NASA

Earth Resources
A Continuing
Bibliography
with Indexes

NASA SP-7041(41)
April 1984

National Aeronautics and
Space Administration

es Earth Resourc
s Earth Resources
Earth Resources E
th Resources Ear
Resources Earth
Resources Earth
sources Earth Re

NASA SP-7041(41)
Earth Resources
A Continuing Bibliography with Indexes
Pages 1-73
April 1984

ACCESSION NUMBER RANGES

Accession numbers cited in this Supplement fall within the following ranges.

STAR (N-10000 Series)	N84-10001 - N84-16114
IAA (A-10000 Series)	A84-10001 - A84-19348

This bibliography was prepared by the NASA Scientific and Technical Information Facility operated for the National Aeronautics and Space Administration by PRC Government Information Systems.

NASA SP-7041(41)

EARTH RESOURCES

A CONTINUING BIBLIOGRAPHY WITH INDEXES

Issue 41

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 January 1 and March 31, 1984 in

- *Scientific and Technical Aerospace Reports (STAR)*
- *International Aerospace Abstracts (IAA).*

NASA Scientific and Technical Information Branch 1984
National Aeronautics and Space Administration
Washington, DC

This supplement is available as NTISUB/038/093 from the National Technical Information Service (NTIS), Springfield, Virginia 22161 at the price of $12.50 domestic; $25.00 foreign for standing orders. Please note: Standing orders are subscriptions which do not terminate at the end of a year, as do regular subscriptions, but continue indefinitely unless specifically terminated by the subscriber.

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 instrumention on orbiting spacecraft or on aircraft.

This literature survey lists 475 reports, articles, and other documents announced between January 1 and March 31, 1984 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 include the original accession numbers from the respective announcement journals.

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 A84-10,000 in ascending accession number order;

STAR entries identified by accession number series N84-10,000 in ascending accession number order.

After the abstract section, there are six indexes:

subject, personal author, corporate source, contract number, report/accession number, and accession number.

AVAILABILITY OF CITED PUBLICATIONS

IAA ENTRIES (A84-10000 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 $8.50 per document. Microfiche[1] of documents announced in *IAA* are available at the rate of $4.00 per microfiche on demand. Standing order microfiche are available at the rate of $1.45 per microfiche for *IAA* source documents.

Minimum air-mail postage to foreign countries is $2.50 and all foreign orders are shipped on payment of pro-forma invoices.

All inquiries and requests should be addressed to AIAA Technical Information Service. Please refer to the accession number when requesting publications.

STAR ENTRIES (N84-10000 Series)

One or more sources from which a document announced in *STAR* is available to the public is ordinarily given on the last line of the citation. The most commonly indicated sources and their acronyms or abbreviations are listed below. If the publication is available from a source other than those listed, the publisher and his address will be displayed on the availability line or in combination with the corporate source line.

Avail: NTIS. Sold by the National Technical Information Service. Prices for hard copy (HC) and microfiche (MF) are indicated by a price code preceded by the letters HC or MF in the *STAR* citation. Current values for the price codes are given in the tables on page viii.

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.

Initially distributed microfiche under the NTIS SRIM (Selected Research in Microfiche) is available at greatly reduced unit prices. For this service and for information concerning subscription to NASA printed reports, consult the NTIS Subscription Section, Springfield, Va. 22161.

NOTE ON ORDERING DOCUMENTS: When ordering NASA publications (those followed by the * symbol), use the N accession number. NASA patent applications (only the specifications are offered) should be ordered by the US-Patent-Appl-SN number. Non-NASA publications (no asterisk) should be ordered by the AD, PB, or other *report* number shown on the last line of the citation, not by the N accession number. It is also advisable to cite the title and other bibliographic identification.

Avail: SOD (or GPO). Sold by the Superintendent of Documents, U.S. Government Printing Office, in hard copy. The current price and order number are given following the availability line. (NTIS will fill microfiche requests, as stated above, for those documents identified by a # symbol.)

Avail: NASA Public Document Rooms. Documents so indicated may be examined at or purchased from the National Aeronautics and Space Administration, Public Document Room (Room 126), 600 Independence Ave., S.W., Washington, D.C. 20546, or public document rooms located at each of the NASA research centers, the NASA Space Technology Laboratories, and the NASA Pasadena Office at the Jet Propulsion Laboratory.

(1) A microfiche is a transparent sheet of film, 105 by 148 mm in size containing as many as 60 to 98 pages of information reduced to micro images (not to exceed 26.1 reduction).

Avail: DOE Depository Libraries. Organizations in U.S. cities and abroad that maintain collections of Department of Energy reports, usually in microfiche form, are listed in *Energy Research Abstracts.* Services available from the DOE and its depositories are described in a booklet, *DOE Technical Information Center - Its Functions and Services* (TID-4660), which may be obtained without charge from the DOE Technical Information Center.

Avail: Univ. Microfilms. Documents so indicated are dissertations selected from *Dissertation Abstracts* and are sold by University Microfilms as xerographic copy (HC) and microfilm. All requests should cite the author and the Order Number as they appear in the citation.

Avail: USGS. Originals of many reports from the U.S. Geological Survey, which may contain color illustrations, or otherwise may not have the quality of illustrations preserved in the microfiche or facsimile reproduction, may be examined by the public at the libraries of the USGS field offices whose addresses are listed in this introduction. The libraries may be queried concerning the availability of specific documents and the possible utilization of local copying services, such as color reproduction.

Avail: HMSO. Publications of Her Majesty's Stationery Office are sold in the U.S. by Pendragon House, Inc. (PHI), Redwood City, California. The U.S. price (including a service and mailing charge) is given, or a conversion table may be obtained from PHI.

Avail: BLL (formerly NLL): British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. Photocopies available from this organization at the price shown. (If none is given, inquiry should be addressed to the BLL.)

Avail: Fachinformationszentrum, Karlsruhe. Sold by the Fachinformationszentrum Energie, Physik, Mathematik GMBH, Eggenstein Leopoldshafen, Federal Republic of Germany, at the price shown in deutschmarks (DM).

Avail: Issuing Activity, or Corporate Author, or no indication of availability. Inquiries as to the availability of these documents should be addressed to the organization shown in the citation as the corporate author of the document.

Avail: U.S. Patent and Trademark Office. Sold by Commissioner of Patents and Trademarks, U.S. Patent and Trademark Office, at the standard price of 50 cents each, postage free.

Avail: ESDU. Pricing information on specific data items, computer programs, and details on ESDU topic categories can be obtained from ESDU International Ltd. Requesters in North America should use the Virginia address while all other requesters should use the London address, both of which are on page vi.

Other availabilities: If the publication is available from a source other than the above, the publisher and his address will be displayed entirely on the availability line or in combination with the corporate author line.

ADDRESSES OF ORGANIZATIONS

American Institute of Aeronautics and Astronautics
Technical Information Service
555 West 57th Street, 12th Floor
New York, New York 10019

British Library Lending Division,
Boston Spa, Wetherby, Yorkshire,
England

Commissioner of Patents and Trademarks
U.S. Patent and Trademark Office
Washington, D.C. 20231

Department of Energy
Technical Information Center
P.O. Box 62
Oak Ridge, Tennessee 37830

ESA-Information Retrieval Service
ESRIN
Via Galileo Galilei
00044 Frascati (Rome) Italy

ESDU International, Ltd.
1495 Chain Bridge Road
McLean, Virginia 22101

ESDU International, Ltd.
251-259 Regent Street
London, W1R 7AD, England

Fachinformationszentrum Energie, Physik, Mathematik GMBH
7514 Eggenstein Leopoldshafen
Federal Republic of Germany

Her Majesty's Stationery Office
P.O. Box 569, S.E. 1
London, England

NASA Scientific and Technical Information Facility
P.O. Box 8757
B.W.I. Airport, Maryland 21240

National Aeronautics and Space Administration
Scientific and Technical Information Branch (NIT-1)
Washington, D.C. 20546

National Technical Information Service
5285 Port Royal Road
Springfield, Virginia 22161

Pendragon House, Inc.
899 Broadway Avenue
Redwood City, California 94063

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

University Microfilms
A Xerox Company
300 North Zeeb Road
Ann Arbor, Michigan 48106

University Microfilms, Ltd.
Tylers Green
London, England

U.S. Geological Survey Library
National Center – MS 950
12201 Sunrise Valley Drive
Reston, Virginia 22092

U.S. Geological Survey Library
2255 North Gemini Drive
Flagstaff, Arizona 86001

U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

U.S. Geological Survey Library
Box 25046
Denver Federal Center, MS 914
Denver, Colorado 80225

NTIS PRICE SCHEDULES

Schedule A

STANDARD PAPER COPY PRICE SCHEDULE

(Effective January 1, 1983)

Price Code	Page Range	North American Price	Foreign Price
A01	*Microfiche*	$ 4.50	$ 9.00
A02	001-025	7.00	14.00
A03	026-050	8.50	17.00
A04	051-075	10.00	20.00
A05	076-100	11.50	23.00
A06	101-125	13.00	26.00
A07	126-150	14.50	29.00
A08	151-175	16.00	32.00
A09	176-200	17.50	35.00
A10	201-225	19.00	38.00
A11	226-250	20.50	41.00
A12	251-275	22.00	44.00
A13	276-300	23.50	47.00
A14	301-325	25.00	50.00
A15	326-350	26.50	53.00
A16	351-375	28.00	56.00
A17	376-400	29.50	59.00
A18	401-425	31.00	62.00
A19	426-450	32.50	65.00
A20	451-475	34.00	68.00
A21	*476-500*	*35.50*	*71.00*
A22	501-525	37.00	74.00
A23	526-550	38.50	77.00
A24	551-575	40.00	80.00
A25	576-600	41.50	83.00
A99	601-up	-1	-2

1/ Add $1.50 for each additional 25 page increment or portion thereof for 601 pages up.

2/ Add $3.00 for each additional 25 page increment or portion thereof for 601 pages and more.

Schedule E

EXCEPTION PRICE SCHEDULE

Paper Copy & Microfiche

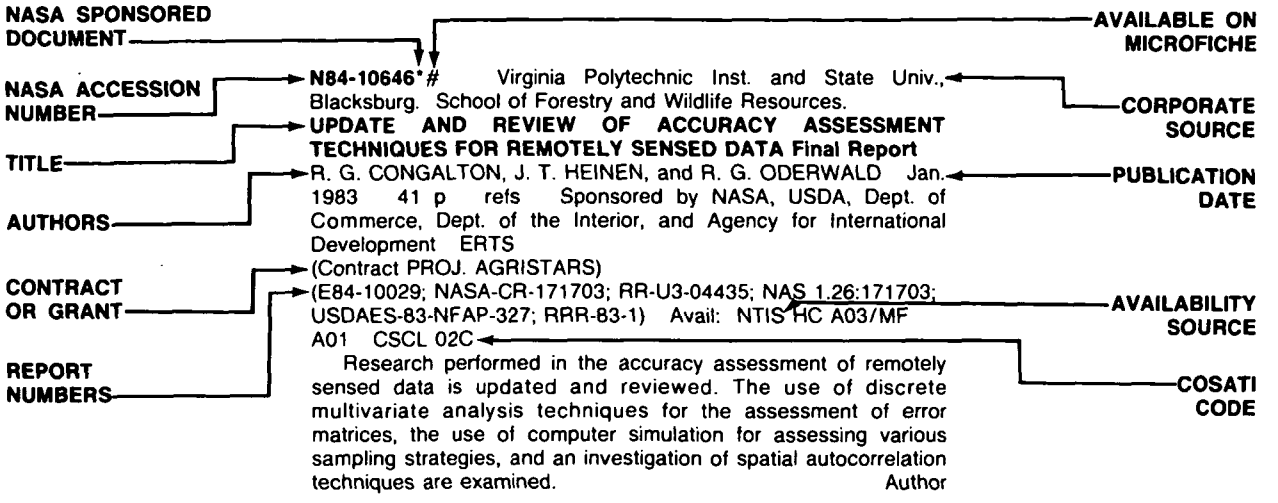
Price Code	North American Price	Foreign Price
E01	$ 6.50	$ 13.50
E02	7.50	15.50
E03	9.50	19.50
E04	11.50	23.50
E05	13.50	27.50
E06	15.50	31.50
E07	17.50	35.50
E08	19.50	39.50
E09	21.50	43.50
E10	23.50	47.50
E11	25.50	51.50
E12	28.50	57.50
E13	31.50	63.50
E14	34.50	69.50
E15	37.50	75.50
E16	40.50	81.50
E17	43.50	88.50
E18	46.50	93.50
E19	51.50	102.50
E20	61.50	123.50

