PREVIOUS EARTH RESOURCE BIBLIOGRAPHIES

Remote Sensing of Earth Resources (NASA SP-7036)
Earth Resources (NASA SP-7041(01))
Earth Resources (NASA SP-7041(02))
Earth Resources (NASA SP-7041(03))
Earth Resources (NASA SP-7041(04))
Earth Resources (NASA SP-7041(05))
Earth Resources (NASA SP-7041(06))
Earth Resources (NASA SP-7041(07))
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Earth Resources (NASA SP-7041(21))

This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by Informatics Information Systems Company.
EARTH RESOURCES

A Continuing Bibliography
With Indexes
Issue 22

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between April 1, 1979 and June 30, 1979

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*
This Supplement is available from the National Technical Information Service (NTIS), Springfield, Virginia 22161, at the price code E05 ($9.00 domestic; $18.00 foreign).
INTRODUCTION

The technical literature described in this continuing bibliography may be helpful to researchers in numerous disciplines such as agriculture and forestry, geography and cartography, geology and mining, oceanography and fishing, environmental control, and many others. Until recently it was impossible for anyone to examine more than a minute fraction of the earth's surface continuously. Now vast areas can be observed synoptically, and changes noted in both the earth's lands and waters, by sensing instrumentation on orbiting spacecraft or on aircraft.

This literature survey lists 390 reports, articles, and other documents announced between April 1 and June 30, 1979 in Scientific and Technical Aerospace Reports (STAR), and International Aerospace Abstracts (IAA).

The coverage includes documents related to the identification and evaluation by means of sensors in spacecraft and aircraft of vegetation, minerals, and other natural resources, and the techniques and potentialities of surveying and keeping up-to-date inventories of such riches. It encompasses studies of such natural phenomena as earthquakes, volcanoes, ocean currents, and magnetic fields; and such cultural phenomena as cities, transportation networks, and irrigation systems. Descriptions of the components and use of remote sensing and geophysical instrumentation, their subsystems, observational procedures, signature and analyses and interpretive techniques for gathering data are also included. All reports generated under NASA's Earth Resources Survey Program for the time period covered in this bibliography will also be included. The bibliography does not contain citations to documents dealing mainly with satellites or satellite equipment used in navigation or communication systems, nor with instrumentation not used aboard aerospace vehicles.

The selected items are grouped in nine categories. These are listed in the Table of Contents with notes regarding the scope of each category. These categories were especially chosen for this publication, and differ from those found in STAR and IAA.

Each entry consists of a standard bibliographic citation accompanied by an abstract. The citations and abstracts are reproduced exactly as they appeared originally in STAR, or IAA, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the variation in citation appearance.

Under each of the nine categories, the entries are presented in one of two groups that appear in the following order:

IAA entries identified by accession number series A79-10,000 in ascending accession number order;
STAR entries identified by accession number series N79-10,000 in ascending accession number order.

After the abstract section, there are five indexes:

subject, personal author, corporate source, contract number and report/accession number.
AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A79-10000 Series)

All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc. (AIAA), as follows: Paper copies of accessions are available at $6.00 per document up to a maximum of 20 pages. The charge for each additional page is $0.25. Microfiche of documents announced in IAA are available at the rate of $2.50 per microfiche on demand, and at the rate of $1.10 per microfiche for standing orders for all IAA microfiche. The price for the IAA microfiche by category is available at the rate of $1.25 per microfiche plus a $1.00 service charge per category per issue. Microfiche of all the current AIAA Meeting Papers are available on a standing order basis at the rate of $1.35 per microfiche.

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Documents on microfiche are designated by a pound sign (#) following the accession number. The pound sign is used without regard to the source or quality of the microfiche.

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**Subject Categories**

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CORPORATE SOURCE INDEX ....................................................................................... C-1
CONTRACT NUMBER INDEX .......................................................................................... D-1
REPORT/ACCESSION NUMBER INDEX ............................................................................ E-1
The concepts of radar remote sensing and microwave radiometry are discussed and their utility in earth resource sensing is examined. The direct relationship between the character of the remotely sensed data and the level of decision making for which the data are appropriate is considered. Applications of active and passive microwave sensing covered include hydrology, land use mapping, vegetation classification, environmental monitoring, coastal features and processes, geology, and ice and snow. Approved and proposed microwave sensors are described and the use of space shuttle as a development platform is evaluated.

A.R.H.


This paper evaluates the costs of producing four remote sensing-based information products: timber volume estimate tables, Level II land use/land cover maps, soil maps, and vegetative cover maps. Two production methods for each product are evaluated, one is based on digital processing of satellite data, and the other on conventional photointerpretation of aircraft data. For each product, a comparison is conducted of the two strategies' production costs (including data acquisition, 'ground truthing', interpretation, compilation, and printing charges) and their performance (as measured by accuracy and timeliness). Each of the production methods reviewed has been demonstrated - either operationally or experimentally - and the costs, timeliness and other performance estimates presented are based on observations made in practice. The results show that for these products, satellite-based production results in significant cost and timeliness improvements at the cost of a loss in accuracy.

(Author)
AContinuingBibliography(Issue22)

JULY1979

01
AGRICULTUREANDFORESTRY

Includecropforecasts,cropsignatureanalysis,soilidentification,disease detection,harvestestimates,range resources,timberinventory,forestfiredetection,andalphilemigration

patterns.

A79-21269 Thevalueofinformationasappliedtothe
LandstFollow-onbenefit-costanalysis.D.B.Wood(NASA,
GoddardSpaceFlightCenter,Greenbelt,Md.).AmericanAstronautical

An econometric model was run to compare the current
forecasting system with a hypothetical (Landst Follow-on) space-
based system. The baseline current system was a hybrid of USDA
SRS domestic forecasts and the best known foreign data. The
space-based system improved upon the present Landst by the higher
spatial resolution capability of the thematic mapper. This satellite
system is a major improvement for foreign forecasts but no better
than SRS for domestic forecasts. The benefit analysis was concen-
trated on the use of Landst Follow-on to forecast world wheat
production. Results showed that it was possible to quantify the value
of satellite information and that there are significant benefits in more
timely and accurate crop condition information. B.J.

A79-21338 Theuseofthermalimageryindefiningfrost
proneareasintheNiagarafruitbelt.R.B.Stewart,E.I.Mukammal
(DepartmentoftheEnvironment,AtmosphericEnvironmentService,
Dowstown,Ontario,Canada),andJ.Wiebe(Ontario,Horticultural
ResearchInstitute,VinelandStation,Canada).RemoteSensingof
supportedbytheOntarioGrapeGrowersMarketingBoard.

Surface temperatures in the Niagara fruit belt measured with a
thermal scanner flow at altitudes of 600 m, 2000 m and 5000 m
were utilized to examine the feasibility of using thermal imagery to
define frost prone zones during spring radiation frost conditions.
Results show that, within a test area in the vicinity of Vineland,
Ontario, as well as for the entire Niagara escarpment area from
Grimsby to Niagara Falls, a number of zones of different tempera-
ture are definable. It was found that a potential frost prone zone
exists below the escarpment in an area considered to be relatively
free of such events. (Author)

A79-21339 Postsenescentgrasscanopyremotesensing.C.
J.Tucker(NASA,GoddardSpaceFlightCenter,EarthResources
Branch,Greenbelt,Md.).RemoteSensingofEnvironment,vol.7,
GB-41233X;No.BMS-73-02027-AO2.

Analysis of in situ collected spectral reflectance data from a
dormant or senescent grass canopy showed a direct relationship
existed between spectral reflectance and biomass for the 0.50-0.80
micron spectral region. The data, collected four weeks after the end
of the growing season, indicated that post senescent remote sensing
of grass canopy biomass is possible and helps to elucidate the spectral
contribution of recently dead vegetation in mixed live/dead canopy
situations. (Author)

A79-21340 Cross-polarizedradarbackscatterfrommoist
soil. H. Hiroswa, S. Komiyama, and Y. Matsuoka (Tokyo,
University, Tokyo, Japan). Remote Sensing of Environment, vol. 7,

Measurements of radar backscatter from bare soil at 9.0 GHz
using a broad beam, with an effective beamwidth of product patterns
and an incident angle of about 17 and 30 deg, respectively, have
shown that the sensitivity of the cross-polarized (HV) return to soil
moisture content was much higher than that of the like-polarized
(HH) one. Analysis of the data shows that the observed HV back
scattering power has a dependency of nearly Gamma-squared, where
Gamma is the power reflection coefficient at a plane soil-air
interface. This fact suggests that multiple scattering on rough soil
surface caused the soil moisture sensitivity of the cross-polarized
return to be high. (Author)

A79-22392 Landsat-simulating radiometer for agricultural
remote sensing. G. D. Lemme (Nebraska, University, Lincoln, Neb.)
and F. C. Westin (South Dakota State University, Brookings, S.
Dak.). Photogrammetric Engineering and Remote Sensing, vol. 45,

The reliability of a Landsat-simulating ground-based spectral
radiometer for use in agricultural remote sensing was investigated.
Significant correlation coefficients in all wavebands except Band 7
were found to exist between Landsat computer compatible tape
(CCT) and ground-based radiometric data from several corn fields.
No significant correlations were found within data from small grain
fields. Combined data from several common agricultural crops
yielded significant correlation coefficients in the wavebands most
commonly employed in agricultural remote sensing. It was also
found that sun angle within certain limits of a given day had minimal
effect on ground-based radiometric measurements taken from a
fallow and barley field. (Author)

A79-22493 Applications of remote sensing to the study of
the agricultural and natural resources. M. A. Sharifi (Ministry of
Agriculture and Rural Development, Informatics and Remote Sens-
ing Dept., Teheran, Iran). In: International Symposium on Remote
Sensing of Environment, 12th, Manila, Philippines, April 20-26,
A data compression technique for multitemporal Landsat imagery which extracts phenological growth pattern information for agricultural crops is described. The principal component greenness transformation was applied to multitemporal agricultural Landsat data for information retrieval. The transformation was favorable for applications in agricultural Landsat data analysis because of its physical interpretability and its relation to the phenological growth of crops. It was also found that the first and second greenness eigenvector components define a temporal small-grain trajectory and nonsmall-grain trajectory, respectively.


The Suits bidirectional reflectance model (1972) for vegetation canopies was used to calculate reflectance values for the four Landsat spectral bands under a variety of canopy and observation conditions. Relationships between characteristics of developing wheat fields and associated reflectances were studied. Coincident measurements of reflectance and Landsat signals were compared using regression analysis techniques. The model was also applied to forest situations both to help establish the extent to which Landsat data may provide direct information about conditions occurring beneath forest overstories and to help develop methods for reducing the effects of terrain slope and aspect in the processing of Landsat data. Finally, a relationship based on model calculations was used to adjust Landsat signal values and was found to reduce topography-related variability and improve subsequent classification performance.

B.J.


The paper shows that accuracies of computer classification of species-specific forest cover types from Landsat imagery can be improved by 27% or more through the incorporation of topographic information from digital terrain tapes registered to multiday Landsat imagery. The topographic information improves classification accuracies because many common forest tree species have preferred elevation ranges and slope aspects. These preferences allow the separation of forest cover types which have similar spectral signatures but different species compositions. It is noted that the development of a classification system which uses prior probabilities and sets of prior probabilities conditioned by one or two external variables represents a significant increase in classification power.

B.J.
Consideration is given to procedures and results of a study to determine the feasibility of using Landsat data to identify and locate Aguaire palm and other forest associations within lowland areas of the tropical forest region of eastern Peru. Both manual interpretation and digital processing techniques demonstrated capabilities for mapping Aguaire and other forest associations which appeared to correspond closely to drainage conditions prevailing in low jungle areas. Classification maps derived from digital processing were considered to be a more accurate portrayal of low jungle vegetation patterns because of more precise boundary location and greater detail in complex scene areas. Implementation of a new multiteme classification rule into the digital processing procedure is discussed.


An approach which uses Landsat data as one of the information sources to aid in the forecast of the production of wheat is discussed. Comparisons are made between ground-based, agromet model-based, and Landsat-based approaches for winter wheat yield forecasts in the U.S. Southern Great Plains. Results of applying a Landsat direct production forecast approach are presented and a proposed combination model is described which is designed to utilize both Landsat and agromet information. (Author)


Applications of satellite remote sensing to tropical forest inventories have emphasized the need for efficient methods to collect more detailed information. Recent developments in tropical applications of large-scale aerial photography are therefore relevant. The developments, which are reviewed, include tests of an airborne radar altimeter and camera system, evaluations of photo specifications and attempts to identify tree species on aerial photographs. Accurate description of tree crowns is a prerequisite for identification. Terms used in describing crowns are defined and illustrated. (Author)


Delineation of forest cover types in two areas of India by analysis of Landsat computer-compatible tapes is described. The two areas are in the northeastern region and the southern central region of the country. In the first area the delineated types included deciduous, evergreen, bamboo, cultivated land, and some intermediate types. In the second area, where there are no evergreens, teak, Hardwickia, bamboo, and intermediate areas were distinguished. In this second area, the trees were partially bare because of the season, and the exposed soils posed some problems in discrimination of cover types. M. L.


Detection of erosion and forest insect damage was tried out in two regions of Mexico: the central part of the State of Puebla and the northeast region of the State of Guerrero. Landsat and Skylab imagery were used, together with conventional aerial photography and ground checking. Results showed the possibilities of applying this type of data to extensively affected areas. The examples derived could very well serve to teach natural resources students the limitations and possibilities of visual interpretation of Landsat and Skylab data in Mexico. (Author)


In a study of the feasibility of remote sensing for agricultural surveillance in Japan, an airborne multiband camera was the main sensor, and the ground image processing equipment included analog systems such as an additive color viewer, a multicolor data system, and digital systems such as an image digitizing system and a data analysis system with interactive color image display operating in tandem with a small computer. In one set of experiments the multiband camera images were analyzed by a densitometer and minicomputer, and crop types were classified by the quadrangular decision rule. In another set of experiments, the multidimensional cell method was employed.

P.T.H.


Landsat-1 imagery, vertical aerial photos, and field observations were used in an exploration of the possibility of identifying forested areas and forest types in Indonesia. The identifiability of the following forest types was determined: mangrove forest, littoral forest, swamp forest, peat forest, highland rain forest, lowland rain forest, monsoon forest, teak forest, and conifer forest. Aerial photographs were used for standing stock estimation. The data collection and regression methods for this study are discussed. There was found to be a significant correlation between standing stock (average number of trees and volume per hectare of forest area) and the crown closure percentage measured from vertical aerial photographs.

P.T.H.


Mix or interaction of vegetation signal on soil information decrease the performance of soil identification and mapping. This paper discusses a simple technique to eliminate the vegetation signals from the remotely sensed data and to extract soil information from vegetated area. This paper demonstrates the usefulness of the technique.

(Author)


Multispectral scanner data in twelve spectral channels, in the wavelength range 0.46 to 11.7 microns, acquired in July, 1971, for three flightlines, were analyzed by applying automatic pattern recognition techniques. These twelve spectral channels were divided into four wavelength groups (W1, W2, W3, and W4), each consisting of three wavelength groups - with respect to their estimated probability of correct classification (Pc) - in discriminating agricultural cover types. The same analysis was also done for the data acquired in August, to investigate the effect of time on these results. The effect of deletion of each of the wavelength groups on Pc, in the subsets of one to nine channels, is given. Values of Pc for all possible combinations of wavelength groups, in the subsets of one to eleven channels, are also given.

(Author)


The Ten-Ecosystem Study was designed to assess the maximum information content of Landsat data and its utility for large area classification using a uniform technical approach on the 10 generalized forest and rangeland ecosystems of the United States. Conclusions on the feasibility of using Landsat remote sensing automatic data-processing methods, selecting the best seasons, analyzing costs and the effects of site complexity, miscellaneous analysis, problems, and recommendations were derived from 2 years of study, the project being three-fourths completed.

(Author)


A photointerpretation analysis of uplands west of Chiang Mai, Northern Thailand, at three different dates (band 7) during the dry season shows the progression of fires (burnt areas). The overall features of the area (uplands and lowlands) is given by interpreting the 27th January 1973 and 8th April 1975 color composite images. Classification of CCT tapes of a part of uplands and lowlands, using supervised methods, gives forest types, swidden area, savanna, paddy fields in the highlands east of Doi Inthanon, and changes of irrigated agriculture between January and March in the alluvial plain.

(Author)

Color aerial photographs at a scale of approximately 1:250 were used to obtain plant inventories for six study sites in a multi-layered arid zone community. Species were divided into size classes based on canopy area. Coordinates for each individual, read from the photographs, were transformed to ground coordinates and used to produce plant counts in contiguous quadrats. Multiple pattern analysis of these data revealed the major features of community variation and their corresponding scales of pattern. Within-site variation in grazing pressure was the major factor influencing community pattern in three sites. Responses of the major species to variation and their corresponding scales of pattern. Within-site analysis of these data revealed the major features of community vegetation pattern on the remaining sites. The presence of these relics is thought to impose a weak fundamental pattern on this community.

(Author)


The imagery acquisition scale for the radar vegetation mapping of Nigeria was 1:250,000 with a swath width of 25 km using an X-band real aperture system. The imagery was taken in two look directions so that there would be complete cover with both a north and south looking direction. It was required that maps be produced at 1:250,000 scale based on the JG series to show the vegetation associations and that selected forest reserves be mapped in detail at 1:100,000 and 1:50,000 scale also based upon the radar imagery. This paper describes current progress on the mapping and digital analysis.

(JH)


The paper deals with methods that can be used for mapping from Landsat data. The methods are grouped into four broad categories: photographic, optical, electronic, and digital, and the advantages and limitations of each group are discussed. The amount of information that can be deduced increases from photographic processes through optical and electronic to the maximum from digital analytical procedures. For optimum results from all of these analytical procedures, dependence on ground coordinates (to a greater or lesser extent) is required on a systematic substage sampling program.

V.P.


The use of remote sensing technology by the U.S. Fish and Wildlife Service in three specific applications under the general category of 'habitat' is discussed. The specific applications relate to environmental impact assessment, baseline ecological analysis, and wildlife resource management. In particular, the analysis of fish and wildlife habitat as a basis for impact assessment and reclamation requirements on lands subject to energy-related development (i.e., strip mining) in the northern Great Plains is examined. The National Wetland Inventory as an example of ecological baseline analysis is also described. The application of remote sensing techniques in the management of specific wildlife resources is demonstrated using the example of monitoring of the nesting habitat of Arctic breeding geese.

F.G.M.


Spectroradiometric measurements with narrow bandwidth were made in the wavelength range from 400 to 1100 nm. The dependence of the spectral reflectance factor R(λ) on solar and observational zenith and azimuth angles for young and ripe wheat, vine, spruce and feeding turnips was investigated. As a result it was found that the shape of the R(λ) curve of young wheat in contrast to ripe wheat depends strongly on the measuring geometry.

(Author)


To determine the potentials of Landsat multispectral data in the inventory of Philippine mangrove forests, the National Resources Management Center observed an investigation employing computerized processing techniques using the Image 100 interactive multispectral analysis system. The study applied two basic procedures, namely, the spectral signature acquisition method and the digital classification program. For ground truth, information came principally from ocular inspection of selected study sites. Preliminary results of the investigation yielded indications of the potentials of Landsat data in mapping and monitoring mangrove areas in general and in detecting the various growth and structural characteristics of mangroves.

