRODUCTION

Land stability is an important consideration of planning agencies in their review of subdivision and development proposals. Of particular concern to the Planning Board of Albany County, N.Y., is the assessment of landslide and erosion potential within the Normans Kill drainage basin of the county. Combinations of specific soils and topography in the basin result in areas that are subject to landsliding and erosion. This study was performed to identify areas where landslides and erosion have been active as well as areas of potential problems.

STUDY AREA

The study area, some 290 square kilometers (110 sq. mi.) in northeastern Albany County, N.Y., covers two U.S. Geological Survey 7-1/2 minute topographic maps, "Voorheesville" and "Albany," and encompasses most of the Normans Kill drainage basin (Fig. 1). This region, part of the Hudson Valley lowland, is marked by low drumlin hills and rounded knolls in the Southwest, stream dissection along the Normans Kill, and an irregular dune landscape in the Northeast.

The area is an old lake plain, characterized by deep glacial lakebed deposits, with many areas of sand and glacial till (Ruedemann, 1930; LaFleur, 1965). In general, the lakebed deposits are subject to landsliding and erosion, especially on steeper slopes. The sandy areas on steeper slopes are subject to erosion by water; and if their vegetative cover is removed, the sandy areas on any slope are susceptible to wind erosion. Glacial till, depending on local composition and slope, may have slight to moderate potential for erosion by water.

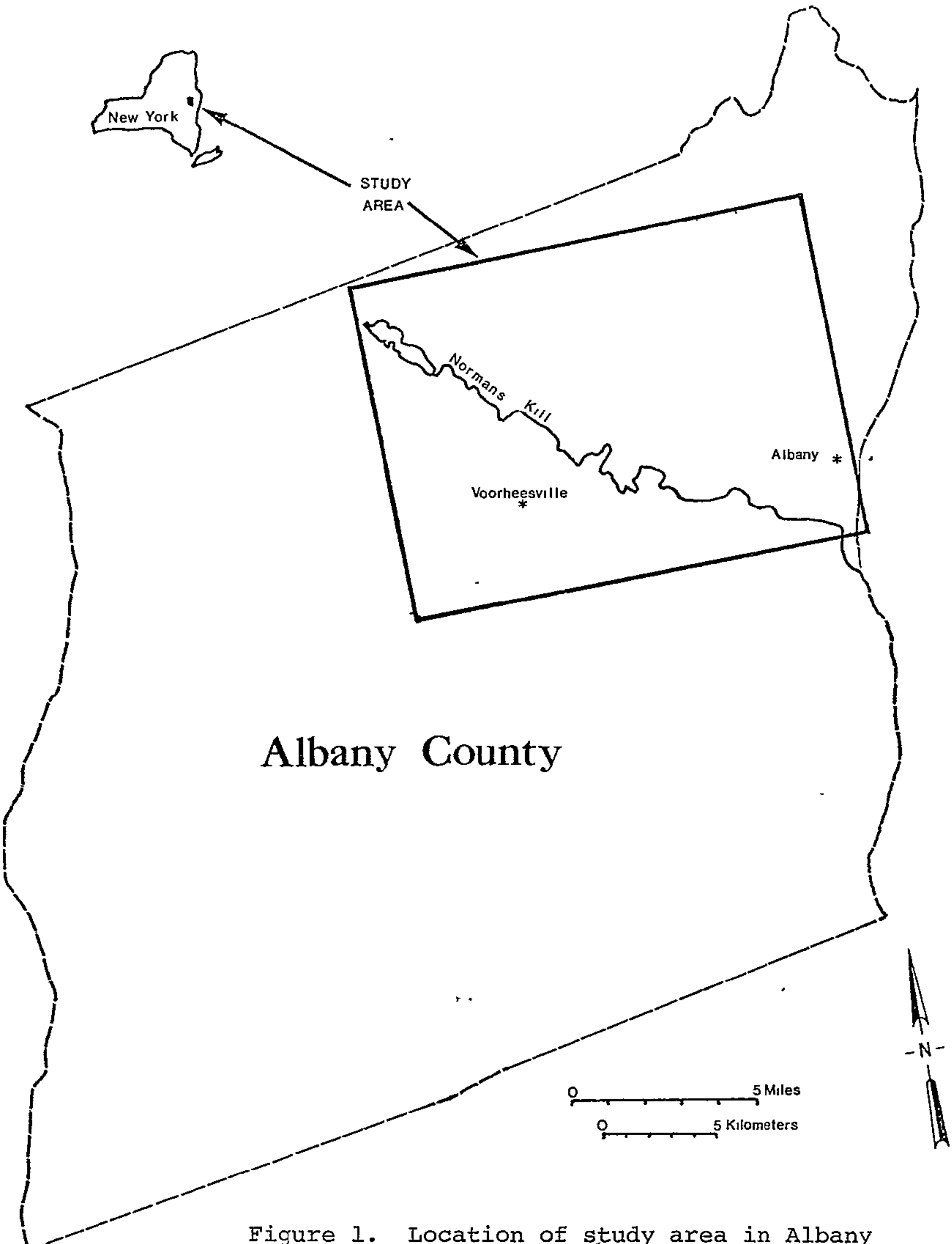


Figure 1. Location of study area in Albany County, New York.

MATERIALS AND METHODS

Information Sources

The primary sources of information used in this investigation were the 1936 Soil Survey of Albany and Schenectady Counties, N.Y., and accompanying 1:62,500 scale map (Lounsbury and Wildermuth, 1936); the 1953 Albany and 1954 Voorheesville U.S. Geological Survey 1:24,000 scale topographic maps; and various available aerial photographs as listed in Table 1.

Table 1. Aerial photographic coverage used in study

Date	Type of Data	Scale	Source
28 May 52	b & w contact print*	1:20,000	U.S. Dept. Agriculture
9 October 60	idem	idem	idem
26 March 68	idem	1:24,000	Lockwood Mapping Inc.
5 October 69	idem	1:40,000	U.S. Dept. Agriculture
30 April 73	color infrared film	1:130,000	NASA

* All black-and-white (b & w) prints were derived from panchromatic films.

Identification of Active Areas

Active erosion and landslides were located through stereoscopic analysis of the aerial photographs. Unless remedied, areas that have been active in the past are likely to be active now, or become active in the future (Rib and Liang, 1978). Therefore, all available photographic coverage for the study area was utilized. The 1968, 1969 and 1973 photographs were used to evaluate the Voorheesville quadrangle; and the 1952, 1960, 1969 and 1973 photographs were used to evaluate the Albany quadrangle (Table 1). Regions interpreted to encompass active areas were delineated on the photographs and visually tranferred onto acetate overlays to the Voorheesville and Albany 1:24,000 scale maps.

Identification of Potential Areas

Areas believed to be potentially susceptible to erosion and landsliding were identified by relating soils information with slope. In some cases, the aerial photographs were used to check or observe areas of the various susceptibility classifications, but most of the interpretations and delineations were based on the soil survey and topographic maps.

Soils were grouped according to parent material--lakebed (clay), sand, or till. Within the study area, every soil reported to be erosive or unstable was mapped onto a 1:62,500 scale overlay as one of the three parent material groups. These delineations were tranferred visually onto acetate overlays to the Voorheesville and Albany 1:24,000 scale maps. Map overlays depicting areas of slopes greater than 10% were also made from the 1:24,000 scale topographic maps.

The 1:24,000 scale map overlays, depicting soils and slopes, were then registered, and their information combined, to compile overlays depicting landslide and erosion susceptibility.

RESULTS AND DISCUSSION

Areas of active and potential landsliding and erosion are depicted on the accompanying 1:24,000 scale overlays for the U.S. Geological Survey topographic maps, for Voorheesville and Albany, N.Y. As described, the active areas were derived through interpretation of aerial photographs. The potential areas were derived primarily from topographic and soil survey information with limited aerial photographic checks.

In developing the map overlays, areas of lakebed deposits on slopes greater than 10% were classified as having high potential for landsliding (map unit 1). Lakebed deposits on slopes less than 10% were classified as having a slight to moderate potential for landsliding (map unit 2). Sand deposits on slopes exceeding 10% were classified as having high potential for erosion by water and, if uncovered, high potential for wind erosion (map unit 3). Sand deposits on slopes less than 10% were classified as having a slight to moderate potential for water erosion but, if uncovered, a high potential for wind erosion (map unit 4). Areas of glacial till, regardless of their slope, were classified as having a slight to moderate water erosion potential (map unit 5). The remaining areas were classified as being stable and should pose no special problems if normal care is taken during their development (map unit 6). These areas are characterized by soils that are reported to be stable and that show no signs of instability in the aerial photographs.

In general, most of the landslide problems are found in the lakebed deposits that are dissected by gullies and streams, especially on the outside of channel meanders. Erosion problems occur in these areas as well as in the sandy areas northeast of the Normans Kill, and to a lesser extent, in some areas of glacial till.

The map overlays are intended to be a guide in assessing the susceptibility for landsliding and erosion within the Normans Kill basin of Albany County, N.Y. Because of the possible inaccuracies of the original soil survey, the topographic maps, and map transfer and enlargment, on site investigations are imperative. This is especially true given the amount of development that has occurred since the soil survey (1936) and the topographic mapping (1953 and 1954). Similarly, active landsliding and erosion that has occurred since 30 April 1973--the date of the most recent aerial photographs analyzed--could not have been detected.

LITERATURE CITED

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Lounsbury, C. and R. Wildermuth. 1942. Soil survey of Albany and Schenectady Counties, New York. Series 1936, No. 16. U.S. Dept. of Agriculture, Cornell Univ. Exper. Station. 79 pp.

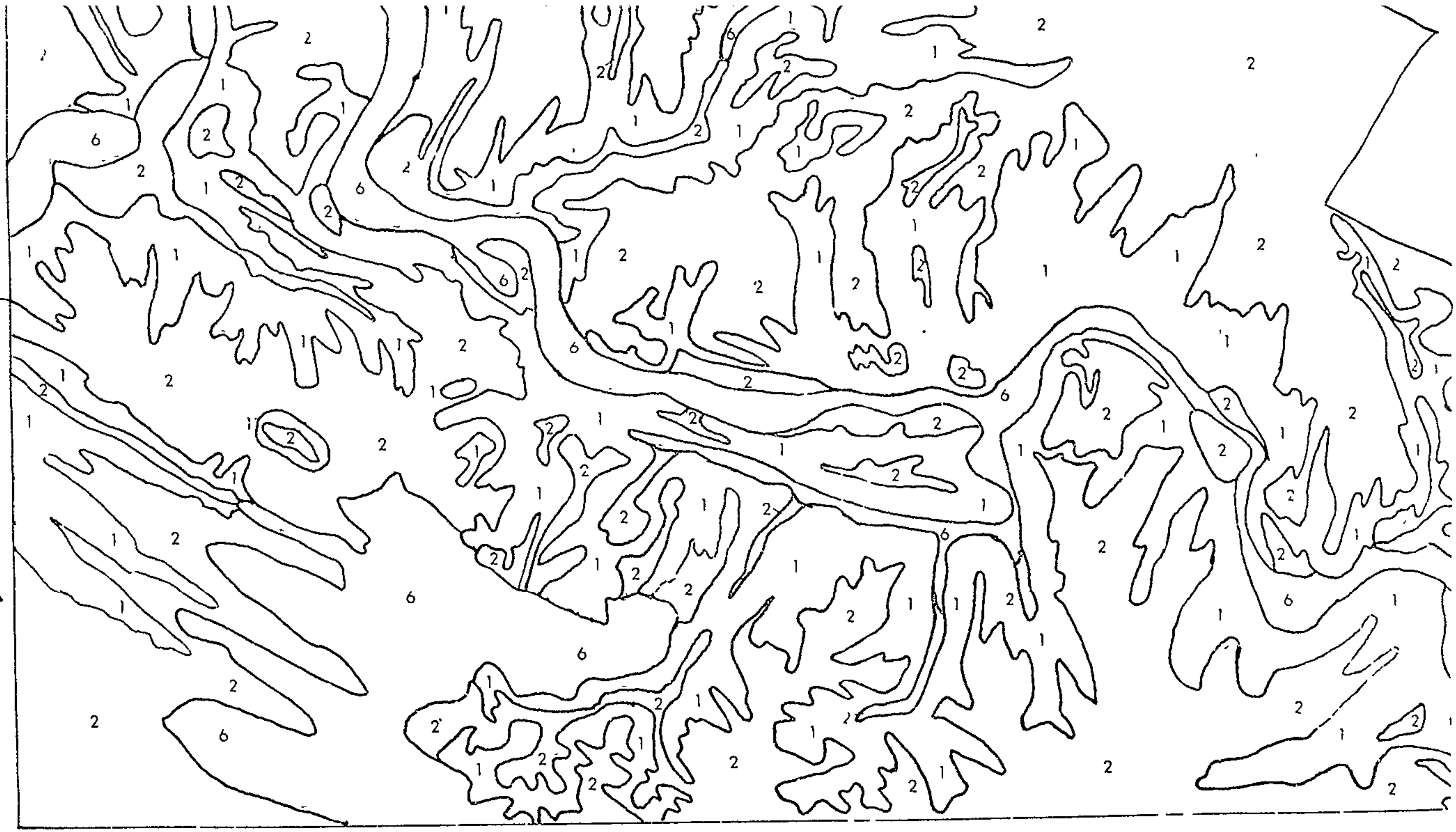
Rib, H. and T. Liang. 1978. Recognition and identification. Chapter 3. In Landslides: Analysis and control. Special Report 176, Transportation Res. Board. Nat. Acad. Sciences, Washington, D.C.