E-99 - Write for quote

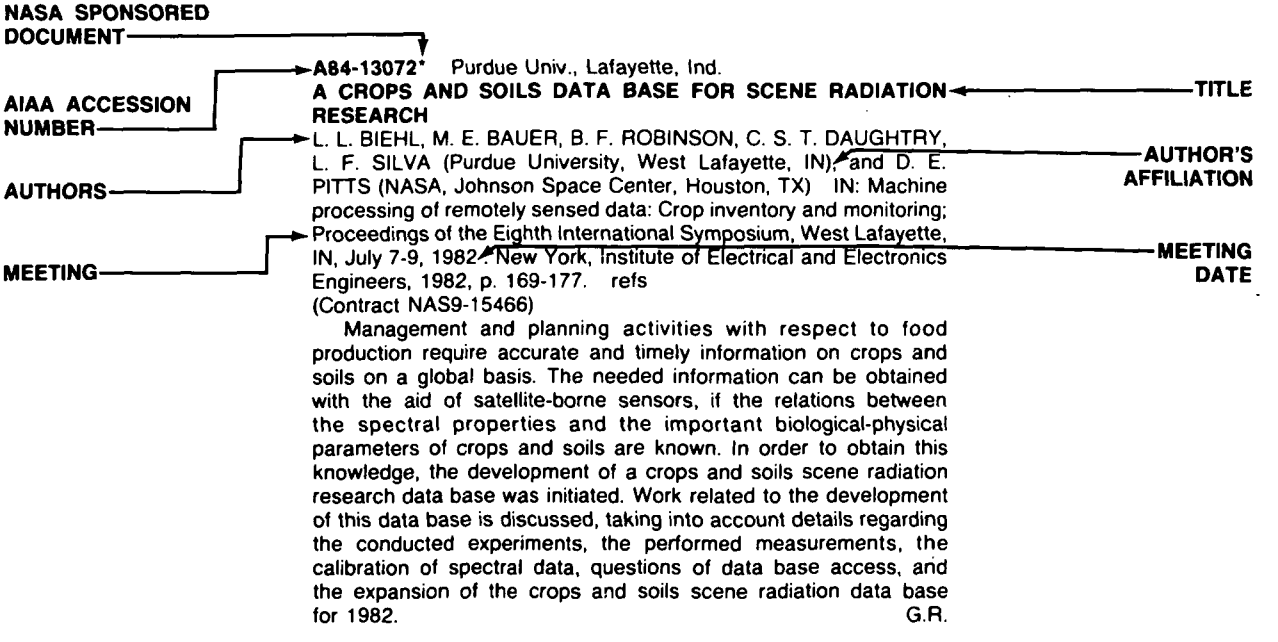
N01	35.00	45.00

TABLE OF CONTENTS

TYPICAL CITATION AND ABSTRACT FROM *STAR*



TYPICAL CITATION AND ABSTRACT FROM *IAA*



EARTH RESOURCES

A Continuing Bibliography (Issue 41)

APRIL 1984

01

AGRICULTURE AND FORESTRY

Includes crop forecasts, crop signature analysis, soil identification, disease detection, harvest estimates, range resources, timber inventry, forest fire detection, and wildlife migration patterns.

A84-10887* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
LANDSAT 4 RESULTS AND THEIR IMPLICATIONS FOR AGRICULTURAL SURVEYS
J. D. ERICKSON, R. M. BIZZELL, D. E. PITTS, and D. R. THOMPSON (NASA, Johnson Space Center, Space and Life Sciences Directorate, Houston, TX) IN: Space applications at the crossroads; Proceedings of the Twenty-first Goddard Memorial Symposium, Greenbelt, MD, March 24, 25, 1983 . San Diego, CA, Univelt, Inc., 1983, p. 79-97. refs
(AAS PAPER 83-160)

Progress on defining the minimum Landsat-4 data characteristics needed for agricultural information in the U.S. and assessing the value-added capability of current technology to extract that level of information is reported. Emphasis is laid on the thematic mapper (TM) data and the ground processing facilities. TM data from all 7 bands for a rural Arkansas scene were examined in terms of radiometric, spatial, and geometric fidelity characteristics. Another scene sensed over Iowa was analyzed using three two-channel data sets. Although the TM data were an improvement over MSS data, no value differential was perceived. However, the development of further analysis techniques is still necessary to determine the actual worth of the improved sensor capabilities available with the TM, which actually has an MSS within itself. D.H.K.

A84-11749#
VEGETATION STATUS ASSESSMENT AND MONITORING IN AGRICULTURAL AREAS BY REMOTE SENSING
G. CSORNAI, J. VAMOSI, O. DALIA, and A. GOTHAR (Institute of Geodesy and Cartography, Budapest, Hungary) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 8 p. Research sponsored by the Ministry of Food and Agriculture. refs
(IAF PAPER 83-135)

Current and projected applications of remote sensing for agricultural crop management in Hungary are discussed. Classifications of different types of soils, the inventory of major crops, and the territories encompassed by cooperatives and state-owned farms are currently being assessed. Aerial photographic surveys are being flown to provide comparison data with ground truth and Landsat data. Attention is also being given to inhomogeneities in planted fields and to developing pattern recognition software for automated identification of healthy and ailing crops. M.S.K.

A84-11750#
CONDITIONS AND PRODUCTIVITY EVALUAED FOR AGRICULTURAL CROPS BY MEASUREMENTS OF SPECTRAL REFLECTANCE FROM SPACE AND AIRCRAFT
A. D. KLESHCHENKO, O. V. VIRCHENKO, V. A. KOVALENKO, L. N. EMELANOVA (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Sel'skokhoziaistvannoi Meteorologii, Obninsk, USSR), P. BOZO, S. LESZTAK, and V. VADASZ (Central Institute for Weather Forecasting, Budapest, Hungary) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 11 p.
(IAF PAPER 83-136)

The results of the first use of a method for operative evaluation of remote sensing data on agricultural crops covering large areas are presented. The data were gathered over a district in a southern European territory controlled by Russia and in a lowland and the Marcal basin of Hungary. Data were gathered on cereal crops and maize and were divided into five categories according to the expected yield. The airborne spectral measurements comprised the total ground cover, the biomass above the surface, the density of plants, total leaf surface, and plant height. Correlations between 0.75-0.85 were obtained between the total biomass and the yield of the grain. Additionally, a formulation was developed that related the young plant total coverage to the ultimate yields, and meteorological satellite data were coordintaed with required agricultural activities such as watering. M.S.K.

A84-13012
ARGENTINA-UNITED NATIONS/78/016 DEVELOPMENT PROGRAMME - A REMOTE SENSING AGRICULTURE FORECAST PROGRAMME
S. F. PAGEL and N. SCQUIZZATO (Comision Nacional de Investigaciones Espaciales, Buenos Aires, Argentina) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 71-75. refs

A84-13013
ACQUISITION OF SPECTRAL SIGNATURES OF CROP FEATURES IN THE TRENQUE-LAUQUEN AREA
M. A. RAED (Centro de Sensores Remotos, Buenos Aires, Argentina) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 76-83. refs

The applications of Landsat data to wheat and corn development stages is discussed for use in Argentina. Spectral measurements are carried out on the soil type, crop density, and the effects of the stage of development on the spectral responses of the winter wheat and corn. Training sets have been gathered and used to differentiate between wheat, barley, pastures, oats, and sown lands by shape and ground truth spectral comparisons. The training area data sets were analyzed by means of a maximum likelihood procedure with a multivariate normal hypothesis. It was concluded that many unresolved difficulties still exist in using MSS data for classifying crops and monitoring growth patterns, due in part to the tendency for the spectral signatures of specific crops

to shift wavelengths, depending on the area in which a crop is grown. M.S.K.

A84-13015
VEGETATION CLASSIFICATION USING SATELLITE IMAGERY AND AREA SAMPLING FRAME TO LOCATE SAMPLING STANDS
M. O. OLANG (Kenya Range Ecological Unit, Nairobi, Kenya) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 96-102.

A84-13017
MAPPING PRIME TIMBERLAND USING LANDSAT AND GRIDDED SOIL DATA BASES
W. H. CLERKE, J. L. CHRISTENSEN (U.S. Department of Agriculture, Forest Service, Atlanta, GA), and J. K. DOOLEY (Earth Resources Data Analysis Systems, Inc., Atlanta, GA) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 112-118.

Prime timberland maps and data bases were prepared for 12 counties in South Carolina and Georgia from Landsat imagery and USDA Soil Conservation Service gridded soil data bases. Information derived from the satellite imagery and ancillary data were combined to produce maps that effectively display the distribution and extent of forest cover by productivity class. The maps, printed at a scale of 1:100,000, and the data bases from which they were derived will be useful for environmental assessment and land management planning activities. Landsat images, acquired in 1973 and 1981, were independently classified to demonstrate the utility of satellite imagery in mapping changes in forest cover on prime timberlands. The objective of the pilot test, conducted under a contract from the USDA Forest Service, was to demonstrate the utility of available data sources and current technology for producing prime timberland maps on a cost effective basis. Image processing and geographic data base subsystems, implemented on mini and microcomputers, were used to perform the analysis. Author

A84-13021* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OPTIMAL LANDSAT TRANSFORMS FOR FOREST APPLICATIONS
T. L. LOGAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and A. H. STRAHLER (Hunter College, New York, NY) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 146-153. refs
(Contract NAS7-918)

Eleven transformations of data from four Landsat MSS channels were investigated to find if any of the transforms accentuated the separability of natural vegetation classes in regions of varying topographical relief. Attention was given to the divergence analysis and classification accuracy of information content of the eleven transforms and four channels. A useful scaling function was observed with the second eigenvector being the denominator in the divergence values obtained. The second eigenvector was found to reduce the effects of shadowing and differential illumination of vegetation signatures, thereby enhancing the divergence values. The highest accuracies in crop identification were provided by the averages of channels 4, 6, and 7 divided by the second eigenvector. M.S.K.

A84-13027* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
A MATHEMATICAL MODEL FOR CROP SPECTRAL-TEMPORAL TRAJECTORIES BASED ON A PLANT GROWTH MODEL
T. L. WOOLFORD (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 208-215. refs
(Contract NAS9-15800)

The Kubelka-Munk radiative transfer model is combined with an approximation of Kauth-Thomas greeness and brightness transforms to derive approximate closed form expressions for crop greeness and brightness surrogates in terms of canopy biomass. The greeness relation derived resembles an existing empirical relation between leaf area index and greeness. A simple growth model based on interception and utilization of photosynthetically active radiation is developed and used to describe the time evolution of greeness and brightness. The model developed does not yet yield definitive profile calculations but suggests a conceptual framework which may be found useful for further profile analysis. Author

A84-13028
AN EFFECTIVE CLASSIFICATION METHOD AND AUTOMATED RESULT TESTING TECHNIQUES FOR DIFFERENTIATING CROP TYPES
G. CSORNAI, O. DALIA, A. KOZICS-GOTHAR, and J. VAMOSI (Institute for Geodesy and Cartography, Budapest, Hungary) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 217-224. Research sponsored by the Ministry of Food and Agriculture. refs

A84-13031* California Univ., Berkeley.
APPLICATION OF A U.S.-BASED ANALYSIS APPROACH TO ARGENTINA CROP IDENTIFICATION
J. B. ODENWELLER, C. M. HAY, and B. L. WOOD (California, University, Berkeley, CA) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 239-243.
(Contract NAS9-14565; NAS9-16413)

A generic, U.S.-based analysis approach was evaluated with respect to corn and soybean identification in Argentina. Using crop separability expectations derived from the analysis of Argentina ancillary data and U.S. spectral data, the approach was applied to Argentina spectral data by an expert analyst. Eight classes were detected and labeled independent of ground data. A high correspondence between the labels and limited ground data was achieved. It was concluded that an approach of this type could be applied to Argentina without major difficulty. Author

A84-13032
AGRISTARS DCLC APPLICATIONS PROJECT - 1982 WINTER WHEAT AREA ESTIMATES FOR COLORADO, KANSAS AND OKLAHOMA
J. W. MERGERSON, V. B. JOHNSON, and R. A. KESTLE (U.S. Department of Agriculture, Statistical Reporting Service, Washington, DC) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 250-255. refs

A84-13051
MACHINE PROCESSING OF REMOTELY SENSED DATA: CROP INVENTORY AND MONITORING; PROCEEDINGS OF THE EIGHTH INTERNATIONAL SYMPOSIUM, PURDUE UNIVERSITY, WEST LAFAYETTE, IN, JULY 7-9, 1982
D. C. MCDONALD, ED. and D. B. MORRISON, ED. Symposium sponsored by the American Society of Agronomy, Crop Science Society of America, IEEE, et al. New York, Institute of Electrical and Electronics Engineers, 1982, 587 p.

The role of remote sensing in meeting crop production information needs is examined and aspects of crop identification and area estimation are discussed, taking into account the integration of Landsat data into the crop estimation program of USDA's Statistical Reporting Service, a Landsat-based inventory procedure for agriculture in California, research in satellite-aided crop inventory and monitoring, and the development, test, and evaluation of a computerized procedure for using Landsat data to estimate spring small grains acreage. Other topics considered are related to information extraction techniques, scene simulation and modeling, crop condition assessment and yield prediction, geometric and radiometric image processing, the thematic mapper and other advanced sensors, natural resource assessment, and pattern recognition and image analysis. Attention is also given to remote sensing applications, temporal profile modeling, applications of georeference information systems, hardware and software systems, and issues in earth observation and resource information systems. G.R.

A84-13052
APPLICATION OF SATELLITE REMOTE SENSING IN USDA CROP INFORMATION SYSTEMS
C. E. CAUDILL (U.S. Department of Agriculture, Statistical Reporting Service, Washington, DC) and J. R. HICKMAN (U.S. Department of Agriculture, Foreign Agricultural Service, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 3-9. refs

During the past two decades procedures have been developed for utilizing remote sensing technology for improving the output of the crop statistics program for foreign countries and the domestic crop statistics program. The Foreign Agricultural Service (FAS) administers operational satellite remote sensing programs covering foreign areas. Reports are provided on food and coarse grains, oil seeds and other industrial crops, winterkill, deforestation, water impoundments, plant disease, and moisture stress in plants. Currently the analyses emphasize the USSR, Eastern Europe, Brazil, Argentina, Mexico, Australia, China, and India. Remotely sensed satellite data (both Landsat and NOAA satellite series) are utilized along with meteorological data, and ancillary data. Domestic operations are also discussed, and attention is given to future operations. G.R.