(Author)


Landsat Multispectral Scanner (MSS) data covering a three-county area in northern Illinois were classified using computer-aided techniques as corn, soybeans, or 'other.' Recognition of test fields was 80% accurate. County estimates of the area of corn and soybeans agreed closely with those made by the USDA. Results of the use of a priori information in classification, techniques to produce unbiased area estimates, and the use of temporal and spatial features for classification are discussed. The extendability, variability, and size of training sets, wavelength band selection, and spectral characteristics of crops were also investigated. (Author)


A technique utilizing transformed Landsat digital data for detection of agricultural drought was empirically defined during the 1976 South Dakota drought. During 1977, the procedure was expanded to the Great Plains for evaluation as a technique for detecting and monitoring vegetative water stress over large areas. The technique, Green Index Number (GIN), uses Landsat digital data from 5 by 6 nautical mile sampling frames (segments) to indicate when the vegetation within the segment is undergoing drought. At known growth stages for wheat, segments were classified as drought or non-drought areas. The remote-sensing-based information was compared to a weekly ground-based index (Crop Moisture Index) provided by the United States Department of Commerce. This comparison demonstrated a high degree of agreement between the 18-day remote sensing technique and the ground-based weekly data. Maps based on GIN of parts of the USSR and Australia were produced with a two-week lag and later compared with other crop assessments of crop GIN of parts of the USSR and Australia were produced with a two-week lag and later compared with other crop assessments of crop


Alternative data systems for a global crop production forecasting system were studied with the aid of a unique simulation facility called the Data System Dynamic Simulator (DSDS). Information system requirements were determined and compared with existing and planned data systems, and deficiencies were identified and analyzed. A first step was to determine the data load for an operational global crop production forecasting system as a function of data frequency, crop types, biophases, cloud coverage, and number of satellites. The DSDS was used to correlate the interrelated influence of orbital parameters, crop calendars, and cloud conditions to generate global data loading profiles. Some of the more important conclusions and the main features of the simulation system are presented. P.T.H.


scanned azimuthally at 0 deg, 10 deg and 20 deg, elevation angles at a range of about 17 to 28 m. There were no significant differences in the plume data at 10 deg and 20 deg (mean antenna temperature and amplified AC components of radiometer output voltages). Burning fuel at -6 deg elevation yielded antenna temperature differences of about 200 K for burning fuel to output voltages). Burning fuel at -6 deg elevation yielded antenna angles at a range of about 17 to 28 m. There were no significant

**N79-17282** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**AGRICULTURE, RANGE, AND FORESTRY**

Robert N. Colwell (California Univ. at Berkeley), F. Philip Weber (Department of Agriculture Forest Service), and Ryborn R. Kirby. In its Skylab EREP Investigations Summary 1978 p 79-118 refs. Original contains color illustrations (For primary document see N79-17279 08-42) Afil. NTIS MF A01: SOD HC CSCL O2C

The data acquired by the EREP data analysis program and how it can be used to satisfy some of the information needs of resource managers is shown. Numerous investigators addressing different information requirements submitted findings and examples are cited. The imagery was acquired in a multispectral format, analyzed by visual interpretation, and digitized for computer analysis. The narrow-band spectral data as acquired by Multi-spectral Scanner System were analyzed by computer processing to identify the optimum spectral bands and combinations of these bands that provide maximum amounts of resource information and minimum costs. Microwave data recorded in an electronic format provided an insight into the mapping and monitoring of available moisture for natural resource consumption. S.E.S.

**N79-17294** Dartmouth Coll., Hanover, N.H.


**ACCURACY ASSESSMENT’S EVALUATION PLAN FOR TY MULTILABELING**


**N79-17299** Instituto de Pesquisas Espacivas. Sao Jose dos Campos (Brazil).

**USE OF AERIAL PHOTOGRAPHY SAMPLING FOR ESTIMATING CULTIVATED AREAS [USO DE AMOSTRAGEM COM FOTOGRAFIAS AERAS NA ESTIMATIVA DE AREAS CULTIVADAS]**


A methodology was developed which enables a decision maker to obtain accurate estimations of the size of cultivated areas using conventional aerial photography. The value system of the decision maker and various types of restrictions on system costs and error calculations were considered. The viability of using statistical techniques for area estimations, specifically sampling techniques, is discussed. A statistical example showing the use of methodology and possible future applications are presented.

**N79-17302** National Aerospace Lab., Amsterdam (Netherlands).

**MEASUREMENT OF LIGHT REFLECTANCE FROM CROPS**

W. Verheof 15 Jun. 1978 23 p refs In DUTCH; ENGLISH summary Presented at the Luchtwaarneming Symp., Delft, Neth. 2 Sep. 1977

(NLMP-77034-U) Afil. NTIS HC A02/MF A01

When measuring the reflectance spectrum of an object it is important to take into account the fact that it depends on the object itself and also on the parameters defining the measurement conditions. It is important to keep the conditions of measurement as constant as possible. With the use of a field-spectrometer this was realised by performing a comparative and simultaneous measurement on the object and a diffuse reflecting reference target which is exposed to the same illumination. By keeping the spatial distribution of the irradiation and the direction and minimal costs processed for the purpose measurements were executed to provide insight into the magnitude of the systematic variation associated with multispectral scanning of crops.

**N79-17303** National Aerospace Lab., Amsterdam (Netherlands).

**NON-DESTRUCTIVE DETERMINATION OF CROP PROPERTIES BY MEANS OF MULTISPECTRAL SCANNING**


(NLMP-77035-U) Afil. NTIS HC A03/MF A01

A mathematical model, physically describing the reflectance by vegetation canopies, was used to investigate information extracted from the reflectance spectrum uniquely related with crop properties of interest for agricultural applications. By means of an example and field measurements performed it is indicated how the soil cover percentage can be determined from multispectral scanning data. The complex relation between the reflectance spectrum and crop variables can be simplified drastically when the direction of incoming radiation and detection coincide and the crop is observed perpendicularly or under an oblique zenith angle of approximately 52 degrees. Active conical scanning under 52 degrees with a restricted number of wavelength bands can offer, besides operational advantages, useful data.

**N79-18372** National Oceanic and Atmospheric Administration. Columbia, Mo.

**LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). USSR SPRING AND WINTER WHEAT MODELS. ADENDUM**


There are no author-identified significant results in this report.


**HCMM HEAT CAPACITY MAPPING MISSION Quarterly Progress Report, 1 Nov. 1978 - 31 Jan. 1979**

Ray D. Jackson, Principal Investigator 31 Jan. 1979 1 p Sponsored by NASA ERTS (E79-10104; NASA-CR-158078) Afil. NTIS HC A02/MF A01 CSCL O5B

**N79-18377** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

**LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE; DATA ACQUISITION, PREPROCESSING...**
01 AGRICULTURE AND FORESTRY

ING AND TRANSMISSION SUBSYSTEM (DAPTS). LANDSAT DATA REQUIREMENTS, VOLUME 1A, REVISION A
Dec. 1975 47 p refs Revised sponsored by NASA, NOAA, and USDA EREP

N79-18378# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE, DATA ACQUISITION, PREPROCESSING AND TRANSMISSION SUBSYSTEM (DAPTS). FIELD DATA REQUIREMENTS, VOLUME 1B, REVISION A
Dec. 1975 42 p Revised sponsored by NASA, NOAA, and USDA EREP

N79-18379# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE; DATA ACQUISITION, PREPROCESSING AND TRANSMISSION SUBSYSTEM (DAPTS). HISTORICAL AGRICULTURAL DATA REQUIREMENTS, VOLUME 1C, REVISION A
Dec. 1975 73 p refs Revised sponsored by NASA, NOAA, and USDA EREP

N79-18380# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE; YIELD ESTIMATION SUBSYSTEM (YES) REQUIREMENTS, VOLUME 3, REVISION A
Sep. 1976 72 p refs Revised sponsored by NASA, NOAA, and USDA EREP
(E79-10111: NASA-TM-79975; LACIE-C00200-Vol-3-Rev-A; JSC-11340-Vol-3-Rev-A) Avail: NTIS HC A04/MF A01 CSCL 02C

N79-18381# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE, CROP ASSESSMENT SUBSYSTEM (CAS) REQUIREMENTS, VOLUME 4, REVISION C
Oct. 1977 145 p refs Revised sponsored by NASA, NOAA, and USDA EREP
(E79-10112: NASA-TM-79976; LACIE-C00200-Vol-4-Rev-C; JSC-11329-Vol-4-Rev-C) Avail: NTIS HC A07/MF A01 CSCL 02C

N79-18382# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE; SYSTEM PERFORMANCE EVALUATION, EFFICIENCY ANALYSIS (SPE- EA) REQUIREMENTS, VOLUME 6A, REVISION A
Nov. 1978 28 p Revised sponsored by NASA, NOAA, and USDA EREP

N79-18383# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE, INFORMATION EVALUATION (IE) REQUIREMENTS, VOLUME 7
16 Dec. 1974 40 p Revised sponsored by NASA, NOAA, and USDA EREP
(E79-10115: NASA-TM-79979; LACIE-C00200-Vol-7) Avail: NTIS HC A03/MF A01 CSCL 02C

N79-18384# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE; RESEARCH REQUIREMENTS, VOLUME 8
16 Dec. 1974 66 p Revised sponsored by NASA, NOAA, and USDA EREP
(E79-10116: NASA-TM-79980; LACIE-C00200-Vol-8) Avail: NTIS HC A04/MF A01 CSCL 02C

N79-18385# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). LEVEL 3 BASELINE; TEST AND EVALUATION (T AND E) REQUIREMENTS, VOLUME 9
16 Dec. 1974 50 p Revised sponsored by NASA, NOAA, and USDA EREP

N79-18386# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). SPECTRAL SIGNATURES OF SELECTED CRCPs OBTAINED FROM LANDSAT MULTISPECTRAL SCANNER DATA
C. M. Chesnutwood, Principal Investigator Oct. 1975 27 p Sponsored by NASA, NOAA, and USDA EREP
(E79-10118: NASA-TM-79982; LACIE-C00200-Vol-1) Avail: NTIS HC A04/MF A01 CSCL 02C

N79-18387# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). EVALUATION OF MULTITEMPORAL DATA ENHANCEMENTS FOR THE IDENTIFICATION OF WINTER WHEAT FIELDS
G. L. Kraus and C. M. Chesnutwood, Principal Investigators Jan. 1976 39 p Sponsored by NASA, NOAA, and USDA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls. S. D. 57198 EREP

N79-18388# National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). WORST CASE SUN ELEVATIONS FOR LACIE COUNTRIES
Richard L. Nance, Principal Investigator Feb. 1976 17 p Sponsored by NASA, NOAA, and USDA EREP
(E79-10120: NASA-TM-79984; LACIE-C00200-Vol-10) Avail: NTIS HC A04/MF A01 CSCL 02C

58
YIELD FROM LANDSAT DATA

Jan. 1978 129 p refs Sponsored by NASA, NOAA, and USDA. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls. S. D. 57198 EREP.

The author has identified the following significant results.

LACIE acreage estimates were in close agreement with SRS estimates, and an operational system with a 14 day LANDSAT data turnaround could have produced an accurate acreage estimate (one which satisfied the 90/90 criterion) 1 1/2 to 2 months before harvest. Low yield estimates, resulting from agrometeorological conditions not taken into account in the yield models, caused production estimates to be correspondingly low. However, both yield and production estimates satisfied the LACIE 90/90 criterion for winter wheat in the yardstick region.


The author has identified the following significant results.

An accuracy of 90/85 was achieved with the October estimates which had a relative bias of -9.9 percent and a coefficient of variation of 5.2 percent for the total wheat production in the USGP. The probability was 0.9 that the LACIE estimate was within + or - 15 percent of true wheat production for the USGP. The LACIE spring wheat production underestimate in August, September, and October were the results of area overestimates for the 90/90 criterion. 1 1/2 to 2 months before harvest. Low yield estimates, resulting from agrometeorological conditions not taken into account in the yield models, caused production estimates to be correspondingly low. However, both yield and production estimates satisfied the LACIE 90/90 criterion for winter wheat in the yardstick region.

LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). FEASIBILITY OF ASSESSING CROP CONDITION AND YIELD FROM LANDSAT DATA Mar. 1978 141 p refs Sponsored by NASA, NOAA, and USDA EREP.

The author has identified the following significant results.

Yield modelling for crop production estimation defined a means of predicting the within-a-year yield and the year-to-year variability of yield over some fixed or randomly located unit of area. Preliminary studies indicated that the requirements for interpreting LANDSAT data for yield may be sufficiently similar to those of signature extraction that it is feasible to investigate the automated estimation of production. The concept of an advanced yield model consisting of both spectral and meteorological components was endorsed. Rationale for using meteorological parameters originated from known between season and near harvest dynamics in crop environmental-condition-yield relationships.


The author has identified the following significant results.

Results of the accuracy assessment activity for Phase IA of LACIE indicated that (1) The 90/30 criteria could be reached if the degree of accuracy of the LACIE performance in Kansas could be equaled in other areas. (2) The classification of both...
wheat and nonwheat fields was significantly accurate for the three 115 segments analyzed. The wheat field classification accuracy varied for the segments. However, this was not so with respect to nonwheat fields. (3) Biophase as well as its interaction with segment location turned out to be an important factor for the classification performance. Analyst interpretation of segments for training the classifier was a significant error-contributing factor in the estimation of wheat acreage at both the field and the segment levels.

LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). CROP PHASE 1 AND PHASE 2 ACCURACY ASSESSMENT Final Report
NASA Apr. 1978 186 p Sponsored by NASA, NOAA, and USDA EREP
(Contract NAS9-15200)
(E79-10134; NASA-CR-158143; LACIE-00450; JSC-13736)
Avail: NTIS HC A09/MF A01 CSCL 02C
The author has identified the following significant results.
The initial CAS estimates, which were made for each month from April through August, were considerably higher than the USDA/SRS estimates. This was attributed to: (1) the practice of considering bare ground as potential wheat and counting it as wheat; (2) overestimation of the wheat proportions in segments having only a small amount of wheat; and (3) the classification of confusion crops as wheat. At the end of the season most of the segments were reworked using improved methods based on experience gained during the season. In particular, new procedures were developed to solve the three problems listed above. These and other improvements used in the rework experiment resulted in pre-harvest estimates that were much closer to the USDA/SRS estimates than those obtained during the regular season.

N79-18401** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). CROP SPECTRA FROM LACIE FIELD MEASUREMENTS
Marilyn M. Hixson, Marvin E. Bauer, and Larry L. Biehl, Principal Investigators Houston, Tex. NASA Jan. 1978 192 p refs Sponsored by NASA, 10AA, and USDA EREP
(Contracts NAS9-14970; NAS9-15466)
(E79-10136; NASA-CR-158145; LACIE-00469; JSC-13734; LARS-011578)
Avail: NTIS HC A09/MF A01 CSCL 02C

N79-18403** Lockheed Electronics Co., Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). TRANSITION YEAR CLASSIFICATION AND MEASUREMENTS SUB SYSTEM (CAMS) DETAILED ANALYSIS PROCEDURES
NASA Mar. 1978 131 p refs Sponsored by NASA, NOAA, and USDA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-15200)
(E79-10138; NASA-CR-158147; LACIE-00723; JSC-13735)
Avail: NTIS HC A07/MF A01 CSCL 02C

N79-18404** National Oceanic and Atmospheric Administration, Columbia, Mo. Center for Climatic and Environmental Assessment.
(E79-10139; NASA-CR-158148; LACIE-00503; JSC-11700; CCEA-TN-76-4)
Avail: NTIS HC A03/MF A01 CSCL 02C

LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). CAMS DETAILED ANALYSIS PROCEDURES
NASA Mar. 1976 159 p refs Sponsored by NASA, NOAA, and USDA EREP
(Contract NAS9-12200)
(E79-10140; NASA-CR-158149; LACIE-00712; JSC-10819)
Avail: NTIS HC A08/MF A01 CSCL 02C

LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). CAMS PHASE 2 FUNCTIONAL PROCEDURES
NASA Mar. 1976 40 p refs Sponsored by NASA, NOAA, and USDA EREP
(Contract NAS9-12200)
(E79-10141; NASA-CR-158150; LACIE-00713; JSC-10820)
Avail: NTIS HC A03/MF A01 CSCL 02C

N79-18407** National Oceanic and Atmospheric Administration, Columbia, Mo. Center for Climatic and Environmental Assessment.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). A WHEAT YIELD MODEL FOR BRAZIL
C. M. Sakamoto, Principal Investigator Houston, Tex. NASA Sep. 1977 16 p refs Sponsored by NASA, NOAA, and USDA EREP
(E79-10142; NASA-CR-158151; LACIE-00504; JSC-11701; CCEA-TN-76-6)
Avail: NTIS HC A02/MF A01 CSCL 02C

N79-18408** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). EXECUTIVE SUMMARY
15 Aug. 1978 57 p refs Sponsored by NASA, NOAA, and USDA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(E79-10143; NASA-TM-79994; JSC-13749)
Avail: NTIS HC A04/MF A01 CSCL 02C
The author has identified the following significant results.
The Large Area Crop Inventory Experiment (LACIE), completed June 30, 1978, has met the USDA at-harvest goals (90% accuracy with a 90% confidence level) in the US Great Plains and U.S.R. for two consecutive years. In addition, in the U.S.S.R., LACIE indicated a shortfall in the '76-'77 wheat crop about two months prior to harvest, thus demonstrating the capability of LACIE to make accurate pre-harvest estimates.

N79-18409** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE). EFFECT OF SUN ANGLE AND HAZE ON GENERATION OF LANDSAT IMAGERY
Charles M. Chesnutwood and Gary L. Kraus, Principal Investigators 7 Oct. 1975 22 p refs Sponsored by NASA, NOAA, and USDA EREP
(E79-10144; NASA-TM-79992; LACIE-00409; JSC-09858)
Avail: NTIS HC A02/MF A01 CSCL 02C
The author has identified the following significant results.
When heavy haze was present over a nonvegetated scene, the mean radiance values for all MSS channels were lowered, with the greatest decrease occurring in channels 1 and 2. Over a vegetated scene, any apparent decrease in mean radiance values due to haze may be marked by an increase in mean radiance values which occurred as vegetation increased in vigor during its growth cycle. Mean radiance values for nonvegetated targets (except water) were closely correlated to the changes in sun elevation angle throughout the year. A sun angle correction to
a fixed reference data appeared to offer the possibility of compensating for haze covered areas by predicting the mean radiance values which would be closely correlated to the normal sun declination curve.