Ruedeman, R. 1930. Geology of the Capital district. N.Y. State Mus. Bull. 285. State Univ. of N.Y., Albany. 218 pp.

ACCOMPANYING MAP OVERLAYS

(all overlays are to U.S. Geological Survey 7-1/2 minute, 1:24,000 scale topographic maps)

1. Landslide and Erosion Potential, Albany Quadrangle
2. Landslide and Erosion Potential, Voorheesville Quadrangle
3. Active Landsliding and Erosion, Albany Quadrangle
4. Active Landsliding and Erosion, Voorheesville Quadrangle



LANDSLIDE AND EROSION POTENTIAL

-lakebed deposits-

1. high (slopes > 10%)

2 slight to moderate (slopes < 10%)

EROSION POTENTIAL

-sand deposits-

3 high by water; high by wind, if uncovered (slopes > 10%)

4. slight to moderate by water; high by wind, if uncovered (slopes < 10%)

-till deposits-

5. slight to moderate by water (all slopes)

OTHER AREAS

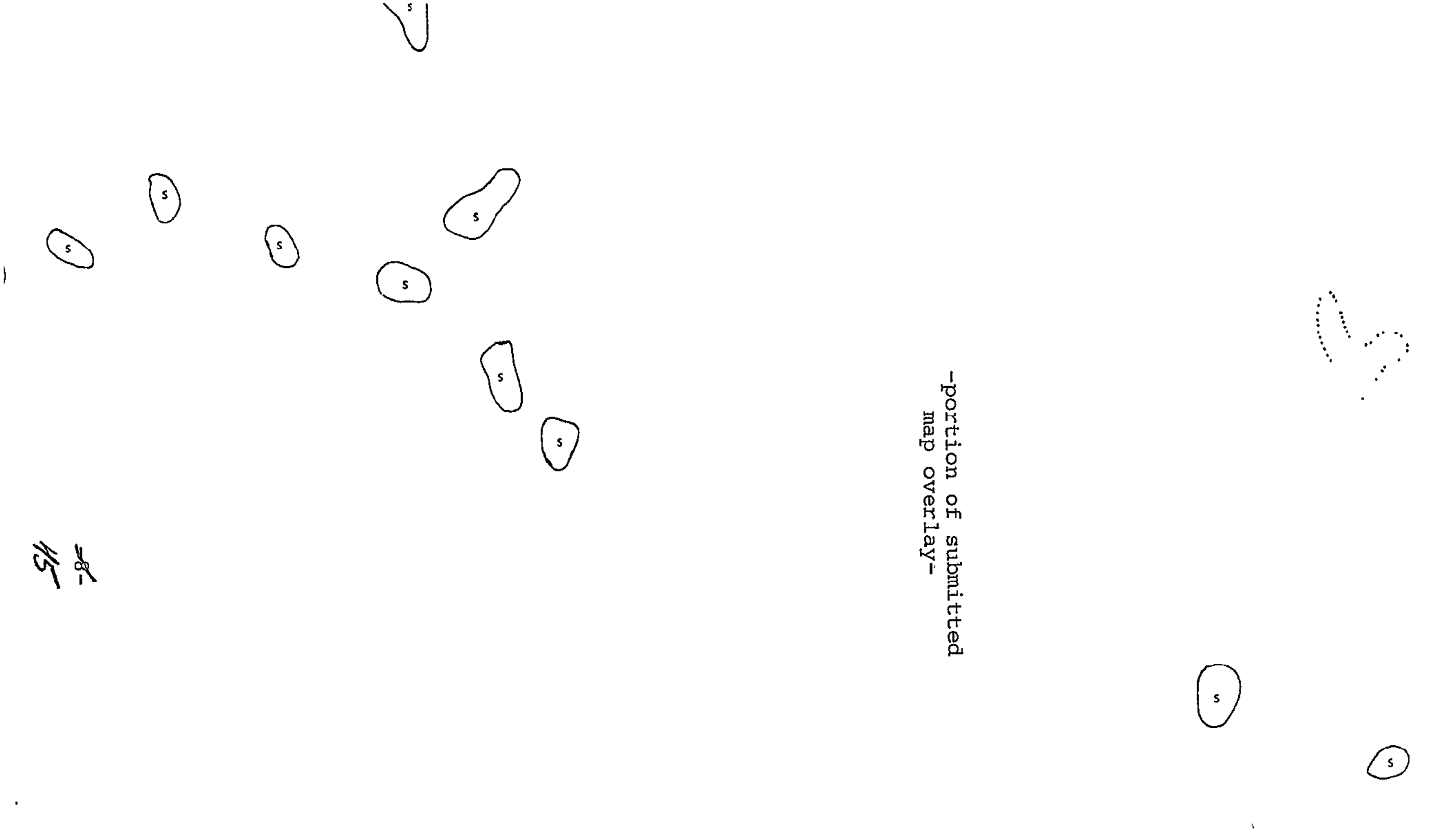
6 no special landslide or erosion problems, except along boundaries; crosscheck on active area overlay

SCALE 1:24000

½ 0

½ 0 1

-portion of submitted map overlay-



ACTIVE AREAS*

S - landslides

- erosion

*As of 30 April 1973; based on interpretations of aerial photographs

SCALE 1:24000

½ 0

½ 0 1 Kilomete

APPENDIX D

PROJECT-RELATED CORRESPONDENCE

New York State Department of Environmental Conservation
50 Wolf Road, Albany, New York 12233

Robert F. Flacke,
Commissioner

March 7, 1979

Mr. Jan Berger
Cornell University - Remote Sensing
School of Civil & Environmental Engineering
Hollister Hall
Ithaca, New York 14858

Dear Mr. Berger:

I would like to thank you for the report, Remote Sensing Assessment of Dam Flooding Hazards, which you sent to this office.

The program presented in the report will be utilized to inventory and inspect smaller dams in the western part of New York State. At present, remote sensing is used in specific dam problems.

I suggest that the U.S. Army Corps of Engineers be informed of said report. The Corps is involved with dam inspection nationwide and I feel the many states that are in the early stages of dam inspection could benefit greatly from your program. I will informally discuss this matter with personnel of the New York District.

Sincerely Yours,

Kenneth D. Harmer
Dam Safety Inspection Coordinator

KDH:dr

SAMPLE PROJECT
REQUEST

THE CAYUGA COUNTY
ENVIRONMENTAL MANAGEMENT COUNCIL
5th FLOOR - COUNTY OFFICE BUILDING - 160 GENESEE STREET
AUBURN NEW YORK 13021
TELEPHONE (315) 253-1276

January 23, 1979

Mr. Warren Phillipson
Sr. Research Associate
Cornell University
School of Civil and Environmental
Engineering
Hollister Hall
Ithaca, New York 14853

re: remote sensing applications

Dear Mr. Phillipson:

I would like to request a meeting to discuss the possibility of remote sensing problem solving in Cayuga County. Following our phone conversation last week I have spoken with James Hotaling the Manager of the Cayuga County Soil and Water Conservation District. He has some interesting ideas and mutual concerns, and would like to join us. Could we meet at your office on the afternoon of January 30th or the 31st? I will contact you for your consideration later this week.

Thanks for your attention.

Sincerely,

Robert Brower
Senior Planner

RB:cd

SEE ATTACHED.
SUGGESTED TOPICS

Cayuga County
Soil and Water Conservation District

RECEIVE

CAYUGA COUNTY
PLANNING BOARD

January 19, 1979

JAMES A. HOTALING
District Manager

CLARK H. JILLSON
District Technician

JEAN B. HITCHCOCK
Treasurer and District Secretary

ORIGINAL PAGE IS OF POOR QUALITY

TO: Robert Brower, Senior Planner
Cayuga County Planning Board

FROM: James Hotaling, District Manager, CCS&WCD
Robert Ingham, District Conservationist, SCS

RE: Remote Sensing - Cayuga County

Dear Rob,

Contained below are the Conservation District's and Soil Conservation Service's thoughts on possible application of remote sensing in Cayuga County. Ideally, remote sensing would allow us to determine to what degree agricultural activities influence water quality. A majority of our office's efforts are aimed at controlling soil erosion by water, and, in particular, the accelerated erosion caused by man's actions on the land. Protection of our soil resource base, minimizing pesticide, sediment and nutrient transport into our watercourses are all actions we take to maintain and improve water quality. Our ultimate goal is to slow down and possibly reverse the cultural eutrophication of our streams and lakes. Hopefully, remote sensing can aid us in these efforts.

Specifically, we are interested in the following:

1. Obtain base-line data for the county on a watershed by watershed basis to compare how effective our land management practices have been; eg. a view of the Dutch Hollow Brook watershed in 1979 and another view 5 years later showing improved water quality after soil conservation measures have been installed.

2. Determine how many acres of the county are adequately treated and how many more need conservation treatment.

3. Obtain the number of land users with the most critical soil erosion problems, so that these areas can be targetted for immediate action.

Cayuga County
Soil and Water Conservation District
PHONE (315) 252-4171

Staff

JAMES A HOTALING
Jordan N Y
District Manager

CLARK H JILSON
Jordan N Y
District Technician

ALAN B HITCHCOCK
Treasurer and
District Secretary

4. Identify agricultural point sources of pollution; eg. muddy discharges from field drainage tiles, or locating farms that have their milkhouse waste linked directly to pipes discharging into ditches or streams.

5. Comparison of water quality between plowed and unplowed fields in Spring under high runoff conditions.

6. Locate sources of severe animal waste runoff from barnyards which runs directly into ditches or streams.

7. Locate areas of the most critical streambank erosion.

8. Locate other sediment sources such as construction sites, roadbanks, urban developments, forested lands.

9. Locate heavy growth areas of aquatic vegetation in all lakes of the county.

10. In addition, the identification of non-point sources of pollution along our lakeshores in the form of seepage from inadequate or faulty septic systems would be of tremendous value towards stemming the proliferation of excessive aquatic plant growth.

At this point in time we do not know the exact capabilities of remote sensing and our questions may be too broad or too limited. The value of the results of remote sensing techniques become important only if practices are implemented to correct the identified problems. And any management decisions relative to pollution control must be made with costs and benefits closely examined. We welcome the opportunity to discuss our ideas further with you and Cornell as soon as possible. Hopefully our conservation efforts can be enhanced and improved by remote sensing.

Sincerely,

Robert Ingham
District Conservationist

James Hotaling
District Manager

Project Proposal
Cornell University
Remote Sensing Program

Contact: Stephen M. McNally
Energy Coordinator

PROBLEM: In order to operate an effective Weatherization Program (Energy Retrofitting) and Residential Energy Evaluation Program, it is necessary to isolate and identify the residences with the greatest heat loss. Due to various sociological reasons the opposite information is received (i.e. the more energy efficient homes are identified).

POSSIBLE SOLUTION: By doing High Altitude or Satellite Infra-Red Techniques, the most energy inefficient. Housing would be targeted for further investigation. In conjunction with a portable, hand-held infra-red scanner, we feel that a more effieient priority system could be established. This would lead to a mor more effective programming of education and retrofitting efforts. The project would also provide a geographic/demographic breakdown of the areas in the County with the most inefficient housing stock and thus make planning a great deal easier..

THE CAYUGA COUNTY
ENVIRONMENTAL MANAGEMENT COUNCIL

5th FLOOR COUNTY OFFICE BUILDING 160 GENESEE STREET
AUBURN NEW YORK 13021
TELEPHONE (315) 253 [illegible]

1. We are in the process of organizing environmental data files on a town to town basis. Our data should be sufficient to allow us to review or generate environmental assessments. We have no current land use data. We have no vegetative cover inventory. We have no air quality data. We have little information on climate or precipitation patterns. We have little information on ground water systems.

2. We believe a problem may exist in the wetlands at the south end of Owasco Lake. An access road and Hurricane Agnes changed the surface hydrology to the extent the extensive tree kills may be occurring.

3 We are interested in determining the feasibility of land disposal of sewage effluent from the Moravia Sewage Treatment Plant.