A84-13053* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
SATELLITE REMOTE SENSING - AN INTEGRAL TOOL IN ACQUIRING GLOBAL CROP PRODUCTION INFORMATION
F. G. HALL (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 10-22. refs

Since NASA's program of research concerning remote sensing was initiated in the 1960s, one of its major objectives has been to advance the state-of-the-art in machine processing of satellite acquired multispectral data. Possibilities have been studied regarding a use of these data to identify type, to monitor condition, and to estimate the ontogenetic stage of cultural vegetation. The present investigation provides a review of the state-of-the-art of the technology used to make remote sensing crop production estimates in foreign regions. Attention is given to Landsat data acquisition, aspects of registration and preprocessing, questions of data transformation, data modeling, proportion estimation, labeling, development stage models, crop condition models, and an outlook regarding future developments. G.R.

A84-13054
THE ROLE OF METEOROLOGICAL SATELLITES IN AGRICULTURAL REMOTE SENSING
H. W. YATES and J. D. TARPLEY (NOAA, National Earth Satellite Service, Washington, DC) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 23-32. refs

The U.S. Department of Agriculture routinely provides forecasts regarding the production of major crops in all areas of the world having significant output. A large part of the data needed for these forecasts is not available from conventional sources, and earth-orbiting satellites represent a prime source of information. The role of the U.S. operational satellite system in contributing data for the forecasts is discussed, taking into account the two spacecraft in geostationary orbit (GOES), and the two spacecraft in polar orbits (NOAA). The main function of the GOES system is to provide frequent imagery to aid weather forecasters in tracking meteorological systems. The instruments of the NOAA satellites provide atmospheric temperature and moisture profiles, sea surface temperatures, and imagery. Attention is given to the estimation of precipitation, a cloud indexing technique, the estimation of daily maximum and minimum temperatures, estimates of insolation, and studies of snowcover and vegetation index. G.R.

A84-13055
1981 AGRISTARS DCLC FOUR STATE PROJECT
J. W. MERGERSON, M. OZGA, M. HOLKO, C. MILLER, S. WININGS, P. COOK, and G. HANUSCHAK (U.S. Department of Agriculture, Statistical Reporting Service, Washington, DC) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 34-44.

AgRISTARS represents a cooperative effort of the U.S. Department of Agriculture, NASA, the U.S. Department of Commerce, the U.S. Department of the Interior, and the Agency for International Development. The Domestic Crops and Land Cover (DCLC) project is one of eight projects under the AgRISTARS program. During 1981, the second phase of the DCLC project was implemented. More precise year-end major crop area estimates in selected states were provided on the basis of a combination of Landsat data with ground-gathered survey data. Attention is given to Landsat data acquisition, data processing, estimation results, program costs, and contributions. G.R.

A84-13056
INTEGRATION OF LANDSAT DATA INTO THE CROP ESTIMATION PROGRAM OF USDA'S STATISTICAL REPORTING SERVICE (1972-1982)
G. A. HANUSCHAK, R. D. ALLEN, and W. H. WIGTON (U.S. Department of Agriculture, Statistical Reporting Service, Washington, DC) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 45-56. refs

The methodology used by the Statistical Reporting Service (SRS) in its domestic crop estimation program includes the employment of a regression estimator which uses jointly Landsat data and data of the June Enumerative Survey (JES). The integration of Landsat data into SRS's program is discussed, taking into account 1972-1973 developments, 1974 developments, a 1975 Illinois project and editor software development, 1976 developments, 1977 developments, the 1978 Iowa project, the use of Landsat imagery in area frame construction, the 1978 Idaho and Arkansas projects, 1979 developments, the SRS role in the Large Area Crop Inventory Experiment, and a six year interagency research program designed to evaluate the potential of aerospace

remote sensing data in meeting the information needs of the Department of Agriculture. G.R.

A84-13057* California Univ., Berkeley.
A LANDSAT-BASED INVENTORY PROCEDURE FOR AGRICULTURE IN CALIFORNIA
S. L. WALL, R. W. THOMAS, C. E. BROWN (California, University, Berkeley, CA), and E. H. BAUER (NASA, Ames Research Center, Moffett Field, CA) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 57-64.

Agriculture, which occupies a vital position in the economy of the State of California, depends crucially on the available water. The California Department of Water Resources (DWR) is, therefore, greatly concerned with the total water requirements for agricultural applications. In view of the limitations of an area-limited, single-date survey system, the DWR has been cooperating with NASA and the University of California in a study of the applicability of Landsat imagery and digital data as an aid in making decisions concerning the management of water resources. Attention is given to a statewide inventory of irrigated land, computer-assisted estimation and mapping of irrigated land, and a crop type analysis using Landsat digital data. G.R.

A84-13058* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
RESEARCH IN SATELLITE-AIDED CROP INVENTORY AND MONITORING
J. D. ERICKSON, J. L. DRAGG, R. M. BIZZELL, and M. C. TRICHEL (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 65-71.

Automated information extraction procedures for analysis of multitemporal Landsat data in non-U.S. crop inventory and monitoring are reviewed. Experiments to develop and evaluate crop area estimation technologies for spring small grains, summer crops, corn, and soybeans are discussed. Previously announced in STAR as N82-32793 M.G.

A84-13059* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
UPDATE ON A SYSTEM FOR LARGE AREA CROP INVENTORY FROM REMOTELY SENSED DATA
T. C. BAKER, J. H. SMITH, and J. T. MALIN (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 72-79. refs
(Contract NAS9-15800)

In connection with the conduction of the Large Area Crop Inventory Experiment (LACIE), a state-of-the-art technology for the inventory of crops using satellite data was developed and tested over a period of three years (1975-77). A method was obtained for determining the total wheat production in a given region by looking at only a subset of its area. The present investigation is concerned with the current state of the art as obtained in the aggregation technology of the Agriculture and Resources Inventory Surveys Through Aerospace Remote Sensing (AgRISTARS) program. Attention is given to details of AgRISTARS baseline aggregation technology, and to recent improvements and future research directions. G.R.

A84-13060* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
DEVELOPMENT, TEST AND EVALUATION OF A COMPUTERIZED PROCEDURE FOR USING LANDSAT DATA TO ESTIMATE SPRING SMALL GRAINS ACREAGE
R. R. J. MOHLER, W. F. PALMER, M. M. SMYRSKI, T. C. BAKER (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and C. V. NAZARE (Intergraph Corp., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 80-87. refs
(Contract NAS9-15800)

A number of methods which can provide information concerning crop acreages on the basis of a utilization of multispectral scanner (MSS) data require for their implementation a comparatively large amount of labor. The present investigation is concerned with a project designed to improve the efficiency of analysis through increased automation. The Caesar technique was developed to realize this objective. The processability rates of the Caesar procedure versus the historical state-of-the-art proportion estimation procedures were determined in an experiment. Attention is given to the study site, the aggregation technology, the results of the aggregation test, and questions of error characterization. It is found that the Caesar procedure, which has been developed for the spring small grains region of North America, is highly efficient and provides accurate results. G.R.

A84-13061
EVALUATION OF THE APPLICATION OF LANDSAT DATA TO CROP DISCRIMINATION IN WESTERN AUSTRALIA
N. A. CAMPBELL, F. R. HONEY, P. T. HICK (Commonwealth Scientific and Industrial Research Organization, Div. of Mathematics and Statistics; Commonwealth Scientific and Industrial Research Organization, Div. of Land Resources Management, Perth, Australia), and M. D. W. CARLTON IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 88-96. Research supported by CBH. refs

A84-13062* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
AUTOMATED PIXEL SCREENING AND SELECTION TECHNIQUE
C. L. DAILEY and G. M. CHAPMAN (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 98-102.
(Contract NAS9-15800)

One approach for estimating crop acreage on the basis of Landsat data involves the sampling of portions of Landsat imagery which represent 5 x 6-n mi areas on the ground, taking into account acreage estimates for each of these areas. Difficulties concerning the estimating procedures are related to labeling. These difficulties arise in particular in connection with mixed pixels. The present investigation is concerned with the employment of a suitable automated technique for overcoming these difficulties. A description of the selected technique is presented, and the test conducted for the evaluation of the technique is discussed. It is found that the employed automated pixel screening and selection procedure provides representative samples of the scene. The amount of time spent on pure pixel selection is significantly reduced by using the automated method. G.R.

A84-13063* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
SSG-4 - AN AUTOMATED SPRING SMALL GRAINS PROPORTION ESTIMATOR
T. B. DENNIS, R. B. CATE, M. M. SMYRSKI, T. C. BAKER (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and C. V. NAZARE (Intergraph Corp., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 103-107.
(Contract NAS9-15800)

In connection with an implementation of the classification procedures employed in the Large Area Crop Inventory Experiment (LACIE), a human analyst had to provide labeled samples. The present investigation is concerned with an automated proportion estimation procedure which has been derived from the early field-labeling procedures used in LACIE. This procedure was developed for the U.S./Canada Spring Small Grains Pilot Experiment. It is demonstrated that the considered spatial/color-based proportion estimation procedure provides the agricultural remote-sensing community with the basic tools to develop unbiased and highly efficient procedures for obtaining crop area estimates at the end of the season. G.R.

A84-13064* Environmental Research Inst. of Michigan, Ann Arbor.
THE EVALUATION OF A SEMI-AUTOMATED PROCEDURE FOR CLASSIFYING CORN AND SOYBEANS WITHOUT GROUND DATA
M. D. METZLER, R. C. CICONE, and K. I. JOHNSON (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 108-115. refs
(Contract NAS9-16538)

Since the launch of Landsat 1 in 1973, research has been conducted with the objective to develop technology which would make it possible to achieve large area crop estimates on the basis of Landsat Multispectral Sensor (MSS) data without the benefit of ground observed training data. The present investigation is concerned with the evaluation of a technology which was developed to produce estimates of corn and soybean acreage in the central U.S. Corn Belt (Iowa, Illinois, and Indiana). A description of the employed technique is provided and details regarding the test of the developed technology are discussed. The obtained results show that considerable progress has been made toward creating an automatic, self-adapting procedure which has favorable bias and variance characteristics. G.R.

A84-13065* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
CAN CROP TYPES BE RESOLVED USING MIXTURE DISTRIBUTION COMPONENTS - SOME INITIAL RESULTS AND IMPLICATIONS
R. K. LENNINGTON, C. T. SORENSEN (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and R. P. HEYDORN (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 116-121.

For the analysis of remotely sensed data, it is frequently necessary to design a classifier in order to locate a ground cover class of interest or to estimate the proportion of this ground cover class. Advantages of a mixture distribution formulation are discussed, and a description is presented of the results of estimating the proportion of small grains in ten Landsat data segments using the mixture model. It is found that the mixture model proportion estimates have a very low variance and coefficient of variation. The discussed investigation implies that the mixtures model is a viable method for determining the distributions of classes of interest in remote sensing problems and in estimating the proportions of these classes directly. G.R.

A84-13068* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A COMPARISON OF SIMULATED THEMATIC MAPPER DATA AND MULTISPECTRAL SCANNER DATA FOR KINGSBURY COUNTY, SOUTH DAKOTA
G. D. BADHWAR, K. E. HENDERSON, D. E. PITTS (NASA, Johnson Space Center, Houston, TX), W. R. JOHNSON, M. L. SESTAK, T. WOOLFORD, and J. CARNES (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 140-148. refs

A84-13069* Environmental Research Inst. of Michigan, Ann Arbor.
SPATIAL AND SPECTRAL SIMULATION OF LANDSAT IMAGES OF AGRICULTURAL AREAS
W. F. PONT, JR. (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 149-154.
(Contract NAS9-15476)

A Landsat scene simulation capability was developed to study the effects of small fields and misregistration on Landsat-based crop proportion estimation procedures. The simulation employs a pattern of ground polygons each with a crop ID, planting date, and scale factor. Historical greenness/brightness crop development profiles generate the mean signal values for each polygon. Historical within-field covariances add texture to pixels in each polygon. The planting dates and scale factors create between-field/within-crop variation. Between field and crop variation is achieved by the above and crop profile differences. The Landsat point spread function is used to add correlation between nearby pixels. The next effect of the point spread function is to blur the image. Mixed pixels and misregistration are also simulated. Previously announced in STAR as N82-32813 M.G.

A84-13071* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
ACQUISITION HISTORY SIMULATION FOR EVALUATION OF LANDSAT-BASED CROP INVENTORY SYSTEMS
J. H. SMITH, J. T. MALIN, C. C. LIN (Lockheed Engineering and Management Services Co., Inc., Houston, TX), and M. DVORIN (Omnitape, Inc., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 163-168. refs
(Contract NAS9-15800)

This paper describes the development and evaluation of a simulation procedure which produces patterns of Landsat data loss attributable to cloud patterns that are characteristic of a crop region. This simulation procedure is part of a simulation system under development which evaluates the performance of crop inventory system components over a number of years and under a variety of conditions. Author

A84-13072* Purdue Univ., Lafayette, Ind.
A CROPS AND SOILS DATA BASE FOR SCENE RADIATION RESEARCH
L. L. BIEHL, M. E. BAUER, B. F. ROBINSON, C. S. T. DAUGHTRY, L. F. SILVA (Purdue University, West Lafayette, IN), and D. E. PITTS (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 169-177. refs
(Contract NAS9-15466)

Management and planning activities with respect to food production require accurate and timely information on crops and soils on a global basis. The needed information can be obtained with the aid of satellite-borne sensors, if the relations between the spectral properties and the important biological-physical parameters of crops and soils are known. In order to obtain this knowledge, the development of a crops and soils scene radiation research data base was initiated. Work related to the development of this data base is discussed, taking into account details regarding the conducted experiments, the performed measurements, the calibration of spectral data, questions of data base access, and the expansion of the crops and soils scene radiation data base for 1982. G.R.