**N79-18411** Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.  
**THE THRESHOLD OF DETECTION OF VEGETATIVE CANOPIES USING REMOTELY SENSED DATA**  
D. P. Rice, W. A. Malila, and R. F. Nalepka, Principal Investigators  
Jan. 1979 30 p refs EREP  
(Contract NAS9-15082)  
(E79-10147; NASA-CR-151880; ERIM-124000-5-P) Avail: NTIS HC A03/MF A01 CSCL 08F

G. K. Arp, Principal Investigator  
Dec. 1978 30 p refs EREP  
(Contract NAS9-15200)  
(E79-10148; NASA-CR-151883; LEC-12718; JSC-14624) Avail: NTIS HC A03/MF A01 CSCL 08F

**SEPARABILITY STUDY OF WHEAT AND SMALL GRAINS**  
R. K. Lennington and N. E. Marquina, Principal Investigators  
Nov. 1978 55 p refs EREP  
(Contract NAS9-15200)  
(E79-10149; NASA-CR-151884; LEC-12581; JSC-14604) Avail: NTIS HC A04/MF A01 CSCL 02C  
The author has identified the following significant results. Barley showed significant separability from spring wheat, both multitemporally and on a single date chosen near the turning time for barley. Oats showed occasional multitemporal separability from barley and spring wheat; however, the cause of this separability was not well understood. Oats showed no significant separability from spring wheat on any single date during the growing season. By pooling data from segments having an acquisition near the turning time for barley, a fixed unitemporal projection for aiding in the labeling of barley versus spring wheat was constructed. This projection has about the same separability from spring wheat as the unitemporal greenness versus brightness plot. The new fixed projection has the advantage that barley occurs consistently in the same general location on the plot with respect to spring wheat and oats. Attempts to construct a fixed multitemporal or a segment-dependent multitemporal projection for aiding in the labeling of spring wheat versus other small grains were unsuccessful due to segment availability and the fact that each segment has a unique acquisition history.

**EVALUATION OF LACIE PHASE 3 YIELD MODELS, DETAILED DATA**  
M. H. Trenchard and D. E. Phinney, Principal Investigators  
Dec. 1978 178 p Sponsored by NASA, NOAA, and USDA EREP  
(Contract NAS9-15200)  
(E79-10152; NASA-CR-151887; JSC-14567; LEC-12570) Avail: NTIS HC A09/MF A01 CSCL 02C

**LABEL IDENTIFICATION FROM STATISTICAL TABULATION (LIST) TEST AND EVALUATION**  
M. D. Pore and R. A. Abbotteen, Principal Investigators  
Nov. 1978 35 p refs Sponsored by NASA, NOAA, and USDA EREP  
(Contract NAS9-15200)  
(E79-10154; NASA-CR-151889; JSC-14466; LEC-12381) Avail: NTIS HC A03/MF A01 CSCL 05B

**SOFTWARE FOR ANALYZING DATA CONTAINED IN OUTPUT FILMS CREATED BY THE SPATL AND MLTCRP ROUTINES OF THE ACCURACY ASSESSMENT SOFTWARE SYSTEM**  
J. G. Carnes, Principal Investigator  
Oct. 1978 33 p refs  
Sponsored by NASA, NOAA, and USDA EREP  
(Contract NAS9-15200)  
(E79-10155; NASA-CR-151890; JSC-14562; LEC-12825) Avail: NTIS HC A03/MF A01 CSCL 02C

**N79-18418** Lockheed Electronics Co., Houston, Tex.  
**ANALYSIS OF THE CLASSIFICATION OF US AND CANADIAN INTENSIVE TEST SITES USING THE IMAGE 100 HYBRID CLASSIFICATION SYSTEM**  
W. T. Hocutt, Principal Investigator  
Nov. 1978 8 p refs  
Sponsored by NASA, NOAA, and USDA EREP  
(Contract NAS9-15200)  
(E79-10156; NASA-CR-151892; JSC-14606; LEC-12393) Avail: NTIS HC A02/MF A01 CSCL 02C  
The author has identified the following significant results. Labeling of wheat rather than total grains, particularly with only one acquisition, led to significant overestimates in some segments. The Image-100 software and procedures were written to facilitate classification of the LACIE segments but were not designed to record data for later accuracy assessment. A much better evaluation would have been possible if accuracy assessment data had been collected following each satisfactory classification.

**PROCEDURES FOR ACCESSING USDA/ESCS STATISTICAL REPORTS RELEASED VIA INFONET NETWORK**  
A. L. Ona, Principal Investigator  
Nov. 1978 19 p refs  
Sponsored by NASA, NOAA, and USDA EREP  
(Contract NAS9-15200)  
(E79-10157; NASA-CR-151893; LEC-12863; JSC-14586) Avail: NTIS HC A02/MF A01 CSCL 02C

**IMPROVEMENT OF GREEN NUMBER AND BRIGHTNESS KEYS USED IN LABEL IDENTIFICATION FROM STATISTICAL TABULATION (LIST)**  
T. B. Dennis and M. D. Pore, Principal Investigators  
Oct. 1978 25 p refs  
Sponsored by NASA, NOAA, and USDA EREP  
(Contract NAS9-15200)  
(E79-10158; NASA-CR-151891; JSC-12698; LEC-12714) Avail: NTIS HC A02/MF A01 CSCL 02C

**IDENTIFICATION OF WOOD ENERGY RESOURCES IN CENTRAL MICHIGAN**  
William D. Hudson and Kyle Kittleson  
Nov. 1978 37 p refs  
(Sponsor Grant NGL-23-004-083)  
(NASA-CR-158130) Avail: NTIS HC A03/MF A01 CSCL 02F
Existing biomass studies were compiled for determining their applicability in measuring forest biomass in an entirely new way. Over sixty tree-weight tables were prepared from existing tables or formulas. An estimate of forest biomass was made on a defined area by using Landsat Satellite data analysis, existing forest cover type maps and actual weighting of the entire biomass. Control plots were cruised for normal volume data and weight data, harvested and weighed to determine actual tonnage yields.

S.E.S.

N79-19423** National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE).
LEVEL 3 BASELINE: INFORMATION STORAGE, RETRIEVAL,
AND REFORMATTING SUBSYSTEM (ISRRS) REQUIRE-
MENTS, VOLUME 5, REVISION A
Nov. 1975 65 p Revised by NASA, NOAA, and
USDA EREP
(E79-10113; NASA-TM-79977; LACIE-C00200-Vol-5-Rev-A;
JSC-0967-Vol-5-Rev-A) Avail: NTIS HC A04/MF A01 CSCL 02C

N79-19424** National Aeronautics and Space Administration.
Lyndon B. Johnson Space Center, Houston, Tex.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE).
YES PHASE 1 YIELD FEASIBILITY REPORT
Jan. 1977 42 p Refs Sponsored by NASA, NOAA, and USDA
EREP
(E79-10121; NASA-TM-79985; LACIE-C00439; JSC-116688)
Avail: NTIS HC A03/MF A01 CSCL 02C

The author has identified the following significant results.
The state model was separately evaluated to determine if a
projected performance to the country level would satisfy a 90/90
criterion. All state models, except the North Dakota and Kansas
models, satisfied that criterion both for district estimates
correlated to the state level and for state estimates directly
from the models. In addition to the tests of the 90/90 criterion,
the models were examined for their ability to adequately respond
or fluctuations in weather. This portion of the analysis was based
on a subjective interpretation of values of certain description
statistics. As a result, 10 of the 12 models were judged to
respond inadequately to variation in weather-related variables.

S.E.S.

N79-19425** National Oceanic and Atmospheric Administration, Columbia, Mo.
Center for Climatic and Environmental Assessment.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE).
AN INDEX FOR ESTIMATING WHEAT YIELD IN AUS-
TALIA
C. M. Sakamoto, Principal Investigator Houston, Tex. NASA
Nov. 1977 40 p Refs Sponsored by NASA, NOAA, and USDA
EREP
(E79-10128; NASA-CR-158137; LACIE-00502; JSC-11699;
CCEA-TN-76-3) Avail: NTIS HC A03/MF A01 CSCL 02C

N79-19426** National Oceanic and Atmospheric Administration, Columbia, Mo.
Center for Climatic and Environmental Assessment.
LARGE AREA CROP INVENTORY EXPERIMENT (LACIE).
A WHEAT YIELD MODEL FOR PUNJAB, INDIA
Michael H. Procter and D. E. Umberger, Principal Investigators
NASA Jan. 1978 34 p Refs Houston, Tex. EREP
(E79-10129; NASA-CR-158138; LACIE-00505; JSC-11705;
CCEA-TN-78-2) Avail: NTIS HC A03/MF A01 CSCL 02C

N79-19427** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
AGRICULTURAL SCENE UNDERSTANDING. VOLUME 1
dispersal of insect swarms, since radar can follow where other means of trapping and observation cannot. Data on large-scale behavior as a function of wind and topography are presented. Displayed techniques which show individual or small swarm motion within some larger cloud or mass, or which can show the overall motion over great distances were developed. The influence of wind and terrain on insect motion and dispersal is determined from radar data. S.E.S.

**N79-20438**
Houston Univ., Tex. Mathematics Dept.
**SMALL GRAINS SEPARATION AND OPTIMAL PASS SELECTION** Final Report, 14 Mar. - 30 Nov. 1978
H. P. Decell, Jr., Principal Investigator; B. C. Peters, W. A. Coberly, W. Tally, M. Malek, R. Basu, and J. Spera 14 Jan. 1979 58 p refs EREP
(Contract NAS9-15543)
(E79-10167; NASA-CR-160116) Avail: NTIS HC A04/MF A01 CSCL 02C

**N79-20443**
(Contract NAS9-15200)
(E79-10172; NASA-CR-160109; JSC-14626; LEC-13003) Avail: NTIS HC A03/MF A01 CSCL 02C

**N79-20444**
Department of Agriculture, Weslaco, Tex. Science and Education Administration
(NASA Order S-401988)
(E79-10173; NASA-CR-158170) Avail: NTIS HC A02/MF A01 CSCL 02C

**N79-20448**
Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing
**FOREST RESOURCE INFORMATION SYSTEM Quarterly Report, 1 Jul. - 30 Sep. 1978**
R. P. Mrozynski, Principal Investigator 30 Sep. 1978 53 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-159525)
(E79-10175; NASA-CR-160118; LARS-093078) Avail: NTIS HC A04/MF A01 CSCL 02F

The author has identified the following significant results. A benchmark classification evaluation framework was implemented. The FRIS preprocessing activities were refined. Potential geo-based referencing systems were identified as components of FRIS.

**N79-20447**
**AGGREGATION OF LARGE AREA CROP INVENTORY EXPERIMENT (LACIE) TRANSITION YEAR DATA USING LACIE PHASE 3 SOFTWARE**
C. J. Lisza, Principal Investigator Jan. 1979 14 p Sponsored by NASA, NOAA, and USDA EREP
(Contract NAS9-15200)
(E79-10176; NASA-CR-160120; JSC-14670; LEC-12686) Avail: NTIS HC A02/MF A01 CSCL 02C

The author has identified the following significant results. A LANDSAT imagery was a reliable resource for the stratification of level 2 forest features (softwood, hardwood, tundra, and water). These features can be classified with an accuracy of 72.4 percent + or - 5.9 percent at the 90 percent confidence level. (2) Training fields selected for signature development from only 10 percent of the area did not adequately and efficiently cover the class variability for the entire area. (3) Derived regression transformations were ineffective in recovering the loss of level 1 forest proportions and level 2 softwood and hardwood proportions.

**N79-20452**
**NATIONWIDE FORESTRY APPLICATIONS PROGRAM. TEN-ECOSYSTEM STUDY (TES) SITE 6, FORT YUKON. ALASKA Final Report**
J. F. Ward, Principal Investigator and B. F. Edwards Dec. 1978 87 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-15200)
(E79-10180; NASA-CR-160132; JSC-15800; LEC-13079) Avail: NTIS HC A05/MF A01 CSCL 08F

The author has identified the following significant results. Analysis of the processing results has led to the following conclusions: (1) LANDSAT imagery was a reliable resource for the stratification of level 2 forest features (softwood, hardwood, tundra, and water). These features can be classified with an accuracy of 72.4 percent + or - 5.9 percent at the 90 percent confidence level. (2) Training fields selected for signature development from only 10 percent of the area did not adequately and efficiently cover the class variability for the entire area. (3) Derived regression transformations were ineffective in recovering the loss of level 1 forest proportions and level 2 softwood and hardwood proportions.

**N79-20453**
**NATIONWIDE FORESTRY APPLICATIONS PROGRAM. TEN-ECOSYSTEM STUDY (TES) SITE 7, WELD COUNTY. COLORADO Final Report**
J. E. Weaver, Principal Investigator and R. H. Almond Jan. 1979 51 p refs Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S. D. 57198 EREP
(Contract NAS9-15800)
The author has identified the following significant results. The best dates for automatic data processing analysis appeared to be in midsummer. The level 2 separation of grassland, water, and other resources was reasonably successful, but the level 3 separation of grassland into cultivated (growing crops) and weeds did not appear feasible. Low simulated inventory proportions of grassland indicated that the restricted inventory signature was not representative of all grassland classes and could not be extended with acceptable accuracy.

**N79-20466**

**National Aeronautics and Space Administration. Earth Resources Lab., Slidell, La.**

THE NATURAL RESOURCES INVENTORY SYSTEM ASVT PROJECT Final Report

Armond T. Joyce Jan. 1979 129 p refs

(NASA-TM-58211) Avail: NTIS HC A07/MF A01 CSCL 06B

The hardware/software and the associated procedures for a natural resource inventory and information system based on the use of LANDSAT-acquired multispectral scanner digital data is described. The system is designed to derive land cover/vegetation information from LANDSAT data and geographically reference this information for the production of various types of maps and for the compilation of acreage by land cover/vegetation category. The system also provides for data base building so that the LANDSAT-derived information can be related to information digitized from other sources (e.g., soils maps) in a geographic context in order to address specific applications. These applications include agricultural crop production estimation, erosion hazard-reforestation need assessment, whitetail deer habitat assessment, and site selection. The system is tested in demonstration areas located in the state of Mississippi, and the results of these application demonstrations are presented. A cost-efficiency comparison of producing land cover/vegetation maps and statistics with this system versus the use of small-scale aerial photography is made.

Author

**N79-21521**

**Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.**


D. A. Landgrebe, Principal Investigator Nov. 1978 93 p refs

Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 EREP 5 Vol.

(Contract NAS9-15466)
The paper presents a review of the fundamental concepts of remote sensing of pollutants. Instruments and modes of operation for different types of measurements are reviewed. Attention is given to sensors such as panchromatic and multiband systems, airborne thermal and multispectral line scanners, side-looking radar, and satellite imagery.

The relationship between land use and the environment is examined. The environmental impact process in the United States is discussed, particularly as it relates to land-use impact assessment. Categories of land use are identified, and the U.S. environmental impact statement process is outlined. Advantages of remote sensing for land-use impact assessment are summarized. A remote sensing project is described in which multispectral scanning is employed to assess changes in upland land use and relate these to changes in water-quality data within Apalachicola Bay in the Florida panhandle. Attention is also given to quality assurance for land-use monitoring, anticipatory land monitoring, and detection of trends and changes in land use.

Mexican participation in NASA Mission 91 projects is reviewed. The mission objectives are the detection of mineral deposits and geothermal zones, data collection for geohydrological studies, flood identification, and crop classification. Projects described include a water pollution study over Acapulco Bay, citrus inventory in the main orange-producing Mexican state of Nuevo Leon, a joint project with USDA to identify hosts of the Mediterranean fruit fly, and water-resource studies for an inland semiarid region, a coastal semiarid region, and a tropical jungle. The advantages of remote sensing as a useful planning tool for regional and national projects in underdeveloped countries are discussed.

The Landsat data under consideration were provided as 70 mm positive film transparencies which were initially screened for land areas and selected images were enlarged to 1:1,000,000-scale film negatives and printed as black and white paper prints. The film negatives were used to produce color composite transparencies by the diazo process. This process was found to be useful for first look evaluation of the relative depth of submarine features. It suggests that further experimentation in color enhancement and perhaps new color assignments to bands 4, 5, and 7 should be considered for high gain Landsat scenes where submarine features are subject to investigation. Digital form-line maps, based on assignment of relative density measurements to approximate depth ranges, appear to show the morphology of bottom features with reasonable reliability. V.P.


This paper examines the basic phenomena that generate the information content of remote sensing images and addresses ways in which these phenomena affect the performance of programmed interpretation techniques. An interactive programmed interpretation procedure, developed at the U.S. Army Engineer Waterways Experiment Station, that combines advantages of both training area and clustering image processing concepts is presented. Concepts for enhancing the performance of programmed interpretation techniques are presented and discussed. (Author)


The use of Landsat data to delineate urban boundaries in Standard Metropolitan Statistical Areas is considered. The project, which is being conducted by the Census-Urbanized Area Application System Verification program, seeks to develop processing techniques and output products that meet urban fringe delineation requirements. A processing approach which will use an interactive processing system to produce digital enhancement and classification results is described. M.L.


Digital analysis was performed on a set of multispectral data collected by a low flying aircraft at study sites in the Gulf of Alaska for the purpose of mapping intertidal algal communities. Both supervised and unsupervised pattern recognition procedures were employed. Results show that it is possible to separate a scene into (1) broad spatial zones corresponding to vegetation density for areas of low percent cover and (2) algae types according to their taxonomic division. (green, blue green, red, etc.) for areas with high levels of percent cover. Clustering techniques were found to be the most effective way to extract training signatures. A minimum of four spectral bands is needed to achieve the recognition performance levels demonstrated in this study. Two channels in the visible (green and red), one in the near-infrared region (about 1.0 micron) and one in the thermal region were found most useful. (Author)


Sequential aerial photography in color, color infrared and black-and-white for 1946, 1956, 1967 and 1975 was employed to map changes in squatter housing and land use in N.E. Kowloon of Hong Kong. Delimitation of the squatter area boundaries, determination of squatter structure density, estimation of squatter population, evaluation of environmental changes and a study of the process and form of squatter settlement growth were undertaken. It was found that photographic remote sensing is capable of generating detailed data on land use and processes of squatter settlement growth which can be usefully employed for more positive solution of the squatter problem by planners. (Author)


The integration of Landsat data and the Japanese land data system is discussed. The digitized mesh data used in the land data system are characterized. It is found that the geometric correction which enables registration of Landsat MSS CCT onto the national data system can be obtained with high accuracy to within one pixel. The production of pseudostereoscopic Landsat images, the estimation of vegetation cover, and the calculation of an urbanization index are considered. M.L.


The use of Landsat data for development studies or in developing countries is reviewed with reference to such applications as planimetric mapping, geological and geophysical mapping, and land and water resources. It is not suggested that any of the methods used are new advanced techniques; rather they are a practical application of Landsat for conventional use and show how, without recourse to computer-based technology, the imagery can still provide invaluable information. Consideration is also given to the application of advanced remote sensing technology to development studies. B.J.


Digital analyses using the Interactive Multispectral Image Analyzer System were carried out to classify the existing land use patterns within Metro Manila, an area composed of four cities and 13 municipalities with a population of about 6,925,000. Using CCT data three subscenes at scale 1:100,000 were extracted from Landsat scenes for December 23, 1972 and April 21, 1976. Preliminary comparative evaluation of the data indicated the extensive changes and growth which occurred in the area during 1972-1976. B.J.


Radar and Landsat imagery should not be considered competitive because the two are entirely different. The Landsat MSS system records data in the visible and near infrared portions of the electromagnetic spectrum whereas radar because of the difference in the nature of properties sensed in the invisible microwave region of the electromagnetic spectrum provides signatures for terrain elements which may contrast markedly with those of optical devices. Therefore, one should expect a contrast in data content between SLAR and Landsat, because they sense different properties of terrain elements and radar acquires images at much lower illumination angles compared with solar elevations for Landsat. Because radar senses microrelief, or surface configuration, and dielectric properties of vegetation rather than degree of vigor as in near infrared imagery, a classification of vegetation unlike that obtained from Landsat imagery should be expected to augment any initial classification and permit a level of discrimination not otherwise obtainable. G.R.