SAMPLE PROJECT
REQUEST

County of Fulton
COUNTY BUILDING
JOHNSTOWN, NEW YORK 12095

Telephone (518) 762-4832

PLANNING DEPARTMENT

PAUL J O'CONNOR, Director

February 1, 1979

Dr. Warren Philipson
Remote Sensing Program
Hollister Hall
Cornell University
Ithaca, NY 14853

Dear Warren,

Regarding your recent request to Paul O'Connor for some type of photointerpretation studies to be conducted, we have the following suggestions:

Through the use of multi-spectral, infrared photography, is it possible to determine the extent of surface and sub-surface pollution from septic systems, surface runoff, barnyard runoff and road surface runoff?

Through the use of traditional aerial photography, can the extent of erosion and sedimentation be determined for particular areas--specifically those streams which enter the Great Sacandaga Lake?

The communities which we believe this type of work would apply to include the Towns of Oppenheim, Ephratah, Caroga, Bleecker, Mayfield, Northampton and Broadalbin.

We hope that these suggestions are of use to you; and if you would like to follow through on these, or have any comments or questions regarding the above, please feel free to call.

Sincerely,

Bernard Schmelz

Bernard Schmelz
Senior Planner

BS:sk

SAMPLE PROJECT REQUEST

ST. LAWRENCE-EASTERN ONTARIO COMMISSION

317 WASHINGTON ST., WATERTOWN, N. Y. 13601

PHONE (315) 782-0100

EXTENSION 263-4

ERNEST J. LA BAFF, Chairman WILLIAM E TYSON, Executive Director

March 5, 1979

Warren R. Philipson
Sr. Research Associate
Cornell University
Remote Sensing Program
School of Civil and Env. Eng.
Hollister Hall
Ithaca, NY 14853

Dear Warren:

As you requested I am forwarding information regarding the two topics you feel you can pursue for the Commission. Each is detailed below.

1) Defining river currents as inputs to oil spill response modeling - In order to reduce negative impacts of oil spills on the St. Lawrence River the Commission is developing a spill response model. A copy of the project scope of work is attached.

It is desired that you pursue the objective of identifying and delineating river currents in the area between Tibbets Point and the St. Lawrence - Franklin County line. Identification of currents will provide information required regarding probable oil movement subsequent to a spill in relation to sensitive ecological and economic areas. This identification will assist in developing a containment/clean-up stategy to be followed in the event of a spill.

Specifically, it would be of value if areas with currents could be identified. This in turn identifies areas without such currents. If delineation of direction and velocity is possible this would also be of value. The direction of flow is of greater importance than velocity.

Sections 4 and 5 of the attached scope address the question of expected benefits of the overall project.

2) Determining near-shore river/lake bottom types - In an effort to develop a CMP for the area it became evident that there was almost no information regarding bottom type. The objective of your efforts would be to identify and delineate bottom types in the near shore area (generally less than 30 feet of water) of Lake Ontario and the St. Lawrence River. This information would assist in fisheries management by assisting in the identification of spawning and other areas the various fish are dependent upon. It would allow, if replicated later, an evaluation of land management techniques implemented to reduce upland erosion and the subsequent sedimentation that occurs.

Short term direct benefit would be the identification of spawning areas and then incorporation into the coastal management program. Longer term benefit would be the ability to access the impact of upland erosion control measures in order to develop an efficient and effective management program.

Hopefully this background will assist you. I am available to meet with you if you feel it would be beneficial. If additional information is required, feel free to contact me.

Sincerely,

Daniel J. Palm
Prin. Coastal Zone
Resources Specialist

as

Attachment

APPENDIX E

RECENTLY PRESENTED RESEARCH PAPERS

DEVELOPING IN SITU FLOOD ESTIMATORS
USING MULTI-DATE LANDSAT IMAGERY

J.N. McLeester and W.R. Philipson

Remote Sensing Program
Cornell University
School of Civil and Environmental Engineering
Ithaca, New York 14853

Paper presented at the 45th Annual Meeting
of the American Society of Photogrammetry
19-23 March 1979, Washington, D.C.

-PAPER IS INCLUDED IN APPENDIX A-

A METHODOLOGY FOR DAM INVENTORY AND INSPECTION WITH REMOTELY SENSED DATA

J.P. Berger, W.R. Philipson and T. Liang

Remote Sensing Program
School of Civil and Environmental Engineering
Cornell University
Ithaca, New York 14853

Paper presented at the 45th Annual Meeting
of the American Society of Photogrammetry
19-23 March 1979, Washington, D.C.

A METHODOLOGY FOR DAM INVENTORY AND INSPECTION WITH REMOTELY SENSED DATA

J.P. Berger, W.R. Philipson and T. Liang

Remote Sensing Program
School of Civil and Environmental Engineering
Cornell University
Ithaca, New York 14853

BIOGRAPHICAL SKETCHES

Jan P. Berger received his B.A. in Geology from Hamilton College, and he is currently completing an M.S. in Aerial Photographic Studies and Remote Sensing at Cornell. He has worked as a NASA-Viking Mission intern at the U.S. Geological Survey Center for Astrogeologic Studies, and as a graduate teaching assistant in airphoto interpretation at Cornell. He is presently a graduate research assistant in Civil and Environmental Engineering.

Warren R. Philipson received his B.C.E., M.S. in Civil Engineering, and Ph.D. in Soil Science (Agronomy) from Cornell. Since 1965, he has taught, conducted research and participated in remote sensing projects in various parts of the world. A senior research associate in Civil and Environmental Engineering, he co-directs the Remote Sensing Program.

Ta Liang received his B.E. from Tsing Hua University, China, and his M.C.E. and Ph.D. from Cornell. He has conducted research and taught courses in airphotos and physical environment evaluation at Cornell since 1957. In consulting and research, his international experience covers all major geographic regions. A professor of Civil and Environmental Engineering, he is principal investigator of the Remote Sensing Program.

ABSTRACT

A methodology is presented to increase the efficiency and accuracy of dam inspection by incorporating remote sensing techniques into field-based monitoring programs. The methodology focuses on New York State and places emphasis on readily available remotely sensed data--aerial photographs and Landsat data. Aerial photographs are employed in establishing a statewide data base, referenced on county highway and U.S. Geological Survey 1:24,000 scale, topographic maps. Data base updates are conducted by county or region, using aerial photographs or Landsat as a primary source of information. Field investigations are generally limited to high-hazard or special problem dams, or to dams which cannot be assessed adequately with aerial photographs. Although emphasis is placed on available data, parameters for acquiring new aircraft data for assessing dam condition are outlined. Large scale (1:10,000) vertical, stereoscopic, color-infrared photography, flown during the spring or fall, is recommended.

1. INTRODUCTION

The failure of dams or other water impoundment structures can have disastrous consequences. In 1972, a National Program of

Inspection of Dams was established by Public Law 92-367. With this law, the U.S. Army Corps of Engineers became responsible for inventorying and inspecting larger dams throughout the United States (i.e., dams at least 25 feet high, with impoundments of at least 15 acre-feet; or at least 6 feet high, with impoundments of at least 50 acre-feet). In New York State, however, this represents only about ten percent of the State's dams. Although the Federal effort is substantial, states such as New York will still have the major responsibility for dam safety. Further, in New York and likely other states, dam inspection has been based solely on field assessment--a near impossible task.

Remote sensing from aircraft or spacecraft offers one means to increase the efficiency and accuracy of field-based, dam inspection. The application of aerial photographs and other remotely sensed data can potentially provide useful information for all required tasks: (1) inventorying dams (includes determining location and size of impoundment, dam type and height, spillway type, and reservoir and dam use); (2) determining their hazard class (categorized on basis of downstream land use and cover); and (3) assessing their condition (includes detection of leaks, overtopping, erosion, deterioration and obstructions).

In this paper, a methodology is presented which incorporates the use of aerial photographs and Landsat satellite data into the New York State Dam Safety Program.* Although the methodology focuses on New York State, similar procedures could be adopted by other states. The methodology has, and is presented in, two phases; the first being the establishment of baseline information, and the second being the implementation of a baseline update (Fig. 1).

2. ESTABLISHING BASELINE DATA

To develop a monitoring procedure, a data base that identifies and characterizes all known dams and reservoirs, at some particular date, must be prepared. New York State's Dam Safety Program operates on a county by county approach, with baseline information already collected for more than half of the counties in the State. These existing data were derived through field inspection and State permits, which are required for constructing all but the smallest water impoundment structure. The data are organized in files and recorded on county highway maps (generally, 1:62,500 in scale) and U.S. Geological Survey topographic maps (1:24,000 in scale). A systematic procedure for preparing data bases for the *remaining* counties follows.

(1) Select County

If data bases for all remaining counties are to be completed in one effort, the order in which counties are selected is arbitrary. If the inventory is to be conducted in stages over

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* A more complete description of the methodology, as well as a review of the value and use of remote sensing for dam inspection, can be found in the report from which this paper was derived, Berger et al., 1978.

more than one season, however, "priority counties" might be chosen. A priority county could be one with a large number of dams, many high-hazard dams, or possibly a large number of older dams. A complete review of existing permit and file information is needed if priority counties are to be identified.

(2) Assemble Existing Dam Information

The State maintains files on all dams with permits, and these are grouped by county. Unless recently field checked, however, the file information is subject to error. The dams may have been removed, they may never have been built, or they may have been incorrectly located or described in the permit. To prepare an accurate county data base, the file information must be compared with image-derived information and/or field checked, and plotted on current map bases.

(3) Acquire Appropriate Maps

The most recent county highway maps and U.S. Geological Survey 1:24,000 scale, topographic maps should be acquired for recording the data base information. It is possible that these maps depict new dam or reservoir information which is not found in the existing files or, if the maps post-date the images, on the available remotely sensed images.

(4) Acquire Appropriate Aerial Photographs

Recent aerial photographic coverage of each county is needed to inventory dams. Although Landsat data are useful for identifying reservoirs and general land use, their resolution is inadequate for obtaining information on most dams.

It is recommended that existing, stereoscopic aerial photographs be borrowed or examined at county or various other offices throughout the state. Most of the available photographs of New York and other states are panchromatic (black-and-white), at scales between 1:15,000 and 1:40,000. These should be adequate, especially if they were acquired during periods of minimum vegetative cover (early spring or late fall). Much information can also be derived from high-altitude (small scale) photographs. If available, color-infrared or color photographs would be preferred over panchromatic coverage because they normally afford more information (Table 1).

(5) Inventory Water Bodies

All county water bodies larger than 0.4 hectare should be located using the maps or more recent aerial photographs. With aerial photographs, the most efficient procedure is to scan the entire area covered by each photograph. High-altitude, color-infrared photographs are normally ideal for this task because of the large area covered by each photograph and the spectral contrast between water and its background in the infrared region.

Photo-identified surface waters which are not shown on the county or topographic maps should be recorded on the maps, preferably on acetate overlays. Similarly, water bodies which appear on the maps but not on more recent photographs should be noted on the overlays. They may have been removed, or they may have dried up permanently or temporarily. The use of map overlays is desirable because baseline information can be recorded without permanently obscuring map features. In addition, as new maps are acquired, only the overlays need be transferred.

(6) Inventory Dams

The inventory of dams includes confirming the existence of known dams as well as finding new dams. As each water body is identified on the most recent aerial photographs, stereoscopic analysis should be employed to search for any impounding structures. All identified dams should be recorded on the acetate overlays, and other possible sites derived from the permit files should also be noted.

A map overlay labeling system should be adopted for designating each dam and defining the information source from which it was identified. For example:

.Number of dam:	a number assigned to each dam by the state
.Information source:	A - aerial photograph S - satellite data P - permit F - field check
.Date of information source(s):	a four digit number designating the month and year of the information source(s); the day may be recorded in the files
.Hazard class:	a - low, b - medium, or c - high

The code "502-A0776c" would signify dam number 502, which was located and evaluated from aerial photographs flown in July 1976, and determined to be a high-hazard structure. If a field check is conducted the following month, the code on the overlay would be changed to 502-F0876c. With this system, the last inspection procedure is readily noted from the map code, and field checks or future updates can be planned accordingly.

A file card corresponding to each coded dam can be compiled to give additional information and to summarize other file data. If desired, all information could be entered into a computer for storage, retrieval, and update. The data should include at least the following:

- .Nature of information sources, e.g., type and scale of imagery.
- .County and nearest downstream city, town, or village, with the population and distance from the dam.
- .U.S. Geological Survey 1:24,000 scale, topographic map name.
- .Coordinates of dam site (longitude and latitude or U.T.M.).

.Name of dam or impoundment and river or stream.

.Type of dam, year completed, height, purpose, maximum capacity and condition.

(7) Site Assessment

Information obtained during field inspections conducted after or near the date of the photography will serve to establish the baseline data on a photo-identified dam. In lieu of such information, a complete photographic assessment of the dam site should be performed when the dam is identified. This includes collecting inventory data, categorizing the hazard class, and evaluating the condition of the dam and site. The assessment is principally a visual, qualitative evaluation, although photogrammetric measurements can be made of reservoir size and dam height (Thompson, 1966). The descriptive evaluation should be placed in the appropriate file.

