CANADIAN ERTS PROGRAM PROGRESS REPORT

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ABSTRACT

This paper reports on the progress of the Canadian ERTS program providing statistics on the production and role of ERTS images both from the CCRS in Ottawa and from the Prince Albert Saskatchewan satellite station. The types of products, difficulties of production and some of the main applications in Canada are discussed.

Under a 4-yr. collaborative agreement between the United States and Canada, the Canada Centre for Remote Sensing reads out and distributes the ERTS data of Canada.

The Canadian receiving station is at Prince Albert, Saskatchewan (Fig. I) shows the range circle of this station. The MSS data of Canada are recorded on high density magnetic tape and then immediately played back through the Quick Look Cathode Ray tube recorder where all the uncorrected images are photographed onto 70 mm. black and white film. 9 x 9 enlargements are made from this film and are sold at a dollar a print by Don Fisher and Associates, a private contractor who was awarded this franchise. He does the photographic processing at the station in Prince Albert and mails the copies directly to his customers from there within two days of the satellite pass.

Immediately after the Quick Look information is extracted, the tapes are air expressed to Ottawa where they are played through the ground data handling system onto electron beam recorders providing all 4 bands and false colour images for distribution by the National Air Photo Library. The National Air Photo Library, Reproduction Centre, located in the same building as the CCRS Ground Data Handling Centre, is fully equipped with automatic film processing equipment for black and white and colour reproduction in quantity.

Investigators in Canada are not centrally funded by the Canada Centre for Remote Sensing. They must seek their funding from the appropriate mission-oriented agency whether such agency is in the federal government, any of the provincial governments, the universities or private industry. CCRS does carry out research in the methodology of interpretation both of the analogue and digital analysis kind.

Fig. II shows the organization of the CCRS and its committee structure. We communicate with users directly and also through the working groups which are organized both by geographic region and by discipline. The working groups meet independently about 3 times a year to initiate remote sensing projects and to make recommendations. The heads of the working groups meet once a year and make recommendations to the CCRS.

A large Canadian symposium on remote sensing is held once every two years. The next one will be held at the University of Guelph April 30 - May 2, 1974.

