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REMOTE SENSING IN CANADA

RESORS

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A NATIONAL PROGRAMME IN REMOTE SENSING IS COORDINATED BY THE DEPARTMENT OF ENERGY, MINES AND RESOURCES IN CO-OPERATION WITH OTHER AGENCIES OF THE GOVERNMENT OF CANADA, PROVINCIAL GOVERNMENTS, INDUSTRY AND CANADIAN UNIVERSITIES

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TENTH CANADIAN SYMPOSIUM ON REMOTE SENSING

MAY 5-8,1986

WESTIN HOTEL , EDMONTON , ALBERTA ,CANADA

Theme: Technology for Value

This Symposium is open to anyone interested in the technical advances and practical usage of remote sensing. The sponsors are the Canadian Remote Sensing Society of the Canadian Aeronautics and Space Institute, the Canadian Institute of Surveying, and the Canada Centre for Remote Sensing.

The technical program will feature all aspects of remote sensing, including:

* sensors
* data acquisition
* processing and analysis
* environmental monitoring

with special emphasis on

* value of remotely sensed data in operational use.

Early registration is before April 18, 1986. Registration forms and information can be obtained from:

Alberta Remote Sensing Center
11th Floor, Oxbridge Place
9820 - 106th Street
Edmonton, Alberta
T5K 2J6

Telephone: (403) 427-2381
Telex: 037-2006

Canadian Remote Sensing Society
222 Somerset Street West
Suite 601
Ottawa, Ontario
K2P 0J1

Telephone: (613) 234-0191

Editor's Note

Thank you to all of this issue's contributors, and a reminder that articles and notices for future issues are always welcome. Please address your submissions to:

The Editor
Remote Sensing in Canada
2464 Sheffield Road
Ottawa, Ontario
K1A 0Y7

Deadline for articles to appear in the next issue: April 14, 1986.

1052203

Land Use Change at the Forest/Agriculture Boundary

In Canada, the boundaries between forest land and agricultural land, and to a lesser extent between wetland and agriculture, are areas of dynamic change in land use. An overview of the subject by M.F. Fox and S.L. Macenko ("The Agriculture - Forest Interface: An Overview of Land Use Change", Lands Directorate Working Paper No. 38, 1985) presented much detail and insight into the type and amount of such change found in parts of Canada. One conclusion presented in the overview was that satellite remote sensing can play an important role in the monitoring of this type of land use change.

Gregory Geoscience Ltd. has conducted research to define possible ways in which LANDSAT data could be used as part of an information analysis package. In this experiment, it was proposed to determine if accurate and up-to-date information on land use and land cover derived by LANDSAT analysis should be an important component of any land use analysis program.

The area of the experiment was limited to one township in the Peace River area of Alberta (Tp 108 R 13 W5). This township includes the town of Fort Vermilion and has a good mix of forest and agriculture.

Earlier work by Gregory Geoscience Ltd. for Statistics Canada under the guidance of Dr. R.A. Ryerson, demonstrated that, for this area, LANDSAT MSS data could be used to map change from forest to agriculture with high accuracy. It was also demonstrated that the land cover of the new agricultural land could be classified as grains, oil seeds, hay pasture or fallow with good accuracy.

In order to rapidly analyze the interrelationships of different data sets, it is important to have an efficient Geographic Information System (GIS). For this experiment, the Spatial Analysis System of Tydac Technologies Inc. was used. It has a very efficient system for compaction and storage of data, as well as a very powerful package for data analysis, all operating on a microcomputer.

The following data base input files were used:

1. CLI agricultural capability
2. CLI forestry capability
3. 1971 agricultural and forest area
*4. 1976 agriculture and forest change
*5. 1981 agriculture and forest change
*6. 1981 agriculture land cover for 1971-1981 change areas.
7. Road network and river for base reference.

* Derived from LANDSAT data.

The spatial analysis of this data base is very rapid with output in map and tabular form (see the following CLI maps). Interesting statistics have been developed from the preliminary analysis, such as:

1. of the 8400 ha of land in the township - 2500 ha were cleared before 1971, 600 ha were cleared between 1971-1976, and 800 ha were cleared between 1976-1981.

2. 5228 ha are CLI class 3,4 agricultural land, 3021 ha are CLI class 3,4 forestry land.

3. 91% of the land opened between 1971-1976 was class 3 agricultural land while only 66% of the land opened between 1976-1981 was in that class, the balance being in lower capability class 4.

4. of the 1400 ha of land converted from forest to agriculture between 1971-1981, in 1981: 50% was cereal crops, 30% was fallow, 10% was oil seed, and 10% was hay.

Other statistics have been produced to define the land use change for this area and relate it to the land capability. Some general conclusions can be made from this experiment:

1. The rate of agricultural expansion increased during the period 1971-1981.

2. More of the land recently cleared for agriculture is of a lower agricultural capability than land cleared early in that period.

3. Land with high forest capability is being increasingly cleared for agriculture.

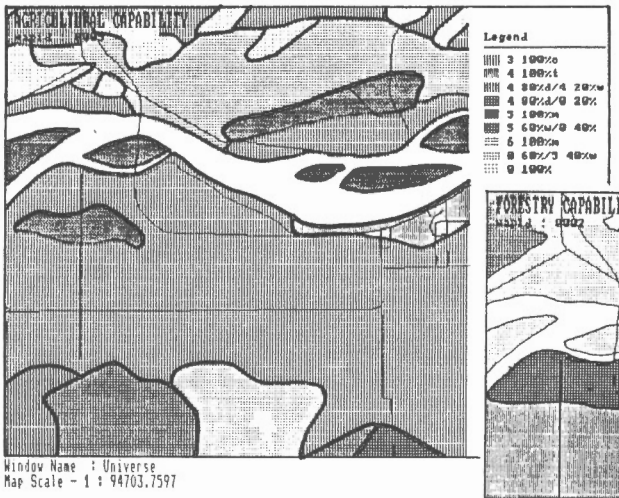
4. 50% of the land cleared between 1971 and 1981 was planted in cereal crops in 1981.