(8) Field Inspection

When establishing the initial data base, field checks should be made if the date of the information source is relatively old (for a high-hazard dam, "old" may be as recent as one year); if new or removed water bodies and/or dams are identified on the photographs or maps; or if the information is derived from permits that post-date the photography. In general, field inspection is also recommended for high-hazard dams, large dams, large reservoirs, and older dams. In some cases, written or verbal communication with the dam owner or responsible county official may suffice and eliminate the need for a field visit. When information is collected, appropriate additions, changes, and deletions can be made on the overlays and in the files.

3. UPDATING BASELINE DATA

Statewide or regional updates of larger water bodies and major changes in land use can be achieved rapidly with satellite data; however, a thorough inventory and inspection of dam sites requires the use of permit file, map, aerial photographic and field information. A methodology for conducting detailed (e.g., county-level) inventories and inspections will be described, followed by an approach to conducting more generalized updates.

3.1. Detailed Data Base Update

A detailed update of baseline data will derive information from various sources in an effort to plan and expedite field inspections. Steps for accomplishing this update are, as follows:

(1) Assemble Required Data

Assemble all permit and file information collected since the last update. It is assumed that as new permits were issued and file information received, the data were appropriately recorded on the basemap overlays. The update will serve to confirm this information. Acquire the most recent aerial photographs and any new county highway or topographic maps.

(2) Impoundment and Dam Identification

If new maps were acquired, they should be compared with the data base overlays for new information when the overlays are transferred to the new maps. Whenever possible, aerial photographs should be used for impoundment and dam identification. Performing this survey with the county and topographic base maps close at hand will aid in locating all known or proposed dam sites. If recent, countywide aerial photographic coverage is available, proceed to Step (3); if it is not, satellite data can be used to locate major changes in surface waters, and thereby confirm permit information and possibly identify illegal impoundments (Sec. 3.2). If new aerial photographic coverage is not anticipated in the near future, field checks to identify new, altered or removed water bodies should follow, as outlined in Step (4).

(3) Site Assessment

When a dam site is encountered on the aerial photographs, it should be fully assessed, with file and base map overlay data appropriately added or updated (Sec. 2). As noted, a complete photographic assessment of each dam site should be made before considering another site, and all new information should be labeled as photo-checked.

(4) Field Checks

Field investigations are critical to dam safety inspection. In general, high-hazard dams and large dams or reservoirs should be field checked regularly even when no problem conditions are detected through photographic analysis. Field inspection is also required whenever a complete evaluation of a dam site cannot be performed with recent photographs (e.g., if a spillway is obscured from view by tree cover), or whenever a dam is determined through photographic analysis to be a high-hazard dam or have some problem condition. In contrast, no field inspection is required of a low-hazard dam for which no change in hazard class and no problem condition is detected through analysis of recent photographic coverage. Moreover, as will be described in Section 4, the actual number or frequency of field checks could be reduced significantly if new remotely sensed data were flown specifically for the purpose of dam site inspection.

3.2. Generalized Data Base Update

If a rapid, regional update of water bodies and major land use changes is desired, the information may be derived from satellite data. This type of update may be warranted if permits indicate a large number of dams have been constructed since the last update, or simply, if recent photographs are not available. On the other hand, a satellite-derived update should not be performed if the data base is old; a detailed update will be required.

Land cover change detection with Landsat Multispectral Scanner (MSS) data is more accurately achieved by computer analysis than by manual (visual) analysis. Computer-compatible tapes, computer access, and special computer software are required

(NASA, 1975; Carter et al., 1977). In general, the analysis requires two dates of Landsat data, one being close to the date of the existing data base (preferred) or older, and the other being the most recent scene available. Both tapes should be of scenes imaged in the late summer. Using appropriate computer software packages, new, removed, or changed water and cultural features can be found for an interim update.

Although manual analyses of satellite images are limited, they may be the only methods that can be implemented before a field check if aerial photographs or computer access are not available. For manual analysis of Landsat data, black-and-white spectral transparencies of late-summer MSS band 7 (near-infrared) images, in a 23-by-23cm (9-by-9 inch) format, are recommended. Using a standard overhead projector whose position and orientation can be controlled, a single, positive transparency can be projected onto the current county map and overlay. Water bodies on the map can be compared to the superimposed image for data base update. Although the higher resolution, Landsat-3 Return Beam Vidicon (RBV) images would also provide useful information, four RBV images must be purchased to cover the same area as that covered by a single MSS image, and the RBV data are panchromatic, which is less effective than infrared for distinguishing water.

As an alternative to simple projection of single images, two dates of each scene could be employed in a multi-date analysis. For example, by "sandwiching" and registering positive and negative band 7 transparencies of an old and recent date, respectively, and by viewing the composite over a source of white light, new water bodies (larger than approximately 10 hectares) will appear as light-toned areas. Other change-detection techniques which make use of an additive-color viewer or diazo might also be employed (Reeves, 1975).

In general, certain land covers, agricultural or climatic differences between the two dates, clouds and cloud shadows can all be sources of confusion for manual or computer approaches to change detection. Furthermore, an aerial photographic or field check is always needed to confirm Landsat-derived information.

4. COLLECTION OF NEW REMOTELY SENSED DATA

It is improbable that New York or any other state would expend funds to fly new remote sensing coverage of all dams in the state, on a regular basis. Sensing for monitoring or assessing the condition of selected problem or high-hazard dams may be economically viable, however, and the development of such a program should be considered.

4.1. Sensor Selection

For monitoring dam sites, a sensor must provide data which will allow an assessment of spatial and spectral relationships. This requirement can only be filled with an imaging sensor. The selection of a particular imaging system will be dependent upon the number and size of impoundments to be monitored, and the availability of equipment, facilities and/or funds. Considering the most useful spectral bands for obtaining dam-related information (Table 1), and recognizing that these bands can be sensed in various ways, it is apparent that nearly all features of interest can be evaluated successfully with a single lens, photographic frame camera and a single color-infrared film. Dam-site monitoring might be conducted more comprehensively with several films (multiple cameras), through multispectral filtering of a single film (multi-lens camera), or with additional sensors. Thermal data, for example, might prove quite valuable for detecting dam leaks or other possible problems, especially if the data were acquired during night-time hours (Table 1). But the advantages of utilizing a single film and a single lens camera are manifold.

4.2. Photographic Scale

Although the complete design of an aerial photographic mission is beyond the scope of this paper, it is noted that the mission design that is optimum for detecting reservoirs and dams would be somewhat different from that of a mission for evaluating hazard class, and quite different from that of a mission for assessing dam condition. All are governed by the camera utilized, the aircraft, whether oblique or vertical photography is to be acquired, and the spatial, spectral and temporal (seasonal and diurnal) characteristics of the features of interest.

Many aspects of dam site monitoring can be accomplished with small scale photographs (1:80,000 to 1:130,000); while medium scale photographs (1:20,000±) are better for "all-purpose" monitoring--inventory, evaluating hazard class and, to a large degree, assessing dam condition. Medium scale, panchromatic photographs are likely to be the primary tool for monitoring because they are acquired periodically by various agencies which normally make them available for distribution. But if new photography is to be flown for assessing the condition of selected problem or high-hazard dams, it is recommended that large scale photographs be acquired.

4.3. Photographic Monitoring of Dam Condition

As outlined in Table 2, color-infrared aerial photographs of the dam structure and its surroundings should be obtained. If landsliding or excessive erosion is judged to be a possible problem, the land surrounding the reservoir should also be photographed; if the impoundment is small, coverage of the entire reservoir might be obtained.

The primary photographic coverage should be stereoscopic and vertical. Oblique photographs, such as those obtainable with a hand-held camera from the window of an aircraft, might be a valuable supplement, especially for inspecting a dam's downstream face. But oblique photography is not an acceptable replacement for vertical photography.

In general, the scale of the vertical photography should be compatible with the size of the dam structure and the other areas to be photographed. Under no circumstances, however, should the scale be smaller than 1:10,000, and scales as large as 1:5,000 are recommended.

Aerial photographic sensing for assessing dam condition should be conducted with high sun angles. In addition, although the likelihood of detecting potential problems should increase as the vegetation or snow cover decreases, a grass cover could serve to enhance wetness or erosion. The optimum period for photographic sensing in New York State would thus be during the early spring or late fall. Notably, the duration of acceptable sun angles may be relatively short at these times.

In conclusion, aerial photographic monitoring of dam sites is one means to increase the efficiency of field operations and/or to reduce the total number of field visits. Similar to the value and purpose of remote sensing for all facets of dam inspection, photographic monitoring is not a replacement for field inspection.

ACKNOWLEDGMENTS

Principal support for this investigation was through funds provided by the United States Department of the Interior, Office of Water Research and Technology, as authorized under the Water Resources Research Act of 1964. Other funds, provided by Grant NGL 33-010-171 from the National Aeronautics and Space Administration, supported the preliminary development of the remote sensing methodology. The authors would like to ackowledge the cooperation of the staff of the Dam Safety Program, of the New York State Department of Environmental Conservation, and in particular, Kenneth D. Harmer.

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4. Reeves, R.G. (ed.). 1975. Manual of remote sensing. 2 vols. Amer. Soc. Photogrammetry, Falls Church, Va. 2144 pp.

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Table 1. Spectral bands for monitoring dams.

TASK OR OBJECT DIFFERENTIATION	REFLECTED RADIATION PRIMARY	REFLECTED RADIATION SECONDARY	VALUE OF THERMAL
I. Inventory			
reservoir vs. background	I*	R	High
dam vs. water	I	R	High
dam vs. vegetation[1]	R	G,B	Mod.
dam vs. soil[1]	B	-	Mod.
dam type[2]	-	-	-
dam height[2]	-	-	-
spillway, wet vs. background	I	R	High
spillway, dry vs. vegetation[1]	R	G,B	Mod.
spillway, dry vs. soil[1]	B	-	Mod.
spillway type (wet)[3,4]	I	R	High
spillway type (dry)[2,4]	-	-	Low
reservoir/dam use[3]	R,G	B,I	Low-Mod.
II. Hazard Classification			
topography[2]	-	-	-
land use (cultural)[3]	I,R	G,B	Low-Mod.
III. Condition Assessment			
non-overflow section:			
.leaks	I	R	High
.earth dam erosion, breaching or overtopping[3]	I,R	-	Mod.
.concrete dam breaching or overtopping[3]	I	R	Low-Mod.
spillway deterioration:			
.wet spillway[3]	I	R	High
.dry spillway[2]	-	-	-
choked spillway where obstructions are:			
.floating or surface[3]	I,R	-	Low-Mod.
.submersed[3]	G,B	-	Low
land surrounding impoundments[3]	I,R	-	Low-Mod.

Notes: *I, infrared; R, red; G, green; B, blue

[1] Assumes concrete structure.

[2] Object differentiation or completion of the task is principally a problem of spatial analysis.

[3] Analysis of spatial properties may be at least as important as spectral analysis.

[4] Categorization of spillway type as internal or external assumes the spillway has been detected.

Table 2. Mission parameters for aerial photographic sensing of dam conditions.

PRIMARY DATA:	VERTICAL PHOTOGRAPHY
.Cameras	one camera; single lens; format of 70mm or larger.
.Film/Filter	color infrared (Kodak Aerochrome Infrared 2443 or 3443); filter with cut-off about 0.4μm (Wratten 12 or 15).
.Scale	dam structure, 1:5,000 to 1:10,000. reservoir & surroundings, 1:10,000.
.Overlap	for stereoscopic coverage, consecutive photos should overlap by at least 50%, and preferably 60%.
.Constraints	flights should be conducted during: a. early spring or late fall (minimum vegetation and no snow) b. highest possible solar altitude c. periods of less than 20% cloud cover
OPTIONAL DATA:	OBLIQUE PHOTOGRAPHY
.Cameras	one camera; single lens; format of 35mm or larger.
.Film/Filter	(see above).
.Scale	variable, preferably 1:5,000± of dam face.
.Overlap	if possible, obtain stereoscopic coverage.
.Constraints	(see above); all oblique photographs should be acquired during the mission to acquire vertical photographs; no special flights are recommended.