Ground Data Handling Centre Production

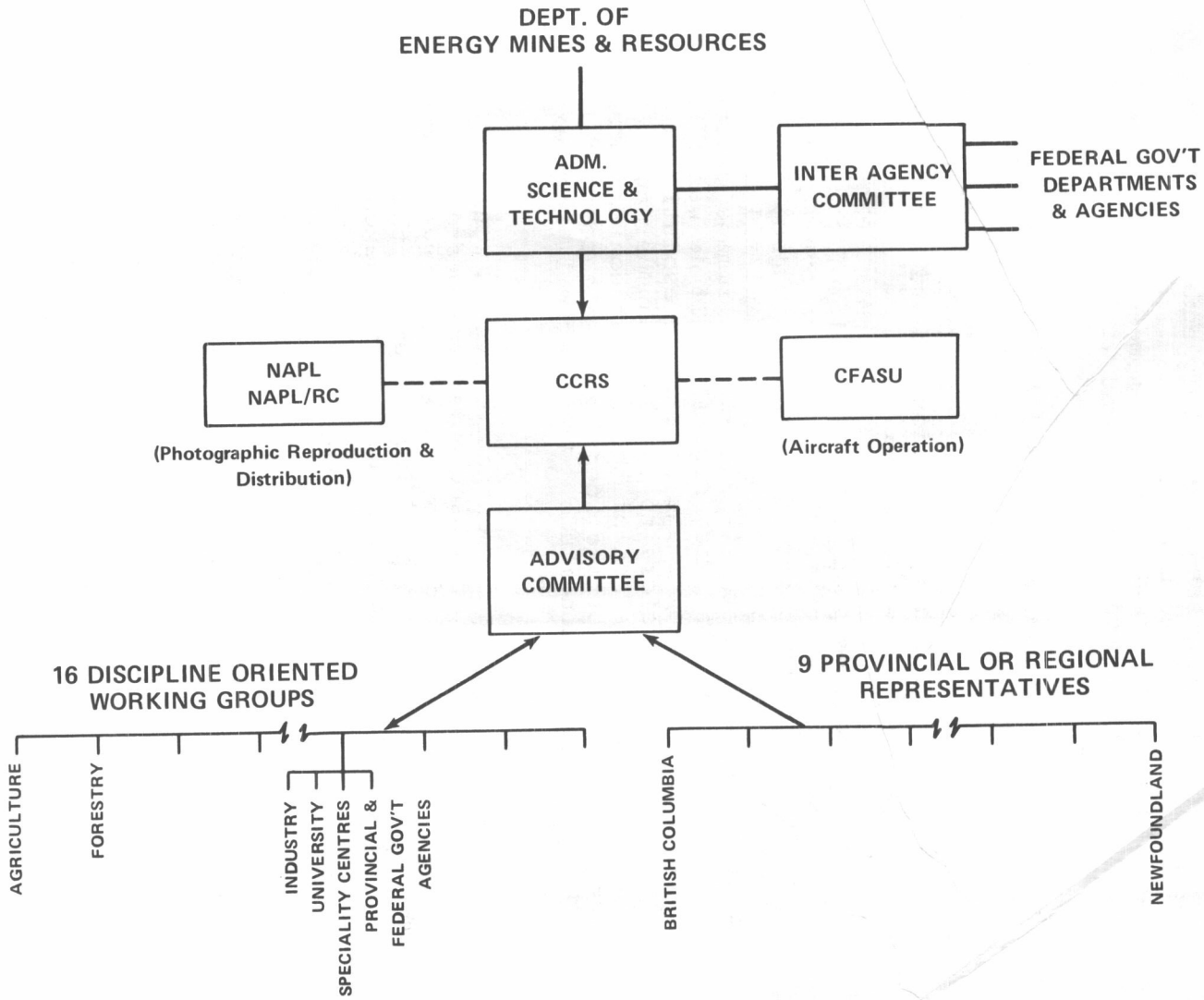
Since the ERTS-1 launch on July 23, 1972, about 25,000 scenes of Canada have been recorded. Of these, 10,428 scenes have been translated into images in all 4 bands and have been placed in inventory. 976 false colour scenes and 111 computer compatible tapes have been produced. The reason for the large backlog has been the unreliability of the electron beam recorders. These are going to be re-furbished and later replaced by a colour laser-beam image reproducer.

Total number of ERTS images produced by the National Air Photo Library This was in response to 1159 orders for data.	272,800
Total production of black and white Quick Look images by Donald Fisher & Associates at Prince Albert is about 9 x 9 black and white images.	50,000

Map Corrected Imagery

The Ground Data Handling System in Ottawa was designed with the capability of producing map-corrected images. Because of the instability of the electron beams in the recorders, it has not been possible to produce accurately corrected images. This program will be resumed after delivery of the laser beam image reproducer in September 1974.

E. A. Fleming of the Surveys and Mapping Branch did a study of the planimetric accuracy of an ERTS image corrected for earth rotation only. She found that this image compared favourably in accuracy to the standard 1:1,000,000 topographical map published by the Surveys and Mapping Branch. The standard deviation was less than a millimeter on a number of points over the whole image. The practical result of this is that it is possible to mosaic ERTS images that have this correction made while uncorrected images produce unsatisfactory mosaics.



ELEMENTS OF "THE NATIONAL PROGRAM ON REMOTE SENSING"

Quick Look Images

The Quick Look images produced at Prince Albert utilize the full 2,400 lines of the MSS but they only have about half the resolution of the images produced by the electron beam recorders in the Ground Data Handling system at Ottawa.

The big advantage of the Quick Look is that there is no backlog, all orbits are processed immediately and the only limitation is the speed of the mail delivery. Facsimile service is available at Prince Albert with some considerable loss of resolution. It is used in a limited way by the ice reconnaissance people.

