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National Aeronautics and Space Administration
Goddard Space Flight Center
Greenbelt Road
Greenbelt, Maryland 20771

Attention: Mr. E. F. Szajna, Code 430

Contract: NAS5-21783

Subject: First Bimonthly Report For Period Covering 1 July-31 August, 1972.

N73-11167
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Dear Sir;

The enclosed material serves as the first bimonthly report for contract NAS5-21783, and discusses progress on nine tasks for the period 1 July-31 August, 1972. Cost reports have been submitted under separate cover.

Work on this contract is performed in the Infrared and Optics Division (Tasks 1-3 and 5-9) directed by Mr. Richard Legault and in the Radar and Optics Division (Task 4) directed by Dr. Leonard Porcello.

Principal Investigators for each task are listed on the report subsections associated with those tasks.

During the early phases of the contract, emphasis has been placed on support of airborne data collection operations for various ERTS experiments and in writing and debugging computer software to convert ERTS-CCT data to formats compatible with our computers. Near the end of this reporting period, ERTS-CCT test tapes were successfully converted.

Respectfully submitted

Frederick J. Thomson

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(E72-10201) [ERTS COMPUTER COMPATIBLE TAPE
DATA PROCESSING AND ANALYSIS] Bimonthly
Progress Report, 1 Jul. - 31 Aug. 1972
F.C. Polcyn, et al (Michigan Univ.)
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First Type I Progress Report - 1 July-31 August, 1972
Task I - Water Depth Measurement - 1388
F. Polcyn, UN 200

Up to now, no data has been received from NASA from either of the two test sites for this project.

The development of the mathematical models have been completed and computer programming efforts underway to process digital tapes of test sites. Plans are to compute water depths based on spectral differences in two channels of the MSS data. Depending on the occurrence of water wave refraction pattern, optical processing techniques will also be employed.

Since the Virgin Islands is not covered in the ERTS-1 standard catalog, a copy of the non-U.S. satellite coverage catalog has been requested.

First Type I Progress Report - 1 July-31 August, 1972
Task II - Yellowstone Park Data - 1398
F. Thomson, UN 621

On 12-13 July, a meeting was held at USGS in Denver to more fully discuss the proposed mapping project. Dr. Smedes and Ralph Root, a Colorado State University graduate student, were to contact the National Park service during the week of 24 July to firm up the mapping project. Mr. Root will be selecting training sets and will select several samples of each area to be mapped. Some of the samples will be used for training and the remainder for testing the recognition process.

Data to be processed will be selected by Dr. Smedes and Mr. Root. Mr. Thomson checked with User Data Services on 25 August and determined that no data had been collected over Yellowstone on the first pass (6 August). If the 24 August pass also produced no usable data, a modification to the standing order form will be initiated to obtain data beyond 15 September.

This project supported a unified effort on two programs to format data to convert 7 track, 800 bpi ERTS-CCT's to formats compatible with the IBM-7094 and CDC-1604 computers. Near the end of this period, a capability to convert ERTS format test tapes (grey scales) to CDC-1604 computer readable format was demonstrated.

In the next period, compatibility with ERTS format will be further demonstrated by converting a requested Monterey Bay set of CCT's to CDC-1604 and IBM-7094 formats. A base map for future investigations will be produced from a mosaic of color infrared photography from an RB-57 flight of September 1969.

No changes in standing order forms were initiated this period. A retrospective request for Monterey Bay CCT's was made by telephone to ERTS User Data Services on 25 August. These tapes will be used to further demonstrate compatibility with ERTS data formats.

First Type I Progress Report - 1 July-31 August, 1972
Task III- Atmospheric Effects (Colorado) - 1410
F. Thomson, UN 636

On 12-13 July, a meeting was held at USGS in Denver to discuss the experiment, to firm up details, and to assign responsibilities for data collection. Mr. Roland Hulstrom of Martin-Marietta Corporation, under subcontract to Dr. Smedes, will make ground measurements of radiation and of atmospheric properties at twelve sites within or near the study area. Mr. Robert Watson (USGS, Denver) will collect airborne spectra with a radiometer then under construction and expected to be finished by 24 August. Mr. Jon Ransom, a graduate student at Colorado State University (working for Dr. Smedes) will make ground measurements and select multiple training sets of categories to be mapped. As with the Yellowstone data, those training sets not used for training will be used to test recognition performance. During the Denver trip, Mr. Thomson also toured the test site to become familiar with the terrain and to take a number of ground photos. CIR aerial photography taken by U. S. Forest Service of a portion of the test site was analyzed on this field trip.