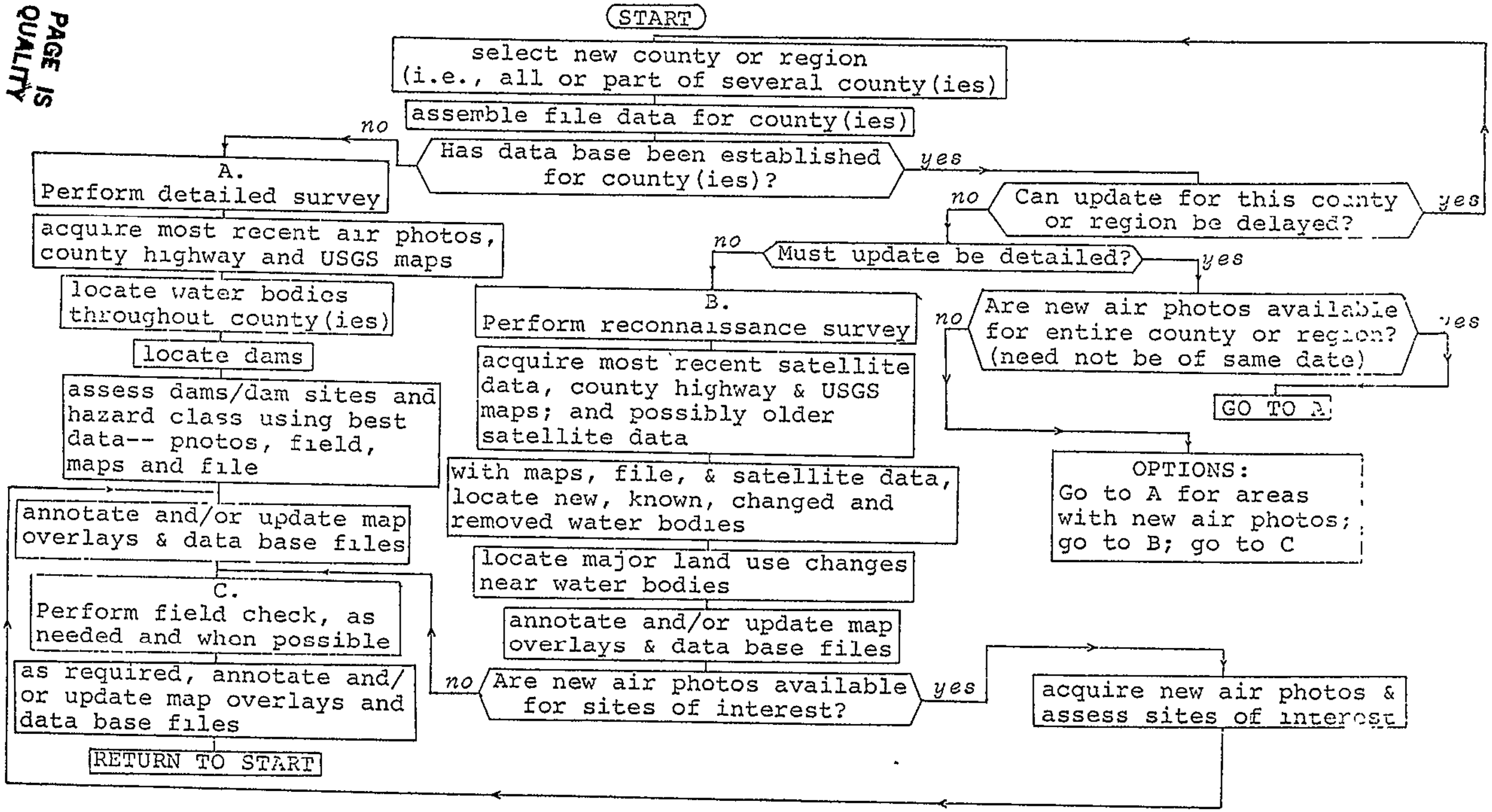

Figure 1. Principal steps for dam inventory and inspection.

APPENDIX F

RECENT SEMINARS AND ORIENTATION SESSIONS

SEMINAR IN REMOTE SENSING

List of Seminars

Spring Term 1979

Date	Speaker	Topic
Jan 24	Warren R. Philipson Cornell University	Organizational Meeting--Overview of Seminars and Introduction to Remote Sensing
Jan 31	Barry S. Siegal Sr. Remote Sensing Geologist Ebasco Services Inc. Greensboro, North Carolina	Geologic Site Investigations with Remotely Sensed Data
Feb 14	Walley W. Brown Sr. Scientist/Biologist Earth Satellite Corp. Washington, D.C.	Wetland Mapping Utilizing Aerial Photography
Feb 21	Robert L. Talerico Research Coordinator Forest Service, USDA Broomall, Pennsylvania	Quantifying Hardwood Defoliation with the Scene Color Standard Technique
Mar 7	George E. Courville Program Manager Department of Energy Washington, D.C.	IR Thermography and Building Heat Loss Analysis
Mar 14	Thomas J. Schmugge Physical Scientist NASA/GSFC Greenbelt, Maryland	Microwave Radiometry and its Applications
Mar 28	Paul G. Teleki Staff Geologist U.S. Geological Survey Reston, Virginia	The Seasat Synthetic Aperture Radar
Apr 4	William E. Collins Assistant Professor Columbia University New York, N.Y.	Spectral Properties of Natural Targets with an Airborne, 500-Channel Spectroradiometer
Apr 11	Gregory M. Wickware Lands Directorate Canada Centre for Inland Waters Burlington, Ont., Canada	Wetland Classification and Environmental Monitoring Using Digital Data

Date	Speaker	Topic
Apr 18	R. Michael Hord Manager, Applications Development Institute for Advanced Computations Alexandria, Virginia	Digital Image Processing on the Illiac IV
May 2	Benny M. Sørensen Project Manager Commission of the European Communities Joint Research Center Ispra, Italy	The European Ocean Color Scanner Experiment 1977 in the North Sea

Conference on LANDSAT Applications
in New York State
STATE UNIVERSITY OF NEW YORK AT ONEONTA

April 6, 1979

AGENDA

9 15 - 10 00 AM	COFFEE HOUR	Rm. 321, Milne Library
10·00 - 11:00	TOPIC: *The Eastern Resources Remote Sensing Applications Center (ERRSAC) Program* SPEAKERS: Dr. Phil Cressey and Mr. Tom Austin, NASA/Goddard.	Rm. 318, Milne Library
11.00 - 12 00	TOPIC· *A State's Applications Program· Vermont* SPEAKERS. Mr. Brian Stone, State of Vermont Dr Roy Whitmore, University of Vermont	Rm. 318, Milne Library
12:00 - 1 15	LUNCH	Hunt College Union
1·15 - 2·00	TOPIC. *Cornell University's Remote Sensing Program· Remote Sensing for the User* SPEAKERS. Dr. Warren Philipson, Cornell University	Rm. 318, Milne Library
2·00 - 3·00	TOPIC: *Automated Geographic Information Systems related to LANDSAT Technology* SPEAKER: Professor Paul Baumann, State University of New York at Oneonta	Rm. 318, Milne Library
3:00 -	Small group discussions	Rm. 318 and 321 Milne Library

Co-sponsored by the NASA/Eastern Resources Remote Sensing Applications Center and the Department of Geography, State University of New York at Oneonta.

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CORNELL UNIVERSITY

WHAT'S NEW?

The Centers and Programs in Engineering

May 8-9, 1979

The Technical Program

8:30 - 9:10

The Materials Science Center (MSC)
Herbert H. Johnson, Professor of Materials Science and Engineering, Director.

9:10 - 9:50

The Center for Environmental Research
Gilbert Levine, Professor of Agricultural Engineering, Director.

9:50 - 10:30

The Center for Applied Mathematics
William F. Lucas, Professor of Operations Research and Industrial Engineering.

11:00 - 11:40

The Laboratory of Plasma Studies
Ravindra N. Sudan, Professor of Electrical Engineering and Applied and Engineering Physics, Director.

11:40-12:15

The Program in Remote Sensing
Ta Liang, Professor of Civil and Environmental Engineering, Director.

2:25 - 3:05

The Cornell Program for the Study of the Continents (COPSTOC)
Sidney Kaufman, Professor of Geological Sciences.

1:45 - 2:25

The Cornell Program on Submicrometer Structures (PRCSUS)
G. Conrad Dalman, Professor and Director of the School of Electrical Engineering.

3:05 - 3:50

The Cornell Injection Molding Project (CIMP)
Shan-Fu Shen, John Edson Sweet Professor of Mechanical Engineering, Co-Principal Investigator.

WHAT'S NEW?

The Centers and Programs in Engineering

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APPENDIX G

NEWSLETTER RECIPIENTS

CORNELL REMOTE SENSING NEWSLETTER
LIST OF RECIPIENTS

CAMPUS GROUPS AND INDIVIDUALS*

1. Administration
   - F.H.T. Rhodes (President, Cornell)
   - W.K. Kennedy (Provost, Cornell)
   - J.W. Spencer (Special Ass't. to President)
2. Administrative Programming Service
   - C. Selvarajah
3. Aerospace Studies (Air Force R O.T.C.)
   - J Levisky (Major)
4. Agricultural Economics
   - O.D. Forker (Chairman; Prof.)
   - D.J. Allee (Prof.)
   - H.E. Conklin (Prof.)
   - G.R. Fohner (Research Specialist)
   - K.V. Gardner (Sr. Extension Assoc.)
   - W.C. Hunt (Extension Assoc.)
5. Agricultural Engineering
   - D.A. Haith (Assoc. Prof., Civil & Envir. Eng'g. and Agr. Eng'g.)
   - L H. Irwin (Assoc. Prof.)
   - W J. Jewell (Assoc. Prof.)
   - G. Levine (Prof.; Dir. Center for Envir. Research)
   - R.C. Loehr (Dir., Environmental Studies; Prof., Civil and Envir. Eng'g. and Agr. Eng'g.)
   - D.C. Ludington (Assoc. Prof.)
6. Agronomy
   - R F. Lucey (Chairman; Prof.)
   - R W. Arnold (Prof.)
   - D.R. Bouldin (Prof.)
   - W.F. Croney (Sr. Ext. Assoc.)
   - M. Drosdoff (Prof. Emer.)
   - E.R. Lemon (Prof ; Soil Scientist, U.S.D.A.)
   - G W. Olson (Assoc. Prof.)
   - J.H. Peverly (Asst. Prof)
   - A R. Van Wambeke (Prof.)
7. Anthropology
8. Applied and Engineering Physics
   - A.F. Kuckes (Prof.)
9. Astronomy
   - F.D. Drake (Dir., Nat'l. Astronomy & Ionosphere Center; Prof.)
   - M.O. Harwit (Prof.)
   - C. Sagan (Dir Planetary Studies, Assoc. Dir. Radiophysics and Space Research; Prof.)
   - Y. Terzian (Prof.)
   - J. Veverka (Assoc. Prof.)
10. Atmospheric Sciences (Agronomy)
    - B.E. Dethier (Prof.)
    - W.W. Knapp (Assoc. Prof.)
    - A.B. Pack (Sr. Extension Assoc.)
11. Biological Sciences
12. Boyce Thompson Institute
    - E.H. Buckley (Plant Biochemist)
    - J.S. Jacobson (Plant Physiologist)
13. City and Regional Planning
    - S. Saltzman (Chairman, Prof.)
    - B.G. Jones (Prof.)
    - S.W. Stein (Prof)
14. Civil and Environmental Engineering
    - R.N. White (Dir. School of C.E.E.; Prof., Structural Eng'g.)
    - G.B. Lyon (Asst. Dir., Assoc. Prof., Envir. Eng'g.)
    - J.F. Abel (Assoc. Prof., Structural Eng'g)
    - D J. Belcher (Prof Emer.)
    - J.J. Bisogni (Asst. Prof., Envir. Eng'g.)
    - W H. Brutsaert (Prof., Envir. Eng'g.)
    - R.I. Dick (Prof , Envir. Eng'g.)
    - L.B Dworsky (Prof., Envir. Eng'g.)
    - T.L. Erb (Research Specialist, Remote Sensing Program)
    - G.P. Fisher (Prof., Envir. Eng'g)
    - C.D. Gates (Prof , Envir. Eng'g.)
    - P. Gergely (Prof., Structural Eng'g.)
    - J.M. Gossett (Asst. Prof., Envir. Eng'g.)
    - J.G. Hagedorn (Data Analyst, Remote Sensing Program)
    - S.C. Hollister (Prof. Emer.)
    - A.R. Ingraffea (Asst. Prof., Structural Eng'g.)

* Newsletters are sent to the main office of each department listed as well as to various individuals within the department. In addition, Newsletters are provided to graduate and undergraduate students, upon request.