The experiment has demonstrated the power of quick, inexpensive LANDSAT interpretation combined with digital spatial analysis. Research is continuing on the application of this type of integration of remote sensing with spatial analysis.

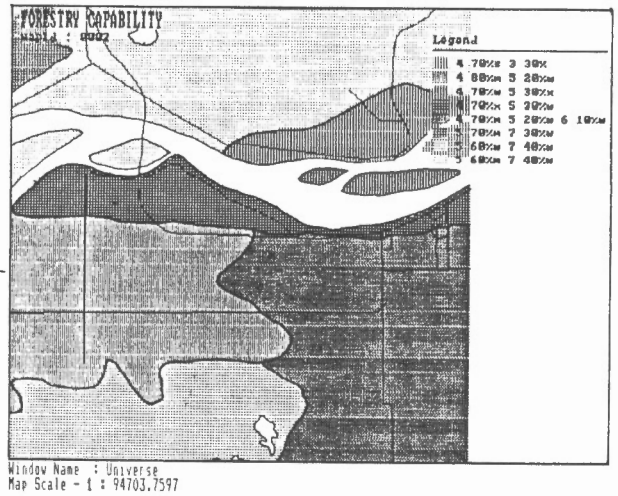
For more information contact:

Harold D. Moore
Vice President Operations
Gregory Geoscience Limited
PRISM Division
1794 Courtwood Crescent
Ottawa, Ontario
K2C 2B5

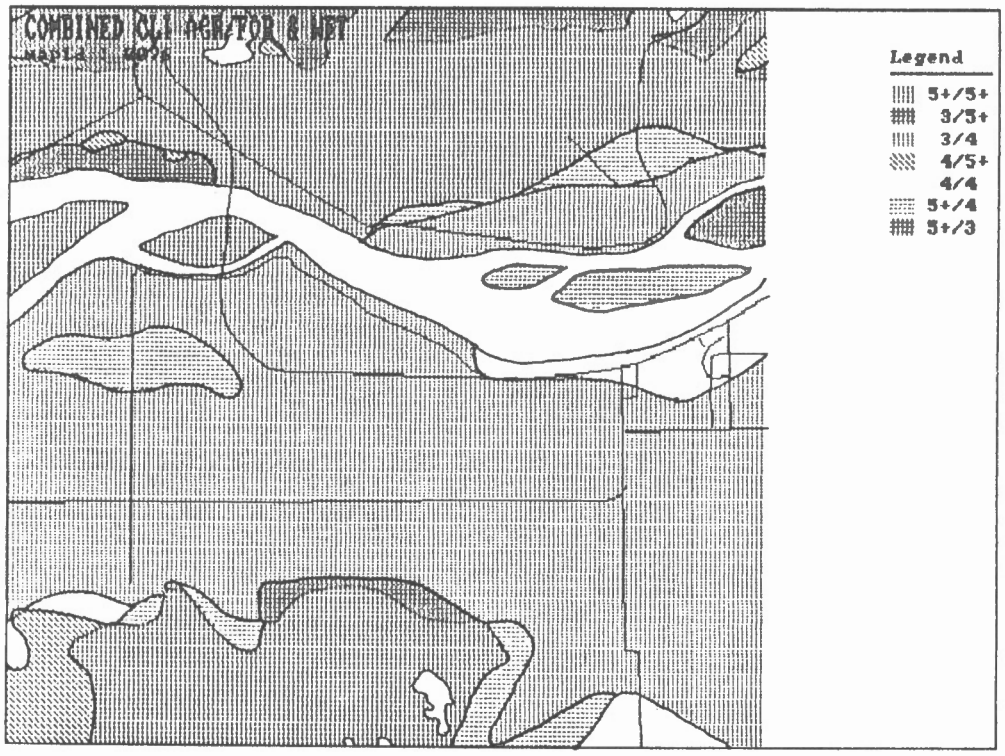
Phone: (613) 224-9565
Telex: 053-4370 OTT



CLI Agriculture and Forestry maps used in the experiment.



Combined CLI map of the above data sets.



NOTE: The originals of these computer-generated maps are in colour.

Thematic Mapper Products

The user response to Thematic Mapper (TM) products has been greater than expected. CCRS has had to triple the planned production for TM quadrants on our research system (TMTS) in Ottawa. We are now producing quick look TM data at the Prince Albert Satellite Station (PASS), Saskatchewan. We have also begun to produce full scene images on contract at MDA in Vancouver. As a result of demand, dispersed location of our production systems, and the resulting pressure on both systems and staff, delivery has been slower than users have come to expect for MSS products from PASS. These problems should largely disappear in mid-year when the full TM production system is installed at PASS. In the meantime, we thank users for their understanding. We shall continue to attempt to deliver TM data within eight to twelve weeks from the date the order is received at the Prince Albert order desk (306-764-3602).

In response to users' requests, CCRS is now producing 1:50,000 TM photo products. Orders must be accompanied by a 1:50,000 or 1:250,000 map outlining the approximate area for enlargement. For technical reasons, band 6 is not available and area covered may be approximate.