Consideration is given to four remote sensing development projects which apply intermediate-level interpretation techniques. The projects, carried out in the Yemen Arab Republic and Sri Lanka, are discussed in terms of objectives, data products, preprocessing, and interpretation methods. The remote sensing efforts concentrated on land evaluation and classification, changes in land use, yield forecasting, and demography. B.J.


The need for an accurate and up-to-date land use information by an airborne or satellite sensor is especially significant when repetitive surveys are required. Remote sensing technique now provides a hitherto unavailable capability for detecting and mapping land use features and monitoring dynamic events of an area, in a repetitive and temporal basis. Land use inventory in Thailand has been undertaken by the Department of Land Development, Ministry of Agriculture and Cooperatives as an important application program of remote sensing from satellites. The program is first being focused upon mapping and determination of the major types of land use in North Thailand. The results are discussed. (Author)


The paper presents the main results of aerial photographic and satellite imagery studies of the coastal swampland of Southeast Sumatra. The purpose was to use these data along with historical records and navigation charts to determine the historical development of the coastal plain, analyze the geomorphic processes currently active in the region, measure rates of erosion and sedimentation along present river banks and shorelines, determine the pattern of sediment deposition in the shallow offshore zone, assess the effect of human activity both in the upper watershed and in coastal plain regions on the geomorphic processes, and pinpoint areas of special sensitivity which are particularly liable to environmental disturbance. P.T.H.

The potential of radar imagery as a land-use mapping base in the northeastern United States is examined. The detectability of Level I and Level II land-use categories is defined, and a regional land-use map was created after determining the dominant land use in one kilometre cells. The effects of environmental modulation on interpretation consistency are explored by comparing the results of this work with an earlier study of the Midwest and West. Although Level I categories were visible in both environments, more detailed analysis quickly precipitated a disparity in the data sets. The paramount factor affecting detectability in the Northeast was omnipresence of forest vegetation, abetted by strikingly different settlement patterns. Comparison of the radar-derived land-use map with two existing land-use maps found few commonalities. The results indicate the importance of the environmental modulation transfer function and, concomitantly, the necessity to carefully consider its inherent parameters in regional land-use inventory programs employing radar imagery as a mapping base. (Author)

A brief survey is presented of the photographic observation of Soviet territory from Salyut 5. Observations are being conducted for purposes of earth resources sensing, environmental monitoring, meteorological studies for the purpose of long-range weather prediction, and small-scale mapping. The particular example of geological investigation from Salyut 5 is discussed.

B.J.


Seasonal high- and low-altitude color IR photographs of the Great Dismal Swamp - a forested wetland located on the Virginia-North Carolina border on the Mid-Atlantic coastal plain - are used to identify and map specific swamp vegetative communities. Vegetative cover classes are defined to provide maximum habitat information for management of the swamp. Canopy and understory class assignments are based on the extent of separation on color IR photographs. These classes are used in combination, resulting in 43 separate canopy designations and 243 vegetative communities (map units). In particular, winter and fall photographs provide the majority of information on the vegetation classes. Winter photographs are used to determine understory and evergreen/deciduous boundaries, while fall photographs are employed for separation of deciduous canopy classes.

S.D.


This paper presents a synopsis of the results of simulation modeling and field studies from which methodologies were formulated for application of remote sensing to the aquatic plant mapping problem. A detailed discussion is presented of the conduct of large-scale field demonstration projects to evaluate the methodologies for their operational effectiveness.

(Author)


A procedure which integrates conventional techniques, Landsat data, and image interpretation to obtain water depth mapping is described. The specialized digital image analysis system developed for the mapping does not require the assumption that the optical characteristics are homogeneous throughout the survey area. A test survey of the Endeavor Strait area off the northeast tip of Australia is considered. It is suggested that the procedure halves, at the least, the cost of high-quality charts.

M.L.


A multistage investigation was undertaken in the upper Nile Region of southern Sudan using temporal Landsat imagery, low level aerial reconnaissance and ground survey to inventory and delineate the soil resources of the 167,474 sq km study area. Five major soil-landscape units were delineated. The synoptic view of Landsat imagery was used to construct interrelationships between the various units. This permitted accurate interpretations of patterns on the imagery which related to soil-landscape conditions.

(Author)


A suite of programs is described, and methods are suggested for the processing of Landsat MSS digital data using a general purpose computer, standard FORTRAN and a standard lineprinter for output. Methods and algorithms for producing cartographically corrected lineprinter output are discussed, enabling the output to be overlaid accurately on a 1/25,000 map to facilitate interpretation and classification. Methods of performing areal computations are given.

(Author)


The Geological Survey of Malaysia has begun a systematic mapping of the coastal plain of the Malaysian peninsula. The present research was conducted to evaluate the use of Landsat digital data to assist the geologist in quaternary mapping. The study was carried out during a 10-day period with the assistance of a geologist with recent field experience in this area of Malaysia. The Remote Sensing Interactive System (STANSORT) was used to view selected channels and ratios on the three-color Grinnell TV display, make simulated-grey level pictures ('dotprints') on a Printronics matrix printer, and scene classification. The supervised classification technique, known as discriminant analysis, was applied based on the knowledge of the geology. A number of soil units were selected from the geological map to define training groups, and then the rest of the study area was classified into the preselected categories. The results indicated that the Landsat information in combination with geological knowledge improved the interpretation and quality of maps with appreciable time savings.

(Author)

Airborne gamma-ray surveys are not easily correlated with published geological maps. This is particularly true in the swampy, glaciated terrain of the northwestern Precambrian Shield, with its numerous lakes. To investigate the applicability of such surveys as aids in geological mapping, high-sensitivity gamma-ray data were collected over 8000 sq km in the Hearne Lake area of the Northwest Territories of Canada. The airborne spectrometer had three channels to measure ground concentrations of potassium, uranium and thorium, and one broader total count channel to measure overall ground radioactivity. It is found that airborne gamma-ray data can be analyzed and displayed in a simple format to provide both mapping and exploration geologists with information not readily available from the original data.

B.J.


This paper reports on additional techniques for mapping and interpretation of coral reef imageries based on the digital processing of Landsat data using the Image 100 Multispectral Analysis System. Major physiographic zones and bottom cover types of Apo Reef (Mindoro Island, Philippines) were categorized and mapped using combinations of unsupervised and supervised modes of digital processing. Categories were checked by actual ground survey. The advantages and limitations of Landsat 1 and 2 data for inventory and monitoring of coral reefs are discussed.

(Author)


The Heat Capacity Mapping Mission (H.C.M.M.) Satellite, to be launched by N.A.S.A. in April 1978 will map thermal patterns of the earth's surface, especially thermal inertia. Thermal inertia of soils is related to soil moisture content, and this gives H.C.M.M. the potential of mapping soil moisture. However, certain restrictions exist, especially in vegetated area, as shown by the experiments made in Sherbrooke, in comparing remotely sensed and ground truth data.

(Author)


As compared with satellite data, aerial MSS data are more complex and have greater radiometric and geometric distortion. It is shown that a combination of three techniques - the maximum likelihood method for discriminating the state of land use, a method for the correction of MSS data distortion, and a method of MSS data mosaicking - can lead to a practical land use compilation system from aerial MSS data. A land use map of the western Tokyo area has been developed on the basis of this technique.

(B.J.)


Theme extraction (supervised classification) on data from Landsat computer compatible tapes has proven valuable for arid land application in Australia. Suitable themes are established using an unsupervised parallelepiped technique. Mapping can be accomplished with this algorithm at considerable savings in computer costs. Understanding and interpretation of the Landsat 4-band signatures allows for vegetation mapping and other uses throughout a given Landsat scene. Color aerial photographs provide suitable data for interpretation and verification.

(Author)


In the framework of the Tellus Project of the European Communities, an algorithm has been worked out permitting the evaluation of the thermal inertia and of the surface relative humidity of bare and sparsely vegetated soils from remotely sensed day and night surface temperatures. The cumulative daily evaporation can also be calculated by this method. The algorithm was tested on existing data from a field experiment and was applied in a flight experiment. While the calculated soil moisture agreed satisfactorily with the average moisture content of the top soil layer, the estimated daily evaporation deviated from the measured values due to simplifications inherent in the model.

(Author)


A method is developed for studying the influence of terrain relief on the accuracy of differential orthophotographic transformation. A formula is obtained relating terrain slope with photograph accuracy, and errors caused by horizontal projection errors and terrain relief are analyzed. Ways to compensate horizontal-projection errors and terrain relief are examined. Ways to compensate horizontal-projection errors are examined.

B.J.


An automated mapping satellite system (MAPSAT) compatible with Landsat satellites but also capable of resolving the three-dimensional mode of topography is proposed. The stereoscopic capability, high resolution and multispectral linear arrays of the proposed satellite are discussed, as well as the requirements of very high stability and pointing accuracy. Sampling frequency, data storage, transmission and compression, and swath width for the MAPSAT also receive attention.

J.M.B.
A land use classification system for use with Remote-Sensor data is presented. Urban and built up land, agricultural land, rangeland, forest land, water barren land, nonforested wetland, tundra, and permanent snow and icefields were surveyed. For land use mapping, the data were collected by Multispectral Photographic System, the Earth Terrain Camera, and the Multispectral Scanner System. Spatial resolution, spectral contrast, and the geometry of the surface are discussed. S.E.S.
GEOLOGY AND MINERAL RESOURCES

Includes mineral deposits, petroleum deposits, spectral properties of rocks, geological exploration, and lithology.


Two types of structural features have been identified from satellite-borne photographs of the Pamir plateau: transzonal breaks and ring structures. The latter may be of importance in localizing regions of endogenous ore-formation.

B.J.


The worldwide availability of uniform remote sensing data has enabled exploration geologists around the world to work in a more coordinated fashion from a common information base representing various parts of the electromagnetic spectrum. This comes at a time when forecasts of future mineral requirements predict acute shortages. There exists, therefore, a need for consolidation of efforts and standardization of terms and symbology in order to take full advantage of this new technology on a worldwide basis in a timely manner. Although data exists for most land areas of the earth, the more remote regions are usually unable to obtain repetitive coverage in a systematic manner. Although data exists for most land areas of the earth, the more remote regions are usually unable to obtain repetitive coverage in a systematic manner.


A method of mapping geology at a reconnaissance scale and locating zones of possible hydrothermal alteration has been developed. This method is based on principal component analysis of Landsat digital data and is applied to the desert area of the Khogai Hills, Baluchistan, Pakistan. A method for airborne spectrometric detection of geobotanical anomalies associated with prophyry Cu-Mo mineralization at Heddleston, Montana has also been developed. This method is based on discriminants in the 0.67 micron and 0.79 micron region of the spectrum.


Radiometric Landsat, aeromagnetic, and topographic data in digital form of an area in central New Mexico were merged and interpreted to determine the value of combining them for geological studies. The area studied is underlain by sedimentary rocks of Permian age cut by shallow intrusive bodies of Tertiary age. The area is characterized by karst topography and internal drainage. Results of the study indicate that the combining and displaying of multiple data sets makes it easier for the interpreter to relate the significance of different observations. Level slicing and color coding allows display of all, part, or combinations of the data sets for ease of analysis.


A microwave remote sensing of snowpack experiment is described and some preliminary data presented. A mobile field laboratory consisting of a four-frequency (S, 10.7, 18 and 37 GHz), all with dual linear vertical and horizontal polarizations, microwave radiometer system attached to a truck-mounted aerial lift was used to study the microwave emission characteristics of snowpacks in the Colorado Rocky Mountains during the winter of 1977-78. The influence of snowpack physical parameters such as water equivalent, grain size, and melt-freeze cycle on its microwave brightness temperature and its implications to the application of microwave radiometric technique to remote sensing of snowpack for runoff prediction are discussed.

(Author)


The use of Landsat MSS computer compatible tape data to aid the search for nickel laterites in islands west of Waigeo Island, Indonesia is described. Areas without laterites have denser vegetation than areas with laterites, and a parallelepiped classification algorithm was employed in a supervised mode to determine the integrated spectral response from vegetation and laterite soil over the laterite areas. The study indicates that analysis of Landsat data can aid in the targeting of ground-based exploration of nickel laterites. M.L.


A detailed image analysis of a selected test area in Tamilnadu State, South India, was conducted to investigate the applicability of Landsat data for hydrogeologic studies. A false-color mosaic, and a reconnaissance map of the geology and lineaments of Tamilnadu State, South India, were prepared. The Landsat multispectral data were visually interpreted for hydrogeological information. Correlation of the existing water wells with the lineaments interpreted and mapped, showed that the locations of high yield wells were related to the lineaments. (Author)


Landsat imagery was used to survey natural resources in the northern part of Chile (the Atacama Desert). The study embracing geology-mining, geomorphology, and soils and vegetation. A connection between geological structural controls and mineral deposits was established. Copper, iron, and manganese were found to be controlled by N-S fractures, while gold, lead, zinc, and silver were controlled by E-W fractures. Geomorphological studies were aimed at detection of the aggradation process affecting regional dynamics. It was possible to establish the behavior of vegetation before and after the dry season in the eastern area. Information was obtained on hydric characteristics and such soil properties as stoniness, saltiness, and active aeolian deposits. P.T.H.


Vegetative ground cover, an important indicator of surface mine reclamation, can be remotely determined by two low cost, semi-automatic techniques. The first utilizes a leaf area meter to measure the extent of vegetation as represented by darkened spots on clear plastic overlays made from aerial photographs of minelands. The second utilizes an image analyzing computer to scan, digitize, and classify ground cover detected in the same aerial photographs. Both methods are rapid and highly (85-95%) accurate, although the computer system is more versatile. Digital image analysis can be coupled with many types of remotely sensed data to monitor surface mining and mineland reclamation anywhere in the world. (Author)


A Landsat image processing system is discussed. The system is based around a mini-computer with image display on an interactive TV system and a film recorder. Software has been developed to provide enhancement techniques including contrast modification, ratioing, spatial filtering, stereo pair production and multi-spectral classification. The system has been used to produce computer enhanced images of approximately one third of Australia in a continuing effort to develop optimum enhancement techniques for each of Australia's major mining areas. (Author)


A Landsat study of the Coipasa area in Bolivia is described. The study area is semiarid, in which volcanic, eolian, fluvial, and lacustrine processes have shaped the terrain; sparse vegetation in the area is dominated by shrub and grass. The hydrological and morphological features of the area are discussed. The purpose of the present paper is to show, using the Bolivian imagery as an example, that (1) Landsat imagery is well suited to the analysis and evaluation of natural resources and (2) geomorphology is the most appropriate science to investigate the natural resources for the development of a particular area.

B.J.


The Technology Application Center, in conjunction with the U.S. Bureau of Mines Liaison Program, is studying the use of Landsat data for the monitoring of coal surface mine reclamation activities. Landsat may provide sufficient information to reduce the number of on-site inspections now required. The focus of the project has been the Navajo Coal Mine located in northwestern N. Mex. On October 15, 1977, a field team recorded spectral measurements at the mine during the time of Landsat’s overpass and a corresponding aerial photographic flight. Training sets were selected from the ground and aircraft data representing vegetated, graded, ungraded and natural environments. A supervised classification of the data was performed and correlated to aerial photos and mine maps. The results, to date, have been very encouraging.

(Author)


Basic theoretical, methodological and practical questions relating to the use of aerial photographic, radar, and thermal techniques in engineering geology and hydrogeology are reviewed. Techniques for the interpretation of various geological features from aerial images are examined. Particular consideration is given to the possibilities of integrating aerial, spaceborne and ground-based (stereophotogrammetric) techniques for purposes of geological investigation.

B.J.


It is pointed out that during the more than 200 years of mining activity in the Northern Anthracite Field of Pennsylvania more than 50% of the original anthracite reserves have been removed. This undermining of the area has caused much subsidence, which in many instances has damaged streets, railroads, private property, and sections of the extensive river flood-prevention system. Mine subsidence is a continuing problem. The U.S. Bureau of Mines estimates that by the year 2000, over 1,500,000 acres of land will have been affected. Subsidence hazards data are essential to state and local planning agencies before any major construction can be undertaken. In an attempt to determine a more efficient and cost effective means of identifying subsidence problem areas, the utility of aerial remote sensing has been examined. The underlying strategy of the project was to recognize that the overall problem is to develop a better approach to land-use management.

G.R.


Stereoescalopic synoptic view and multispectral coverage of different areas of interest are provided. Regional patterns of geology, landforms, and drainage are examined. The availability of a variety of images which give the best image or combination of images is discussed. Results of the analysis of EREP data indicate: (1) Photogeological reconnaissance and regional maps as good as or better than published small-scale maps can be rapidly prepared, (2) geological maps were made for arid or semiarid regions for ground checking, (3) topographic and drainage analysis were conducted for heavily vegetated areas, (4) active faults and other ground movements were located, (5) maps were made of rock fracturing, mineral resources, ground water, and engineering applications, (6) surface-water and snow-cover inventories were found feasible, (7) considerable reduction in costs of exploration was documented. S.E.S.


04 GEOLOGY AND MINERAL RESOURCES
04 GEOLOGY AND MINERAL RESOURCES

N79-17281* Geophysical Survey, Denver, Colo.

APPLICATION OF PLATE TECTONICS TO THE LOCATION OF NEW MINERAL TARGETS IN THE APPALACHIANS

J. Kutina and G. Rabchevsky

Jun. 1978 154 p

Grant NSF AER-76-81807

(E79-10095: NASA-CR-1508666) Avail. NTIS

HC A04/MF A01 CSCL 08G

The author has identified the following significant results.

Based on LANDSAT 1 and 2 data, applications in the fields of coal mining, lignite exploration, and thematic mapping in geology are demonstrated. The hybrid image processing system, its software, and its utilization for educational purposes is described. A pre-operational European satellite is proposed.

N79-17292* Stanford Univ., Calif. School of Earth Sciences.

HCM: SOIL MOISTURE IN RELATION TO GEOLOGIC STRUCTURE AND LITHOLOGY, NORTHERN CALIFORNIA

Ernest I. Rich, Principal Investigator

Jan. 1979 2 p ERTS

(Contract NAS5-24479)

(E79-10103: NASA-CR-158059) Avail. NTIS

HC A02/MF A01 CSCL 08M

The author has identified the following significant results. A preliminary analysis of the HCM imagery of the project area indicated that locally some differentiation of lithologic units within the Northern Coast Range may be possible. Of significance, however, was a thermally cool linear area that appeared on the 30 May 1978 Nite-IR. This linear feature seemed to coincide with the Bear Mt. Fault and with the axis of the Chico Monocline along the eastern margin of the Sacramento Valley.