Plans for the future of Prince Albert call for upgrading of the resolution of the Quick Look system, the installation of automatic photo processing equipment, the setting up of a microfiche service on all ERTS imagery of Canada and earth rotation correction. New higher resolution facsimile equipment may be installed if there is a demand for it.

Donald Fisher and Associates plan to produce microfiche cards containing Quick Look images of each day's orbits over Canada. Subscribers will get 365 cards per year and all images, clouds or not, will be shown in one band. The images will all be annotated with the orbit number (1 - 75) and the immage centre number (1 - 31) as well as the date, Fig. III. If he wants to order either a 9 x 9 Quick Look image or a high resolution image from Ottawa he simply refers to the image number and date. This should eliminate a lot of the present confusion about trying to specify % cloud cover and identifying the corners of the area by latitude and longitude. The user will know exactly what he is getting.

It strikes me that such a data dissemination system would be useful in meeting the demands of sensed nations who are insisting on getting copies of data over their country and who want it before third parties see it. The system has the advantage of being quick, cheap and methodically indexed by date and area.

Ground Data Collection Platforms

To date 14 DCP units have been installed and tested at various locations across Canada. Fig. IV. Reliable data retrieval from all units was demonstrated. The Water Resources Branch of the Department of the Environment has 9 units measuring river velocity, water level, precipitation, ice thickness and ice movement. The Mackenzie River data is used by the river boat traffic and the Columbia river data to forecast runoff for dam control.

The Canada Centre for Inland Waters uses its platforms to monitor water quality in Lake Ontario. The Atmospheric Environment Service monitors precipitation, humidity, air and water temperature at

its installations. Applications for 6 new units will be made soon.

Data are recorded at CCRS on magnetic tape from the Goddard telephone line in parallel with a hard copy print out. Each morning the data are put into the PDP-10 computer at CCRS where it is sorted, converted into engineering units and stored on a user disc files. The user may then retrieve his data in hard copy through Telex from any location in Canada.

The data retransmission system through CCRS has been operating since January 1973 to the complete satisfaction of all users to date. Users are looking forward to expanding the number of units.

Some Demonstrated and Potential Economic Benefits

1. The Arctic

(a) Seismic survey ships operating in the Arctic require information on ice conditions of the type provided by ERTS, that is a broad enough coverage to show the general ice conditions in the area but of high enough resolution to ensure the ships can run straight survey lines. This summer, because of ERTS imagery, one survey company operating in Norwegian Bay was able to survey an area it would not have otherwise. Quick-look ERTS imagery obtained 2 days after passage of the satellite showed the presence of open water beyond a large ice floe and was useful to the captain in navigating within the floe. The information which could not be obtained from helicopter support on board the ship because of the extent of the floe, permitted survey of an additional 75 miles which represented over $100,000 additional revenue to the company. They also know in hindsight from ERTS imagery of at least 250 other miles representing close to $400,000, they could have surveyed with the one ship stationed in the area had they been able to receive coverage in a more timely manner. They are therefore examining possibilities of relaying ERTS images directly to their ships from Prince Albert.

This company expects that ERTS will also be valuable to them in their winter seismic studies. They have been studying ice floes moving down and consolidating so they will have information on ice type and surface roughness. This will aid the company in deciding where to take contracts for winter surveys and what type of equipment to use.

(b) Ice Forecasting Central of the Department of the Environment has recommended that April aircraft flights used to determine ice conditions in the Arctic be replaced by ERTS quick-look imagery. The flights utilize about 50

hours at a cost of about $50,000 compared to a cost of ERTS imagery of $1,500. The imagery will permit an initial analysis of ice conditions for the seasonal outlook and permit the May aircraft flights to concentrate on key areas so defined. Ice Forecasting Central recommends that ERTS imagery be obtained from April through September to give increased information about ice conditions and permit a better deployment of reconnaissance aircraft.