This project, as is the Yellowstone project, is supporting a unified effort on two programs to format data to convert ERTS-CCT's to formats compatible with the IBM 7094 and CDC-1604 computers here. Mr. Thomson checked with User Data Services on 25 August to find that no data were collected on the first passes over the test site on 2 or 20 August.

During the next quarter, available photography and maps of the test site will be analyzed. Consultation with Dr. Smedes may result in a modification of the standing order form if no data are collected on the next pass over the test site.

First Type I Progress Report - 1 July-31 August 1972
Task IV - Lake Ice Surveillance - 1406
L. Porcello, UN 201

During the initial two months of work on this project, no problems have been encountered which impede the progress of fulfilling the contract.

The major thrust of the project during July-August 1972 has been in the planning and preparation of logistics and equipment acquisition and design to be implemented during the field stage of the work. Preparations for designing field data reporting systems compatible with use for remote sensing data verification are being developed.

During the next two months, it is proposed to complete the design and fabrication of a small instrument for measurement of electrical properties of snow and ice. Bench tests will be conducted and possibly some tests on artificial ice and snow will be conducted. Flight lines and flight schedules for the remote sensing underflights in connection with ERTS-1 passes will be prepared.

At this time, no "significant results" have been realized.

No changes in standing order forms have been initiated at this time.

First Type I Progress Report - 1 July-31 August 1972
Task V - Recreational Land Use - 1387
I. Sattinger, UN 225

Current effort on the project will be limited to analysis of airborne imagery until satellite imagery of the test area is obtained.

The objective of this investigation is to use and evaluate ERTS data in continuing studies of land use in the seven-county area centered on Detroit, with special emphasis on identifying and evaluating land that should be acquired and preserved for open space and recreational use and to maintain the environmental quality of the area.

Initial effort on this project has been devoted to planning and coordinating the collection of data to supplement and interpret the ERTS-1 imagery. Mission 205 was flown by NASA on June 10-11 to obtain RB-57 photographic coverage of the seven-county area around Detroit which will be studied during the investigation. This flight was only partially successful in obtaining high-altitude photographic coverage; cloud cover prevented coverage of the eastern part of the area. A repetition of coverage was therefore requested. This repeated coverage is presently scheduled for Mission 211, which is to be conducted at some time during a period beginning September 11.

A flight of the C-47 multispectral scanner aircraft was made on 29 August over test sites in Southern Michigan to provide higher-resolution scanner data for interpretation of the ERTS data.

The ERTS-1 satellite passes over the test area in Southern Michigan on 5 August and again on 23 August; however, imagery of the area was not obtained on either orbital pass. Current effort on the project will be limited to analysis of the C-47 and RB-57 imagery until satellite imagery of the test area can be obtained.

Consultations have been held among staff members of the Willow Run Laboratories and the Oakland County Planning Commission to define the types of information to be obtained from the processing.

During the next reporting period, effort will be concentrated on interpretation and processing of data acquired by the C-47 and RB-57 sensors. The initial processing and interpretation will be confined to the areas covered by the C-47 scanner flights. The C-47 scanner data will be processed to produce recognition maps of significant categories of vegetation, urban/rural boundary areas, and inland lakes, since these are the features most likely to be used for interpretation of ERTS data. Additional categories of surface features can be processed at a later date, if necessary.

First Type I Progress Report - 1 July-31 August 1972
Task VI - IFYGL (Lake Ontario) - 1384
F. Polcyn, UN 635

Current progress on this project is impeded by the lack of ERTS-1 data. To date, no ERTS imagery or data tapes have been received for analysis. While ground support and aircraft data collection have proceeded on schedule, no complementary satellite data are available. Haze conditions during periods of aircraft data collection and ERTS overpasses may have somewhat degraded the quality of remote sensor data collected during this reporting period. A multispectral remote sensor mission planned for the week of 1-5 August was postponed to 7 September because of low visibility resulting from atmospheric haze over much of the Lake Ontario Basin.