LATE DIAGENETIC INDICATORS OF BURIED OIL AND GAS. 2: DIRECT DETECTION EXPERIMENT AT CEMENT FIELD, OKLAHOMA AND TEXAS, USING ENHANCED LANDSAT 1 AND 2 IMAGES

Terrence J. Donovan, Patricia A. Termain, and Mitchell E. Henry, Principal Investigators

1979 49 p refs

(Contract NASP-24479)

(E79-10099: NASA-CR-158055; Rept-79-243) Avail. NTIS

HC A03/MF A01 CSCL 08G

The author has identified the following significant results. The Cement oil field, Oklahoma, was a test site for an experiment designed to evaluate LANDSATs capability to detect an alteration function of numerical information derived from various sources, including: (1) soil and stream sediment geochemistry, (2) aeromagnetic data, (3) Bouguer gravity values, (4) LANDSAT digital spectral data, (5) digitized linear parameters, and (6) documented mine/prospect qualitative data. The methods were designed to improve spatial classifications which previously relied on remotely sensed imagery alone. Extending the spectral signature to a physical signature by providing additional data types for the classifier was believed to be a step toward this goal. R-mode principal components factor analysis was applied to all variates for data reduction and provided insight into variable correlations.

N79-18527* American Univ., Washington, D. C.

APPLICATION OF PLATE TECTONICS TO THE LOCATION OF NEW MINERAL TARGETS IN THE APPALACHIANS

J. Kutina and G. Rabchevsky

Jun. 1978 154 p

(Grant NSF AER-76-81807)

(PB-287899/9: NSF/RA-780218: SAPR-2) Avail. NTIS

HC A08/MF A01 CSCL 08I

These results provide a new structural-geological framework for a metallocenic study by: recognizing a block structure of a broad territory extending westward from the Appalachian folded belt; finding a relationship between the curvature of the Appalachian folded belt and the boundaries of blocks of the Precambrian basement; and postulating the presence of three major lineaments extending east-westernly along southern and northern boundaries of major basins and uplifts, which are supposed to reflect major fracture zones of the Precambrian basement. The spacing between the east-west lineaments was of the same order of magnitude as spacing between the transfer faults which displace the crest of the Mid-Atlantic Ocean Ridge. This may represent relics of basement fractures of the plates that moved away from the rift zone. These findings have led to a study of distribution and occurrence of deposits of the individual metals superimposed on the new structural base. The distribution of epigenetic uranium is presented in Part A. Part B includes two manuscripts describing work completed in remote sensing studies.
Photographs and images of the Great Smoky Mountains National Park and adjacent areas available from the USGS are listed. The list includes: (1) LANDSAT 1 and 2 (formerly ERTS), 1972 to 1978; (2) Skylab, 1973 to 1974; (3) NASA aircraft photography, 1969 to 1973; (4) USGS mapping photography, 1956 to 1975.

Photographs and images of biosphere reserves taken from spacecraft and aircraft provide a significant data base showing broad views and details of the landscape and are invaluable in searching for changes and trends in forest cover, water area, and other diagnostic landscape features. Each data report in this series lists remotely sensed data gathered from spacecraft and aircraft available for a single biosphere reserve. Computer listings of data are provided by the EROS Data Center of the U.S. Geological Survey, which contains in its archives all of the listed material in photographic form and, in the case of LANDSAT images, can make available computer-compatible magnetic tapes of any LANDSAT scene.

A rationale for the collection of ground truth data for remote sensing measurements is outlined. A model of how remotely sensed data provide the information desired is developed, and two general classes of ground truth are distinguished, along with three types of site observation of concern for ground truth. Sampling strategies for ground truth are discussed. The general applicability of ground truth collection techniques is demonstrated using the example of the NASA/Cousteau Bathymetry Experiment, a project that involves the mapping of ocean water depth. It is concluded that ground truth is a most important component of remote sensing projects and that a model that relates the user's parameter of interest to remotely sensed data should be developed in order to guide the selection of both surface and remote measurements.

F.G.M.


The history of remote sensing studies of the oceans is surveyed, and some applications of current ocean-sensing spacecraft are examined. Topics considered include maritime weather and hazard forecasting, environment and resources, and deep ocean processes. Future developments are discussed with reference to the missions and capabilities of planned satellites.

M.L.


Theoretical investigations and studies with color sensors operated from ships and aircraft have demonstrated the feasibility of space measurements of ocean color. The NIMBUS-G spacecraft, scheduled for launch in August 1978, will carry a Coastal Zone Color Scanner (CZCS) designed for in situ measurements of chlorophyll and sediment concentrations, and possibly fish distribution patterns and physical features of ocean surfaces. Several investigations have been conducted using spectroradiometers, including an Ocean Color Scanner, to develop and test techniques for isolating ocean color data from atmospheric interference and extraction of usable information. A NIMBUS-G Experiment Team (NET) was formed to evaluate the technical performance of the CZCS and to develop algorithms for data analysis. Nine member experiments are scheduled. (Author)

An attempt was made to combine remote sensing data and a data base management system for marine living resources assessment, in an effort to study the feasibility of tracing fish migration patterns. The selected study area was water off the Sankiru coast (an important fishing area) and the selected study resource was saury, Cololabis saira. This paper discusses the relationship between results of nonparametric clustering analysis for commercial fishing data and Landsat MSS data, and classification results of sea water by the LARSYS program.


The paper deals with some results obtained by remote sensing in coastal regions of Indonesia. The usefulness of multispectral photography in oceanography is demonstrated; the blue band proved useful in studying bottom features, and the green band for studying coral reefs, benthic flora, and sediment transport. Good results in mapping and in the study of mangrove forests were obtained in the IR band. The same applies to Landsat Imagery in identifying uncharted reefs. Some results obtained with radiometers and thermal scanners are illustrated.


The missions normally performed by the Coast Guard include pollution surveillance (oil slick detection), search and rescue, ice reconnaissance, and enforcement of laws and treaties, requiring large-scale ocean surveillance. Evaluation of sensor systems of various type has shown that the Coast Guard missions can be performed effectively using sensor-equipped aircraft. Particularly convincing were the excellent results obtained with the Airborne Ocean Surveillance systems, AOSS I and AOSS II. The airborne sensors discussed in the present paper include the side-looking airborne radar, the IR/UV line scanner, the aerial reconnaissance camera, the airborne data annotation system, and the control display and record console.


A method is proposed for determining the physical parameters of oceans from satellite measurement data. For illustration, the method is applied to the processing of microwave data transmitted from Cosmos 243.


Through time series analysis of GOSSTCOMP satellite data, time differences in the occurrence of maximum and minimum mean monthly SSTs off the coast of Brazil were observed in the region of 20-26 deg S by 34-47 deg W and showed the maximum surface water temperature to lag the coastal land station (Cananeia) by two months and the minimum by one month. For annual components of SST, maximum amplitudes were observed at Cabo Frio (influenced by upwelling) and Cananeia (influenced by Malvinas current) and minimum amplitudes at coastal and oceanic area between Ubatuba and Santos, a more thermally stable area.


The Satellite Ocean-Related Imagery Applications Program (SORIAP) has the objective to evaluate the usefulness of both Landsat and NOAA Imagery and computer compatible tapes obtained at the newly operating Shoal Cove Satellite Receiving Station, with respect to providing worthwhile data products to the ocean user community. Application areas of study are related to sea surface temperature contouring, sea ice distribution, and iceberg/ocean vessel detection and identification. The geographic areas of interest include Grand Banks and Labrador Sea. Attention is also given to a SORIAP program follow-up.


Observations of the influence of cyclonic eddies at thermal front boundaries on phytoplankton growth in the regions of fronts between cold, well mixed waters rich in nutrients and warm, stratified waters which are nutrient depleted around the British Isles are presented. Infrared satellite imagery was taken of the area southwest of the English Channel and compared with distributions of surface temperature, salinity and chlorophyll a, measured by ship. The surface distributions were found to match the eddy structures shown by infrared imagery except for a region within the spiral arm of the eddy, which may have come from a local upward displacement of the thermocline. It is found that the higher chlorophyll levels in frontal waters are due partly to an increase in the abundance of several diatom and dinoflagellate species and partly to patches of phytoplankton derived from the thermocline.


Potential applications of remote sensing technology to the study of coastal marine environments are reviewed, emphasizing water quality and biological measurements. Parameters measurable by airborne or spaceborne remote sensors include particulates, measured by visual or multispectral photography, chlorophyll a, measured by the Ocean Color Scanner or Coastal Zone Color Scanner, temperature distributions, by IR or microwave scanners, and salinity, by means of microwave radiometers. Research projects in which wide
area synoptic or repetitive remote sensing can make a major contribution include the study of estuarine and continental shelf sediment transport dynamics, marine pollutant transport, marine phytoplankton dynamics and ocean fronts.

A.L.W.

**N79-17284** National Aeronautics and Space Administration, Lyndon B. Johnson Space Center, Houston, Tex.

**OCEANS AND ATMOSPHERE**


Avail: NTIS MF A01; SOD HC CSCL 0BJ

The oceanographic problems related to atmospheric conditions were studied. The Multispectral Scanner System and The Multispectral Photography System were used to investigate estuaries, bays and coastlines. The wide scale of variations in the ocean which moderate and influence climate are discussed. The wind over the ocean which depends on the properties of the waves generated were measured.

S.E.S.

**N79-17296** National Physical Research Lab., Pretoria (South Africa).

**REPORT ON THE NPRL PARTICIPATION ON NIMBUS G PRELAUNCH SEA TRUTH EXPERIMENTS: CRUISE 24-27 JANUARY 1978**


In conjunction with the prelaunch studies for the Nimbus G experiment, a cruise along the east coast of South Africa was scheduled. This report outlines the scientific objectives of the cruise. Data tables are presented for transmittance measurements. The visual observations and results of the cruise are discussed.

G.Y.

**N79-17297** National Physical Research Lab., Pretoria (South Africa). Optical Sciences Div.

**REPORT ON THE NPRL PARTICIPATION ON NIMBUS G PRELAUNCH SEA TRUTH EXPERIMENTS: CRUISE 20-24 FEBRUARY 1978**


In conjunction with the prelaunch studies for the Nimbus G experiment, a cruise along the west coast of South Africa was scheduled. Being related to the remote sensing and interpretation of water color, the scientific objectives of this and similar cruises were: (1) to collect data relevant to the water color phenomena in different types of water under different environmental and oceanographic conditions; (2) to gain experience in the operation and evaluation of those types of measurements, which are related to water color; and (3) to gain experience in the combined aircraft, ship, and ski boat operation for the purpose of collecting meaningful data from a large area within a short time.

G.Y.

**N79-17301** Environmental Research Inst. of Michigan, Ann Arbor. Applications Div.


A multichannel algorithm has been developed for bottom-type recognition under a variable depth of water. This algorithm is described, and the two-channel version of the algorithm is evaluated theoretically and empirically for several hypothetical and real situations. The radiative transfer model used for development and testing of this algorithm is also described, and an empirical verification of the model is presented. Author (GRA)

**N79-18375** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

**A METHOD FOR THE AUTOMATIC STANDARDS FOR CLASSIFICATION OF MULTISPECTRAL IMAGES OBTAINED FROM ORBIT IN COASTAL WATERS [METODO PARA CLASSIFICACAO AUTOMATICA DE PA DROES MULTIESPECTRAIS DE IMAGENS ORBITAIS EM AGUAS COSTEIRAS]**


**N79-18553** Chesapeake Research Consortium, Inc., Baltimore, Md.

**SUBMERGED AQUATIC VEGETATION, CHESAPEAKE BAY BASELINE DATA ACQUISITION Final Report** Apr. 1978 333 p (Contract EPA-68-01-3994) (PB-288215/7; EPA-903/9-78-020) Avail: NTIS HC A15/MF A01 CSCL 0BA

A directory of research activities on submerged aquatic vegetation; annotated bibliography of the Chesapeake Bay submerged aquatic vegetation; data files of Chesapeake Bay submerged aquatic vegetation; monitoring programs for the Chesapeake Bay are reported.

GRA

**N79-19428** Brevard County Health Dept., Titusville, Fla.

**VEGETATION AND OTHER PARAMETERS IN THE BREvard COUNTY BAY: BUILT ESTUARIES**


It is shown that low-altitude aerial photography, using specific interpretive techniques, can effectively delineate sea-grass beds, oyster beds, and other underwater features. Various techniques were used on several sets of aerial imagery. Imagery was tested using several data analysis methods, ground truth, and biological testing. Approximately 45,000 acres of grass beds, 2,500 acres of oyster beds, and 4,200 acres of dredged canals were mapped. This data represents selected sites only. Areas chosen have the highest quality water in Brevard County and are among the most highly recognized biologically productive waters in Florida.

L.P.

**N79-19587** Computer Sciences Corp., Silver Spring, Md.

**A SURVEY OF POTENTIAL USERS OF THE HIGH ALTITUDE POWERED PLATFORM (HAPP) IN THE OCEAN/COASTAL ZONE COMMUNITY** Final Report


The results of a survey of the ocean/coastal zone community to determine potential applications of a High Altitude Powered Platform (HAPP) are reported. Such a platform, capable of stationkeeping for periods up to a year over a given location, could make frequent and repeated high resolution observations of a given region or serve as a high-altitude regional communications link. Users were surveyed in person and via a questionnaire to determine the desirability of the HAPP within the ocean/coastal zone community. The results of the survey indicated that there is strong interest in all areas of the user community (research and development, operational agencies, and private industry) in having NASA develop the HAPP.

G.Y.
Variations in the extent and concentration of sea ice cover on the Southern Ocean are described for the three-year period 1973-75 using information derived from the Nimbus-5 passive microwave imager. Author

THE USE OF INFRARED AND VISIBLE IMAGERY FOR SEA ICE MONITORING
Global mapping of pack ice conditions and the climatic roles of ice are dealt with along with the presentation of information on visible and infrared observations from spacecraft and aircraft. Historical ice records are identified. GRA
HYDROLOGY AND WATER MANAGEMENT

Includes snow cover and water runoff in rivers and glaciers, saline intrusion, drainage analysis, geomorphology of river basins, land uses, and estuarine studies.


A Landsat image of part of the flooded area of Cooper Creek, Queensland, Australia, in February 1974, shows large dark areas within the flooded valley. The dark areas are believed to be wet, but unflooded, areas of dark alluvial soil. These striking features, which have not previously been identified on Landsat images, must be properly interpreted so as not to confuse them with clear water. (Author)


Seasonal flooding, the corresponding variations in the flow regime and the attendant influx of organic and inorganic materials into Lake Kainji are producing environmental changes in the lake system. The physical size of the lake, however, makes it impossible for field crews to carry out badly needed regular synoptic surveys of the lake. Earlier studies have suggested a link between horizontal turbidity gradients and general pattern of circulation in the lake. In this study, ratioing of the spectral albedo in selected multi-seasonal and multi-spectral scanner (MSS) bands of Landsat satellite have shown a significant correlation with the turbidity characteristics of the lake monitored between 1972 and 1974. The spectral classification of the lake’s water, using remote sensing technique, has been found useful in charting the movement of different water masses within the lake. (Author)


The use of remote sensing analysis to identify different categories of surface features is discussed, and two remote sensing studies of Delaware's coastal environment are described. In one study, eigenvector analysis of Landsat data was used to distinguish clear water from water containing industrial waste. The second example involves the use of field radiometric surveys for specifying the physical basis for wetland reflectance characteristics. Potential extensions of the techniques are considered. M.L.


The feasibility of measuring water color and turbidity from satellites can be assessed by considering light and water interaction processes and by evaluating the effects of atmospheric and hydrologic variables. The principles of these interactions are described and the water-quality information in Landsat data is evaluated. The economics of obtaining water turbidity measurements by remote sensing techniques are also investigated, taking into account the relevance of the obtained information. It is found that remote sensing provides an optical measure of water color and turbidity. Pollutants must affect color or turbidity to be detectable, although dissolved luminescent constituents can be detected by the Fraunhofer Line Discriminator. One of the major problems in calculating water turbidity from a remotely measured flux is the difference in absorption and scattering of light in the atmosphere from one time to another. G.R.


The reported investigation is concerned with the use of Landsat remote sensing to define input parameters for an array of hydrologic models which are used to synthesize streamflow and water quality parameters in the planning or management process. The ground truth sampling and problems involved in translating the remotely sensed information into hydrologic model parameters are discussed. Questions related to the modification of existing models for compatibility with remote sensing capabilities are also examined. It is shown that the input parameters of many models are presently overdefined in terms of the sensitivity and accuracy of the model. When this overdefinition is recognized many of the models currently considered to be incompatible with remote sensing capabilities can be modified to make possible use with sensors having rather low resolutions. G.R.


The electromagnetic scattering properties of soils and snow are being measured in situ under natural environmental conditions. A physical analysis is done at each test site to determine the physical properties of the sample for correlation with its electromagnetic signature. (Author)


06 HYDROLOGY AND WATER MANAGEMENT

This model could not be applied to the actual remotely sensed data,
Symposium on Remote Sensing of Environment, 12th, Manila,

A quantitative model is proposed for measuring and analyzing
the water quality distribution of a large body of water by remote
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but it is shown that more data would give rise to satisfactory results.


Landsat multispectral scanner imagery provides a unique tool for investigations of coastal and shallow-water geomorphology. Small scale patterns (1 to 100 kilometers) are much easier to detect from a vantage point in space than they are from the ocean surface or from conventional aircraft photos. The extensive Bermuda platform has been a puzzle in geomorphology for many years. Recent Landsat scenes have allowed the development of a new hypothesis which can be checked by conventional geological and geophysical field investigations. The hypothesis states that the gross morphology of subaerial and submarine Bermuda resulted from lateral transportation of sediments and that modern analogs of Bermuda's relict spits and bars can be found along many other coastal areas.


A new classification system was developed for wetlands in the Tennessee Valley Region. It was found that seasonal color IR photographs provide sufficiently detailed information to map wetland areas as small as 0.5 ha in size and 20 m in width. A minimum of ground truth is required, although field checking of final or interim products is always advisable. Dates of photographs, and thus wetland boundaries, can be related to stage records to give an indication of range in water-level fluctuation and placement of boundaries within this range.

G.R.


Color infrared photography and thermal infrared imagery were used for mapping saline seeps in southwestern North Dakota. Two flights, 9 September 1975 and 19 May 1976, both at 2742 and 914 meters AGL, gathered the imagery used in the study. Saline seeps were observed during ground investigation to occur in three stages of development: (1) emergent or incipient, new wetness; (2) intermediate, wet and saline indicated by salt tolerant vegetation; and (3) mature, wet saline with bare salt crust. Stages two and three were best identified using color infrared photography, with little or no identification improvement when thermal data were added. Seep location accuracies were in the 75 to 90 percent range on a numerical basis and 70 to 90 percent on an areal basis. Although insufficient ground data were obtained on stage one seeps, thermal data did record areas (seep and non-seep) with cooler apparent temperatures than the surrounding dry areas. Class one seeps could not be detected on color infrared imagery.

Author


A unified package of files and programs has been developed to automate the multidate Landsat-derived analyses of water quality for about 3000 inland lakes throughout Wisconsin. A master lakes file which stores geographic information on the lakes, a file giving the latitudes and longitudes of control points for scene navigation, and a program to estimate control point locations and produce microfiche character maps for scene navigation are among the files and programs of the system. The use of ground coordinate systems to isolate irregular shaped areas which can be accessed at will appears to provide an economical means of restricting the size of the data set.

J.M.B.