After producing scores of photographic TM images, we have become more experienced, and can offer further guidelines to users.

Users should not order images with clouds or other large, extremely bright objects either east or west of their areas of interest. These large, bright features usually cause banding immediately to the east and west of their location. Bright features at the edge of a full scene image, or at the edge of the adjacent east/west quadrant may cause additional problems. These relate to the fact that the TM sensor scans in both directions and is particularly sensitive to dramatic changes in brightness.

If users wish to order a scene with mountains, clouds, water, snow, ice, cities or other high contrast features, they should clearly specify their main area of interest. Images usually cannot be produced to bring out details within two highly contrasted features.

In addition to these other difficulties, CCRS and users have had problems with the so-called "normal colour" TM photo products. These are composed of bands 1, 2 and 3 as blue, green and red, respectively. At certain times of the year, such as winter and mid-growing season, normal color is <u>not</u> recommended. The basic problem is that the green vegetation tends to be dark, with little contrast within it. Also, haze and smoke severely limit the available detail. In winter, one sees conifers and snow and often nothing else. For mid-summer images, or where one might expect haze, high contrast features or large quantities of green vegetation, we recommend the purchase of color infrared composites or other combinations. CCRS is doing further research into this problem.

R.A. Ryerson
User Assistance and Marketing Unit
CCRS

A Day at CACRS

Over the past several years, members of Canadian industry have expressed interest in attending part of the annual meeting of the Canadian Advisory Committee on Remote Sensing (CACRS).

The Advisory Commitee is very anxious to have input from industry and have been considering how this could be accomplished without being discriminatory and, at the same time, preserving the working group nature of the meeting. Therefore in 1986, Canadian remote sensing industries are invited to send a maximum of one representative each to listen to a panel discussion and participate in workshops on "A Futuristic Outlook on Remote Sensing" (looking at potential scenarios around the year 2000), at the Government Conference Center, Arnprior, Ontario on Thursday, April 3, 1986. Industrial visitors must pay their own travel and accommodation costs, but lunch will be provided during Thursday.

If you are interested in attending this session, please confirm your interest in writing before the end of March, if possible, to:

Frances Macdonnell
CACRS Liaison
Canada Centre for Remote Sensing
2464 Sheffield Road
Ottawa, Ontario
K1A 0Y7

Uniform Productivity Area and Land Use Maps

Two maps are now available to assist in analyzing and interpreting satellite imagery of the agricultural region of Manitoba, Saskatchewan and Alberta. For each province, a Uniform Productivity Area (U.P.A.) map and Land Use map have been prepared at a scale of 1:1 000 000 for large area applications. Each is available individually or in any combination along with a physiographic reference base map (rivers, towns, highways) and a Crop Reporting District map. They may be obtained as a transparency or as an ozalid map product.

The U.P.A. maps delineate broad areas having similar vegetation and cropping practices associated with known soil and climatic characteristics. Soil and climatic parameters were used which most dominantly affect vegetation growth and cropping practices under dryland conditions in temperate regions. Several years of summer LANDSAT scenes were used to map the areas having a level of uniformity of agricultural productivity and spectral response defined by soil landscape boundaries. The soil landscape areas for the U.P.A. maps were developed from the Generalized Landscape Maps which had been specially prepared by the Land Resource Research Institute, Agriculture Canada, from standard soil survey information (1:30 000). The companion Land Use map identifies the areas of major land-use categories as defined by the Canada Land Inventory (i.e. Grasslands wooded areas, cultivated fields, water bodies). The boundaries for the previously mapped areas were updated using recent LANDSAT images.

By overlaying the Land Use map on satellite imagery (LANDSAT MSS or NOAA-AVHRR), the major "permanent" features are readily identified and the unwanted categories eliminated from further analysis. The U.P.A. overlay segregates the remaining image into classes having known land features associated with different vegetation cropping and cultural features for subsequent analysis and interpretation.

Spectral data of vegetation under dryland agricultural practices represent an integration of the radiation reflected from both the plant and the uncovered soil surface. By stratifying the data according to soil climatic zones and textural classes some of the variability from soil reflectance component (noise) is reduced and variations due to "plant" phase may be more readily analyzed and interpreted.

The first edition (1985) will be revised at a future date and slight modifications are anticipated resulting from new techniques and revisions which Agriculture Canada will be undertaking.

The maps were prepared in a cooperative arrangement between Agriculture Canada and the Canada Centre for Remote Sensing.

For more information, contact the authors or the CCRS User Assistance Unit.

Alexander Mack
Agriculture Canada

Christian Prévost
Canada Centre for Remote Sensing

David Bain
Student, Waterloo University

Proceedings of the Vth Conference of the Quebec Remote Sensing Association

The Quebec Remote Sensing Association (L'Association québécoise de télédétection) announces the publication of the Proceedings of the Vth Conference of the Association held in Chicoutimi (Quebec), May 22 to 24, 1985. The book contains over 625 pages, nine of which are color plates.

The Conference theme was "Remote Sensing and Resources Management: Operational Aspects". Close to 50 papers were presented (pleniary and poster sessions), and over 250 persons were present during the three day period.

The Proceedings reproduce papers presented during this event, and all relate to the operational aspects of Remote Sensing. Applications in many fields are presented such as: cartography, agriculture and land-use, forestry, geology and environment. Also, different development policies, programs, methodologies and data processing techniques are addressed. Finally, results of a round table discussion under the theme "Operational Remote Sensing: realities and perspectives" are to be found.