A84-13073* Purdue Univ., Lafayette, Ind.
CORN AND SOYBEAN LANDSAT MSS CLASSIFICATION PERFORMANCE AS A FUNCTION OF SCENE CHARACTERISTICS
G. T. BATISTA, M. M. HIXSON, and M. E. BAUER (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 178-187. refs
(Contract NAS9-15466)

In order to fully utilize remote sensing to inventory crop production, it is important to identify the factors that affect the accuracy of Landsat classifications. The objective of this study was to investigate the effect of scene characteristics involving crop, soil, and weather variables on the accuracy of Landsat classifications of corn and soybeans. Segments sampling the U.S. Corn Belt were classified using a Gaussian maximum likelihood classifier on multitemporally registered data from two key acquisition periods. Field size had a strong effect on classification accuracy with small fields tending to have low accuracies even when the effect of mixed pixels was eliminated. Other scene characteristics accounting for variability in classification accuracy included proportions of corn and soybeans, crop diversity index, proportion of all field crops, soil drainage, slope, soil order, long-term average soybean yield, maximum yield, relative position of the segment in the Corn Belt, weather, and crop development stage. Author

A84-13074* Purdue Univ., Lafayette, Ind.
SPECTRAL ESTIMATES OF INTERCEPTED SOLAR RADIATION BY CORN AND SOYBEAN CANOPIES
K. P. GALLO, C. C. BROOKS, C. S. T. DAUGHTRY, M. E. BAUER, and V. C. VANDERBILT (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 190-198. refs
(Contract NAS9-15466)

Attention is given to the development of methods for combining spectral and meteorological data in crop yield models which are capable of providing accurate estimates of crop condition and yields throughout the growing season. The present investigation is concerned with initial tests of these concepts using spectral and agronomic data acquired in controlled experiments. The data were acquired at the Purdue University Agronomy Farm, 10 km northwest of West Lafayette, Indiana. Data were obtained throughout several growing seasons for corn and soybeans. Five methods or models for predicting yields were examined. On the basis of the obtained results, it is concluded that estimating intercepted solar radiation using spectral data is a viable approach for merging spectral and meteorological data in crop yield models. G.R.

A84-13075* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
AN INITIAL MODEL FOR ESTIMATING SOYBEAN DEVELOPMENT STAGES FROM SPECTRAL DATA
K. E. HENDERSON and G. D. BADHWAR (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 199-205. refs

A model, utilizing a direct relationship between remotely sensed spectral data and soybean development stage, has been proposed. The model is based upon transforming the spectral data in Landsat bands to greenness values over time and relating the area of this curve to soybean development stage. Soybean development stages were estimated from data acquired in 1978 from research plots at the Purdue University Agronomy Farm as well as Landsat data acquired over sample areas of the U.S. Corn Belt in 1978 and 1979. Analysis of spectral data from research plots revealed that the model works well with reasonable variation in planting date, row spacing, and soil background. The R-squared of calculated U.S. observed development stage exceeded 0.91 for all treatment variables. Using Landsat data the calculated U.S. observed development stage gave an R-squared of 0.89 in 1978 and 0.87 in 1979. No difference in the models performance could be detected between early and late planted fields, small and large fields, or high and low yielding fields. Author

A84-13076
ASSESSING CROP CONDITION AT THE FIELD LEVEL USING LANDSAT SPECTRAL DATA
S. E. HOLLINGER, M. M. HIXSON, and M. E. BAUER (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 206-212. refs

A vegetation index (Kauth-Thomas greenness) was used to estimate a stress-no stress condition on corn and soybean fields in AgRISTARS segments. The procedure is an adaptation of the method developed by Thompson and Wehmanen to determine stress levels on the entire segments using Landsat spectral data. The predictions were compared to the Palmer Crop Moisture Index (CMI) and an area was assumed to be stressed when the CMI was less than -1.0. Although additional tests need to be run using years when more severe stress occurs to check the validity of the procedure, in 1978 the procedure predicted 90 and 91 percent of the stress-no stress conditions correctly for corn and soybeans, respectively. Author

A84-13077
REMOTE SENSING OF SUNFLOWERS IN MINNESOTA'S RED RIVER VALLEY REGION - A SUMMARY OF INTERIM RESULTS
O. M. LINDSTROM, JR., T. M. LILLESAND, and M. GOLDBLATT (Minnesota, University, Saint Paul, MN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 221-225.

A84-13078
ROLE OF MULTISPECTRAL DATA IN ASSESSING CROP MANAGEMENT AND CROP YIELD
M. V. K. RAO, R. S. AYYANGAR (National Remote Sensing Agency, Secunderabad, India), and P. P. N. RAO (Indian Space Research Organization, Bangalore, India) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 226-234. refs

Rice crop management levels are identified, and regional agricultural potentials are assessed, by means of airborne multispectral data in conjunction with ground truth data. Different management levels result in significant crop spectral reflectance response characteristics. The spectral reflectance ratio of red and IR regions is found to increase gradually with crop growth, and to decrease with crop maturation, at all management levels. The average crop spectral response suggests that high spectral response is related to good management and higher crop yields. This spectral logging technique may serve as a means for monitoring the agricultural potential of a region. O.C.

A84-13079* IBM Federal Systems Div., Houston, Texas.
LANDSAT IMAGE REGISTRATION FOR AGRICULTURAL APPLICATIONS
R. H. WOLFE, JR. (IBM, Federal Systems Div., Houston, TX), R. D. JUDAY (NASA, Johnson Space Center, Houston, TX), A. G. WACKER (Saskatchewan, University, Saskatoon, Canada), and T. KANEKO (IBM, Communication Systems Div., San Jose, CA) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 236-244. refs
(Contract NAS9-14350)

An image registration system has been developed at the NASA Johnson Space Center (JSC) to spatially align multi-temporal Landsat acquisitions for use in agriculture and forestry research. Working in conjunction with the Master Data Processor (MDP) at the Goddard Space Flight Center, it functionally replaces the long-standing LACIE Registration Processor as JSC's data supplier. The system represents an expansion of the techniques developed for the MDP and LACIE Registration Processor, and it utilizes the experience gained in an IBM/JSC effort evaluating the performance of the latter. These techniques are discussed in detail. Several tests were developed to evaluate the registration performance of the system. The results indicate that 1/15-pixel accuracy (about 4m for Landsat MSS) is achievable in ideal circumstances, sub-pixel accuracy (often to 0.2 pixel or better) was attained on a representative set of U.S. acquisitions, and a success rate commensurate with the LACIE Registration Processor was realized. The system has been employed in a production mode on U.S. and foreign data, and a performance similar to the earlier tests has been noted. Author

A84-13081* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
A COMPARATIVE STUDY OF THE THEMATIC MAPPER AND LANDSAT SPECTRAL BANDS FROM FIELD MEASUREMENT DATA
G. D. BADHWAR and K. E. HENDERSON (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 266-272. refs

Principal component and factor analysis techniques were applied to the spectral data collected over 27 field plots of various crops under varying agronomic conditions. The spectral data was integrated over the proposed thematic mapper bands and Landsat MSS spectral bands. The results were examined to compare the discrimination power of the thematic mapper. Previously announced in STAR as N81-33549 Author

A84-13082* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
CROP IDENTIFICATION WITH MULTIFREQUENCY, MULTIPOLARIZATION, AND MULTIANGLE RADARS
J. F. PARIS (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 273-280. refs

In a corn and soybeans test site in Webster County, Iowa, airborne radar scatterometers were used on August 19 and September 10, 1980, to investigate the backscattering properties of these crops at wavelengths of 2.3, 6.3, and 19 cm (Ku-, C-, and L-band, respectively). Both horizontal transmit-horizontal receiver (HH) polarization and horizontal transmit-vertical receive (HV) polarization combinations were used at L- and C-band. Only the VV polarization combination was available at Ku-band. Measurements were obtained at 10 angles of observation from 5 to 50 deg in steps of 5 deg (referenced to the nadir). Excellent separation between corn and soybeans was achieved when either C-band HV at 50 deg or when a defined depolarization factor was used at C-band. Good separation existed at L-band also using either L-band HH at 50 deg or an L-band polarization factor. Significant row direction effects were observed for all HH data near 10 deg. Significant effects of surface soil moisture were observed for all configurations at L-band and C-band. Author

A84-13083
THE NOAA/AVHRR - A NEW SATELLITE SENSOR FOR MONITORING CROP GROWTH
S. R. SCHNEIDER and D. F. MCGINNIS, JR. (NOAA, National Earth Satellite Service, Washington, DC) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 281-290. refs

Visible and near-infrared data from the Advanced Very High Resolution Radiometer onboard NOAA-6 and NOAA-7 are assessed for their usefulness in vegetation and crop monitoring. This paper surveys the programs being carried out by several United States and international agencies with the help of these AVHRR data. Areas of current and anticipated research and development are set forth. Author

A84-13085* Purdue Univ., Lafayette, Ind.
AN EVALUATION OF THEMATIC MAPPER SIMULATOR DATA FOR MAPPING FOREST COVER
M. E. DEAN and R. M. HOFFER (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 300-307. refs
(Contract NAS9-15889)

Computer-aided analysis techniques applied to Thematic Mapper Simulator (TMS) data were evaluated for the purpose of mapping forest cover types. Classification results obtained using a supervised set of training statistics and various combinations of three and four channel subsets of the seven available TMS channels are compared for the L2 (Minimum Euclidean Distance), GML (Gaussian Maximum Likelihood), and SECHO (Supervised Extraction and Classification of Homogeneous Objects) classification algorithms. SECHO performed significantly better than either of the two per-point classifiers for the untransformed data. Overall classification results of the Karhunen-Loeve transformation increased for the L2 algorithm, but decreased for both the GML and SECHO algorithms. D.H.

A84-13092
SAMPLE DESIGN WITH IRREGULAR SAMPLING UNITS FOR A CROP PROPORTION ESTIMATION PROCEDURE BASED ON LANDSAT DATA
T. G. LYCTHUAN-LEE (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 353-358. refs

A84-13098
LANDSAT IMAGE AVAILABILITY FOR CROP AREA ESTIMATION
S. B. WININGS (U.S. Department of Agriculture, Remote Sensing Branch, Washington, DC) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 390-393.

This report describes an analysis of the National Aeronautics and Space Administration's (NASA) Landsat data series on the U.S. Department of Interior's (USDI) EROS data base for completeness concerning the needs of the Statistical Reporting Services (SRS) of the U.S Department of Agriculture (USDA). A temporal window of mid-July to mid-August was used to study the effects of clouds and missing Landsat scenes on crop area estimation of corn and soybeans. This study shows that for reasonable coverage of the corn belt two satellites are the minimum operational configuration for USDA/SRS needs. Author

A84-13100
REGIONAL AQUIFER SYSTEM ASSESSMENT THROUGH LANDSAT DIGITAL IMAGE ANALYSIS
H. N. ANDERSON, M. W. GROSS, and S. M. MANNING (Idaho Department of Water Resources, Boise, ID) IN: Machine Processing of remotely sensed data; Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 402-404.

The development and testing of a digital image-analysis program to map irrigated and nonirrigated croplands and wildlands from Landsat images is reported. The project described covered a 15,600-sq-mile area of the Snake River Plain, classifying land areas as to cover type and irrigation source. Data from six 1978 Landsat scenes were stratified by visual inspection prior to digitization, random selection of 200 sample units 2.5 km square, aerial photography to determine field boundaries, field visits to 100 units, and digitization of field data from 50 units for matching to the Landsat areas. Fifteen training areas were used (taking a modified clustering approach) to establish the master spectral statistics file for classifying the Landsat areas. The results are evaluated using contigency tables to demonstrate crop-type discrepancies and a simple linear-regression method to compare actual and Landsat irrigrated-acreage values. The overall coefficient of determination (r squared) is found to be 0.89. D.G.

A84-13101
COMPUTER-AIDED INVENTORY OF SUGAR CANE IN MEXICO
S. ARREDONDO G., J. A. VALDES A., and J. I. MIRANDA V. (Direccion General de Geografia del Territorio Nacional, Mexico City, Mexico) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 406-411. refs

A84-13102
REMOTE SENSING FOR DISCRIMINATION OF POTATO DISEASES
S. J. VENTURA and D. I. ROUSE (Wisconsin, University, Madison, WI) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 412-415. refs

A84-13103* Cornell Univ., Ithaca, N.Y.
GRAPEVINE CANOPY REFLECTANCE AND YIELD
K. A. MINDEN and W. R. PHILIPSON (Cornell University, Ithaca, NY) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, 1982, p. 430-433. refs
(Contract NGL-33-010-171)

Field spectroradiometric and airborne multispectral scanner data were applied in a study of Concord grapevines. Spectroradiometric measurements of 18 experimental vines were collected on three dates during one growing season. Spectral reflectance, determined at 30 intervals from 0.4 to 1.1 microns, was correlated with vine yield, pruning weight, clusters/vine, and nitrogen input. One date of airborne multispectral scanner data (11 channels) was collected over commercial vineyards, and the average radiance values for eight vineyard sections were correlated with the corresponding average yields. Although some correlations were significant, they were inadequate for developing a reliable yield prediction model. Author

A84-13105* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
PROFILE MODELING FOR CROP DISCRIMINATION
G. D. BADHWAR (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 454-460. refs

A complete automatic unsupervised classification approach has been developed to estimate the proportion of corn, soybeans, and other crops in a Landsat 5-by-6-nanometer segment. The technique involves extracting crop growth variables that are predictable from agromet models, it provides a signature extension not possible before. The technique has been applied in 3 years (1978-1980) for 56 segments and shows neither a year-to-year effect nor any geographic effect. The results to date are considered far better than those obtainable from any other currently available technique. Nontheless, the technique can be improved to reduce the bias. D.H.