N79-16322 Texas A&M Univ., College Station. INVENTORY OF SURFACE WATER USING LANDSAT Ph.D. Thesis

Gary Eugene Graybeal 1978 130 p

Avail: Univ. Microfilms Order No. 7900974

The study site selected for this investigation covered approximately 132,000 hectares in east-central Texas and contained 100 bodies of surface water that ranged in size from 0.83 hectare to 17.48 hectares. The classification results, using the recommended procedure, contained no areas in the study site which had been identified as water which were actually nonwater. The identification results also showed that 58 percent of the 69 water bodies ranging in size from 0.81 hectare to

85
2.02 hectares and 33.3 percent of the 15 water bodies ranging in size from 2.03 hectares to 4.04 hectares were misclassified as nonwater. However, the identification results showed that all 16 water bodies 4.05 hectares or greater were correctly identified as water.

**N79-16329** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**SOIL MOISTURE WORKSHOP**

J. L. Heilman, ed. (South Dakota State Univ.), D. G. Moore, ed. (South Dakota State Univ.), T. J. Schmugge, ed., and D. B. Friedman, ed. Nov. 1978 219 p refs. Workshop held at Beltsville, Md., 17-19 Jan. 1978; sponsored in part by NASA and the US Dept. of Agriculture (NASA CP 2073) Avail. NTIS HC A10/MF A01 CSCL 08M The Soil Moisture Workshop was held at the United States Department of Agriculture National Agricultural Library in Beltsville, Maryland on January 17-19, 1978. The objectives of the Workshop were to evaluate the state of the art of remote sensing of soil moisture; examine the needs of potential users; and make recommendations concerning the future of soil moisture research and development. To accomplish these objectives, small working groups were organized in advance of the Workshop to prepare position papers. These papers served as the basis for this report.

**N79-16330** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**FORMATION OF THE SOIL MOISTURE WORKSHOP**

In its Soil Moisture Workshop Nov. 1978 2 p Avail. NTIS HC A10/MF A01 CSCL 08M A brief discussion of the need for the formation of the Soil Moisture Workshop and its objectives is presented. G.Y.

**N79-16331** Department of Agriculture, Washington, D.C. Agricultural Research Service.

**REMOTE SENSING AS A TOOL IN ASSESSING SOIL MOISTURE**

Carl W. Carlson. In NASA, Goddard Space Flight Center Soil Moisture Workshop Nov. 1978 9 p Avail. NTIS HC A10/MF A01 CSCL 08M The effects of soil moisture as it relates to agriculture is briefly discussed. The use of remote sensing to predict scheduling of irrigation, runoff and soil erosion which contributes to the prediction of crop yield is also discussed. G.Y.

**N79-16332** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**REMOTE SENSING OF SOIL MOISTURE: A NASA VIEWPOINT**

L. H. Meredith In its Soil Moisture Workshop Nov. 1978 4 p Avail. NTIS HC A10/MF A01 CSCL 08M A representative of NASA/Goddard Space Flight Center addressed the Workshop and offered a few points in terms of where NASA might be able to help provide observational and information handling capabilities. The function of NASA is briefly discussed in order to determine how NASA could help in this endeavor. Several questions are posed to the Workshop for consideration. G.Y.

**N79-16333** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**APPLICATIONS OF SOIL MOISTURE INFORMATION**

C. J. Johannsen, E. T. Engman, B. J. Blanchard, O. Bockes, D. Brueck, J. Deardorff, J. L. Heilman, L. Myrup, and M. Keener In its Soil Moisture Workshop Nov. 1978 35 p refs Avail. NTIS HC A10/MF A01 CSCL 08M The needs of specific users within the areas of agriculture, hydrology, and meteorology are discussed. Sections are also included on the importance of drought, foreign needs for soil moisture information, some specific requirements for data information systems, and agency and organization uses of soil moisture. G.Y.

**N79-16334** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**SOIL MOISTURE ESTIMATION USING REFLECTED SOLAR AND EMITTED THERMAL INFRARED RADIATION**

R. D. Jackson, J. Chiar, J. E. Estes, J. L. Heilman, A. Kahle, E. T. Kanemasu, J. Millard, J. C. Price, and C. L. Wiegand In its Soil Moisture Workshop Nov. 1978 47 p refs Avail. NTIS HC A10/MF A01 CSCL 08M Classical methods of measuring soil moisture such as gravimetric sampling and the use of neutron moisture probes are useful for cases where a point measurement is sufficient to approximate the water content of a small surrounding area. However, there is an increasing need for rapid and repetitive estimations of soil moisture over large areas. Remote sensing techniques potentially have the capability of meeting this need. The use of reflected-solar and emitted thermal-infrared radiation, measured remotely, to estimate soil moisture is examined. G.Y.

**N79-16335** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**MICROWAVE AND GAMMA RADIATION OBSERVATIONS OF SOIL MOISTURE**

T. J. Schmugge, E. G. Njoku, E. Peck, and F. T. Ulaby In its Soil Moisture Workshop Nov. 1979 37 p refs Avail. NTIS HC A10/MF A01 CSCL 08M The unique dielectric properties of water at microwave wavelengths afford the possibility for remotely sensing the moisture content in the surface layer of the soil. The surface emissivity and reflectivity for the soils at these wavelengths are strong functions of its moisture content. The changes in emissivity can be observed by passive microwave techniques (radiometry) and the change in reflectivity can be observed by active microwave techniques (radar). The difference in the natural terrestrial gamma ray flux measured for wet and dry soil may be used to determine soil moisture. The presence of water moisture in the soil causes an effective increase in soil density, resulting in an increased attenuation of the gamma flux for wet soil and a corresponding lower flux above the ground surface. G.Y.

**N79-16336** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**PROCEEDINGS OF SUMMARY AND RECOMMENDATIONS SESSION**

In its Soil Moisture Workshop Nov. 1979 53 p Avail. NTIS HC A10/MF A01 CSCL 08M Discussion by discipline scientist and information users throughout the Workshop showed the diversity of opinion on the actual use of soil moisture information and the approaches which may lead to successful remote sensing measurements of soil moisture. Soil moisture has varying definitions and information needs depending on perspective of discipline and defined use. With these differences of need and definition, the summary panel provides summaries of the activities and recommendations with interaction from all participants of the Workshop. G.Y.

**N79-16337** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**RECOMMENDATIONS**

In its Soil Moisture Workshop Nov. 1979 5 p Avail. NTIS HC A10/MF A01 CSCL 08M Significant progress was made in the development of remote sensing techniques for estimating soil moisture, and some useful applications for soil moisture information was demonstrated. However, there is an array of questions that must be answered before an operational program is appropriate. A substantial research-oriented program is justified. A summary of recommendations made by participants in the workshop concerning future
research and development is presented. These recommendations represent a consensus of opinions from the Workshop participants, but are not necessarily unanimous views.

G.Y.

N79-16344# State Univ. of New York at Plattsburgh.

REMOTE SENSING TO IDENTIFY, ASSESS, AND PREDICT ECOCOLOGICAL IMPACT ON LAKE CHAMPLAIN WETLANDS Final Report
Donald J. Bogucki and Gerhard K. Gruendling 1978 204 p refs. Sponsored by Dept. of the Interior. [PB-287339/6; W78-12601; OWRT-C-6075(5210)(1)] Avail: NTIS HC A10/ MF A01 CSCL 06C

The effect of lake level regulation on wetland plant communities and on the twelve priority wetlands of Lake Champlain was investigated. Topics discussed included: imagery acquisition and evaluation; development of a vegetation interpretation key; mapping procedures; physical characteristics of Lake Champlain wetlands; vegetative descriptions of Lake Champlain wetlands; effect of water temperature on the growth of green timber habitats; and responses of major emergents and shrubs to naturally fluctuating Lake Champlain water levels. GRA

N79-16473# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.

PRELIMINARY RESULTS OF SAR SOIL MOISTURE EXPERIMENT NOVEMBER 1975

The experiment was performed using the Environmental Research Institute of Michigan's (ERIM) dual-frequency and dual-polarization side-looking SAR system on board a C-46 aircraft. For each frequency, horizontally polarized pulses were transmitted and both horizontally and vertically polarized return signals were recorded on the signal film simultaneously. The test sites were located in St. Charles, Missouri: Centralia, Missouri; and Lafayette, Indiana. Each test site was a 4.83 km by 8.05 km (3 mile by 5 mile) rectangular strip of terrain. Concurrent with SAR overflight, ground soil samples of 0-2.5 cm and 0-15 cm layers were collected for soil moisture estimation. The surface features were also noted. Hard-copy image films and the digital data produced via optical processing of the signal films are analyzed in this report to study the relationship of radar backscatter to the moisture content and the surface roughness. Many difficulties associated with processing and analysis of the SAR imagery are noted. In particular, major uncertainty in the quantitative analysis appeared due to the difficulty of quality reproduction of digital data from the signal films.

Author

N79-16479# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.

STUDIES OF SNOWPACK PROPERTIES BY PASSIVE MICROWAVE RADIOMETRY

Research involving the microwave characteristics of snow was undertaken in order to expand the information content currently available from remote sensing, namely the measurement of snow-covered area. Microwave radiation emitted from beneath the snow surface can be sensed and thus permits information on internal snowpack properties to be inferred. The intensity of radiation received is a function of the average temperature and emissivity of the snow layers and is commonly referred to as the brightness temperature (T sub b). The T sub b value varies with snow grain and crystal sizes, liquid water content and snowpack temperature. The T sub b of the 0.8 cm wavelength channel was found to decrease more rapidly with increasing snow depth than the 1.4 cm channel. More scattering of the shorter wavelength radiation occurs thus resulting in a lower T sub b for shorter wavelengths in a dry snowpack. The longer 21.0 cm wavelength was used to assess the condition of the underlying ground. Ultimately it may be possible to estimate snow volume over large areas using calibrated brightness temperatures and consequently improve snowmelt runoff predictions.


The author has identified the following significant results. In early April 1978, heavy spring runoff from snowmelt caused significant flooding along a portion of the Big Sioux River Basin in southeastern South Dakota. The flooded area was visible from surrounding areas on a May 15 HCMM IR test image. On May 15, the flood waters had receded but an area of anomalous residual high soil moisture remained. The high soil moisture area was not visible on a HCMM day visible test image of the same scene, or on LANDSAT imagery. To evaluate the effect of water table depth on surface temperatures, thermal scanner data collected on September 5 and 6, 1978 at approximate HCMM overpass times at an altitude of 3650 m were analyzed. Apparent surface temperatures measured by the scanner were compared to the actual contributions from soil surface and the land cover. Results indicated that the shallow water tables produced a damping of the amplitude of the diurnal surface temperature wave.

N79-17293# National Environmental Research and Technology, Inc., Concord, Mass.

INVESTIGATION OF THE APPLICATION OF HCMM THERMAL DATA TO SNOW HYDROLOGY

The purpose of the experiment was to determine if remote microwave sensing of snowpack data could be used to predict runoff, thereby allowing more efficient management of the water supply. A four-frequency microwave radiometer system was attached to a truck-mounted aerial lift and was used to gather data on snowpacks at three different sites in the Colorado Rocky Mountains. Ground truth data measurements (density, temperature, grain size, hardness, and free-liquid water content) were taken at each site corresponding to each microwave scan. L.S.

N79-19519# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.

PRELIMINARY RESULTS OF PASSIVE MICROWAVE SNOW EXPERIMENT DURING FEBRUARY AND MARCH 1978

The purpose of the experiment was to determine if the remote microwave sensing of snowpack data could be used to predict runoff, thereby allowing more efficient management of the water supply. A four-frequency microwave radiometer system was attached to a truck-mounted aerial lift and was used to gather data on snowpacks at three different sites in the Colorado Rocky Mountains. Ground truth data measurements (density, temperature, grain size, hardness, and free-liquid water content) were taken at each site corresponding to each microwave scan. L.S.

N79-20445# National Oceanic and Atmospheric Administration, Washington, D. C.

APPLICATIONS OF HCMM DATA TO SOIL MOISTURE SNOW AND ESTUARINE CURRENT STUDIES

The author has identified the following significant results. In early April 1978, heavy spring runoff from snowmelt caused significant flooding along a portion of the Big Sioux River Basin in southeastern South Dakota. The flooded area was visible from surrounding areas on a May 15 HCMM IR test image. On May 15, the flood waters had receded but an area of anomalous residual high soil moisture remained. The high soil moisture area was not visible on a HCMM day visible test image of the same scene, or on LANDSAT imagery. To evaluate the effect of water table depth on surface temperatures, thermal scanner data collected on September 5 and 6, 1978 at approximate HCMM overpass times at an altitude of 3650 m were analyzed. Apparent surface temperatures measured by the scanner were compared to the actual contributions from soil surface and the land cover. Results indicated that the shallow water tables produced a damping of the amplitude of the diurnal surface temperature wave.

N79-19519# National Aeronautics and Space Administration.
Goddard Space Flight Center, Greenbelt, Md.

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The purpose of the experiment was to determine if remote microwave sensing of snowpack data could be used to predict runoff, thereby allowing more efficient management of the water supply. A four-frequency microwave radiometer system was attached to a truck-mounted aerial lift and was used to gather data on snowpacks at three different sites in the Colorado Rocky Mountains. Ground truth data measurements (density, temperature, grain size, hardness, and free-liquid water content) were taken at each site corresponding to each microwave scan. L.S.
A methodology was developed to increase the efficiency and accuracy of dam inspection in New York State by incorporating remote sensing techniques into the State Dam Safety Program. The methodology placed emphasis on readily available remotely sensed data-aerial photographs and LANDSAT data. Aerial photographs were employed in establishing a statewide database referenced on county highway and U.S. Geological Survey 1:24,000 scale, topographic maps. Data base updates were conducted by region or county, using LANDSAT or aerial photographs as a primary source of information. Field investigations were generally limited to high-hazard or special problem dams.

Research involving the microwave characteristics of snow was undertaken in order to expand the information content currently available from remote sensing, namely the measurement of snow-covered area. Microwave radiation emitted from beneath the snow surface can be sensed and thus permits information on internal snowpack properties to be inferred. The intensity of radiation received is a function of the average temperature and emissivity of the snow layers and is commonly referred to as the brightness temperature (T_b). The T_b varies with snow grain and crystal sizes, liquid water content, and snowpack temperature. The T_b of the 0.8 cm wavelength channel was found to decrease more so with increasing snow depth than the 1.4 cm channel. More scattering of the shorter wavelength radiation occurs thus resulting in a lower T_b for shorter wavelengths in a dry snowpack. The longer 21.0 cm wavelength was used to assess the condition of the underlying ground.
DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing, computer technology, satellite and aircraft hardware, and imagery.


The monitoring of the earth through NASA's three Landsats (first launching: 1972) is described, together with information on present and projected use of Landsat pictorial data about the earth's surface, its population, vegetation, geology and mineralogy. The most efficient of the three data systems used by Landsats to monitor the planet is the multi-spectral scanner (MSS), a nonphotographing sensing device with four spectral regions (between 0.5 and 1.1 microns) which scans narrow swaths of surface and translates the intensities of light into strings of digital data, which are then sent to Goddard Space Flight Center and converted there to black-and-white pictures, with the final processing done at the U.S. Geological Survey's ERDS Data Center. Research has shown that most users apply Landsat imagery and digital data to studies of land use, hydrology, agriculture, and geography.

A.A.


The paper defines some basic processing functions than can be performed digitally, discusses a variety of computer peripherals including hard copy output devices and television terminals, compares the characteristics of stand-alone image analysis systems, and briefly describes the important features of image processing and geographic information systems software. Several examples are discussed to demonstrate the efficient use of computers through implementation of hard copy image recorders and television display terminals. The commercially available stand-alone image analysis systems include a computer, appropriate peripherals, and sufficient software to perform analysis without other computational support.

S.D.


Two computer algorithms are presented. The first, called SCREEN, is used to automatically identify pixels representing clouds, cloud shadows, snow, water, or anomalous signals in Landsat-2 data. The second, called XSTAR, compensates Landsat-2 data for the effects of atmospheric haze, without requiring ground measurements or ground references. The presentation of these algorithms includes their theoretical background, algebraic details, and performance characteristics. Verification of the algorithms has for the present been limited to Landsat agricultural data. Plans for further development of the XSTAR technique are also presented.

(Author)


The JAFSA project, a Japanese airborne remote sensing project, is discussed. Components of the data acquisition system and of the data processing system are characterized, and the organization and research activities of the project are examined. Components considered include the MSS-BG-I, the onboard data acquisition system, the FM MT quick-look system, and CCTV converter, quick-look system, and photoprinter.

M.L.


An outline is presented of the first stage of a research project which has been undertaken to look at the spatial distribution of terrain features and to identify temporal changes by analyzing successive images of one Landsat scene. For this to be done individual pixels from different images need to be spatially related one to


Use of remote sensing imagery to map areas in Florida is described. Aerial photographs were obtained, and an automatic computing plotting system was developed to plot maps showing land use. The digitizing process used 1:24,000 aerial photos and existing 7.5 min quad projection information. The retrieval capabilities of the system are considered, and the history of the development of the mapping system is surveyed.

M.L.
07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

Another. The accuracy to which this can be achieved is an important consideration in interpreting changes on the ground. The survey area 40 by 25 kilometers in extent is located in the upper part of the Hunter Valley of New South Wales. Geometric errors in Landsat data are considered along with modelling techniques, aspects of ground control, an approach for refining the modelling process, the accuracy of results, and a comparison of the data from one scene to another.

G.R.


The National Environmental Satellite Service (NESS) currently operates two environmental satellite systems. These are polar-orbiting NOAA-5 (a sun-synchronous satellite providing twice-daily global coverage) and the Geostationary Operational Environmental Satellites (GOES). The two GOES satellites provide environmental data of the earth's disk facing each satellite at periodic intervals. The environmental data from both satellite systems are routinely processed by the NESS into a variety of quantitative and image products, which are then distributed to users. The GOES views the earth's disk through the Visible and Infrared Spin-Scan Radiometer (VISSR) instruments. The operational and experimental uses of the digital VISSR data at the NESS from the GOES satellites are discussed. Attention is given to the VISSR data base, landmark registration/geographic registration, gridding, cloud-motion wind vector estimates, a sea surface thermal analysis, the analysis of a hurricane rain potential, fruit-vegetable crop freeze warnings, solar insolation estimates, and cloud-top height analysis.


A79-22622 / Landsat user needs and administrative responses - Density scales, data catalogues, image annotation. A. Falconer (Queensland, University, Brisbane, Australia), D. Gray (Department of Science, Canberra, Australia), and A. A. Green (Commonwealth Scientific and Industrial Research Organization, Sydney, Australia). In: International Symposium on Remote Sensing of Environment, 12th, Manila, Philippines, April 20-26, 1978, Proceedings. Volume 3.


The present procedure of system interrogation and the consequent response to users which is necessary in order to identify a Landsat image, order and receive it, can apparently be simplified by the use of an illustrated image catalog. The illustrated catalog can be rapidly compiled using existing system procedures based on the Canadian ISIFICHIE model and using off-set litho printing. The consequent ease of consultation of the catalog and the flexibility in forming weekly, monthly or annual catalogs alongside the daily catalog system appear as major advantages. The illustrated catalog provides the user with a ready reference to the position of cloud cover within the scene and the major locational detail is visible also. An improved method of annotating the grey scale on individual bands and thus making colour composites easier to analyse is also described. In total a system of receiving stations providing quicklook imagery and a catalog service backed by a central processing facility creating images as required by user demand, appears to offer an efficient use of regional resources. It may be a useful model for future planning of facilities amongst nations receiving Landsat data.