14. Civil and Environmental Eng'g (Cont.)

G H Jirka	(Asst Prof., Envir Eng'g.)
P.R Jutro	(Sr. Research Assoc., Envir. Eng'g.)
F.H. Kulhawy	(Assoc. Prof., Structural Eng'g.)
T. Liang	(Prof., Remote Sensing Program)
J.A. Liggett	(Prof., Envir. Eng'g.)
P. Liu	(Asst Prof., Envir. Eng'g.)
D P. Loucks	(Chairman, Envir. Eng'g., Prof.)
W.R. Lynn	(Prof , Envir. Eng'g.)
W. McGuire	(Prof., Structural Eng'g.)
A J McNair	(Prof., Civil and Envir. Eng'g.)
A H. Meyburg	(Prof , Envir. Eng'g.)
A H. Nilson	(Chairman, Structural Eng'g., Prof.)
N. Orloff	(Assoc. Prof , Envir. Eng'g.)
T Pekoz	(Assoc. Prof., Structural Research Mgr.)
W.R. Philipson	(Sr. Research Assoc., Remote Sensing Program)
D A. Sangrey	(Assoc. Prof., Structural Eng'g.)
R.E. Schuler	(Assoc. Prof., Envir. Eng'g. and Economics)
C.A. Shoemaker	(Asst. Prof , Envir. Eng'g.)
F.O. Slate	(Prof., Structural Eng'g.)
J R. Stedinger	(Asst. Prof., Envir. Eng'g.)
G. Winter	(Prof. Emer.)

15. College of Agriculture and Life Sciences

D L. Call	(Dean)

16. College of Architecture, Art and Planning

K.C. Parsons	(Dean, Prof.)
H.W. Richardson	(Assoc. Dean, Assoc. Prof.)

17. College of Engineering

T.E. Everhart	(Dean)
P R. McIsaac	(Assoc Dean; Prof., Electrical Eng'g.)
F.J. Ahimaz	(Dir., Eng'g. Basic Studies; Prof.)

18. Computer Graphics

D.P. Greenberg	(Dir., Prof., Arch.)

19. Computer Science

20. Design and Environmental Analysis

21. Ecology and Systematics

J.P. Barlow	(Assoc. Prof., Oceanography)
P.F. Brussard	(Assoc. Prof., Ecology)
G.E. Likens	(Prof., Ecology)
P.L. Marks	(Assoc. Prof., Biology)

22. Education

R B. Fischer	(Prof.)
V.N. Rockcastle	(Prof.)

23. Electrical Engineering

R. Bolgiano, Jr.	(Prof.)
M. Kim	(Prof.)
W.H. Ku	(Prof.)
S. Linke	(Prof.)
C. Pottle	(Assoc. Prof.)
G.J. Wolga	(Prof.)

24. Entomology

25. Entomology Extension

26. Floriculture and Ornamental Horticulture

M.I. Adleman	(Assoc. Prof., Landscape Architecture)
A S. Lieberman	(Prof., Landscape Architecture)
P.J Trowbridge	(Asst. Prof., Landscape Architecture)

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J.M. Bird	(Prof.)
A.L. Bloom	(Prof.)
C.E. Karig	(Assoc. Prof.)
J. Ni	(Research Specialist)
W.B. Travers	(Assoc. Prof.)

28. History of Art

29. International Agriculture

J.F Metz	(Director; Prof., Marketing)
L.W. Zuidema	(Asst. Director)

30. International Studies, Center

31. Landscape Architecture Grad. Program

L. Mirin	(Asst. Prof.)

32. Materials Science and Engineering

33. Mechanical and Aerospace Engineering

34. Media Services

A.S. Moffat	(Science Newswriter)

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A. Schultz (Prof.)
B W. Turnbull (Assoc. Prof.)

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42. Plant Pathology

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J.C. Studenroth (Research Asst.)
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43. Pomology

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44. Public Information

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45. Resource Information Laboratory

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46. Rural Sociology

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47. Sociology

48. Sponsored Programs

T R. Rogers (Director)

49. Theoretical and Applied Mechanics

50. Thermal Engineering

51. Unclassified Students

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52. University Archives

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53. U.S. Plant, Soil and Nutrition Laboratory

54. Vegetable Crops

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APPENDIX H

RECENT NEWSLETTERS

The Newsletter, a monthly report of articles and events in remote sensing, is sent to members of the Cornell community who have an interest in sensors and their applications.

SEMINAR IN REMOTE SENSING--SPRING '79

The Seminar in Remote Sensing (CEE A696) is a one credit-hour course in the School of Civil and Environmental Engineering. Seminars are held on Wednesdays, at 4:30 p.m., in Hollister Hall. Each week a different topic on remote sensing research, developments or applications is presented by a guest speaker from industry, government, Cornell or other institution. The audience generally includes students and staff from at least ten Cornell departments.

Many of the spring semester seminars have been scheduled. The speakers include: William Collins, Columbia University (airborne spectroradiometric studies); Walley W. Brown, Earth Satellite Corp. (wetland mapping); Robert Talerico, U.S. Forest Service (forestry studies); James C. Hammack, Defense Mapping Agency (hydrographic applications); George E. Courville, U.S. Department of Energy (thermal sensing and energy conservation); Thomas Schmugge, National Aeronautics and Space Administration (microwave radiometry); and Paul G. Teleki, U.S. Geological Survey (Seasat's imaging radar). Consult the Newsletter and weekly seminar announcements, or contact Warren Philipson (tel. 607-256-4330), for current information.

Seminars scheduled for January are, as follows:

Wed., 24 Jan	Organizational meeting--Overview of Seminars and Remote Sensing: Ta Liang and Warren Philipson, Cornell.
Wed., 31 Jan	(Topic: Remote Sensing for Power Plant Siting): Dr. Barry Siegal, Ebasco Services, Inc., Greensboro, North Carolina.

SATELLITE UPDATE

A "pre-launch" review of four earth resources satellites--Landsat-C, the Heat Capacity Mapping Mission Satellite, Seasat-A and Nimbus G--was included in the March 1978 Newsletter (v.6, n.7). The status of each is, as follows: Landsat-C was launched on 5 March 1978 and redesignated Landsat-3. Although the Return Beam Vidicon and Multispectral Scanner (MSS) reflective band systems have provided data since launch, problems have been experienced with the MSS thermal band. Presently, real-time thermal data are being acquired with one detector, and these data are being duplicated to fill a vacant data line caused by the failure of the second detector. (continued, p.2)

CALL FOR PAPERS

The 8th Annual Remote Sensing of Earth Resources Conferences will be held at the University of Tennessee Space Institute, 27-29 March 1979. Proposals for papers on all facets of remote sensing should be submitted to: Dr. F. Shahrokhi, Conference Director, Univ. of Tenn. Space Institute, Tullahoma, Tenn. 37388. Proposals must be received by 10 January 1979. They should include a titled abstract (approx. 150 words), together with the author's name, address and position.

LANDSAT DATA FROM NON-U.S. SOURCES

According to the Landsat Data Users Notes (Nov. 78, no.3), listings of Landsat data received and processed by Brazil, Canada and Italy will be available from the EROS Data Center by early 1979. Information regarding coverage and the appropriate country to contact will be in a geographically retrievable format and will be available to all users. Contact the EROS Data Center, U.S. Geological Survey, Sioux Falls, S.D. 57198 (tel. 605-594-6511) for details.

Digital Image Processing of Earth Observation Sensor Data; 5-9 Feb; $530 fee; Contact: Continuing Engineering Education, George Washington Univ., Washington, D.C. 20052.

Remote Sensing and Digital Information Extraction; 12-16 Feb; $530 fee; Contact: George Washington Univ. (see above).

7th Alberta Remote Sensing Course (designed to instruct multidisciplinary users in application, acquisition and interpretation of Landsat and aircraft imagery); 26 Feb-2 Mar; $135 fee; Contact: Alberta Remote Sensing Center, 11th Floor, Oxbridge Place, 9820 - 106th St., Edmonton, Albt., Canada T5K 2J6 (phone 403-427-2381).

Satellite Update, continued

Seasat-A was launched on 27 June 1978 and redesignated Seasat-1. The visual and infrared radiometers failed in September, and the spacecraft's power system failed in October. Before shutdown, however, a large volume of visual, infrared and, especially, microwave data had been acquired.

The Heat Capacity Mapping Mission Satellite and its dual-channel radiometer have functioned well since launch on 26 April 1978. Data processing and distribution are now getting into full operation. Similarly, Nimbus G, now designated Nimbus 7, was placed in orbit on 24 October 1978, and first look data from all sensors are of good quality.

SELECTED ARTICLES

Holderman, F., M. Bohner, B. Bargel and H. Kazmierczak. 1978. Review of automatic image processing. Photogrammetria 34:6:225-258.

Kirschner et al. 1978. Map unit composition assessment using drainage classes defined by Landsat data. Soil Sci. Soc. Amer. Jour. 42:5:768-771.

Legeckis, R. 1978. A survey of worldwide sea surface temperature fronts detected by environmental satellites. Jour. Geophysical Research 83:C9:4501-4522.

Mengers, P. 1978. Low contrast imaging. Electro-Optical Systems Design 10:10:20-26.

Mintzer, O.W. and D. Spragg. 1978. Mini-format remote sensing for civil engineering. Transportation Eng'g. Jour. of ASCE 104:TE6: 847-858.

Journal of Research of the U.S. Geological Survey 1978, v.6, n.6.

-Gaydos & Newland. Inventory of land use of the Puget Sound region using Landsat digital data.

-Gaydos, L. Low-cost computer classification of land cover in the Portland area, Oregon, by signature extension techniques.

Photogrammetric Eng'g. & Remote Sensing 1978. v.44, n.8 (Aug.)

-Warne, D.K. Landsat as an aid in the preparation of hydrographic charts.

-Eyton & Kuether. Macrophotography of satellite images.

-Best & Smith. Photographic contrast enhancement of Landsat imagery.

-Richardson, S.L. Remote sensing on a shoestring.

-Bauer et al. Area estimation of crops by digital analysis of Landsat data.

-Civco et al. A technique for evaluating inland wetland photointerpretation: The Cell Analytic Method.

-Jordan et al. Use of manual densitometry in land cover classification.

-Hunka, G.W. Aided-track cursor for improved digitizing accuracy.

The Newsletter is made possible by a grant from the National Aeronautics and Space Administration. Comments or correspondence should be directed to Dr. Warren R. Philipson, Remote Sensing Program, Cornell University, 464 Hollister Hall, Ithaca, NY 14853 (tel. 607-256-4330).

The Newsletter, a monthly report of articles and events in remote sensing, is sent to members of the Cornell community who have an interest in sensors and their applications.

PRELIMINARY ASSESSMENT OF LOVE CANAL LANDFILL

During the past summer, leaching of toxic chemicals from the Love Canal landfill in Niagara Falls, N.Y. caused the site to be declared a Federal disaster area, and some 240 homes were scheduled to be evacuated. At the height of the crisis, officials of the New York State Department of Health requested the staff of the Cornell Remote Sensing Program to assist in determining the extent of leachate migration. In order to provide a rapid response in evaluating the site, Program staff relied solely on interpretation of aerial photographic coverage available at Cornell. This included medium scale, panchromatic coverage acquired in 1938, 1951 and 1966. These dates were significant because, in 1938, the landfill was an open canal in a generally undeveloped area; dumping had occurred during the 1940s and early 1950s; backfilling had begun by 1951; and the canal was covered and the area built-up by the mid-1950s.

Through stereoscopic analysis of the photographs, Cornell staff: (1) assessed the area's physiographic setting, (2) compiled time-sequential, 1:24,000 scale map overlays depicting generalized land use and drainage, and (3) identified critical sites for field sampling, based primarily on interpretation of soil and drainage patterns. In addition, the basic parameters for flying new, color-infrared aerial photography of the area were outlined for State Health personnel. The entire effort was completed over a two-day period. (continued, p. 2).

REMOTE SENSING FACULTY POSITION OPEN AT CORNELL

Cornell University's School of Civil and Environmental Engineering is seeking to fill one faculty position in Remote Sensing, at the assistant or associate professor level. Applicants should have a thorough background in airphotos and remote sensing, with a Ph.D. degree in engineering or natural sciences. Academic and professional experience should have emphasis in quantitative remote sensing and digital analysis, and/or qualitative remote sensing and applications. The position will involve teaching and advising undergraduate and graduate students, and developing and conducting research in various disciplines. The teaching and research will interface with airphoto interpretation. Please send a detailed resume and references to Professor Ta Liang, Remote Sensing Program, School of Civil and Environmental Engineering, Hollister Hall, Cornell University, Ithaca, N.Y. 14853. Cornell is an equal opportunity/affirmative action employer and welcomes applications from women and minority members.

SEMINAR IN REMOTE SENSING

The Seminar in Remote Sensing is held on Wednesdays, at 4:30 p.m., in Hollister Hall. Anyone is welcome to attend. Seminars scheduled for February are, as follows:

Wed., 7 Feb — Spectral Properties of Natural Targets Observed with an Airborne, 500-Channel Spectroradiometer: W. Collins, Columbia Univ. & Goddard Institute for Space Studies, New York, N.Y.

Wed., 14 Feb — Wetland Mapping Utilizing Aerial Photography: W.W. Brown, Earth Satellite Corp., Washington, D.C.