The book is available through the Association québécoise de télédétection, C.P. 10047, Sainte-Foy, Québec, G1V 4C6.

Price: 35.00$ Members of L'A.Q.T.
40.00$ Non-members

Papers are mainly in French, with abstracts in English.

Gaëtan L. Lessard

RADARSAT Incorporates In-Orbit Servicing

RADARSAT, Canada's first remote sensing satellite is planned for launch in the early 1990's. It is now in phase B, the system definition and ground segment definition phase. In planning for RADARSAT we are intending to design the satellite with a capability for in-orbit servicing (IOS). This means that after the satellite has been in operation for perhaps five years it can be flown down to rendezvous with the shuttle and have items like batteries, tape recorders, even solar arrays changed for new ones. Fuel tanks can be refilled and sensors can be replaced with new (or improved) ones.

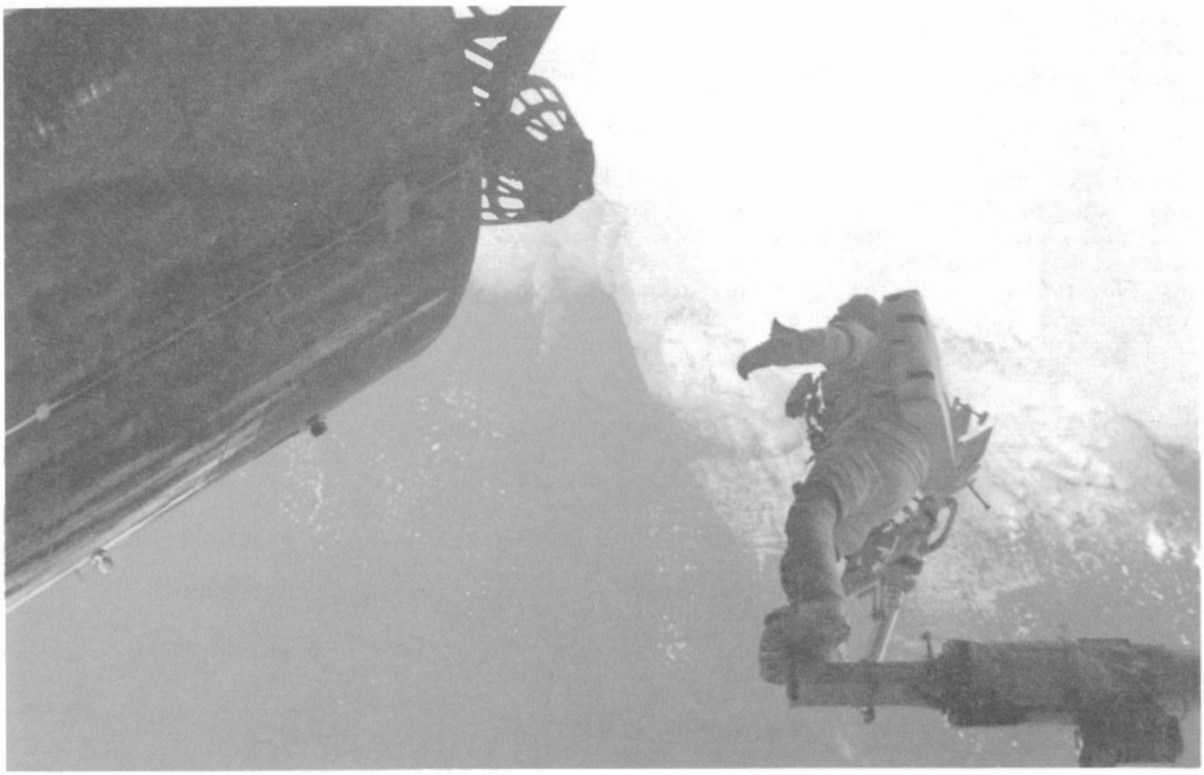
This IOS mission will require astronauts to go EVA (Extra-Vehicular Activity) to accomplish the maintenance tasks. In this regard, astronauts train in advance in a large water tank where they go down in their regular space suits, and experience a weightless environment similar to that of space. The tank is large enough to accommodate the entire shuttle bay. Apart from rehearsals for the mission, the tank is also used earlier in the program to validate the design of the satellite - that is, a mock-up of the satellite is made, full scale, with the regions that require servicing fabricated in high fidelity. The astronauts can then determine whether such aspects as access, visibility, and muscular effort are suitable. Often this process leads to redesign to ensure smooth, reliable and safe EVA operations.

In November, a number of staff on the RADARSAT program from Spar Aerospace and the government visited the NASA Johnson Space Centre in Houston to examine the tank - termed WETF, Weightless Environment Test Facility - and to discuss with NASA staff how our training mock-up should be fabricated.

Another feature of the visit was a workshop that was being held at the Space Centre on the subject of satellite servicing. A highlight of the workshop was a presentation and film by astronaut Dr. James van Hoften on the remarkable repair task that he and Bill Fisher accomplished in September 1985 with the failed Leasat spacecraft.

Jim van Hoften had previously repaired the Solar Max satellite in April 1984. He visited Ottawa in June 1984 to consult with RADARSAT designers and to offer advice based on his experience in space. (See Remote Sensing in Canada, Vol. 13, No. 1, Spring 1985).

H.R. Warren



Astronaut James van Hoften, repairing the Leasat satellite, September 1985.