An investigation was conducted to determine the littoral and sublittoral mudflats of Thailand based on Landsat imagery. The interpreted map was verified by ground truth survey using cars, boats and helicopters. A combination scheme of diazochrome color composite transparencies was conceived which yields best results for mudflat identification. The study showed an area of 910 sq km and 3700 sq km for Thailand's littoral and sublittoral mudflats, respectively.


In remote sensing data processing the classification rules for identifying land cover types are mainly evaluated by two performance factors: the amount of computation time used and the correct recognition rate achieved. A decision-tree classifier is considered in the present paper. The decision tree is formally shown to be embedded in an AND/OR tree that represents all possible classification performance factors: the amount of computation time used and the correct recognition rate achieved. A decision-tree classifier is considered in the present paper. The decision tree is formally shown to be embedded in an AND/OR tree that represents all possible classification outcomes. These outcomes are obtained with respect to all feature sets generated by a moderate number of pattern features. A search process in terms of forward and backward procedures is developed to
generate the tree. A cost function based on the two performance factors is used to order nodes for expansion. Various types of pointers and tables are set up to link and to store all relevant tree structure data. An alpha-beta procedure is stated to make the search more efficient. Experimental results are included and discussed.

(Author)


(Author)


An image processing system is described which, starting with digital remote sensing data, produces either a thematic interpretation or a general map product. Specific results are described concerning forest fires studies, town planning, revision elements for topographic maps in France and Africa. Finally the advantages are shown of using an interactive image processing system such as the 101 system at the Institut Géographique National particularly the fundamental role played by the display console.

(Author)


In order to evaluate the results of a remote sensing study, ground truth data often are collected and a cross-classification table is prepared. However, the commonly used Percent Correct Classification criterion may be misleading. An operationally meaningful measure of success of prediction is proposed. An example using corn blight data demonstrates the value of this new index and casts some doubt on earlier conclusions based on the percent correct classification criterion.

(Author)


Experiments on the relationship between the images of soil recorded by a photographic polarization method and the humidity content of the soil were carried out. Peat samples of varying moisture content were imaged, and a positive correlation between polarization and soil moisture was noted when unfiltered visible light was used. The differences in recorded light polarization between different soil moisture states, however, decreased with increasing observation height. It appears that polarized imagery at aircraft altitudes is promising, but serious questions remain as to the value of satellite polarization imagery.

P.T.H.


material behavior are compared. The analytical results of crack synthetic aperture radar (SAR) and Landsat multispectral scanner (MSS) images using optical and digital merging techniques. The unique characteristics of airborne and orbital SAR and Landsat MSS imagery are discussed. The case for merging the imagery is presented and tradeoffs between optical and digital merging techniques explored. Examples of Landsat and airborne SAR imagery are used to illustrate optical and digital merging. Analysis of the merged digital imagery illustrates the improved interpretability resulting from combining the outputs from the two sensor systems.

(Author)


A method of converting polygon map information into a digital form which does not require manual tracing of polygon edges is discussed. The maps must be in color-coded format with a unique color for each category in the map. Color scanning using a microdensitometer is employed and a three-channel color separation digital data set is generated. The digital data are then classified by using a Gaussian maximum likelihood classifier, and the resulting digitized map is evaluated. Very good agreement is observed between the classified and original map.

(Author)


Aspects of image restoration are considered along with image processing and correction, image registration, image enhancement for manual interpretation, information extraction by machine processing, and image data compression/compaction. Attention is given to the transfer function compensation of sampled imagery, image restoration by singular value decomposition, digital mapping and associated digital image processing, digital imaging processing of earth observation sensor data, a class of algorithms for fast digital image registration, multitemporal geometric distortion correction utilizing the affine transformation, image processing in the context of a visual model, pattern recognition in remote sensing of the earth's resources, picture recognition, and intraframe coding for picture transmission.

G.R.

N79-16588# Centro Studi ed Applicazioni in Tecnologia Avanzate, Bari (Italy).


The software evaluation and comparison criteria are presented.

The criteria are then applied to the following image processing software: (1) ER-MAN II, which is the Earth Resources Management System; (2) IDAMS, which is the Image Display and Manipulation System; (3) LARSYS, which is the Laboratory for Application of Remote Sensing System; (4) PAX II, which is the Picture Processing System; and (5) VICAR, which is the Video Image Communication and Retrieval System. A quantitative and qualitative analysis is carried out for each package, and finally an over-all comparison among packages is reported.

F.O.S.

N79-17287# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

APPENDIX D: PRINCIPLES OF PHOTOGRAPHIC AND DIGITAL DATA ANALYSIS. In its Skylab EREP Investigations Summary 1978 p 377-383 ref. Avail. NTIS MF A01; SOD HC CSCS 14E
Photographic interpretation which involves the systematic examination of negative and positive prints and transparencies for the purpose of indentifying objects and judging their condition is described. Photographic geometry, photointerpretive equipment, photograph enhancement, photograph characteristics, and interpretative activities are discussed. Preprocessing, display and enhancement, analysis and classification, and evaluation are studied in processing and analyzing digital data from EREP Multispectral Scanners.

N79-18374*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

CLASSIFICATION ON ACCURACY OF DIFFERENT OPTIONS OF THE IMAGE 100 SYSTEM.


N79-18410*# Zentralstelle fuer Geo-Photogrammetrie und Fernerkundung, Munich (West Germany).

APPLICATION OF LANDSAT DATA AND DIGITAL IMAGE PROCESSING Final Report, 1975 - 1978


ESTIMATION OF PROPORTIONS USING LINEAR MAPS AND THE COVARIANCE MATRIX FOR A SAMPLE OF INCOMPLETE DATA VECTORS


N79-18426# Lockheed Electronics Co., Houston, Tex.

DAM PACKAGE VERSION 7007: SOFTWARE FIXES AND ENHANCEMENTS


The Detection and Mapping package is an integrated set of manual procedures, computer programs, and graphic devices designed for efficient production of precisely registered, formatted, and interpreted maps from digital LANDSAT multispectral scanner data. This report documents changes to the DAM package in support of its use by the Corps of Engineers for inventoring impounded surface water. Although these changes are presented in terms of their application to detecting and mapping surface water, they are equally relevant to other land surface materials.

N79-18432# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

LANDSAT 3 WORLD STANDARD CATALOG. 1-31 DECEMBER 1978


The World Standard Catalog lists imagery acquired by LANDSAT 3 which was processed and input to the data files during the referenced period. Information on cloud cover and image quality is given for each scene. The microfilm roll and frame on which the scene may be found is given.

N79-18433# National Aeronautics and Space Administration, Goddard Space Flight Center, Greenbelt, Md.

LANDSAT 2 WORLD STANDARD CATALOG, 1.31 DECEMBER 1978


The World Standard Catalog lists imagery acquired by LANDSAT 2 which was processed and input to the data files during the referenced period. Information on cloud cover and image quality is given for each scene. The microfilm roll and frame on which the scene may be found is given.


SAMPLE-MOMENT ESTIMATES FOR THE MEAN VECTOR AND THE COVARIANCE MATRIX FOR A SAMPLE OF INCOMPLETE DATA VECTORS


The author has identified the following significant results. The tape read and write programs currently available on the 1-100 perform their intended functions of reading and writing tapes, but are difficult to use because they contain a number of inconsistencies. These inconsistencies can often be overcome by the use of work-around procedures and by trial and error, which is an inefficient use of expensive computer systems that should not be necessary.

N79-19431# National Aeronautics and Space Administration.


31 Jan 1979 171 p (GSFC/LWC/3-79/01; NTISUB/E/277-001) Avail: NTIS HC A08/MF A01 CSCL 05B

The World Standard Catalog lists imagery acquired by LANDSAT 3 which was processed and input to the data files during the referenced period. Information such as cloud cover and image quality is given for each scene. The microfilm roll and frame on which the scene may be found is given.

Author

N79-19432# National Aeronautics and Space Administration.

LANDSAT 2 WORLD STANDARD CATALOG, 1-31 JANUARY 1979

31 Jan 1979 69 p (NASA-TM-79996; GSFC/LWC/2-79/01; NTISUB/E/279-001) Avail: NTIS HC A04/MF A01 CSCL 05B

The World Standard Catalog lists imagery acquired by LANDSAT 2 which were processed and input to the data files during the referenced period. Information such as cloud cover and image quality is given for each scene. The microfilm roll and frame on which the scene may be found is given.
The author has identified the following significant results. It was observed that OLS was not adequate as an estimation procedure when the independent or regressor variables were involved in multicollinearities. This was shown to cause the presence of small eigenvalues of the extended correlation matrix $A'A$. It was demonstrated that the biased estimation techniques and the all-possible subset regression could help in finding a suitable model for predicting yield. Latent root regression was an excellent tool that found how many predictive and nonpredictive multicollinearities there were.

The author has identified the following significant results. Analysis of the geometric characteristics of the aircraft synthetic aperture radar (SAR) relative to LANDSAT indicated that relatively low order polynomials would model the distortions to subpixel accuracy to bring SAR into registration for good quality imagery. Also the area analyzed was small, about 10 miles square, so this is an additional constraint. For the Air Force/ERIM data, none of the tested methods could achieve subpixel accuracy. Reasons for this is unknown; however, the noisy (high scintillation) nature of the data and attendant unrecognizability of features contribute to this error. It is concluded that the quadratic model would adequately provide distortion modeling for small areas, i.e., 10 to 20 miles square.

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08

INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.


One of the newest sources of meteorological data is the passive scanning microwave spectrometer (SCAMS) aboard the Nimbus 6 satellite. SCAMS is designed to produce global maps of tropospheric temperature profiles and liquid water and water vapor amounts over ocean surfaces. The present study determines analytically the effect of clouds and precipitation on the upwelling radiance observed by the SCAMS radiometer aboard the Nimbus 6, and develops theoretical-empirical equations for the interference of liquid water content and rainfall rates. The results are presented in graphical form. S.D.


A conceptual design for a future microwave-radiometer spacecraft is presented. The intended remote sensing mission is centered around soil moisture measurements and requires all-weather day and night observations at a low microwave frequency (less than 5 GHz) in order to penetrate clouds, haze, and ground cover. The specific mission requirements are summarized in terms of two broad mission objectives, the system design requirements are outlined, and three structural approaches are evaluated at the conceptual design level. The weights, Shuttle flights, and structural member lengths for the three concepts are compared. The dual momentum vector control concept for pointing and slewing control is examined. F.G.M.


An airborne experiment was conducted under NASA auspices to test the feasibility of detecting soil moisture by microwave remote sensing techniques over agricultural fields near Phoenix, Arizona at midday of April 5, 1974 and at dawn of the following day. Extensive ground data were obtained from 96 bare, sixteen hectare fields. Observations made using a scanning (2.8 cm) and a nonscanning (21 cm) radiometer were compared with the predictions of a radiative transfer emission model. It is shown that (1) the emitted intensity at both wavelengths correlates best with the near surface moisture, (2) surface roughness is found to more strongly affect the degree of polarization than the emitted intensity, (3) the slope of the intensity-moisture curves decreases in going from day to dawn, and (4) increased near surface moisture at dawn is characterized by increased polarization of emissions. The results of the experiment indicate that microwave techniques can be used to observe the history of the near surface moisture. The subsurface history must be inferred from soil physics models which use microwave results as boundary conditions. (Author)


The reflection or scattering of electromagnetic radiation from a surface as a function of surface roughness is discussed, with particular application to remote microwave radiometry. Examples of multiparameter synthetic-aperture radar (SAR) imagery are examined, the status of the art in SAR sensors is considered, and the data flow for the SAR system is investigated. A very bright future is predicted for SAR application development. Fundamentals of microwave radiometry are outlined, and typical specifications of present-day passive sensors for microwave radiometers are summarized. Applications of microwave radiometry in land-use identification and in mapping large-scale meteorological features are described. F.G.M.


A synthetic aperture radar (SAR) system, such as carried aboard Seasat, depends on linear Doppler phase histories of scene elements to create fine along-track resolution of the scene in the image. The large phase velocities of swell and the orbital and wind velocities of capillary waves distort these Doppler records to the point where, were it not for existing images as evidence to the contrary, it could be argued that SARs should not be used to image waves. In the present paper, it is shown that the most appropriate SAR observation model for uncrested waves is based on orbital motion of the capillaries with an explicit inclusion of the vertical component of the underlying gravity wave motion. For breaking or created waves, the most suitable model is based on phase velocity of the gravity wave field. Neither case admits evidence for the presence of true focus modulation by gravity wave phase velocity. V.P.


Application of remote sensing for earth resources survey is one of the major activities of the Space Applications Center of the Indian Space Research Organization (ISRO). ISRO has developed a five-channel multispectral scanner (MSS). The present MSS instrument has a capability to choose any four spectral bands between 0.5 to 1.1 micron and one channel in the 8 to 12 micron band. The MSS instrument has a field of view of 5 milliradian and a spatial resolution of 15 m when flown at a height of 3 km. The instrument has some unique features incorporated for operational needs. A checkout facility enables the operator to monitor the complete health of the MSS to give GO/NO-GO decision before the mission starts. The instrument is mounted on a Dakota DC-3 aircraft and is being used to collect data for various user agencies in India. The work in respect of data preprocessing and the final data product is also discussed. (Author)


The paper reports on two remote sensing satellite systems currently being studied under the European Remote Sensing Program. One system is a multidisciplinary geosynchronous satellite with optical payload (MEOS), and the other is a polar sun-synchronous Earth observation satellite with combined optical and microwave payload (ERDSAT). The systems are complementary. MEOS payload will consist of a very high resolution optical telescope with 1-m aperture which can perform imaging and sounding simultaneously. Capabilities are of imaging an area 400 x 625 km with a resolution of 100 km within 7 minutes, and sounding of atmospheric vertical temperature profiles and water vapor profiles of 400 x 625 km region with 35 km resolution within 12 minutes. The model payload for ERDSAT consists of an optical multispectral scanner with CCD arrays in the focal plane.

P.T.H.


New Zealand involvement in the Landsat II investigation program has led to the rapid development of a digital image processing facility within the Remote Sensing Section of the Physics and Engineering Laboratory of the Department of Scientific and Industrial Research. Our recently acquired Optronics C4300 Colorwrite machine is being used to write our processed imagery directly out as a colour transparency. This paper describes the digital image rectification and enhancement techniques which we have developed for use on a minicomputer.

(Author)


The paper reviews the use in Chile of satellite data collection systems to collect environmental ground truth data from remote sites. Several automatic sensing stations called data collection platforms transmit sensor-obtained data to satellites which relay them to a ground receiving station for final distribution to users. The basic characteristics of Landsat and GOES data collection systems are discussed with reference to the Chilean experience.

B.J.


In an experimental study of the spectra of the microwave radiation of the earth's surface in vegetation-covered regions, the microwave radiation characteristics specific to different types of vegetation were identified. Quantitative estimates of the effect of vegetation cover on the radiation properties of the earth's surface were obtained. The relation between microwave radiation characteristics and various biometric parameters of vegetation was established.

P.T.H.


The present status of the applications of Synthetic Aperture Radars (SARs) is reviewed, and the technology state-of-the-art as represented by the Seasat-A and SIR-A SARs examined. The potential of SAR applications, and the near- and longer-term technology trends are assessed.

(Author)


Topics related to buoy technology are considered along with acoustic systems, ocean sciences, underwater work systems and procedures, economy and management of coastal regions, instrumentation, fisheries, unmanned underwater vehicles, law and policy, electromechanical cables/connectors and their components, acoustic sources and sonars, the large-scale development of ocean energy resources, remote sensing from satellites and aircraft, institutional aspects of ocean development, satellite radiometric and visible sensing, marine pollution analysis and monitoring, and navigation. Attention is also given to sea floor engineering, information and data systems, education and training for ocean involvement, novel devices for extracting energy from the ocean, deep-sea mining, wave direction measurement technology, and problems concerning the financing of ocean development.

G.R.


During the months of February and March of 1977 the Environmental Research Institute of Michigan X- and L-band dual polarized synthetic aperture imaging radar (SAR) was used to obtain radar imagery of sea ice off the Labrador coast. During the course of imaging specific areas, imagery of ocean swell patterns in consolidated pack ice was obtained. Surface data regarding direction, period and approximate wave height were collected in one particular area. Tilt modulation, roughness modulation, orbital velocity and parametric effects models for the SAR imaging of ocean waves were examined for applicability. The ability to image these wave patterns is important in enabling ice observers to distinguish between areas of solid ice cover and semi- and unconsolidated pack.

(Author)


The paper describes a method of coding remote-sensing imagery where quantization of brightness levels and discretization of the field are carried out separately. A block diagram of an electronic system for transformation and coding of video information in conventional colors is briefly explained. The system is comprised of a TV camera that transforms the primary monochromatic image into a corresponding video signal and permits optical change of the image scale, a synchro pulse generator for ensuring synchronous operation of the whole system, a black-and-white TV monitor serving as output device and to display the transformed and color-coded video information, and an electronics block for quantization and selection of isolevels.

P.T.H.

An image plane scanner concept has been evaluated for application to a medium resolution visible and infrared multispectral imaging instrument (MRVIR) that was originally planned to be flown on the French earth observation satellite SPOT-1. The instrument design includes several distinctive features, in particular: (1) an all-reflective Schmidt telescope having 17 deg fov, (2) a 18-objects scan wheel supported on a magnetic bearing, (3) dichroic beam splitters, (4) cooled focal plane array for IR detectors, (5) CFRP structure, (6) semi-active thermal control. MRVIR is designed to provide 70 m ground resolution in bands 1-6 and 140 m in band 7 (thermal infrared). A relatively large swath width of 240 kms improves the repetition rate of the ground coverage. (Author)


The remote-sensing spectrometer MSS-2 (used aboard Salyut 4 for investigating the earth surface and atmosphere) is described; the device operates in the spectral range of 0.4-0.8 micron with a spectral resolution of 0.007 micron. The principle of operation of the device is discussed and airborne utilization of the device to measure backscattering from various natural objects is examined. B.J.


The use of Nimbus 6 RAMS system in the collection of ice motion and weather data in the Canadian frontier areas is discussed. An experiment for improving accuracy employing a translacation technique is analyzed, showing that the technique does not provide significant improvement. The use of a RAMS platform for the retransmission of data is described, and its reliability evaluated. The application of the ARGOS system to similar experiments is noted. A.A.


The function and operation of the remote sensing technique used in the ARDS system are described. The technique involves the observing of the earth’s surface by means of visible, infrared or microwave transducers so as to provide an inventory of the natural resources. The handing of acquired data necessitates what is called ‘ground-truth’, which consists of collecting as much in-situ information as possible, and in allowing the investigator to analyze and correctly use the remote sensing documents. The principal advantage of the ARDS system is that it operates continuously with a very short time for access to data, transmitting the latter at a rate of error acceptable for most applications. A.A.