(c) In 1972 a geophysical survey company spent 6 weeks in difficulty in ice-congested waters in and near Barrow Strait. Bellot Strait, an alternate route was open for 4 days and navigable for some time beyond that with ice breaker support. In this region ERTS has 5 - 6 consecutive days of overlap out of 18. The probability of obtaining a useful ERTS photo showing the ice free conditions of Bellot Strait (taking into account cloud cover) was then about 10%. Barrow Strait which was closed in would be covered by a different series of orbits so that the probability of obtaining information which would have helped the ship was at least twice that or 20%. The company believe they could have saved 1.5 million dollars with better information on ice conditions in the area. ERTS gave a 20% probability of providing this information.

2. ERTS imagery is being used in Saskatchewan in mapping forest fire burns. 42 burns across the northern part of the province are being mapped. Helicopters have been used in the past in the mapping of such burns. Using approximate values for helicopter time of one hour per burn for mapping and transit time the cost at $253 per hour would be over $10,000 for the helicopter. ERTS imagery costs less than $100 and the manual time involved in using satellite imagery is less. The accuracy of the mapping is greatly improved using ERTS imagery.

3. A profitable application of ERTS imagery is in the mapping of large reservoirs in hydro power development projects. An accurate knowledge of reservoir storage is necessary to determine how much firm power can be generated. In one northern Canada project, the reservoir was flown with aircraft three times when the reservoir was filling up at a cost of the order of 1/4 million dollars. The reservoir could be covered by 2 ERTS images. During the course of one survey the water level changed 1 foot because of the time factor in covering the entire reservoir. Satellite data taken at one point in time would give a much less expensive and better volume estimate. This would result in a better estimate of firm power capability and would affect the contracts for power generation entered into by the company. In the project mentioned above there are now indications that the reservoir storage is several percent greater than expected. They believe this could be translated into about 1% extra power generation (worth 1 million dollars). They will try to use ERTS to assess the extra storage capacity. Although they have entered into

a long term contract, they could still make it known to the customer that they had the capability of generating this extra amount of power.

ERTS imagery is being considered in the mapping of Reindeer Lake in Saskatchewan which will be used as a storage reservoir for a power development on the Churchill River. Reindeer Lake has been surveyed by aircraft at a cost of $46,000. A mosaic from which an area measurement could be made would cost $35,000. The reservoir can be covered by 2 ERTS frames and several ERTS images taken at various lake water levels should give a better extrapolation to the final reservoir storage when the new dam is built. E. A. Fleming, of the Department of Energy, Mines and Resources, investigating ERTS for topographic mapping purposes, has concluded from a study of the reservoir formed by Kettle Rapids Dam in Manitoba that the reservoir outline from ERTS for 1:250,000 mapping would be more accurate than could be obtained from 85 pictures at 2,000 foot/inch.

4. High Benefit Applications of ERTS imagery are in land use mapping and in the selection of routes for pipelines, transmission lines and highways. ERTS imagery is being used together with larger scale imagery in studies to select a route for the Polar Gas pipeline. Preliminary estimates of updating of present land use mapping in Western Canada indicate cost savings of about 4 to 1 for high altitude photography over conventional aerial survey photography and approximately 20 to 1 if satellite imagery is used. The satellite imagery would have to be used in digital form to give the required resolution.

Conclusions:

The greatest difficulty we experience is with potential users who are reluctant to change their way of doing things because they don't realize the obvious advantages to using the satellite data. It will take time.

References:

Remote Sensing in Canada - Newsletters Nos. 1 - 5
The Canadian Advisory Committee on Remote Sensing 1972 Report
Resource Satellites and Remote Airborne Sensing for Canada: Proceedings of the First Canadian Symposium on Remote Sensing, February, 1972.

The above reports are all available through the Canada Centre for Remote Sensing, Department of Energy, Mines and Resources, Ottawa, Canada KIA OE$, Tel. (613) 993-3350.