A84-13107* California Univ., Berkeley.
CROP IDENTIFICATION USING LANDSAT TEMPORAL-SPECTRAL PROFILES
J. B. ODENWELLER (California, University, Berkeley, CA) and K. I. JOHNSON (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 469-476. refs
(Contract NAS9-14565; NAS9-15476)

The temporal-spectral profile is a detailed indicator of the physical state of a field through time. Characteristic profiles have been observed for a variety of crops and other cover classes from Landsat data in the United States Corn Belt. These profiles contain information to support crop identification at various levels. Author

A84-13108
ESTIMATING CROP DEVELOPMENT STAGES FROM MULTISPECTRAL DATA
J. C. TILTON and S. E. HOLLINGER (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 477-484. refs

A technique has been developed that is designed to estimate the calendar day that a crop reaches a particular development stage early or late in the growing season. The method requires Landsat observations from the first half of the growing season for the early season estimate and from the last half of the season for the late season estimate. The crop model employed (corn) is described, and the application of the method to Purdue Agronomy Farm data collected by a truck-mounted Exotech-100 radiometer and to Landsat MSS data is described. First results indicate that the method has good potential for making accurate estimates of the calendar day that a crop reaches a particular development stage (depending on the training data). The method can be used to initialize a meteorological model which can be either run forward in time to forecast yields or backward to estimate planting dates. D.H.

A84-13109
A DATABASE TO SUPPORT CROP CONDITION ASSESSMENT USING REMOTELY SENSED DATA
W. G. DRIGGERS (U.S. Department of Agriculture, Foreign Agricultural Service, Houston, TX) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 486-494. refs

A system for crop condition assessment is described, consisting of a minicomputer network (four PDP 11-70's), an agricultural and meteorological database called CADRE (Crop Assessment Data Retrieval and Evaluation) which is accessed via color graphics displays, and digital image analysis. The application of the system is described, with emphasis on the design, implementation, and administration of the interactive database which supports crop condition assessment. It is concluded that the CADRE database structure should be useful even to a broader range of geographic applications. Map projections and scales can vary, the basic data type to be stored and retrieved can vary, and the scale of the application can be changed within the overall framework of the system. The approach could be applied also to analysis of other resources such as water, forests, energy, or land use. D.H.

A84-13110*
AGRICULTURAL LAND COVER MAPPING WITH THE AID OF DIGITAL SOIL SURVEY DATA
E. R. STONER (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 495-502. refs

A study is recounted which assessed the effect of stratifying multidate Landsat MSS data on land cover classification accuracy. The study area covered 49,184 ha (121,534 acres) in Gentry County in northwestern Missouri. A pixel-by-pixel comparison of the two land cover classifications with field-verified land cover indicated improvements in identification of all cover types when land areas were stratified by soils. The introduction of soil map information to the land cover mapping process can improve discrimination of land cover types and reduce confusion among crop types that may be caused by soil-specific management practices, soil-induced crop development differences, and background reflectance characteristics. D.H.

A84-13115
ROLE OF SCENE RADIATION MODELS IN REMOTE SENSING
J. A. SMITH (Colorado State University, Fort Collins, CO) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 546-549. refs

Scene radiation modeling will likely play an important part in total system simulation studies in the analysis of sensor and algorithm design tradeoffs for future satellite based information delivery systems. While the direct application of crop canopy reflectance models to crop inventory and monitoring may be limited, their indirect use, particularly when combined with well-structured experimental programs will lead to practical assessment techniques. Finally, scene radiation modeling provides a unifying perspective of electromagnetic interactions with terrain materials. Author

A84-13346
A COMPARATIVE STUDY BY IMAGE TREATMENT FOR SOME PARAMETERS AFFECTING THE BEHAVIOR OF MOISTURE OF BARE SOILS [ETUDE COMPAREE PAR TRAITEMENT D'IMAGE DE QUELQUES PARAMETRES INFLUENCANT LE COMPORTEMENT HYDRIQUE DES SOLS NUS]
I. ANGLADE (Toulouse II, Universite, Toulouse, France) Photo Interpretation (ISSN 0031-8523), vol. 21, May-June 1982, 12 p. In French, English, and Spanish.

Multitemporal SPOT imagery of soil moisture in a farming region was taken with airborne instrumentation operating in the red (0.6-0.6 micron) to IR (0.75-9.5 microns) channels. Ground truth data were also obtained for the brown calcerous and calcic soils, differentiated by color, texture, and limestone content. A numerical value was defined as an index for the soil moisture, taking into account the temperature and precipitation levels. An algorithm was devised for separating bare soils from vegetation for the remotely sensed data. The limestone content was found to be the most significant parameter affecting soil moisture that could be sensed remotely. The limestone acted like a sand above a specific threshold, and aided in structuring the soil. M.S.K.

A84-13602
IDENTIFICATION AND MAPPING OF RIPARIAN WOODLANDS FROM SIMULATED THEMATIC MAPPER DATA
W. A. BLANCHARD and A. FRICK (Oklahoma State University, Stillwater, OK) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 50-61. refs

A84-13607* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE INFLUENCE OF AUTOCORRELATION IN SIGNATURE EXTRACTION - AN EXAMPLE FROM A GEOBOTANICAL INVESTIGATION OF COTTER BASIN, MT
M. L. LABOVITZ and E. J. MASUOKA (NASA, Goddard Space Flight Center, Geophysics Branch, Greenbelt, MD) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 245-255. refs

The presence of positive serial correlation (autocorrelation) in remotely sensed data results in an underestimate of the variance-covariance matrix when calculated using contiguous pixels. This underestimate produces an inflation in F statistics. For a set of Thematic Mapper Simulator data (TMS), used to test the ability to discriminate a known geobotanical anomaly from its background, the inflation in F statistics related to serial correlation is between 7 and 70 times. This means that significance tests of means of the spectral bands initially appear to suggest that the anomalous site is very different in spectral reflectance and emittance from its background sites. However, this difference often

disappears and is always dramatically reduced when compared to frequency distributions of test statistics produced by the comparison of simulated training sets possessing equal means, but which are composed of autocorrelated observations. Previously announced in STAR as N82-25602 Author

A84-13612
FUELS MAPPING FROM LANDSAT IMAGERY AND DIGITAL TERRAIN DATA AND FIRE SUPPRESSION DECISIONS
S. A. SADER, D. S. LINDEN (Technicolor Government Services, Inc., Denver. CO), and M. MCGUIRE IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 345-351.

A84-13613* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
AN AUTOMATED APPROACH TO LARGE SAMPLE AREA CROP INVENTORY BASED ON COLOR AND TOPOLOGY
H. G. SMITH, R. B. CATE, and T. B. DENNIS (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 384-389.
(Contract NAS9-15800)

A84-13913* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
COMMENT ON THE ARTICLE 'ESTIMATION OF SUGAR BEET PRODUCTIVITY FROM REFLECTION IN THE RED AND INFRARED SPECTRAL BANDS'
C. J. TUCKER (NASA, Goddard Space Flight Center, Earth Survey Applications Div., Greenbelt, MD) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, Oct.-Dec. 1983, p. 837, 838, Reply, p. 838, 839. refs

A84-13974
REMOTE-SENSING DETERMINATION OF THE CONDITION OF WINTER RYE ON THE BASIS OF SPECTRAL CHARACTERISTICS [DISTANTSIONNAIIA OTSENKA SOSTOIANIIA OZIMOI RZHI PO SPEKTRAL'NYM KHARAKTERISTIKAM]
L. I. KISELEVSKII, S. F. BUGA, V. E. PLIUTA, E. A. IANOVSLAIIA, and A. F. IANOVSKII (Akademiia Nauk Belorusskoi SSR, Institut Fiziki, Minsk, Belorussian SSR) Akademiia Nauk BSSR, Doklady (ISSN 0002-354X), vol. 27, no. 11, 1983, p. 976-978. In Russian. refs

A84-14042
A COMPARISON OF VISUAL AND NUMERICAL ANALYSES OF LANDSAT DATA FOR GRASSLAND AND FOREST INVENTORIES IN SWAZILAND
B. N. HAACK (Regional Remote Sensing Facility, Nairobi, Kenya; Ball State University, Muncie, IN) ITC Journal (ISSN 0303-2434), no. 1, 1983, p. 6-12. Research supported by Ball State University. refs

A84-14183
THE K-L EXPANSION AS AN EFFECTIVE FEATURE ORDERING TECHNIQUE FOR LIMITED TRAINING SAMPLE SIZE
M. J. MUASHER (University of Petroleum and Minerals, Dhahran, Saudi Arabia) and D. A. LANDGREBE (Purdue University, West Lafayette, IN) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, Oct. 1983, p. 438-441. refs

Experimental results from investigations of feature selection analysis techniques for interpreting Landsat and airborne MSS crop imagery are reported. The data were gathered over corn and wheat fields, with part of the imagery being used as training sets. The data were treated with a Karhunen-Loeve (K-L) transformation, with features ordered in terms of the highest eigenvalues that were produced. Features were also ordered using a transformed divergence method, and according to the Bhattachryya distance. The K-L transformations were demonstrated to be an effective feature selection method with a limited training set, displaying better recognition accuracy, less variability, and a clearer peaking effect than the other techniques. Quantitative data were also obtained demonstrating the effect of the number of samples on the accuracy of interpretation, i.e., the Hughes effect. M.S.K.

A84-14185* Computer Sciences Corp., Silver Spring, Md.
MONTE CARLO SIMULATION OF THE EFFECT OF SOIL MOISTURE VARIATION ON THE MICROWAVE EMISSION FROM SOILS
T. MO (Computer Sciences Corp., Silver Spring, MD) and T. J. SCHMUGGE (NASA, Goddard Space Flight Center, Hydrological Sciences Branch, Greenbelt, MD) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, Oct. 1983, p. 473-479. refs

In this paper, results of a Monte Carlo simulation of the effect of noise on the relationship between the microwave emissivity of soil and its moisture content are presented. It is found that whenever the magnitude of the noise for the independent variable, in this case the soil moisture, is increased, both the slope of the regression and the correlation coefficient decrease. In particular, when the noise has magnitude equivalent to a coefficient of variation of 0.25, the slope and correlation coefficient are in good agreement with those obtained from the data of a 21-cm airborne microwave radiometer which was flown over a test site in hand county, South Dakota. The comparison was made using a linear relationship to determine the estimated emissivity from the ground measurements of soil moisture. The linear relationship was derived from a radiative transfer model calculation of the microwave emissivities using realistic soil-moisture profiles. The effect of surface roughness was included in the relationship, and the variability of the surface roughness was also simulated by a Monte Carlo technique. Author

A84-14594
SPECTRAL INDICES IN N-SPACE
R. D. JACKSON (U.S. Department of Agriculture, Water Conservation Laboratory, Phoenix, AZ) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Nov. 1983, p. 409-421. refs

The calculation of coefficients for n-space indices is demonstrated using the Gram-Schmidt process with a minimum of data points. An example of the usefulness of these indices for remote sensing is given by calculating n-dimensional greenness (a measure of the amount of green vegetation) for various combinations of bands representative of the Landsat-4 MSS, Thematic Mapper, SPOT HRV, and AVHRR of NOAA-6 and NOAA-7 sensors. The dynamic range of greenness values is used to rank the various sensors and band combinations within sensors as to their ability to discriminate vegetation from the soil background. C.D.

A84-14847
INVESTIGATION OF VEGETATION ARCHITECTONICS ON THE BASIS OF ITS HOT SPOTS USING LASER REMOTE SENSING [ISSLEDOVANIE ARKHITEKTONIKI RASTITEL'NOSTI PO EE OBRATNOMU BLESKU S POMOSHCH'IU DISTANTSIONNOGO LAZERNOGO ZONDIROVANIIA]
V. A. KANEVSKII, V. F. RIAZANTSEV, IU. R. SHELIAG-SOSONKO, and IU. K. ROSS (Akademiia Nauk Ukrainskoi SSR, Institut Botaniki, Kiev, Ukrainian SSR; Akademiia Nauk Estonskoi SSR, Institut Astrofiziki i Fiziki Atmosfery, Tartu, Estonian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 81-84. In Russian. refs

A84-15294* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SATELLITE REMOTE SENSING OF TOTAL DRY MATTER PRODUCTION IN THE SENEGALESE SAHEL
C. J. TUCKER (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD), C. VANPRAET, E. BOERWINKEL, and A. GASTON (Ecosystems Pastoraux, Dakar, Senegal) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Dec. 1983, p. 461-474. refs

Nine predominantly cloud-free NOAA-7 advanced very high resolution radiometer images were obtained during a three-month period during the 1981 rainy season in the Sahel of Senegal. The 0.55-0.68- and 0.725-1.10-micron channels were used to form the normalized difference green leaf density vegetation index and the 11.5-12.5-micron channel was used as a cloud mask for each of the nine images. Changes in the normalized difference values among the various dates were closely associated with precipitation events. Six of the images spanning an 8-week period were used to generate a cumulative integrated index. Ground biomas samplings in the 30,000 sq km study area were used to assign total dry biomass classes to the cumulative index. Author

A84-15295
THE RECIPROCITY RELATION FOR REFLECTION AND TRANSMISSION OF RADIATION BY CROPS AND OTHER PLANE-PARALLEL SCATTERING MEDIA
J. CHEN (Landbouwhogeschool, Wageningen, Netherlands; Chinese Academy of Sciences, Plant Physiology Institute, Shanghai, Peoples Republic of China) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Dec. 1983, p. 475-486. Research supported by the Ministry of Education and Science of the Netherlands. refs