1052204

Forest Clearcut Mapping in Northern Ontario Using LANDSAT Thematic Mapper

Introduction

Clearcut mapping operations in Ontario are generally carried out by each of the district offices of the Ministry of Natural Resources and/or, more recently, by logging companies which have signed long term Forest Management Agreements with the provincial government. Clearcut mapping normally consists of annually mapping cutovers from supplementary aerial photograph (SAP) usually taken as soon as possible after the end of the government fiscal year (March 31). Mapping of clearcuts and other features consists of transferring boundaries from the photography to the Forest Resources Inventory (FRI) forest stand maps using manual techniques. Statistics such as area cutover and species depleted are subsequently measured and included in annual reports to the Ministry of Natural Resources head office in Toronto.

Previous studies using MSS data for clearcut mapping have shown that high classification accuracies are obtainable, particularly in softwood forested areas. Most of these studies have used either digital image-to-image change detection methods or manual mapping at small scales independent of forestry maps.

The present study has been conducted in order to assess the capability of higher resolution Thematic Mapper images. Combined with a cost-effective methodology this could encourage foresters presently conducting clearcut mapping to continue their mapping operations using satellite images.

Method

Pelletier Township in the Hearst district of northern Ontario was chosen as the study site. A system corrected 1:500 000 Thematic Mapper transparency in a natural colour format (bands 1, 2, 3) recorded on August 5, 1984 was used as data.

An image-to-map method was utilized rather than an image-to-image comparison of changes. The image was integrated with a clean copy of an FRI (forest stand) map of Pelletier Township at a scale of 1:15 840. The integration was facilitated by the PROCOM-2 optical instrument. The instrument is designed to allow small scale data such as LANDSAT images to be integrated with large scale data such as forest inventory maps.

The boundaries of all clearcuts up to 1984 were delineated on the map. Features common to both data sets such as water bodies, marshes and roads were used as geographic control. Area measurements were obtained using a Hewlett Packard digital planimeter.

Results

Partial results of the clearcut mapping using TM are shown in a reduced form in Figure 1. For comparison purposes, a map of clearcuts derived by conventional means is shown in Figure 2. Area measurements are presented in Table 1.

Using TM interpretation, the total area of clearcutting over the nine years was 6925.3 ha. The comparable area by conventional interpretation was 6800.3 ha, giving a difference of 1.8%. However, the difference is only relative since the comparison data cannot be considered as absolute "truth" in either classification or position.

The overall distribution of clearcuts is very similar using the two methods of interpretation (Figures 1 and 2). The differences that exist between the two interpretations result from a variety of factors:

1. Positional errors: These are mainly due to incorrect positioning of clearcuts from the photography. Geometric errors in low altitude photography are believed to be greater than the near-orthographic projection of the TM. The relative positioning of high contrast features such as clearcuts using LANDSAT TM at large scales has been measured at less than 20 m (±1.3 mm at 1:15 840), when local registration techniques are used.

2. Omissions in mapping: Some areas of clearcuts were not mapped from one of the data sets. The greatest differences were areas which contained obvious clearcuts but were not mapped from the SAP. All major differences are currently being re-examined from the original photography.

3. Selective cutting: Another difference between the two interpretations is related to partially or selectively cut areas of the forest. Some of the areas were not observed; others were difficult to map from the TM image. However, selective cutting represents a small proportion (1%) of the change in Pelletier Township.

It was found in this study that areas of clearcut less than about 2 ha in size could be detected on the TM image, but portraying their shape and size correctly was not always

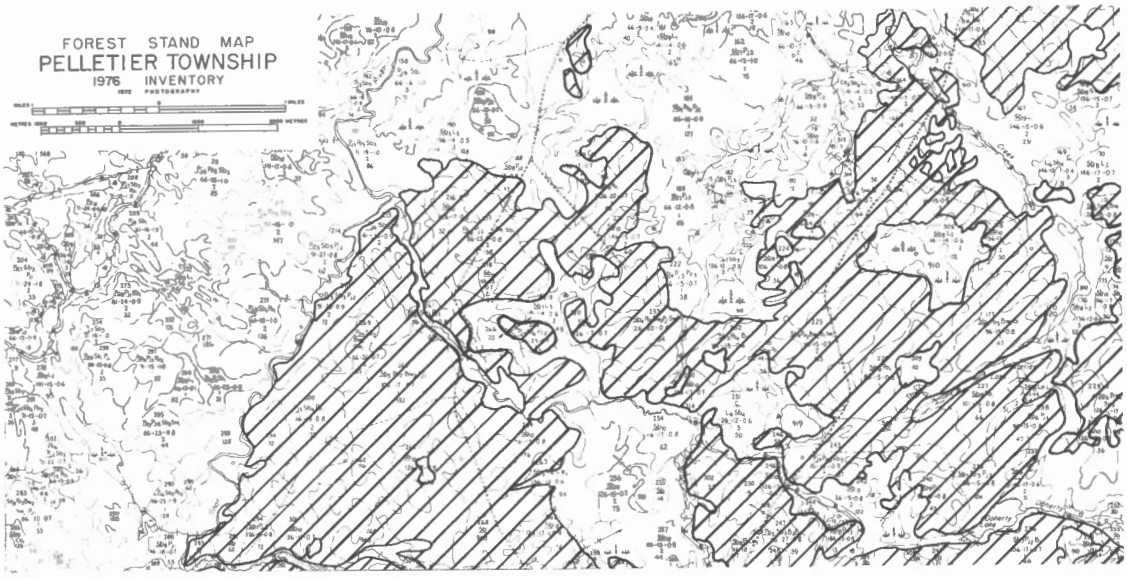


Figure 1: Forest clearcuts of Pelletier Township 1975-1984 as mapped from Thematic Mapper image.