On 17-18 June 1972, new multispectral remote sensor data were collected by The University of Michigan's Willow Run Laboratories over hydrological study areas in or adjacent to the Lake Ontario Basin. Of these data obtained by Michigan's C-47 aircraft, approximately 110 data flightline miles were flown over terrestrial areas.

Multispectral data were collected with Michigan's new M-7 optical-mechanical scanner system. This scanner became operational in the summer of 1971 and provides complete registration and full 90° field of view for all data channels. The twelve spectral bands recorded are listed as follows: 0.41-0.48 μm (violet), 0.48-0.52 μm (blue), 0.50-0.54 μm (green), 0.52-0.57 μm (yellow-green), 0.55-0.60 μm (yellow), 0.58-0.64 μm (orange), 0.62-0.70 μm (red), 0.67-0.94 μm (near infrared), 0.71-0.73 μm (near infrared), 1.5-1.8 μm (mid infrared), 2.0-2.6 μm (mid infrared), 9.3-11.7 μm (thermal infrared). Video playback of four selected channels indicates that the multispectral data is of good quality. In addition to the data channels as listed, sun sensor, thermal reference plates, and references lamps were also recorded.

Four cameras were used to collect aerial photographic data of the study areas. These include 70 mm color, false color, and black and white IR film, and 9" panchromatic film. The false color positive transparencies are of good quality. The positive color film appears to have a reddish-orange cast, possibly due to improper film development. All original film will be supplied to NASA-Houston, from which copies may be obtained.

Upward and downward looking pyronometer data were recorded during each of the flights. These data will be reduced and correlated with the calibrated scanner data for energy budget determination.

Three study sites were selected for the development and testing of remote sensing techniques for application to terrestrial hydrological information. Both dawn and midday multispectral data were obtained from two of the sites.

No. 6 Highway (Guelph Area).

In cooperation with the earth science-remote sensing group at the University of Guelph (headed by Dr. A. Falconer), a study area was selected which included agricultural land adjacent to No. 6 Highway northwest of the City of Guelph. This area includes the Elora Research Farm for which a great deal of current and historical hydro-meteorological information is available. Faculty of the University of Guelph aided in collecting ground truth during the day of overflights.

Lower Oakville Creek Representative Basin:

In cooperation with staff of the Ontario Water Resources Commission, Department of the Environment (Mr. R. Ostry), an extensive study area was selected which included the City of Oakville, on the western end of Lake Ontario. Several objectives were satisfied by the 64 sq. mile area. It provided the opportunity to test the ability of the multispectral remote sensor to detect and map areas of ground water seeps. Numerous small springs contribute ground water from the subdued Trafalgar moraine to streams which empty into Lake Ontario. The extent and variety of terrain surfaces associated with Oakville will provide further data for developing the ability to automatically classify pervious and impervious surfaces. Several small watersheds within this study area will be useful for testing the development of computer techniques for computing energy budget parameters (net radiation) from aircraft. Ground truth were obtained by OWRC and WRL personnel from Oakville Creek Basin during the day of the data collection flights.

Niagara Escarpment (Grimsby area).

This study area, selected in cooperation with the Ontario Water Resources Commission, was flown using a two-element thermal detector at dawn. These data will serve two purposes. One will be to try to identify the location of ground water seeps from or adjacent to the face of the escarpment. Secondly, a ratio of the two-channel thermal data will be used to study the ability of this technique to obtain $\text{SiO}_2\text{-Al}_2\text{O}_3$ content information of the surface materials. The numerous bare soils cultivated by local vineyards will provide good examples for testing this technique. WRL personnel collected PRT-5 ground-truth data during the time of the flight.

Two aircraft multispectral flights are planned for the next reporting period -- one in the first week of September (mission postponed from August), and the other in mid-October. Continued close cooperation and coordination of data collection and analysis with IFYGL participating universities and agencies is planned.