A84-15296* State Univ. of New York, Binghamton.
INVERSION OF VEGETATION CANOPY REFLECTANCE MODELS FOR ESTIMATING AGRONOMIC VARIABLES. I - PROBLEM DEFINITION AND INITIAL RESULTS USING THE SUITS MODEL
N. GOEL (New York, State University, Binghampton, NY) and D. E. STREBEL Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Dec. 1983, p. 487-507. refs
(Contract NAS9-16662)

An important but relatively uninvestigated problem in remote sensing is the inversion of vegetative canopy reflectance models to obtain agrophysical parameters, given measured reflectances. The problem is here formally defined and its solution outlined. Numerical nonlinear optimization techniques are used to implement this inversion to obtain the leaf area index using Suits' canopy reflectance model. The results for a variety of cases indicate that this can be done successfully using infrared reflectances at different views or azimuth angles or a combination thereof. The other parameters of the model must be known, although reasonable measurement errors can be tolerated without seriously degrading the accuracy of the inversion. The application of the technique to ground based remote-sensing experiments is potentially useful, but is limited to the degree to which the canopy reflectance model can accurately predict observed reflectances. Author

A84-15677* Lockheed Engineering and Management Services Co., Inc., Houston, Tex.
DETECTION AND EVALUATION OF MIXED PIXELS IN LANDSAT AGRICULTURAL SCENES
M. B. MERICKEL, J. C. LUNDGREN, and R. K. LENNINGTON (Lockheed Engineering and Management Services Co., Inc., Houston, TX) IN: NTC '82; National Telesystems Conference, Galveston, TX, November 7-10, 1982, Conference Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. D4.6.1-D4.6.4.
(Contract NAS9-15800)

A major problem area encountered in the identification and estimation of agricultural crop proportions in Landsat imagery involves the large proportion of the pixels which are mixed pixels, whose spectral response is influenced by more than one ground cover type. The development of methods for the detection and estimation of crop proportions in mixed pixels is presently reported. The procedure designated CASCADE, based on the estimation of the gradient image for the detection of mixed pixels, considers the consequences of a linear mixing model and is found to provide a method for the allocation of mixed pixels to the surrounding homogeneous region. O.C.

A84-16723
ESTIMATING GREEN LAI FROM MULTISPECTRAL AERIAL PHOTOGRAPHY
P. J. CURRAN (Sheffield, University, Sheffield, England) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Dec. 1983, p. 1709-1720. Sponsorship: Natural Environment Research Council. refs
(Contract NERC-GR/3/4076)

An experiment is presented determining the accuracy with which low cost multispectral aerial reflectance data obtained from a hand-held 35-mm camera can be used to estimate green LAI (leaf area index). Conducted on a heathland in Berkshire, England, the experiment used ground and aerial reflectance data from four vegetation associations representing two contrasting types of semi-natural vegetation. The green LAI of the four vegetation canopies was estimated from multispectral aerial photography combined with a detailed knowledge of the relationship between canopy reflectance and green LAI. At an error of + or - 0.1 green LAI for the young and mature Calluna association and + or - 1.0 green LAI for the Pteridium and Pteridium/Calluna associations, accuracies of green LAI estimation were around 74 percent. At times of canopy stability in the winter and early spring and at the same errors of estimate, accuracy increased to 84 percent. J.N.

A84-16724
SPECTRAL ASSESSMENT OF LEAF AREA INDEX, CHLOROPHYLL CONTENT, AND BIOMASS OF CHICKPEA
MR. AJAI, D. S. KAMAT (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India), G. S. CHATURVEDI, A. K. SINGH, and S. K. SINHA (Indian Agricultural Research Institute, New Delhi, India) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Dec. 1983, p. 1721-1727. refs

N84-10640 Kansas Univ., Lawrence.
MICROWAVE RADIOMETRIC SENSITIVITY TO SOIL MOISTURE UNDER VEGETATION COVER Ph.D. Thesis
M. RAZANI 1982 205 p
Avail: Univ. Microfilms Order No. DA8303911

The presence of a vegetation layer on top of a soil surface causes the level of emission intensity to increase, thereby decreasing the radiometric sensitivity to soil moisture variations. This phenomenon is due partly to the screening of soil emission by the vegetation layer and partly to the inherent emission of radiation from the vegetation layer itself. The effect of the vegetation cover on the radiometric sensitivity to soil moisture is studied both theoretically and experimentally. Theoretically, the dielectric properties of the vegetation cover were studied and mixing formulas were established, then a simple radiative transfer model was employed and extended to improve the understanding of the vegetation effect on soil-moisture sensing. Experimentally, the airborne data from the 1978 Colby experiment were analyzed. The test site consisted of bare soil, wheat stubble, and fully mature corn fields. The results of corn indicate that the radiometric sensitivity to soil moisture decreases in magnitude.
Dissert. Abstr.

N84-10643*# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
RADAR REMOTE SENSING FOR CROP CLASSIFICATION AND CANOPY CONDITION ASSESSMENT: GROUND-DATA DOCUMENTATION
F. T. ULABY, Principal Investigator, B. JUNG, K. GILLESPIE, M. HEMMAT, A. ASLAM, D. BRUNFELDT, and M. DOBSON Apr. 1983 252 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development
(Contract NCC9-4; PROJ. AGRISTARS)
(E84-10020; NASA-CR-171702; SR-K3-04424; NAS 1.26:171702; RLS-TR-580-2) Avail: NTIS HC A12/MF A01 CSCL 02C

A vegetation and soil-moisture experiment was conducted in order to examine the microwave emission and backscattering from vegetation canopies and soils. The data-acquisition methodology used in conjunction with the mobile radar scatterometer (MRS) systems is described and associated ground-truth data are documented. Test fields were located in the Kansas River floodplain north of Lawrence, Kansas. Ten fields each of wheat, corn, and soybeans were monitored over the greater part of their growing seasons. The tabulated data summarize measurements made by the sensor systems and represent target characteristics. Target parameters describing the vegetation and soil characteristics include plant moisture, density, height, and growth stage, as well as soil moisture and soil-bulk density. Complete listings of pertinent crop-canopy and soil measurements are given. M.G.

N84-10646*# Virginia Polytechnic Inst. and State Univ., Blacksburg. School of Forestry and Wildlife Resources.
UPDATE AND REVIEW OF ACCURACY ASSESSMENT TECHNIQUES FOR REMOTELY SENSED DATA Final Report
R. G. CONGALTON, J. T. HEINEN, and R. G. ODERWALD Jan. 1983 41 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract PROJ. AGRISTARS)
(E84-10029; NASA-CR-171703; RR-U3-04435; NAS 1.26:171703; USDAES-83-NFAP-327; RRR-83-1) Avail: NTIS HC A03/MF A01 CSCL 02C

Research performed in the accuracy assessment of remotely sensed data is updated and reviewed. The use of discrete multivariate analysis techniques for the assessment of error matrices, the use of computer simulation for assessing various sampling strategies, and an investigation of spatial autocorrelation techniques are examined. Author

N84-10647*# Lockheed Engineering and Management Services Co., Inc., Houston, Tex. Renewable Resources Dept.
AGRISTARS DOCUMENTS TRACKING LIST REPORT
J. L. HAWKINS 17 Oct. 1983 107 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract NAS9-15800; PROJ. AGRISTARS)
(E84-10030; NASA-CR-171704; AP-L3-04416; JSC-18887; NAS 1.26:171704; LEMSCO-19557) Avail: NTIS HC A06/MF A01 CSCL 02C

A quarterly listing of documents issued and placed in the AgRISTARS tracking system is provided. The technical publications are arranged by type of documents. The reference AgRISTARS document number, title and date of publication, the issuing organization, and the National Technical Information Service reference number is given. A.R.H.

N84-11359*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EFFECTS OF VEGETATION CANOPY ON THE RADAR BACKSCATTERING COEFFICIENT
T. MO (Computer Sciences Corp., Silver Spring, Md.), B. J. BLANCHARD, and T. J. SCHMUGGE Jul. 1983 71 p refs (NASA-TM-85070; NAS 1.15:85070) Avail: NTIS HC A04/MF A01 CSCL 17I

Airborne L- and C-band scatterometer data, taken over both vegetation-covered and bare fields, were systematically analyzed and theoretically reproduced, using a recently developed model for calculating radar backscattering coefficients of rough soil surfaces. The results show that the model can reproduce the observed angular variations of radar backscattering coefficient quite well via a least-squares fit method. Best fits to the data provide estimates of the statistical properties of the surface roughness, which is characterized by two parameters: the standard deviation of surface height, and the surface correlation length. In addition, the processes of vegetation attenuation and volume scattering require two canopy parameters, the canopy optical thickness and a volume scattering factor. Canopy parameter values for individual vegetation types, including alfalfa, milo and corn, were also determined from the best-fit results. The uncertainties in the scatterometer data were also explored. Author

N84-11538 Minnesota Univ., Minneapolis.
EVALUATION OF SOME REMOTE SENSING TECHNIQUES FOR OIL AND CROP MANAGEMENT Ph.D. Thesis
P. C. ROBERT 1983 131 p
Avail: Univ. Microfilms Order No. DA8308116

Color infrared aerial photography (CIR) is a fairly common near real time management tool in irrigated, cash crop, and orchard farming. Its use has seen a developing interest in rain-fed areas of corn and soybean production. The objective of this study is a feasibility test of using some remote sensing techniques, primarily CIR aerial photography, as a practical, efficient management tool on nonirrigated corn and soybean fields. Limitations and requirements in equipment (cameras, films), flight, scale, data processing, photointerpretation (procedures, ground information), soil and crop management feature interpretation, and cost effectiveness are reviewed from the project experience. The study was conducted on fifteen farms located in southwestern Minnesota. Detection, location of soil and crop management features or problems were principally interpreted on low altitude aerial photography, complemented by collateral data (e.g., soil maps, field cultural practice records) and ground surveys.
Dissert. Abstr.

N84-11546*# Florida Univ., Gainesville. Inst. of Food and Agricultural Sciences.
USE OF THERMAL INERTIA DETERMINED BY HCMM TO PREDICT NOCTURNAL COLD PRONE AREAS IN FLORIDA Final Report, Mar. 1981 - Mar. 1983
L. H. ALLEN, JR., Principal Investigator Oct. 1983 74 p refs Original contains color imagery. Original imagery may be purchased from NASA Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
(Contract NAS5-26453)
(E84-10005; NASA-CR-174520; NAS 1.26:174520) Avail: NTIS HC A03/MF A01 CSCL 05B

Pairs of HCMM day-night thermal infrared (IR) data were selected during the 1978-79 winter to examine patterns of surface temperature and thermal inertia (TI) of peninsular Florida. The GOES and NOAA-6 thermal IR, as well as National Climatic Center temperatures and rainfall, were also used. The HCMM apparent thermal inertia (ATI) images closely corresponded to the general soil map of Florida, based on soil drainage classes. Areas with low ATI overlay well-drained soils, such as deep sands and drained organic soils, whereas with high ATI overlay areas with wetlands and bodies of water. The HCMM ATI images also corresponded well with GOES-detected winter nocturnal cold-prone areas. Use

of HCMM data with Carlson's energy balance model showed both high moisture availability (MA) and high thermal inertia (TI) of wetland-type surfaces and low MA and low TI of upland, well-drained soils. Since soil areas with low TI develop higher temperatures during the day, then antecedent patterns of highest maximum daytime surface temperature can also be used to predict nocturnal cold-prone areas in Florida. M.G.

N84-11556*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PASSIVE MICROWAVE SENSING OF SOIL MOISTURE CONTENT: SOIL BULK DENSITY AND SURFACE ROUGHNESS
J. R. WANG May 1982 32 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract PROJ. AGRISTARS)
(E84-10019; NASA-TM-83937; SM-G2-04285; NAS 1.15:83937)
Avail: NTIS HC A03/MF A01 CSCL 02C

Microwave radiometric measurements over bare fields of different surface roughnesses were made at the frequencies of 1.4 GHz, 5 GHz, and 10.7 GHz to study the frequency dependence as well as the possible time variation of surface roughness. The presence of surface roughness was found to increase the brightness temperature of soils and reduce the slope of regression between brightness temperature and soil moisture content. The frequency dependence of the surface roughness effect was relatively weak when compared with that of the vegetation effect. Radiometric time series observation over a given field indicated that field surface roughness might gradually diminish with time, especially after a rainfall or irrigation. This time variation of surface roughness served to enhance the uncertainty in remote soil moisture estimate by microwave radiometry. Three years of radiometric measurements over a test site revealed a possible inconsistency in the soil bulk density determination, which turned out to be an important factor in the interpretation of radiometric data. Author

N84-12563*# Texas Univ., Austin.
AN EMPIRICAL BAYES APPROACH TO SPATIAL ANALYSIS Final Report
C. N. MORRIS and H. KOSTAL *In its* Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 143-166 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 12A

Multi-channel LANDSAT data are collected in several passes over agricultural areas during the growing season. How empirical Bayes modeling can be used to develop crop identification and discrimination techniques that account for spatial correlation in such data is considered. The approach models the unobservable parameters and the data separately, hoping to take advantage of the fact that the bulk of spatial correlation lies in the parameter process. The problem is then framed in terms of estimating posterior probabilities of crop types for each spatial area. Some empirical Bayes spatial estimation methods are used to estimate the logits of these probabilities. Author

N84-12581# Joint Research Centre of the European Communities, Ispra (Italy).
MONITORING OF RENEWABLE RESOURCES (A LAND INFORMATION SYSTEM FOR EUROPE)
G. FRAYSSE *In* ESA Remote Sensing Appl. for Environ. Studies p 9-12 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