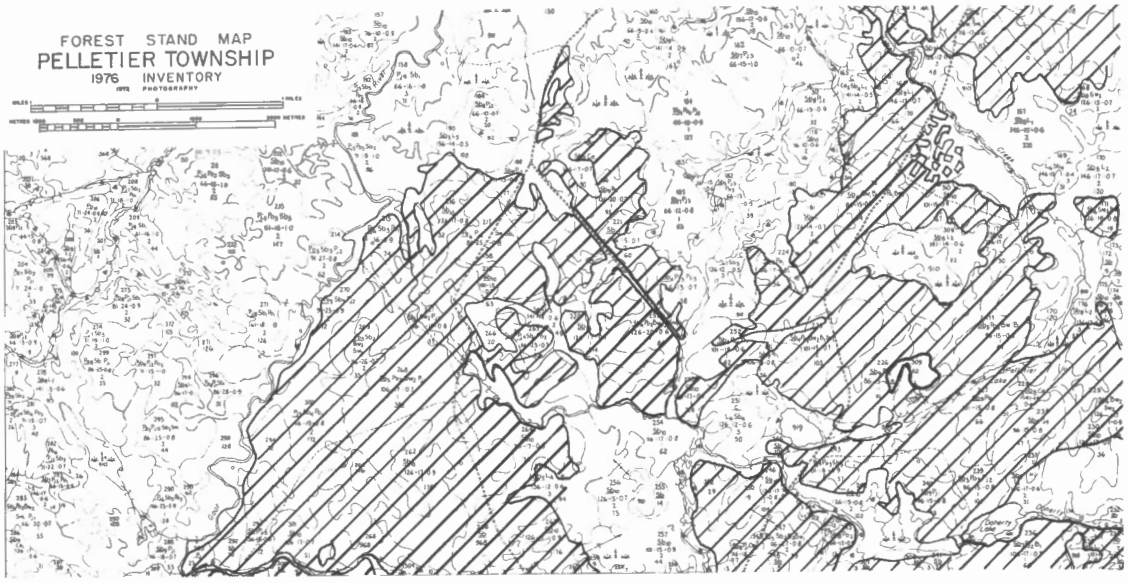


Figure 2: Forest clearcuts of Pelletier Township 1975-1984 as mapped from supplementary aerial photography.

AREA CLEARCUT (HA)		DIFFERENCE	
LANDSAT-TM	SAP	HA	%
6925.3	6800.3	125.0	1.8

Table 1: Comparison of area of change in clearcuts between LANDSAT TM and supplementary aerial photography (SAP).

possible. The outlines of clearcuts greater than 2 ha in size are very similar in shape and size when either method is used.

Discussion

While the method used in this study has been shown to be accurate for mapping clearcuts at large scale, other advantages are apparent:

1. Other information important to the forester can also be mapped. Features such as roads, energy corridors, fires and encroachment of farmland are also visible and can be mapped with similar accuracy (±20 m).

2. A wide time frame can be chosen. Either summer or winter images can be interpreted for clearcuts when the map information is an integral part of the interpretation process.

3. The costs of data and instruments are relatively low and the interpretation techniques are similar to those used for photo interpretation. Therefore, this method could be readily used by foresters familiar with photo interpretation techniques.

4. Other types of images such as SPOT could be easily substituted for TM using this method.

5. Other band combinations which include one or more infrared bands can be used and may improve interpretation.

Conclusion

A relatively simple and cost-effective image-to-map technique was used to demonstrate that LANDSAT TM images can be used to accurately delineate clearcuts and other features which change in the forest environment. The technique could be of use to foresters at the provincial, regional or district level as well as those in private industry. The method can be used to either replace or supplement conventional methods.

For further information contact:

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K2C 2B5

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Telex: 053-4370 OTT

Remote Sensing Mission to India

Dr. R.A. "Bob" Ryerson, Chief of UAMU headed a remote sensing Trade Mission to India funded by External Affairs. Companies on the Mission included (from Western to Eastern Canada) Pamap Graphics, MDA, Intera Technologies, F.G. Bercha, Moniteq, Perceptron, Dendron Resource Surveys, Gregory Geoscience, Dipix Systems and Digim. The focus of the visit was the 6th Asian Remote Sensing Conference on Remote Sensing held in Hyderabad. The Canadian delegation was the third largest from any nation, and the largest non-Asian group. As a result of this mission it is expected that commercial and other remote sensing linkages between Canada and India will become much stronger.

R.A. Ryerson

CCRS Divisions Plan Move

The Canada Centre for Remote Sensing is currently spread around seven locations in the Ottawa area. This situation will improve next summer when three locations amalgamate into leased space in an office building at 1547 Merivale Road, Nepean in June or July 1986. The entire Applications Technology Division including User Assistance and Marketing, Technology Enhancement, Technical Information Services and RESORS will move to this building as well as the Methodology Section of Digital Methods Division. In other words, all units currently located at Belfast Road, Bank Street, and Woodward Drive. New telephone numbers will be available at a later date.

RESORS Update

RESORS (REmote Sensing On-line Retrieval System) now has over 50,000 remote sensing related documents in its collection. These documents include symposia proceedings, journals, books, technical reports, theses and newspaper articles. Also included are over 2,400 French language documents, and over 700 documents of other languages (e.g. German, Spanish, Portuguese, Japanese).