Wed., 21 Feb — Quantifying Hardwood Defoliation with the Scene Color Standard Technique: R.L. Talerico, U.S. Forest Service, Broomal, Pa.

Wed., 28 Feb — Hydrographic Remote Sensing: J.C. Hammack, Defense Mapping Agency Hydrographic Center, Washington, D.C.

ASCE CALL FOR PAPERS

During the Spring 1980 Convention of the American Society of Civil Engineers, to be held in Portland, Oregon in April 1980, the Remote Sensing Committee of the Aerospace Division will sponsor a technical session, "Applications of Aerial Remote Sensing in Mining and Evaluation of Geologic Hazards." Five papers describing the practical use of aerial sensors in mining industry applications, or in the detection or evaluation of geologic hazards related to engineering projects or the environment, are desired. Authors should send a one-page abstract and brief resume to: Dr. Donald B. Stafford, Dept. of Civil Engineering, Clemson Univ., Clemson, S.C. 29631, before 1 March 1979.

CALL FOR PAPERS

The 7th Biennial Workshop on Color Aerial Photography in the Plant Sciences will be held at the University of California-Davis, 15-17 May 1979. Those wishing to present a paper or participate in an informal poster session should submit a titled summary of about 200 words; their name, address, position and professional affiliation; the estimated time of presentation (20 mins. max.); and the required visual aids. This information should be sent to: Mr. William M. Cielsa, USDA Forest Service, FI & DM/Methods Application Group, 2810 Chiles Rd., Davis, Calif. 95616, before 15 March 1979.

Love Canal, continued

State personnel have sampled all recommended sites and flown new 35mm and 70mm photography. The Remote Sensing Program has acquired additional "historic" aerial photographs and background reports, and consultations are continuing. Funds to support the Cornell staff's participation have been provided by an ongoing grant from NASA to the School of Civil and Environmental Engineering. For further information, contact Warren Philipson at Cornell, or Dr. C. Stephen Kim, Chief, Biometrics Lab., Div. of Labs. & Research, N.Y.S. Dept. of Health, Empire State Plaza, Albany, N.Y. 12201 (tel. 518-474-1518).

SELECTED ARTICLES AND PUBLICATIONS

Brown, R.J. & J. Cihlar. 1978. Introduction to aerial thermography applications in energy conservation programs. Research Report 78-2. Canada Centre for Remote Sensing, Ottawa. 25p.

Proceedings 12th Int'l. Symp. on Remote Sensing of Environment. Held April 1978, in Manila. 2382 pp. Available: E.R.I.M., Box 8618, Ann Arbor, Mich. 48107. ($60 + post./handling, $2.50 in U.S.).

Swain, P.H. & S.M. Davis (eds.). 1978. Remote sensing: The quantitative approach. McGraw-Hill Inc. 396p. ($39.50).

Photogrammetric Eng'g. & Remote Sensing 1978. v.44, n.9 (Sept.)

- -Murtha, P.A. Symposium on remote sensing for vegetation damage assessment.
- -Murtha, P.A. Remote sensing and vegetation damage: A theory for detection and assessment.
- -Heller, R.C. Case applications of remote sensing for vegetation damage assessment.
- -Watkins, T. The economics of remote sensing.
- -Welby, C.W. Application of Landsat imagery to shoreline erosion.
- -Rao et al. Crop discriminability in the visible and near infrared regions.
- -Lawton & Palmer. Enhancement of linear features by rotational exposure.

The Newsletter is made possible by a grant from the National Aeronautics and Space Administration. Comments or correspondence should be directed to Dr. Warren R. Philipson, Remote Sensing Program, Cornell University, 464 Hollister Hall, Ithaca, NY 14853 (tel. 607-256-4330).

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REMOTE SENSING AND U.S. FOREIGN POLICY

by
Charles K. Paul

Dr. Paul is with the Agency for International Development, where he is Manager of Remote Sensing Programs, in the Office of Science and Technology. He received his M.S. and Ph.D. in Photogrammetric and Geodetic Engineering at Cornell, in 1967 and 1970, respectively. The views expressed here are those of Dr. Paul and do not necessarily reflect the views or policy of the Cornell Remote Sensing Program.

There can no longer be any doubt that scientists play a significant role in focusing international concern on the plight of dissidents who are denied basic human and political rights. Actions of individual scientists of the American Association for the Advancement of Science and the Federation of American Scientists have vividly exposed the suppression of Soviet Jewish scientists and, for better or for worse, have affected recent U.S./Soviet scientific, and even political, relations. Pakistan's refusal to sign international nuclear regulatory agreements saw the subsequent shutting off of all U.S. foreign assistance, which was just started up again late in 1978. The role of communications satellites in the voice links through the White House-Kremlin "hotline" and the severe storm predictions by weather satellites to prepare for disaster are obvious examples of the effects of science on our foreign policy. But the most inconspicuous scientific tool of them all guarantees for most people on the earth at least a certain degree of comfort each night before they go to sleep--the guarantee that SALT agreements are verifiable, and the belief that the provisions of these agreements are being verified. This tool is the quiet, unobtrusive remote sensing sentinel of space. The impact of these satellites on our foreign policy is unfathomable. *(cont'd. p.2)*.

SHORT COURSES

Air and Space Technology in the Forest Environment; 19-24 Aug; $300 fee; Contact: NASA Technology Transfer Project, Humboldt State Univ., Arcata, Calif. 95521 (tel. 707-826-3112).

Advanced Topics in the Analysis of Remote Sensing Data; 14-18 May; $595 fee; Contact: Prof. P.H. Swain, LARS, 1220 Potter Dr., West Lafayette, Ind. 47906 (tel. 317-749-2052).

SEMINAR IN REMOTE SENSING

The Seminar in Remote Sensing is held on Wednesdays, at 4:30 p.m., in B-14 Hollister Hall. Anyone is welcome to attend. Seminars scheduled for March, and a change in the last February seminar, are as follows:

Wed., 28 Feb	(Topic: Oceanographic Surveys): Dr. Alexander Malahoff, Chief Scientist, National Ocean Survey, NOAA, Rockville, Md.
Wed., 7 Mar	IR Thermography and Building Heat Loss Analysis: Dr. George E. Courville, U.S. Department of Energy, Washington, D.C.
Wed., 14 Mar	Microwave Radiometry and Its Applications: Dr. Thomas Schmugge, NASA Goddard Space Flight Center, Greenbelt, Md.
Wed., 21 Mar	No Seminar, Spring Vacation
Wed., 28 Mar	(Topic: Seasat's Imaging Radar): Dr. Paul G. Teleki, U.S. Geological Survey, Reston, Va.

Yet as these satellites attempt to limit man's materialistic preparations for war, they at the same time can address man's questions regarding the war of the coming century--the war on global poverty. If NASA's Large Area Crop Inventory Experiment (LACIE) verified nothing else, it did show that we can indeed survey accurately and timely the Soviet wheat crop. If one scales this technology down to a more appropriate, multi-stage technique, with aerial photos and large numbers of field enumerators, existing and future satellite systems offer great potential to provide accurate crop statistics where it really counts--in the developing world. The U.S. Department of Agriculture and the Agency for International Development have initiated just such a technique in twelve developing countries in Latin America, Africa, and Southeast Asia. The economic benefits of accurate crop statistics in the developing world are measurable: (1) they permit agricultural ministries to buy on international markets if shortfalls appear imminent, or export if crop excesses appear likely; (2) they can govern the U.S. P.L. 480 Food for Peace Program, by avoiding excess food exports to countries with larger-than-expected crop production, the excess of which reduces food prices in that country and thus lowers income gained by small farmers; and (3) they can, if they reveal probable large harvest production, serve as collateral for small farmers to acquire bank loans for farm improvements. In several countries of the Sahel and south Asia, the social benefits translate directly to human lives.

It is in the training of remote sensing technology where shoulder-to-shoulder scientific diplomacy is played out. Remote sensing is clearly a U.S.-dominated technology, still today. The developing world looks mostly to us for technical assistance in both learning the technology and developing national institutions to carry out resource exploration on their own. If our present space policy continues, our lead in developing satellite remote sensing systems and programs benefiting the third world will erode around 1983, with both the French and the Japanese overtaking us. This erosion in U.S. leadership has forced A.I.D. to coordinate its development of regional remote sensing centers with the United Nations and industrialized nations of Europe and Asia. The regional centers are thus able to accommodate, and encourage, students who would otherwise not be able or willing to attend an institution if it were run strictly by the U.S. or solely by another industrialized nation. Examples of this professional contact in regional remote sensing centers are numerous: the Nairobi center sees Somalians, Ugandans, and Tanzanians working together on common resource problems; the Soviets have offered us satellite data and technicians in Upper Volta; and the Vietnamese, Thai, and Chinese will be attending the Bangkok center. Remote sensing, because of its objective view, its ignorance of political borders, its exciting, space-oriented technology, and its search for resource clues over large areas, is geopolitics in evolution.

SELECTED ARTICLES AND PUBLICATIONS

Civco, D.L., W.C. Kennard & M.W. Lefor. 1978. Handbook of remote sensing imagery of Connecticut. Storrs Agr. Exp. Sta. Bulletin 448. 98p. Avail: Agr. Publications Office, U-35, College of Agr. & Natural Resources, Univ. of Conn., Storrs, Conn. 06268 ($2.00).

Rango, A., et al. 1979. Snow-covered area utilization in runoff forecasts. Jour. Hydraulics Div., ASCE 105:HY1:53-66.

The Newsletter is made possible by a grant from the National Aeronautics and Space Administration. Comments or correspondence should be directed to Dr. Warren R. Philipson, Remote Sensing Program, Cornell University, 464 Hollister Hall, Ithaca, NY 14853 (tel. 607-256-4330).

The Newsletter, a monthly report of articles and events in remote sensing, is sent to members of the Cornell community who have an interest in sensors and their applications.

MONITORING DAMS WITH REMOTELY SENSED DATA

The value and use of remotely sensed aircraft and satellite data for inventorying dams, determining their hazard class, and assessing their condition were reviewed in a recent study by staff of Cornell's Remote Sensing Program. The work culminated in the development of a methodology for increasing the efficiency and accuracy of field-based dam inspection by incorporating remote sensing techniques into state or federal monitoring activities.

The methodology focuses on the New York State Dam Safety Program, placing emphasis on readily available remotely sensed data--aerial photographs and Landsat satellite data. Aerial photographs are employed in establishing a statewide data base, referencing dam information to county highway and U.S. Geological Survey 1:24,000 scale topographic maps. Updating of the data base is performed on a county or regional basis using aerial photographs or Landsat data as a primary source of information. In general, field inspections are limited to high-hazard or special problem dams, or to dams which cannot be assessed adequately with aerial photographs. (continued, page 2).

SURVEY FOR URBAN-MOSQUITO CONTROL

In a NASA-sponsored demonstration project for the New York State Department of Health, staff of Cornell's Remote Sensing Program completed an airphoto survey of potential mosquito breeding sites in an urban area of central New York. A comprehensive inventory of over 400 permanent and seasonal wet sites was derived entirely through stereoscopic analysis of 1:5,000 scale panchromatic aerial photographs, supplied by the U.S.A.F. Rome Air Development Center. All inventory data were submitted to State Health officials on an overlay to a 1:9,600 scale planimetric map. (continued, page 2).

CONFERENCES

2nd Congress Quebec Remote Sensing Association; 3-4 May; in Sherbrooke, Canada; Contact: Dr. Ferdinand Bonn, Dept. de Geographie, Univ. de Sherbrooke, Sherbrooke, Quebec, Canada J1K 2R1.

Symposium on Measurement, Mapping, Management in the Coastal Zone from Virginia to Maine; 21-23 May; in New York, N.Y.; sponsored by American Congress on Surveying and Mapping; Contact: MMM Symposium, Federal Building, Suite 32-120, 26 Federal Plaza, New York, N.Y. 10007.

3rd International Conference on Cartographic Processing and Analysis of Satellite Imagery; 19-22 June; in Toulouse, France; Contact: G.D.T.A., 18, avenue Edouard-Belin, 31055 Toulouse Cedex, France.

SEMINAR IN REMOTE SENSING

The Seminar in Remote Sensing is held on Wednesdays, at 4:30 p.m., in B14 Hollister Hall. Anyone is welcome to attend. Seminars scheduled for April are, as follows:

Wed., 4 Apr	Spectral Properties of Natural Targets Observed with an Airborne, 500-Channel Spectroradiometer: William E. Collins, Columbia Univ. & Goddard Inst. for Space Studies, N.Y., N.Y.
Wed., 11 Apr	Wetland Classification and Environmental Monitoring Using Digital Data: Gregory M. Wickware, Lands Directorate, Canada Centre for Inland Waters, Burlington, Ontario, Canada.
Wed., 18 Apr	Digital Image Processing on the Illiac IV: R. Michael Hord, Institute for Advanced Computation, Alexandria, Virginia.
Wed., 25 Apr	NO SEMINAR--Remote Sensing Symposium in Michigan

2. Monitoring Dams, cont'd.

Although the methodology places emphasis on available data, the parameters for acquiring new aircraft data are outlined and various sensors are considered. Large scale (1:10,000) vertical, stereoscopic, color-infrared aircraft photography, flown during periods of minimum vegetation and no snow, is recommended for assessing dam condition.