The primary experiment on the Geodynamics Experimental Ocean Satellite-3 (GEOS-3) is the radar altimeter. This experiment’s major objective is to demonstrate the utility of measuring the geometry of the ocean surface; i.e., the geoid. Results obtained from this experiment so far indicate that the planned objectives of measuring the topography of the ocean surface with an absolute accuracy of + or - 5 m can be met and perhaps exceeded. The GEOS-3 satellite altimeter measurements have an instrument precision in the range of + or - 25 cm to + or - 50 cm when the altimeter is operating in the ‘short pulse’ mode. After one year’s operations of the altimeter, data from over 5000 altimeter passes have been collected. With the mathematical models developed and the altimeter data presently available, mapping of local area topography has been realized to the planned accuracy levels and better. This paper presents the basic data processing methods employed and some interesting results achieved with the early data. Plots of mean sea surface heights as inferred by the altimeter measurements are compared with a detailed 1 by 1 deg gravimetric geoid. (Author)
A multisensor data base for assessing the use of standard information extraction techniques is developed. Photographic, electro-optical mechanical, and microwave sensors were used to investigate. The space flight performance of EREP remote sensors is evaluated and data analysis techniques used for each sensor are summarized. Microdensitometry and color encoding, multiband image enhancement and analysis, digitization and computer techniques, and wavelengths are reported. S.E.S.

N79-17288*# National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

APPENDIX A: EREP SENSOR SYSTEMS

Roy L. Eason in Its Skylab EREP Investigations Summary 1978 p 343-362 Original contains color illustrations

Avail: NTIS HC A01; SOD HC CSCL 14B

The ratio rule for selecting EREP sensors was based on the desire to explore various portions of the electromagnetic spectrum, the need for more correlating data among sensors, the state-of-the-art sensor development, and adaptability of the sensors. The following five systems were selected by EREP: (1) The Multispectral Photographic Facility; (2) the Infrared Spectrometers; (3) the Multispectral Scanner; (4) the microwave Radiometer/Scanner and Alimeter; and (5) the L Band Radiometer. The wavelength of the earth-viewing EREP Skylab sensors is described. S.E.S.

N79-18423/# American Inst. of Aeronautics and Astronautics, New York

MATHEMATICAL MODELING OF FISH DETECTION WITH A SCANNING AIRBORNE LASER


Avail: NTIS HC A02/MF A01

A mathematical model was developed to predict the power received at an airborne detector from laser radiation reflected from fish. The radiation source was an airborne pulsed laser beam sweeping transverse to the aircraft's flight direction. The received power was calculated as a function of aircraft altitude, angle of incidence of radiation on ocean surface, and fish depth. The method was demonstrated by using a wind velocity of 5 meters/second, volume attenuation coefficient of 0.2 meters-1, and laser beam radius of 0.50 meters. A laser swath width of 75 meters transverse to the flight direction was chosen to provide for adequate coverage of the search area in a practical time. The optimum aircraft altitude for maximum received power for a given fish depth was determined. The results of the mathematical model reveal that a complete scanning laser system would be practical for fish detection. Author

N79-18520*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

THE MAGSAT VECTOR MAGNETOMETER, A PRECISION FLUXGATE MAGNETOMETER FOR THE MEASUREMENT OF THE GEOMAGNETIC FIELD


A description of the precision triaxial fluxgate magnetometer to be flown aboard the MAGSAT spacecraft is presented. The instrument covers the range of + or - 64,000 nT with a resolution of + or - 0.5 nT, an intrinsic accuracy of + or - 0.001% of scale and an angular alignment stability of the order of 2 seconds of arc. It was developed at NASA's Goddard Space Flight Center and represents the state-of-the-art in precision vector magnetometers developed for spaceflight use. Author

N79-19326/# Environmental Monitoring and Support Lab., Las Vegas, Nev.


Robert W. Thomas Aug. 1978 32 p refs (PB-288458/3; EPA-600/4-78-045) Avail: NTIS HC A03/MF A01 CSCL 13B

A dual differential radiometer was tested on numerous eastern United States lakes and reservoirs. Remotely sensed data were compared with ground-truth chlorophyll a values. Results indicate that the instrument has limited application in the remote sensing of chlorophyll a in the nation's lakes. At its present state of development, its use should be confined to large, deep, relatively clear water bodies in conjunction with ground-truth and surface survey efforts. GRA


OPTICAL-MECHANICAL SCANNERS FOR EARTH OBSERVATION


Avail: NTIS HC A04/MF A01

The main information sources in the radio-television complex of the Meteor experimental satellites intended primarily for observation of the earth's surface are the low-resolution (MSU-M) medium-resolution (MSU-S) multichannel scanners. These transmit images from the visible and near IR ranges with a terrain resolution on the order of a kilometer (MSU-M) or hundreds of meters (MSU-S). In terms of their operation, these scanners are optomechanical systems with single-line scanning and single-element detectors, whose frame scanning is effected by the movement of the satellite. The MSU-M operates in four spectral ranges and the MSU-S in two. A radio link simultaneously transmits signals from the MSU-M's four channels and from one channel (selectable) of the MSU-S. Two channels may be transmitted simultaneously for the MSU-S by switching the video signal from line to line, with resultant decreased frame resolution. Author

N79-20180*# National Environmental Satellite Service, Washington, D.C.

THE COASTAL ZONE COLOR SCANNER (CZCS) EXPERIMENT


Avail: NTIS HC A14/MF A01 CSCL 14B

The CZCS is used to map chlorophyll concentration, sediment distribution, gelbstroffe concentration, and temperature of coastal waters and the open ocean. The data processing techniques used to enhance contrasts over the ocean and to remove the effect of the backscattered atmosphere are presented. The multi-channel scanning radiometer of CZCS is described. The content of water is determined primarily by the CZCS measurement. S.E.S.

N79-20298*# Environmental Sensing Algorithm Development Co., Sunland, Calif.

EVALUATION AND ANALYSIS OF SEASAT A SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR) ANTENNA PATTERN CORRECTION (APC) ALGORITHM

Final Report

S. N. Kitzis and J. L. Kitzis 16 Mar. 1979 84 p refs Prepared for JPL (Contracts NAS7-100, JPL-955368) (NASA-CR-158367) Avail. NTIS HC A05/MF A01 CSCL 20N

The accuracy of the SEASAT-A SMMR antenna pattern correction (APC) algorithm was assessed. Interim APC brightness temperature measurements for the SMMR 6.6 GHz channels are compared with surface truth derived sea surface temperatures. Plots and associated statistics are presented for SEASAT-A SMMR data acquired for the Gulf of Alaska experiment. The cross-track gradients observed in the 6.6 GHz brightness temperature data are discussed. Author
An improved design for the reflectance spectrometer is described to be used on various terrestrial body missions. These improvements were made on the original Lunar Polar Orbiter design. These include a larger entrance mirror, rectangular aperture, multiple optical beams, spatial resolution, and a bandwidth extension to 5 microns. In addition, detailed electronic designs were produced for a charge amplifier and an amplifier/demodulator/integrator. Design of a microprocessor driven test system was begun. Laboratory tests were performed on a tuning fork chopper.

J.A.M.

The author has identified the following significant results. The integration of the available methods provided the analyst with the unified scanner analysis package (USAP), the flexibility and versatility of which was superior to many previous integrated techniques. The USAP consisted of three main subsystems: (1) a spatial path, (2) a spectral path, and (3) a set of analytic classification accuracy estimators which evaluated the system performance. The spatial path consisted of satellite and/or aircraft data, data correlation analyzer, scanner IFOV, and random noise model. The output of the spatial path was fed into the analytic classification and accuracy predictor. The spectral path consisted of laboratory and/or field spectral data, EXOSYS data retrieval, optimum spectral function calculation, data transformation, and statistics calculation. The output of the spectral path was fed into the stratified posterior performance estimator.
GENERAL
Includes economic analysis.


This book deals with prospective areas of application for present-day IR technology. The areas considered include space navigation, spacecraft range measurement and tracking, space communications, astrophysical studies, and earth resources surveys. Attention is given to IR systems operation in space, problems in space navigation, IR horizon sensors, astrophysical observations from manned and unmanned spacecraft, and IR instruments for satellite tracking and range measurement. Meteorological studies performed with the aid of spaceborne IR instruments are discussed, along with the role of satellites in synoptic meteorology, thermal sounding of the atmosphere, spacecraft IR radiometers for thermal sounding of the upper atmosphere, and space IR laser communication systems. Applications of IR devices in natural-resource studies, geology, and forest-fire detection are examined. Spaceborne IR systems for monitoring nuclear explosions and observing ballistic-missile launches are described.

F.G.M.


In the Earth Resources Program, one can see the emergence of a completely new set of activities, rather than the continuation of old activities with new tools. These new activities are very diverse, extending into almost all disciplines that study, cultivate, mine, manage, and monitor the earth's surface. The technology used is still in its infancy. An investigation is conducted concerning the trends of the past 6 years, taking into account the applications and the processing of earth resources data. A description is presented of the options that seem to exist as structures which might support an operational earth resources program in the 1990 time-frame. A series of questions and suggested answers is used to point out the places where key decisions still need to be made before a real answer can be given to the question, regarding the best operating framework for an operational earth resources program.

G.R.


It is suggested that a national program should be organized to facilitate exploration of natural resources. The significance of remote sensing data obtained by aircraft and spacecraft is considered, and estimates of potential oil and gas reserves are examined with reference to geopolitics and the transition to the post-petroleum era. The importance of Landsat, which detects landscape lineaments and provides repetitive coverage of the earth's surface, is explained, and extension of remote sensing techniques is discussed.

M.L.


The papers outline the remote sensing activities being carried out in a number of countries throughout the world, and present details on a variety of individual projects. Topics studied include a worldwide approach to remote sensing and mineral exploration, a land use information system based on statistical inference, acoustic radar and remote sensing in the boundary layer, procedure for land-use analysis in developing countries, an airborne geochemical system, remote sensing of snowpack with microwave radiometers for hydrologic applications, wheat production forecasts based on Landsat data, airborne lidar aerosol measurements over the U.S. and Europe, Landsat inventory of agricultural and forest resources in Bangladesh, application of satellite imagery to flood plain mapping in Thailand, and vegetation mapping of Nigeria from radar.


The paper outlines the scope of remote sensing activities, including conventional aerial photo-interpretation and airborne geophysical surveys as well as the satellite remote sensing programs, in India. The aircraft facilities, data analysis and photo processing facilities, and the interpretation and ground truth collection facilities are briefly described. Work done and work in progress over the past two years is mentioned, including the FEO satellite, aerial geophysical surveys, aerial multispectral scanner surveys, Landsat CFT data analysis, and some aerial photo-interpretation projects involving land surveys. Already a third of India has been interpreted by remote sensing techniques. The FEO satellite is equipped with sensors in the visible, near IR and microwave regions, and will conduct earth observation experiments related to meteorology, hydrology, and oceanography.

P.T.H.


Landsat D, scheduled for launch in 1981, is designed to be a complete end-to-end highly automated data gathering and processing system providing a major step forward in global remote sensing for earth resources applications. This paper discusses the major components of the flight segment (the Multimission Modular Spacecraft, the Thematic Mapper and the Multispectral Scanner Subsystem) and of the ground segment (the Data Management System and the Landsat-D Assessment System). Descriptions and diagrams illustrating various aspects of flight and ground segments are provided.


In 1974 USAID initiated an experimental small grant program aimed at transferring remote sensing technology to developing countries. The program to date has provided 13 grant awards and technical assistance on a competitive basis to investigators in 11 countries. Eight of the 10 grants completed have provided information actively being used in national development planning. Ingredients for a successful grant project were found to be (1) high-level management support, (2) an enthusiastic and resourceful grantee, and (3) involvement of investigators in 11 countries.

A79-22605 # An evaluation of Landsat technology for operational use by Nepal resource agencies. A. S. Andrawis (South Dakota State University, Brookings, S. Dak.), K. D. Bhattarai, P. M. Joshi, M. D. Rajbhandari, N. N. Vaidya, and P. P. Shrestha. In: International Symposium on Remote Sensing of Environment, 12th, Manila, Philippines, April 20-26, 1978, Proceedings. Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1978, p. 1503-1512. Resource scientists from Nepal utilized Landsat imagery in studying certain areas of their country with which they were acquainted to investigate the applicability of Landsat multispectral scanner data for delineating forest lands, monitoring forest cutting areas, tracing geologic structures and lineaments, and studying drainage patterns and river basins. Results indicate that Landsat data...
can be successfully utilized for assessing, mapping and monitoring the natural resources of Nepal, and is a valuable tool for identifying major landslide and erosion areas that threaten the limited agricultural soils of the country.

(Author)


The problems that one has to face in organizing an operational Remote Sensing Unit in a developing country are discussed, giving many possible approaches to these problems and suggestions on the different levels of sophistication in technique. The case in Sri Lanka is described. Possible solutions are taken up for discussion with suggestions for improvements in technology transfer and training aspects.

(Author)


An economic way of data handling and reproduction of the Landsat data was designed and implemented at the Thailand National Remote Sensing Program, National Research Council. Effective low cost procedures which are appropriate for use in other developing countries are presented. The discussion is centered around the reproduction of black and white imagery at 1:1 million, 1:500,000 and 1:250,000 scale and the dioxochrome color composite transparencies at 1:1 million scale. The system enables Thailand to provide all the required data at the quality and quantity needed by user agencies and can be expanded to meet the regional requirements.

(Author)


The Chandrapur Project is a multidisciplinary effort involving the study of natural resources in an area of nearly 6000 sq km in Chandrapur District, India. The region is largely covered by forests and is endowed with mineral resources not fully explored and utilized. The project involves the use of satellite remote sensing data along with aerial photographs followed by ground check, with geological, hydrological, geotechnical and pedological investigations.

B.J.


Published work on the utilization of satellites for the monitoring of earth resources and the environment is reviewed. Consideration is given to such applications of satellite remote sensing as air pollution, forestry and agriculture, geology, hydrology, and oceanography.

B.J.


The paper deals with some advances which have been made in the field of space remote sensing of the earth’s natural resources and in the application of space techniques to the improvement of resource management and better understanding of the physical and dynamic nature of the earth. The current status and planned developments in the management of renewable and nonrenewable resources are reviewed.

V.P.


The report summarizes the measurement needs of the major earth applications disciplines which have been culled from a wide range of documentary sources. These measurement needs are matched against present or funded-for-launch space-borne measurement capabilities. A brief prognosis of this program’s abilities to eliminate or reduce the voids and gaps in performance between the measurement needs and the existing capability is included, based on the author’s present understanding of technology.

(Author)


Spaceborne systems for measuring and predicting environmental conditions have achieved a level of development that justifies a look at the total environmental system. There are common requirements in all the disciplines, and many of the same measurements are needed to satisfy various discipline needs. It is this factor - the commonality of needs and measurements - that will be used in our future missions. The needs and requirements in the future plan will be faced by combining mission and data requirements that may be satisfied from orbiting spacecraft. There are also similarities in information requirements, as a result of which there is a need for developing an integrated data/information system where information will be produced in a format that will be of immediate utility to the users.

V.P.


The present activities and future missions of the ESA program of spaceborne remote sensing of earth resources and environment are discussed. Program objectives have been determined to be the satisfaction of European regional needs by agricultural, land use, water resources, coastal and polar surveys, and meeting the requirements of developing nations in the areas of agricultural production, mineral exploration and disaster warning and assessment. The Earthnet system of data processing centers presently is used for the distribution of remote sensing data acquired by NASA satellites. Remote sensing experiments to be flown aboard Spacelab are the Metric Camera, to test high resolution mapping capabilities of a large format camera, and the Microwave Remote Sensing Experiment, which operates as a two-frequency scatterometer, a synthetic aperture radar and a passive microwave radiometer. Studies carried out on the definition of future remote sensing satellite systems are described, including studies of system concepts for land applications and coastal monitoring satellites.

A.L.W.
The requirements of developing countries for the kind of data and information that satellite systems (primarily LANDSAT) can provide are examined. These platforms and their sensors are considered as complementary to other aerospace platform and sensor combinations and to ground traversing and sampling programs. The most essential requirements are the maintenance and improvement of agricultural production, ordered ground water and mineral exploration and development, and the prediction of disasters. For these to be achieved without destroying environmental resources, integrated methodology and techniques are to provide the best framework for the necessary survey, inventory, census, and monitoring programs. Illustrations of some key applications are provided. The establishment of international regional centers of remote sensing that can acquire data, and then process, interpret, distribute and apply them, undertake pure and applied research, and provide education and training programs appropriate to the areas they serve is discussed.

J.M.S.
Activities at various French research centers are discussed for the following areas: astronomy; solar physics; solar system; ionospheric and magnetospheric physics; aeronomy; meteorology; oceanography; earth resources observations and data reduction; geodesy and geodynamics; and exobiology and aerospace medicine. French satellites put into orbit by domestic and foreign launch vehicles are listed.


The Multipurpose Interactive NASA Information Systems (MINIS) was developed in response to the need for a data management system capable of operation on several different minicomputer systems. The desired system had to be capable of performing the functions of a LANDSAT photo descriptive data retrieval system while remaining general in terms of other acceptable user definable data bases. The system also had to be capable of performing data base updates and providing user-formatted output reports. The resultant MINI System provides all of these capabilities and several other features to complement the data management system. The MINI System is currently implemented on two minicomputer systems and is in the process of being installed on another minicomputer system. The MINIS is operational on four different data bases.


The hardware/software and the associated procedures for a natural resource inventory and information system based on the use of LANDSAT-acquired multispectral scanner digital data is described. The system is designed to derive land cover/vegetation information from LANDSAT data and geographically reference this information for the production of various types of maps and for the compilation of acreage by land cover/vegetation category. The system also provides for data base building so that the LANDSAT-derived information can be related to information digitized from other sources (e.g., soils maps) in a geographic context in order to address specific applications. These applications include agricultural crop production estimation, erosion hazard-reforestation need assessment, whitetail deer habitat assessment, and site selection. The system is tested in demonstration areas located in the state of Mississippi, and the results of these application demonstrations are presented. A cost-efficiency comparison of producing land cover/vegetation maps and statistics with this system versus the use of small-scale aerial photography is made.

Author


Advantages and disadvantages of traditional methods of obtaining required information for land and resources management and the possibilities of remote sensing are discussed. The services available, organization and objectives of the pilot operation are presented. Emphasis is placed on multidisciplinary dialog among designers, builders, operators, interpreters and users in all phases. The principles, operation and practical applications of remote sensing systems and processing systems under the pilot operation are presented.

Author
Typical Subject Index Listing

SUBJECT HEADING  TITLE EXTENSION

GREAT PLAINS CORRIDOR (NORTH AMERICA)
Large Area Crop Inventory Experiment (LACIE).
[79-10137] Supplement to AERIAL PHOTOGRAPHY

ACCURACY
Accuracy assessment's evaluation plan for TY multibeamers. 51 North Dakota, Montana, Minnesota, South Dakota, Oklahoma, and Colorado [79-10137]


Large Area Crop Inventory Experiment (LACIE). Accuracy assessment report phase 1A, November - December 1974. Kansas [79-10129]

Large Area Crop Inventory Experiment (LACIE). LACIE phase 1 and 2 accuracy assessment. Kansas, Texas, Minnesota, Montana, and North Dakota [79-10134]

Software for analyzing data contained in output files created by the SPATL and MLCTR programs of the accuracy assessment software system [79-10155]

Accuracy assessment disk data base development for LACIE. Phase 3: User's information [79-10173]

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### Typical Report/Accession Number Index Listing

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