There are approximately 6,000 35 mm slides in RESORS. They consist of "theme" sets, teaching sets and RESORS-document related slides. Most slides have supporting documents or tapes.

Searches of our document and slide databases may be done by our experienced personnel or online via direct dial or the DATAPAC network. Documents listed in our database may be borrowed or photocopied for a nominal charge.

Our new edition of the RESORS keyword dictionary is now available. Other material available from RESORS includes SATLIS, a listing of remote sensing satellites of the past, present and future; ACRON, a compilation of remote sensing acronyms; and RESORSfiche, a catalogue of the RESORS collection. RESORSfiche are available to all online users.

RESORS Staff

SPECIAL NOTE TO ALL RESORS USERS:

RESORS has moved on March 1st, 1986 into temporary quarters at 25 McArthur Road, 6th Floor, Vanier, Ontario, K1A 0Y7. By June or July of this year, we expect to move into our permanent facilities at 1547 Merivale Road, Nepean, Ontario. We will keep you informed of phone number changes for RESORS, should they occur. Our present number is (613) 990-5870. Our telex number is 0533777.

RESORS service will continue with as little disruption as possible, except for a day or two when we will be closed at moving time. We apologize for any inconvenience to our users.

For further information regarding RESORS, contact us at our new location.

PCI Offers Wide Range of Services

Building on over three years of experience in image analysis software design, PCI is expanding its Image Analysis Services Department to provide consulting services to clients in the fields of mineral and oil exploration, engineering, forest resource management, agriculture and rangeland applications.

The company also offers a series of training courses in digital image analysis related to general remote sensing. The series includes image analysis, programming and software development using PCI's own EASI/PACE software.

A philosophy of hardware independence has enabled the company to convert all of its image analysis software to run on the IBM PC AT. This product, IMAVISION, was developed in cooperation with Roy Ball Associates of Ottawa, with technical assistance from the Department of Fisheries and Oceans (DFO). IMAVISION is expected to open a new market for image analysis in education, consulting, research, and regional and municipal planning applications. Also, a copying service is available to transfer clients' data from any of eleven magnetic tape formats (SPOT, TM, MSS, etc.) to 1.2 mb floppy disks.

PCI's current project is the development of an interactive geographic information system (GIS). Technical assistance is being provided by Environment Canada (Canada Land Data Systems Division) with funding from NRC-PILP. This system will have applications such as the alignment of agricultural and forestry reporting boundaries, and the registration of transportation route overlays or drill-hole locations with remotely sensed or thematic imagery. Phase I, with a projected completion date of 31 October, 1986, is a basic GIS that will allow input from remotely sensed image data. It will provide attribute and topological query functions, graphic coverage overlay and map or image output.

For further information on the company and its services, contact:

PCI
4800 Dufferin Street
Suite 202
Downsview, Ontario
M3H 5S8

(416) 736-0452

Forestry Geographic Information System: A New Service Offered by Dendron

Dendron Resource Surveys Ltd. is pleased to announce the acquisition of GEOMAP*, and the expansion of its services to include forestry computer mapping and resource data analysis. This service complements our regular photo interpretation, image analysis, resource mapping, data sampling and analysis, and forest management planning services.

GEOMAP is a complete stand-alone geographic information system (GIS) developed for use on microcomputers and minicomputers. The hardware consists of an XY digitizer, high-resolution colour graphics display, microcomputer with high capacity disc storage, a full mapsheet line plotter, ink jet colour plotter and printer. The software consists of a central data base around which several modules input or retrieve both digitized data and descriptive numbers, names, codes or symbols. The modules control input, editing, analysis, updating, and output (maps and tables) for resource management analysis and planning.

GEOMAP will be used to capture forest resource and related data in digital form. The system is designed to act as a "front-end" to existing large GIS's and will create data files compatible with these systems. As a stand-alone system it is capable of producing high-quality line maps. Through editing and overlay capabilities, it has the ability to update maps as changes occur. In forestry, this means monitoring the effects of major disturbances or changes such as fire, insect attack, disease, harvesting operations, reforestation and stand improvement. For example, by reference to forest inventory data, the quantity of timber lost to a fire can be quickly appraised. Through the use of the colour plotter, forest stands reaching a certain stage of maturity can be highlighted to provide the planner with a quick, overall picture of the resource. Forest stand characteristics can be overlaid and combined with soils, hydrologic, and topographic data to examine the impact of various forest practices or to assess operational limitations, such as access.

The overlay and analysis capabilities of GEOMAP enable the planner to rapidly review, through maps and associated tables, the practicality of management options. In the planning context, GEOMAP should greatly assist forest companies and provincial agencies concerned with operational forest management.

For further information or a demonstration of GEOMAP capabilities, please contact Dr. Alan Aldred at (613) 725-2971 or write to Dendron Resource Surveys Ltd., 880 Lady Ellen Place, Ottawa, Ontario, K1Z 5L9.

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* A trade mark of PAMAP Graphics Ltd.