The study was conducted by Jan P. Berger under the direction of Warren R. Philipson and Ta Liang, and with the cooperation of Kenneth D. Harmer of the New York State Department of Environmental Conservation. Funding was provided by a grant from the Office of Water Research and Technology, U.S.D.I., and by an ongoing grant for applied research from the National Aeronautics and Space Administration. Copies of the final report, "Remote Sensing Assessment of Dam Flooding Hazards: Methodology Development for the New York State Dam Safety Program," are available from NTIS, 5285 Port Royal Rd., Springfield, Va., 22161 (NTIS No. PB289371; $3.00 microfiche, $5.25 paper copy). A limited number of copies of the report are also available from the Remote Sensing Program, Cornell Univ., Hollister Hall, Ithaca, N.Y. 14853, for a charge of $5.00 per copy.

Mosquito Survey, cont'd.

Selected field checks by county health personnel verified the accuracy and value of the airphoto inventory. All ground-level sites sampled had mosquito larvae or cast skins. In addition, the inventory pointed out one potential drawback of conventional ground surveys in urban areas--over 15% of the identified sites were water accumulations on rooftops. Although no mosquito larvae were found at any of the rooftops sampled, most sites supported varying degrees of plant and insect life, indicating that mosquito breeding could occur during the summer. Based on these findings, officials of the State Health Department are currently considering aerial surveys in other parts of the State.

The airphoto analysis was performed by William R. Hafker under the direction of Warren R. Philipson. For further information, contact Dr. Philipson at Cornell, or Dr. Charlie Morris, N.Y.S. Dept. of Health, Illick Hall, Rm. 133, College of Environmental Science & Forestry, Syracuse, N.Y. 13210 (tel. 315-473-8751).

SHORT COURSES

Remote Sensing Techniques and Applications in Arid Lands; 14-25 May; $650 fee; Contact: Philip N. Slater, Committee on Remote Sensing, Bldg. 94, Univ. of Arizona, Tucson, Ariz. 85721 (tel. 602-626-4242).

4th Annual Institute of Cartographic Methods and Remote Sensing Applications; six 3-credit courses conducted over two 5-week sessions from 4 June to 10 Aug.; $85/credit or $1,000/total on non-credit basis, plus fee; Contact: Prof. Bruce LaRose, Inst. of Cartography, Pace University, Briarcliff Manor, N.Y. 10510 (tel. 914-769-3200).

RECENT PUBLICATION

Todd, W.J., 1978. A selective bibliography: Remote sensing applications in land use and land cover inventory tasks. NTIS document #PB-283027/AS, 33pp. (N.T.I.S., 5285 Port Royal Rd., Springfield, Va. 22161, $3.00 microfiche, $4.50 paper copy.)

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FLOOD MODELING WITH LANDSAT

In a NASA-sponsored feasibility study, Landsat satellite imagery was used as the primary source of information on the extent of flooding in the Black River Basin of northern New York State. Similar to many other low gradient rivers, the Black River floods regularly, inundating farm land and breaching roadways. The average annual flood damages are estimated to exceed $500,000; however, ground surveys of inundation may be incomplete and thus inadequate for estimating losses.

Landsat images (band 7, 0.8-1.1μm) depicting flood conditions during several flood seasons since 1973 were obtained for analysis. Through visual interpretation of photographically enlarged and projected images, the flood boundaries were delineated on matte acetate at a scale of approximately 1:84,000. A qualitative assessment of flood boundary changes and flood prone areas was obtained from the acetate sheets by overlaying different combinations of dates. For area measurements, however, the flood boundaries were further enlarged to 1:24,000 scale, U.S. Geological Survey map overlays. The area of flooding depicted on each map overlay was then determined with a planimeter, and the total area of inundation was tabulated for each date.

A "best estimate" curve was developed to relate the area of flooding in the most critical portion of the basin to discharge measurements recorded at a station some 30 kilometers downstream. Successful refinement of this curve will allow real-time estimation of the extent of flooding to be made on the basis of in situ discharge measurements.

The study was conducted by Jay N. McLeester under the direction of Warren R. Philipson. A follow-up investigation has been proposed, and this would employ various visual enhancement techniques and Landsat digital data to improve the flood boundary delineation and curve reliability. For further information, contact Dr. Philipson at Cornell, or Mr. Kenneth H. Mayhew, Chief Engineer, N.Y.S. Board of Hudson River-Black River Regulating District, 491 Eastern Boulevard, Watertown, N.Y. 13601 (tel. 315-788-5440).

SEMINAR IN REMOTE SENSING

The final seminar of the spring semester will be held on Wednesday, 2 May, at 4:30 p.m., in B-14 Hollister Hall. Anyone is welcome to attend. The speaker, Benny M. Sørensen, is a project manager with the Joint Research Center of the Commission of the European Communities, and he is located at the Ispra Establishment, Varese, Italy. His topic is "The European Ocean Color Scanner Experiment 1977 in the North Sea."

CORNELL STUDENT RESEARCH IN REMOTE SENSING

Topics which are currently being investigated by Cornell students in Aerial Photographic Studies and Remote Sensing (Civil and Environmental Engineering) are: a remote sensing analysis of lateritic engineering materials for Thailand (Pichit Jamnongpipatkul, Ph.D. candidate); detection and categorization of inactive surface mines with small scale remotely sensed data (Jan Berger, M.S. candidate); Landsat analysis of flooding in the western plains of Venezuela (Rafael Avila, M.S. candidate); and mineral exploration in the western Adirondacks, N.Y. (Caren Rubin, MEC candidate). Other topics being considered for remote sensing thesis research include arid regions (William Teng, Ph.D. candidate), tropical crops (Elaine Aderhold, M.S. candidate), and coastal environments (William Hafker, M.S. candidate). For further information, contact the student, c/o Remote Sensing Program, Cornell Univ., Hollister Hall, Ithaca, N.Y. 14853.

NEWS MISINFORMATION

Contrary to recent news reports, infrared surveys to assess building insulation do require special sensors. They cannot be performed with infrared photographic films. National news reporters are apparently unimpressed by the remote sensing community's efforts to correct this misconception.

REMOTE SENSING FACULTY POSITION OPEN AT CORNELL

Cornell University's School of Civil and Environmental Engineering is seeking to fill one faculty position in Remote Sensing, at the assistant or associate professor level. Applicants should have a thorough background in airphotos and remote sensing, with a Ph.D. degree in engineering or natural sciences. Academic and professional experience should have emphasis in quantitative remote sensing and digital analysis, and/or qualitative remote sensing and applications. The position will involve teaching and advising undergraduate and graduate students, and developing and conducting research in various disciplines. The teaching and research will interface with airphoto interpretation. Please send a detailed resume and references to Professor Ta Liang, Remote Sensing Program, School of Civil and Environmental Engineering, Hollister Hall, Cornell University, Ithaca, N.Y. 14853. Cornell is an equal opportunity/affirmative action employer and welcomes applications from women and minority members.

WORKSHOPS/SHORT COURSES

Eastern Regional Remote Sensing Workshop; 4th Friday, every month; at NASA Goddard Space Flight Center; no cost; Contact: Dr. Nicholas Short, ERRSAC, NASA/GSFC, Code 902.1, Greenbelt, Md. 20771 (tel. 301-344-5515 or 800-638-0748).

Terrain Analysis--Interpretation of Aerial Photographs & Images; 18-22 June; in Sioux Falls, S.D.; $450 fee; Contact: Ms. Lisa Underkoffler, Continuing Education Summer Program, Harvard Graduate School of Design, Gund Hall L-37, Cambridge, Mass. 02138 (tel. 671-495-2578).

Remote Sensing & Image Interpretation; 18-22 June; at Univ. Minn.; $110 fee; Contact: Eugene Anderson, Office of Special Programs, 405 Coffey Hall, 1420 Eckles Ave., Univ. of Minnesota, St. Paul, Minn. 55108 (tel. 612-373-0725).

CONFERENCES/MEETINGS

Annual Meeting, Central New York Region-Amer. Soc. Photogrammetry; 18 May; in Ithaca, N.Y.; Contact: William Teng, Cornell University, 464 Hollister Hall, Ithaca, N.Y. 14853 (tel. 607-256-4330).

Remote Sensing for Natural Resources--An Int'l. View of Problems, Promises & Accomplishments; 10-14 Sept.; at Univ. Idaho; Contact: Univ. of Idaho, Office of Continuing Education, Moscow, Idaho 83834.

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NASA Lyndon B. Johnson Space Center. 1978. Skylab EREP investigations summary. NASA SP-399. NASA, Washington, D.C. 386 pp. (Available: Superintendent of Documents, U.S. Gov't. Printing Office, Washington, D.C. 20402; no. NAS 1.21:399; stock no. 033-000-00741-8; $13.50).

Proc. 4th Canadian Sympos. Remote Sensing. Held May 1977, Quebec. Papers in French or English. 626 pp. Available: Canadian Aeronautics & Space Inst., Saxe Bldg., 60-75 Sparks St., Ottawa, Ont., Canada K1P 5A5. ($40).

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Tyler, J.E. 1979. In situ quantum efficiency of oceanic photosynthesis. Applied Optics 18:4:442-445.
Welsted, J. 1979. Air-photo interpretation in coastal studies--Examples from the Bay of Fundy, Canada. Photogrammetria 35:1:1-27.
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- -Cannon et. al. Comparison of image restoration methods.
- -Genda & Okayama. Estimation of soil moisture and components by measuring the degree of spectral polarization with a remote sensing simulator.
- -Fujii et al. Incoherent optical heterodyne detection and its application to air pollution detection.
- -Peppers & Ostrem. Determination of wave slopes from photographs of the ocean surface: A new approach.

Bulletin of Amer. Metereological Soc. 1978. v.59, n.12

- -Gruber & Winston. Earth-atmosphere radiative heating based on NOAA scanning radiometer measurements.
- -Houghton & Suomi. Information content of satellite images.
- -Rasool, I. NASA's role in weather prediction.

IEEE Transactions on Geoscience Electronics 1979. GE-17, no.1

- -Fung, A. Scattering from a vegetation layer.
- -Kaupp & Holtzman. Skylab scatterometer measurements of Hurricane Ava.

IBM Jour. of Research & Development 1978. v.22, n.5

- -Santisteban & Munoz. Principal components of a multispectral image: Application to a geological problem.
- -Hernandez & Flores. Machine processing of remotely sensed data: Three applications in Mexico.

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- -Sicco Smit, G. Shifting cultivation in tropical rainforests detected from aerial photographs.
- -Spiers, B. A vegetation survey of semi-natural grazing lands (dehesas) near Merida, S.W. Spain.

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- -Tonelli, A.M. Surface texture analysis with thermal and near infrared scanners.
- -Scarpace, F.L. Densitometry on multi-emulsion imagery.
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- -Talerico et al. Quantifying gypsy moth defoliation.
- -Hsu, S. Texture-tone analysis for automated land-use mapping.
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- -White, M.E. Reservoir surface area from Landsat imagery.

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Photogrammetric Eng'g. & Remote Sensing 1978. v.44, n.12 (Dec.)
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-Lemme & Westin. Landsat-simulating radiometer for agricultural remote sensing.

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-Grunthal & Smith. Photogrammetry is many things.

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-Ikeda & Stevenson. Time series analysis of NOAA-4 sea surface temperature data.

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-Kondratyev & Pokrovsky. A factor analysis approach to optimal selection of spectral intervals...
-Fuller & Rouse. Spectral reflectantance changes accompanying a post-fire recovery sequence in a subarctic spruce lichen woodland.
-Miller & Carter. Rational land use decision-making: The Natchez State Park.
-Evans, R. Air photos for soil survey in lowland England...
-Turk, G. GT Index: A measure of the success of prediction.
-Bauer et al. Identification and area estimation of agricultural crops by computer classification of Landsat MSS data.

SUMMER VACATION/ADDRESS CHANGES

Volume VII of the Cornell Remote Sensing Newsletter ends with this May issue. The Newsletter is currently received by more than 500 individuals and groups in 40 states and 20 countries. As planned, Volume VIII of the Newsletter will begin next September. Notices of address changes should be sent to the Remote Sensing Program (see below).

The Newsletter is made possible by a grant from the National Aeronautics and Space Administration. Comments or correspondence should be directed to Dr. Warren R. Philipson, Remote Sensing Program, Cornell University, 464 Hollister Hall, Ithaca, NY 14853 (tel. 607-256-4330)