First Type I Progress Report- 1 July-31 August 1972
Task VII - Image Enhancement - 1385
W. Malila, UN 612, and R. Nalepka, UN 178

Experience has been gained at WRL over the past decade in computer processing and extraction of information from airborne multispectral scanner data and in modeling atmospheric effects in received radiance signals. The general objective of Task VII is to adapt techniques existing at WRL for their application to ERTS-1 data, to assess the applicability of these techniques by applying them to selected ERTS-1 data, and to identify any additional problems that might be associated with such processing of satellite multispectral scanner data. Three areas are to be studied: (1) compensation for atmospheric effects in ERTS-1 data, (2) preprocessing for improved recognition performance, and (3) estimation of proportions of unresolved objects in individual resolution elements.

The principal activities during the reporting period have been in planning aircraft missions and field observations, preparing and providing ground support for aircraft and ERTS-1 overflights, collecting field observations in the test site area, and modifying computer software.

We believe that one usable set of ERTS-1 data, with corresponding airborne multispectral scanner data, has been collected over the test site in Eaton County, Michigan. ERTS-1 has made two pairs of passes over our test site, one on 6/7 August and the other on 24/25 August. As far as we know, the ERTS-1 MSS was operational during both sets of passes, but we have been unable to obtain any confirmation through ERTS User Services or to obtain a good estimate of when imagery will be made available. It is unlikely that the 6/7 August data will be usable since there was a heavy cloud overcast in the test area during both passes. Planned aircraft missions and supporting ground measurement missions were cancelled, because of the bad weather, after operating on standby status.

The sky was generally clear over the test site during the second of the next pair of passes, i.e., on 25 August. Simultaneous underflight coverage was obtained by The University of Michigan's C-47 multispectral scanner aircraft, ground-based spectral measurements were made of sky radiance and irradiance, and detailed observations were made of the conditions of agricultural fields in the test area.

Field observations or "ground truth" data have been obtained for a large fraction of the fields in each of the counties in the test area through the cooperation of ASCS personnel of the U. S. Department of Agriculture and the coordination efforts of Michigan State University (MSU) personnel. In addition, extensive field-by-field checking and ground photography have been carried out jointly by MSU and U of M personnel in a 100-sq. mile area, the intensive test area for Task VII. RB-57 camera coverage of the total test area was carried out in the month of June and the photographs were to have served as base maps for ground-truth mapping but, as of this date, the photography has not been received from NASA.

The modification of digital computer software for the processing of ERTS-1 multispectral scanner data is under way but progress was hampered by the late receipt (just a few days before the ERTS-1 launch) of simulated data tapes from NASA.

During the coming reporting period, we expect to support the next set of ERTS-1 passes (11/12 September) with field measurements and airborne MSS data collection, begin analysis of airborne MSS data, consolidate field measurement and observation data, continue software modifications, and begin analysis of a frame of ERTS-1 data, if received in time.

First Type I Progress Report - 1 July-31 August 1972
Task VIII - Water Quality Monitoring - 1400
C. Wezernak, UN 625

Work prior to launch consisted of a review of existing data and programs dealing with the study areas, and organization of related ground-truth activities. Existing earth resources aircraft data were obtained for portions of the southern California test site and prints made of selected features in the study area. This data will be used in the interpretive process of ERTS-1 imagery.

Work during the month of August consisted of activities (aircraft and ground) in support of ERTS-1, primarily at the New York, South-east Florida and Tampa study areas. Multispectral aircraft missions in support of ERTS-1 were organized at the above locations. Missions were flown by the Michigan C-47 multispectral aircraft on the following dates:

New York Bight:	16 August 1972
S. E. Florida:	18 August 1972
Tampa Bay:	19 August 1972

Data is currently being processed.

To date, satellite data have not been received. A telephone check with User Support and Services indicates that satellite data were collected over all study areas except Lake Erie. In the next reporting period, we plan to process aircraft data, and, if available, process satellite data.

No significant results are available at this time.

First Type I Progress Report - 1 July-31 August 1972
Task IX - Oil Pollution Detection - 1389
R. Horvath, UN 606

This program was officially funded and effective 10 August 1972. No work had been accomplished as of the reporting date.