A combination of data collected by second generation Earth observation satellites and meteorological satellites with conventional data used as input to an agromet model is suggested for an agricultural information system for the European Community. Legislative, economic, and social benefits, parameters and required action are summarized. Accuracy requirements, sampling strategy, and system design are outlined. Author (ESA)

N84-12582# Freiburg Univ. (West Germany). Abt. Luftbildmessung und Fernerkundung.
CONSIDERATIONS ON A PERMANENT INVENTORY AND MONITORING SYSTEM FOR EUROPEAN FORESTS
G. HILDEBRANDT *In* ESA Remote Sensing Appl. for Environ. Studies p 13-18 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

A forest inventory approach, in which short term monitoring of major forest area changes by satellite image interpretation is combined with a longterm multiphase sampling of forest resources and silvicultural conditions using IR aerial photographs and ground measurements, is introduced. The approach involves precise geometric correction of the satellite images; and overlay of boundaries (countries, inventory units) and north-south or east-west oriented gridlines of the geodetic reference system in 8 km distances. For each unit, determination of the area of forest lands and main forest types for the entire unit and each strip within the unit; calculation of the strip's forest area in percentage; and PPs-selection with random figures from 1 to 100 until a certain percentage of the unit's forest area is achieved. The selected strips are defined by their x/y coordinates and are used for any following inventory as permanent sample strips. The approach was tested using the Black Forest. Author (ESA)

N84-12588# Centre de Recherches en Physique de l'Environnement, Issy-les-Moulineaux (France).
RADAR INVESTIGATION OF SOILS AND SEA (ERASME): C BAND HELICOPTER-BORNE SCATTEROMETER. APPLICATION TO SOIL MOISTURE MEASUREMENT [ERASME: DIFFUSIOMETRE HELIPORTABLE EN BANDE C. APPLICATION A LA MESURE DE L'HUMIDITE DES SOLS]
R. BERNARD and D. VIDAL-MADJAR *In* ESA Remote Sensing Appl. for Environ. Studies p 59-64 Jul. 1983 refs In FRENCH
Avail: NTIS HC A14/MF A01

A 5.35 GHz scatterometer used to simulate the ERS-1 (ESA satellite) and other spaceborne instruments is described. It can operate at several angles of incidence and polarization configurations. It was used for agronony, glaciology, and ocean surface wind measurements. The use of the scatterometer to study changes in surface water layers (down to 1 m) is outlined. Author (ESA)

N84-12595# Universite Catholique de Louvain (Belgium). Lab. de Teledetection.
SAR 580: IMAGES FOR AGRICULTURAL AND FOREST SURVEY. FIRST RESULTS IN MIDDLE BELGIUM
E. BARTHOLOME and E. BARISANO *In* ESA Remote Sensing Appl. for Environ. Studies p 115-121 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Some X and C band SAR 580 optical data acquired over Middle Belgium were analyzed for agricultural and forest inventory. On a mid range test site, visual classification gives mean agreement level of 78% compared with ground truth, while statistically classified spectral data derived from photos give 75%, and visual classification up to 99%. On a forest test site, six species can be classified on black and white air photos, while SAR discriminates four classes. Confusions do not appear between the same species on SAR data and multispectral data, underlining the interest of combination of both kinds of data. Author (ESA)

N84-12599# Freiburg Univ. (West Germany). Abt. Luftbildmessung und Fernerkundung.
FIRST RESULTS OF THE EVALUATIONS OF THE EUROPEAN SAR 580 DATA FOR AGRICULTURAL AND FORESTRY PURPOSES IN TEST SITE D6, FREIBURG (WEST GERMANY)
R. KESSLER, P. REICHERT, and P. LOESCHE *In* ESA Remote Sensing Appl. for Environ. Studies p 137-145 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

The separability of vegetation classes using X and C band HH polarized SAR 580 data was investigated. Results show that visual interpretation leads to better results than a standard maximum likelihood classification. However, the visual interpretation can be

improved by analog or digital image enhancement techniques. The radar signal intensity allows a reliable distinction of the agricultural and forestry crops; pattern recognition technics have to be applied as well, especially for the classification of forest types. Use of the L-band and the crosspolarized data improve the separability of agricultural and forestry crops. Author (ESA)

N84-12602# Sheffield Univ. (England). Dept. of Geography.
THE USE OF AIRBORNE THEMATIC MAPPER SIMULATION DATA FOR THE ESTIMATION AND MAPPING OF GREEN LEAF AREA INDEX (GLAI)
D. E. WILLIAMS (Natural Environment Research Council, Swindon, UK), P. CURRAN, and N. WARDLEY *In* ESA Remote Sensing Appl. for Environ. Studies p 157-160 Jul. 1983 refs
(Contract NERC-MSS-82)
Avail: NTIS HC A14/MF A01

An experiment to estimate and map the green leaf area index (GLAI), as part of simulation studies for the LANDSAT 4 thematic mapping mission, is described. Using an airborne channel scanner, the perpendicular vegetation index (PVI) was obtained from the ratio of the near infrared band, i.e., bands MSS 7 + 8, over the red bands (MSS 4 + 5). The GLAI was then predicted using the equation PVI = 16.59 (8.11 log GLAI). Due to a reduced number of sample points, four classes of GLAI were used. Results show that the accuracy of classification increases for higher GLAI. This is to be expected because the same error is a smaller percentage to the absolute PVI than for low GLAI. Woodland areas were included because with the high resolution data the texture and shading gives spurious results. Author (ESA)

N84-12614# Belfotop P.v.b.a., Wemmel (Belgium).
INVENTORY OF FLEMISH FORESTS USING MEDIUM-SCALE COLOR INFRARED (CIR) PHOTOGRAPHY AND CIR ORTHOPHOTOPLANS AS BASE FOR A FOREST MANAGEMENT DATA BANK
P. R. COPPIN, B. DEROOVER, W. M. DEWISPELAERE (CEVA, Melle-Gontrode, Belgium), and R. E. GOOSSENS (CEVA, Melle-Gontrode, Belgium) *In* ESA Remote Sensing Appl. in Environ. Studies p 249-255 Jul. 1983
Avail: NTIS HC A14/MF A01

Remote sensing techniques were used for a complete assessment of the Flemish forest situation in order to develop an operational methodology for producing sequential forest inventories; to create a forest management data bank; and to produce base maps with high accuracy. Material consisted of CIR-transparencies and orthophotoplans. digitizer and microcomputer were used. The information resulting from interpretation, fieldwork and other sources was produced in numerical and analog (overlays, computer-maps) form. The data bank allows further extension of information at management level. Author (ESA)

N84-13634*# California Univ., Berkeley. Space Sciences Lab.
ANALYSIS OF THE QUALITY OF IMAGE DATA ACQUIRED BY THE LANDSAT-4 THEMATIC MAPPER (TM) OF THE BLACK HILLS AREA, SOUTH DAKOTA Final Technical Report, 8 Sep. 1982 - 14 Sep. 1983
R. N. COLWELL, Principal Investigator 27 Oct. 1983 5 p refs ERTS
(Contract NASA ORDER S-98091-B)
(E84-10041; NASA-CR-174593; NAS 1.26:174593) Avail: NTIS HC A02/MF A01 CSCL 05B

The structure, format, and quality of the LANDSAT-4 TM and MSS photographic and digital products for one scene covering the Black Hills area of South Dakota were assessed and the extent to which major resource categories can be detected and identified on various photographic products generated from a subset of TM spectral bands and from all bands of the MSS was determined. The overall spectral, spatial, and radiometric quality of the TM data was found to be excellent. Agricultural fields of variable shape, size, and orientation were detected with relative ease. The addition of the short-wave infrared band (TM5) has significantly improved the ability to detect and identify crop types on single date imagery. M.G.

N84-13635*# Kansas Univ. Center for Research, Inc., Lawrence. Remote Sensing Lab.
A SIMULATION STUDY OF SCENE CONFUSION FACTORS IN SENSING SOIL MOISTURE FROM ORBITAL RADAR Final Report
F. T. ULABY, Principal Investigator, M. C. DOBSON, S. MOEZZI, and F. T. ROTH Aug. 1983 138 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NCC9-6; PROJ. AGRISTARS)
(E84-10042; NASA-CR-171715; SR-K3-04438; NAS 1.26:171715; RSL-601-1) Avail: NTIS HC A07/MF A01 CSCL 08M

Simulated C-band radar imagery for a 124-km by 108-km test site in eastern Kansas is used to classify soil moisture. Simulated radar resolutions are 100 m by 100 m, 1 km by 1km, and 3 km by 3 km. Distributions of actual near-surface soil moisture are established daily for a 23-day accounting period using a water budget model. Within the 23-day period, three orbital radar overpasses are simulated roughly corresponding to generally moist, wet, and dry soil moisture conditions. The radar simulations are performed by a target/sensor interaction model dependent upon a terrain model, land-use classificaton, and near-surface soil moisture distribution. The accuracy of soil-moisture classification is evaluated for each single-date radar observation and also for multi-date detection of relative soil moisture change. In general, the results for single-date moisture detection show that 70% to 90% of cropland can be correctly classified to within +/- 20% of the true percent of field capacity. For a given radar resolution, the expected classification accuracy is shown to be dependent upon both the general soil moisture condition and also the geographical distribution of land-use and topographic relief. An analysis of cropland, urban, pasture/rangeland, and woodland subregions within the test site indicates that multi-temporal detection of relative soil moisture change is least sensitive to classification error resulting from scene complexity and topographic effects. M.G.

N84-13642*# Pan American Univ., Edinburg, Tex.
SEASONAL SOYBEAN CROP REFLECTANCE Final Technical Report
E. W. LEMASTER, Principal Investigator and J. E. CHANCE 1983 90 p refs ERTS
(Contract NSG-9033)
(E84-10049; NASA-CR-174617; NAS 1.26:174617) Avail: NTIS HC A05/MF A01 CSCL 05B

Data are presented from field measurements of 1980 including 5 acquisitions of handheld radiometer reflectance measurements, 7 complete sets of parameters for implementing the Suits mode, and other biophysical parameters to characterize the soybean canopy. LANDSAT calculations on the simulated Brazilian soybean reflectance are included along with data collected during the summer and fall on 1981 on soybean single leaf optical parameters for three irrigation treatments. Tests of the Suits vegetative canopy reflectance model for the full hemisphere of observer directions as well as the nadir direction show moderate agreement for the visible channels of the MSS and poor agreement in the near infrared channel. Temporal changes in the spectral characteristics of the single leaves were seen to occur as a function of maturity which demontrates that the absorptance of a soybean single leaf is more a function of the tramsmittance characteristics than the seasonally consistent single leaf reflectance. A.R.H.

N84-13652# Marine Biological Lab., Woods Hole, Mass. Ecosystems Center.
DEFORESTATION MEASURED BY LANDSAT: STEPS TOWARD A METHOD
G. M. WOODWELL, J. E. HOBBIE, R. A. HOUGHTON, J. M. MELILLO, B. J. PETERSON, G. R. SHAVER, T. A. STONE, B. MOORE (New Hampshire Univ., Durham), and A. B. PARK (General Electric Co., Lanham, MD.) Jun. 1983 66 p refs
(Contract DE-AC02-80EV-10468)
(DE83-016645; DOE/EV-10468/1) Avail: NTIS HC A04/MF A01

The magnitude of the annual carbon flux due to deforestation is a function of the rate of deforestation and biotic factors including biomass, soil organic matter, and the fraction of the stock of organic matter oxidized following disturbance. Immediate improvement in estimation of the carbon flux to the atmosphere depends on reducing the uncertainty in estimates of rates of deforestation. Three approaches to the use of LANDSAT data seemed possible. First, if a sufficiently detailed classification of vegetation can be made from a single LANDSAT image, an estimate of net flux is possible through use of a model. This is the single image approach. Second, LANDSAT imagery might be used to construct two classification inventories of the amount of carbon in the vegetation at different dates. Finally, the technique of change detection using satellite imagery might be applied by substracting the digital information in a later image from a former image to produce a third data set that records only the changes. DOE

N84-13663# Forest Service, Asheville, N.C.
THE HARDWOOD RESOURCE ON NONINDUSTRIAL PRIVATE FOREST LAND IN THE SOUTHEAST PIEDMONT
W. A. BECHTOLD and D. R. PHILLIPS 31 Aug. 1983 23 p refs
(PB83-252759; FSRP-23-236) Avail: NTIS HC A02/MF A01 CSCL 02F

More than half of the commercial forest land in the Southeast Piedmont supports hardwood stands held by small nonindustrial private landowners. Only 21 percent of all Nonindustrial Private Forest (NIPF) stands are fully stocked with growing-stock trees. Only 37 percent of all hardwood biomass harvested from these stands is currently being utilized. As these stands are harvested, about 39 tons of living residues per acre are left standing. GRA

N84-13664# Forest Service, New Orleans, La. Forest Inventory and Analysis Research Work Unit.
FOREST STATISTICS FOR SOUTHWEST-SOUTH ALABAMA COUNTIES, FOREST SERVICE RESOURCE BULLETIN
Feb. 1983 19 p
(PB83-249763; FSRB/SO-91) Avail: NTIS HC A02/MF A01 CSCL 02F

The report tabulates resource information from a new inventory of the southwest-south Unit of Alabama. GRA

N84-14167# Joint Publications Research Service, Arlington, Va.
REMOTE SENSING OF THE EARTH AND AGRICULTURE
G. I. BELCHANSKIY *In its* USSR Rept.: Space, No. 25 (JPRS-84946) p 87-95 14 Dec. 1983 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow), no. 3, May. - Jun. 1983 p 27-32
Avail: NTIS HC A07

The improvement of the effectiveness of agricultural production which requires a substantial improvement in planning and control methods is discussed. Modern remote sensing methods which study and monitor the state of agricultural resources make an important contribution to this task. E.A.K.