MEETINGS/CONFERENCES/COURSES

APRIL - JUNE 1986

Third International Conference on Optical and Electro-Optical Applied Science and Engineering
April 14-24, 1986
SPIE
Innsbruck, Austria

Course: The SPOT System
English: April 14-25, 1986
November 3-14, 1986
French: January 6-17, 1986
September 15-26, 1986
GDTA
Toulouse, France

Second Image Symposium: Image Processing Synthesis and Applications
April 21-25, 1986
CESTA
Nice, France

10th Canadian Symposium on Remote Sensing
May 5-8, 1986
Edmonton, Alberta

Second Conference on Satellite Meteorology/Remote Sensing and Applications
May 12-16, 1986
AMS
Williamsburg, VA

Canadian Artificial Intelligence Conference
May 21-23, 1986
Canadian Society for Computational Studies of Intelligence
Montreal, Quebec

International COSPAR Workshop on Remote Sensing of the Earth-Atmosphere System
May 23-24, 1986
Tokyo, Japan

Course: SITEL: Introductory Course on Remote Sensing
May 26 - June 20, 1986
September 29 - October 24, 1986
November 17 - December 2, 1986
GDTA
Toulouse, France

Symposium on Photogrammetric and Remote Sensing Systems for Data Processing and Analysis
May 26-30, 1986
ISPRS Commission II
Baltimore, MD

1986 ACM-SIGMOD Conference on Management of Data
May 28-30, 1986
Washington, DC

Conference on Mathematics and Its Applications in Remote Sensing
May 28-30, 1986
Remote Sensing Society
Danbury, Essex, UK

Course: Remote Sensing Applications in Agriculture and Forestry
June 2-27, 1986
University of New Mexico
Albuquerque, New Mexico

SPIE's 1986 Québec International Symposium on Optical and Optoelectronic Applied Sciences and Engineering
June 2-6, 1986
Québec City, Québec

13th International Symposium on Computer Architecture
June 2-5, 1986
IEEE
Tokyo, Japan

ITC '86: International Conference on Ice Technology
June 10-12, 1986
MIT
Cambridge, Mass.

CLEO '86, OSA/IEEE Conference on Lasers and Electro-Optics
June 10-13, 1986
San Francisco, CA

Third Canadian Conference on Marine Geotechnical Engineering
June 11-13, 1986
Memorial University
St. John's, Newfoundland

Real-Time Photogrammetry - A New Challenge
June 16-19, 1986
ISPRS Commission V
Ottawa, Ontario

Computer Vision and Pattern Recognition
June 22-26, 1986
IEEE
Miami Beach, Florida

2nd International Conference on Image Processing and Its Applications
June 24-26, 1986
IEE
London, UK

ESA/EARSeL Symposium on Europe from Space
June 25-29, 1986
Technical University of Denmark
Lyngby, Denmark

Course: Image Processing of Satellite Data for Natural Resource Applications
June 30 - July 18, 1986
University of New Mexico
Albuquerque, New Mexico

International Conference on Information Processing and Management of Uncertainty in Knowledge - Based Systems
June 30 - July 4, 1986
Paris, France

XXVI COSPAR General Meeting
June 30 - July 12, 1986
Toulouse, France

JULY - SEPTEMBER 1986

ESPACE '86: Exhibition of Scientific Space Technologies
July 3-9, 1986
CNES
Toulouse, France

Second International Symposium on Spatial Data Handling
July 6-10, 1986
IGU
Seattle, WA

10th International CODATA Conference: The Computer Handling and Dissemination of Data
July 14-17, 1986
International Council of Scientific Unions
Ottawa, Ontario

Course: Climatology and Space Observations
July 15-31, 1986
CNES
Roscoff, France

13th International Laser Radar Conference
August 11-15, 1986
Environment Canada and AMS
Toronto, Ontario

Course: Remote Sensing Applications in Meteorology and Climatology
August 17 - September 6, 1986
University of Dundee
Dundee, Scotland

ACM SIGGRAPH '86: 13th Annual Conference on Computer Graphics and Interactive Techniques
August 18-22, 1986
Dallas, Texas

8th International Symposium on Ice
August 18-22, 1986
IAHR
Iowa City, Iowa

International Symposium From Analytical to Digital
August 19-22, 1986
ISPRS Commission III
Rovaniemi, Finland

International Symposium on Remote Sensing for Resources Development and Environmental Management
August 25-29, 1986
ISPRS
Enschede, The Netherlands

International Symposium on Progress in Imaging Sensors
September 1-5, 1986
ISPRS
Stuttgart, FRG

Symposium on Remote Sensing in Glaciology
September 6-12, 1986
International Glaciological Society
Cambridge, England

International Symposium on Mapping from Modern Imagery
September 8-12, 1986
ISPRS
Edinburgh, Scotland

Geographic Information Systems and Remote Sensing
September 8-10, 1986
IGU
Madrid, Spain

Course: CETEL: Remote Sensing Training Cycle
September 8, 1986 - June 19, 1987
GDTA
Toulouse, France

IGARSS '86, International Geoscience and Remote Sensing Symposium
September 8-11, 1986
Zurich, Switzerland

Auto-Carto London 1986
September 14-19, 1986
London, England

Economic, Professional and Educational Aspects of Photogrammetry and Remote Sensing
September 22-26, 1986
ISPRS Commission VI
Badagry, Lagos State, Nigeria

ASPRS-ACSM Fall Convention
September 28 - October 3, 1986
Anchorage, Alaska

Fifth Thematic Conference: Remote Sensing for Exploration Geology
September 29 - October 2, 1986
ERIM
Reno, Nevada

OCTOBER - DECEMBER 1986

Eighth International Conference on Pattern Recognition
October 28-31, 1986
AFCET
Paris, France

Course: Remote Sensing Applications for Earth Sciences
November 10 - December 20, 1986
ITC
Enschede, The Netherlands

20th International Symposium on Remote Sensing of Environment
December 4-10, 1986
ERIM
Nairobi, Kenya

If there are subject areas which you would like to see covered, conferences which have been missed or upcoming conferences which you are aware of or for further information contact:

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