N84-14582# Environmental Research and Technology, Inc., Concord, Mass.
STUDY OF THE COMBINED USE OF DATA FROM SATELLITE THERMAL INFRARED AND MICROWAVE SENSORS FOR SOIL MOISTURE DETECTION Final Report
J. C. BARNES and L. J. GENDRON Jun. 1983 85 p refs
(PB83-252734; ERT-B195F; NOAA-83082406) Avail: NTIS HC A05/MF A01 CSCL 08M

The prospect of utilizing combined data from satellite thermal infrared and microwave sensors for detecting soil moisture is investigated. Satellite data for a study area in Oklahoma for two periods, one in the spring and one in the fall, and analyzed and correlated with meteorological data and soil moisture data. The thermal infrared data used in the study are the Advanced Very High Resolution Radiometer data from the TIROS-N and NOAA-6 spacecraft; the microwave data are the Scanning Multifrequency Microwave Radiometer data from the Nimbus-7 spacecraft. Microwave emissivities calculated using estimated soil temperatures have a trend toward high values with decreased soil moisture in both study periods. Author (GRA)

N84-15626*# State Univ. of New York, Albany.
THEMATIC MAPPER RADIOMTRIC VARIABILITY ON OSTENSIBLY UNIFORM AGRICULTURAL SCENES Quarterly Status and Technical Progress Report
M. J. DUGGIN 7 Nov. 1983 7 p refs ERTS
(Contract NAS5-27595)
(E84-10035; NASA-CR-174587; NAS 1.26:174587) Avail: NTIS HC A02/MF A01 CSCL 05B

The effects of the interaction of the sensor point spread function with a heterogeneous scene consisting of elements giving rise to different spectral radiant intensities cause errors in multitemporal signatures due to fractional pixel repositioning errors. In the case of a heterogeneous scene, the repositioning accuracy between acquisitions could affect the radiometric output in any band and could affect the spectral distribution of radiance between bands. Error caused by within-band and between-band variations in radiance with time could be compounded by resampling along and between scan lines during processing. The magnitude of both error sources depends on the degree of heterogeneity of the scene. A.R.H.

N84-15629*# Texas A&M Univ., College Station. Remote Sensing Center.
DEVELOPMENT OF VISIBLE/INFRARED/MICROWAVE AGRICULTURE CLASSIFICATION AND BIOMASS ESTIMATION ALGORITHMS, VOLUME 2 Final Report
W. D. ROSENTHAL, M. J. MCFARLAND, S. W. THEIS, and C. L. JONES, Principal Investigators Feb. 1982 222 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS 3 Vol.
(Contract NSG-5134)
(E84-10059; NASA-CR-173140; NAS 1.26:173140; RSC-3458-130-VOL-2) Avail: NTIS HC A010/MF A01 CSCL 02C

Agricultural crop classification models using two or more spectral regions (visible through microwave) were developed and tested and biomass was estimated by including microwave with visible and infrared data. The study was conducted at Guymon, Oklahoma and Dalhart, Texas utilizing aircraft multispectral data and ground truth soil moisture and biomass information. Results indicate that inclusion of C, L, and P band active microwave data from look angles greater than 35 deg from nadir with visible and infrared data improved crop discrimination and biomass estimates compared to results using only visible and infrared data. The active microwave frequencies were sensitive to different biomass levels. In addition, two indices, one using only active microwave data and the other using data from the middle and near infrared bands, were well correlated to total biomass. Author

N84-15635*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
A CORRELATION ANALYSIS OF PERCENT CANOPY CLOSURE VERSUS TMS SPECTRAL RESPONSE FOR SELECTED FOREST SITES IN THE SAN JUAN NATIONAL FOREST, COLORADO
M. K. BUTERA Nov. 1983 30 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS
(Contract PROJ. AGRISTARS)
(E84-10066; NASA-TM-85516; NSTL/ERL-212; DC-Y3-04440; NAS 1.15:85516) Avail: NTIS HC A03/MF A01 CSCL 02F

The correlation of canopy closure with the signal response of individual thematic mapper simulator (TMS) bands for selected forest sites in the San Juan National Forest, Colorado was investigated. Ground truth consisted of a photointerpreted determination of percent canopy closure of 0 to 100 percent for 32 sites. The sites selected were situated on plateaus at an elevation of approximately 3 km with slope or = 10 percent. The predominant tree species were ponderosa pine and aspen. The mean TMS response per band per site was calculated from data acquired by aircraft during mid-September, 1981. A correlation analysis of TMS response vs. canopy closure resulted in the following correlation coefficients for bands 1 through 7, respectively: -0.757, -0.663, -0.666, -0.088, -0.797, -0.763. Two model regressions were applied to the TMS data set to create a map of predicted percent forest canopy closure for the study area. Results indicated percent predictive accuracies of 71, 74, and 57 for percent canopy closure classes of 0-25, 25-75, and 75-100, respectively.
M.G.

N84-15636*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
ANALYSIS OF DATA ACQUIRED BY SYNTHETIC APERTURE RADAR OVER DADE COUNTY, FLORIDA, AND ACADIA PARISH, LOUISIANA
S. T. WU Dec. 1983 45 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Original contains color imagery. Original photography may be purchased from EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract PROJ. AGRISTARS)
(E84-10067; NASA-TM-85517; NSTL/ERL-218; DE-Y2-04396; NAS 1.15:85517) Avail: NTIS HC A03/MF A01 CSCL 02C

Results of digital processing of airborne X-band synthetic aperture radar (SAR) data acquired over Dade County, Florida, and Acadia Parish, Louisiana are presented. The goal was to investigate the utility of SAR data for land cover mapping and area estimation under the AgRISTARS Domestic Crops and Land Cover Project. In the case of the Acadia Paris study area, LANDSAT multispectral scanner (MSS) data were also used to form a combined SAR and MSS data set. The results of accuracy evaluation for the SAR, MSS, and SAR/MSS data using supervised classification show that the combined SAR/MSS data set results in an improved classification accuracy of the five land cover classes as compared with SAR-only and MSS-only data sets. In the case of the Dade County study area, the results indicate that both HH and VV polarization data are highly responsive to the row orientation of the row crop but not to the specific vegetation which forms the row structure. On the other hand, the HV polarization data are relatively insensitive to the orientation of row crop. Therefore, the HV polarization data may be used to discriminate the specific vegetation that forms the row structure. M.G.

02

ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis, urban and metroplitan studies, environmental impact, air and water pollution, geographic information systems, and geographic analysis.

A84-10541
SATELLITE DETECTION OF EFFECTS DUE TO INCREASED ATMOSPHERIC CARBON DIOXIDE
J. T. KIEHL (National Center for Atmospheric Research, Boulder, CO) Science (ISSN 0036-8075), vol. 222, Nov. 4, 1983, p. 504-506. refs

The use of satellites to detect climatic changes due to increased carbon dioxide was investigated. This method has several advantages over ground-based methods of monitoring climatic change. Calculations indicate that, by monitoring the outgoing longwave flux for small intervals in the 15-micrometer spectral region, changes in stratospheric temperatures due to doubled atmospheric carbon dioxide are large enough to be detected above the various sources of noise. This method can be extended to other spectral regions so that causal links between changes in outgoing longwave radiation due to other trace gases and the thermal structure of the atmosphere could be established.
Author

A84-11775#
ORBITING MONITORS FOR THE LOW EARTH ORBIT MAN-MADE DEBRIS POPULATION
R. C. REYNOLDS, N. H. FISCHER, and G. T. RUCK (Battelle Columbus Laboratories, Columbus, OH) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 10 p.
(IAF PAPER 83-251)

Candidate detector designs for obtaining data on the distributions and locations of millimeter-sized micrometeoroids and debris in LEO are discussed. Current instrumentation using NORAD ground-based apparatus is capable of detecting objects down to 4 cm diameter. The IR astronomy satellite (IRAS) has demonstrated the ability of space-based electro-optical systems to detect mm-sized objects at significant distances. An orbiting radar system using a pencil beam could detect 0.1 cm particles 3.8 km in one direction and 11.6 km in another. Shaping the field of view would aid in discerning artificial from natural particles, especially since meteors would have a large vertical velocity component. Horizontally widening and flattening of the detection cone could enhance the discrimination faculty. Range-gating techniques are another method of discrimination. M.S.K.

A84-12511
AERIAL TESTING OF A KRF LASER-BASED FLUOROSENSOR
G. A. CAPELLE, L. A. FRANKS, and D. A. JESSUP (EG & G, Inc., Goleta, CA) Applied Optics (ISSN 0003-6935), vol. 22, Nov. 1, 1983, p. 3382-3387. refs
(Contract DE-AC08-83NV-10282)

The results of aerial testing of a KrF laser-based fluorosensor conducted over sites consisting of fabricated targets, industrial effluents, oil slicks, and various backgrounds including natural terrain and cultivated areas are summarized. The sites included the Nevada Test Site, the Naval Petroleum Reserve, the Santa Barbara Channel, and the san Joaquin Valley. The Naval Petroleum Reserve offered the first opportunity to test a KrF fluorosensor over an actual industrial operation. Relatively high SNRs were obtained at altitudes to 310 m over fabricated targets, including a known coal processing effluent. Detection in the UV channel was not measurably reduced in full daylight, although reduced performance was noted in the visible channel. Effluents from petroleum-based by-products were detected from altitudes to 610

m in full daylight and without the use of photomultiplier tube gating. C.D.

A84-13016
LANDUSE MAPPING AND CHANGE DETECTION WITH THE AID OF SYNTACTIC APPROACH
H. SHIMODA, K. FUKUE, Y. KINOSADA, and T. SAKATA (Tokai University, Tokyo, Japan) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 103-110. refs

A decade of land use change monitoring in Japan by means of Landsat MSS data is summarized. The focus is on a study area that includes Osaka, covering 200 x 150 km sq, i.e., three Landsat scenes. The data were gathered in 1972, 1978, and 1981. The preprocessing steps used to treat the data were destriping, geometric correction, normalization, and classification. A syntactical method was employed to raise the land use classification accuracy and remove cloud cover effects. Three different grammers were developed, together with a land use change algorithm. Evidence for population growth due to conversion of lands into housing regions was noted, as was a termination of development after 1981. M.S.K.

A84-13030
INVESTIGATION OF LANDUSE/LANDCOVER CHANGES IN EASTERN SAUDI ARABIA
M. A. KHAN, F. INCE, and M. UKAYLI (University of Petroleum and Minerals, Dhahran, Saudi Arabia) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 234-238.

A84-13048
BOLIVIAN DIGITAL GEOGRAPHIC INFORMATION SYSTEM
L. A. BARTOLUCCI, T. L. PHILLIPS, and C. R. VALENZUELA (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 374-388. refs

The present investigation is concerned with a project which consists of the conceptualization and design of a digital Geographic Information System (GIS) for the entire territory of the Republic of Bolivia, and the development and implementation of this system for the Oruro Department. Attention is given to the selection of the appropriate data structure, details concerning the cartographic map projection, aspects of data storage, the input subsystem, the data base subsystem, the management subsystem, the modeling of an analysis subsystem, the output subsystem, and the characteristics of the digital geographic information system for the Oruro Department in Bolivia. G.R.

A84-13093
ANCILLARY DATA INTERFACE TO VICAR/IBIS
M. W. GROSS (Idaho Department of Water Resources, Boise, ID) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 359-362.

The present investigation is concerned with the techniques utilized at the Idaho Image Analysis Facility (IIAF) to merge spectrally derived Landsat classification data with ancillary geographic information for production of spatially registered data on the areal extent of irrigated agriculture by water source within the Snake River Plain of southern Idaho. The primary digital analysis was conducted with the aid of VICAR/IBIS (Video Image Communications and Retrieval/Image Based Information System) software. The considered system, which was developed in response to immediate project needs, has greatly extended analysis capabilities without great capital outlay. G.R.

A84-13099
A GEOGRAPHIC INFORMATION SYSTEM FOR COLUSA COUNTY, CALIFORNIA
B. L. WOOD and L. H. BECK (California, University, Berkeley, CA) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 394-401. refs

A84-13190
REPETITIVE-SCANNING DERIVATIVE SPECTROMETER AS A MONITOR OF ENVIROMENTAL AIR POLLUTION
T. IZUMI and N. TAKEDA (Anritsu Electric Co., Ltd., Atsugi, Kanagawa, Japan) Applied Optics (ISSN 0003-6935), vol. 22, Nov. 15, 1983, p. 3618-3621. refs

The derivative spectrometer, developed for monitoring environmental air pollutants, employs signal processing to subtract the mean of the minima of second derivative from the maximum, and to average the subtracted values. The signal processing leads to compensation of the long-term drift and hence to improvement of the sensitive, i.e., the detection limit is 2-3 ppb or less for such gases as SO2, NO, and NO2, under circumstances were the ambient temperature fluctuates between 0 and 40 C. Author

A84-13608* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
UPDATING LANDSAT-DERIVED LAND-COVER MAPS USING CHANGE DETECTION AND MASKING TECHNIQUES
W. LIKENS (NASA, Ames Research Center, Moffett Field, CA) and K. MAW (Technicolor Government Services, Inc., Moffett Field, CA) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 256-271. refs

The California Integrated Remote Sensing System's San Bernardino County Project was devised to study the utilization of a data base at a number of jurisdictional levels. The present paper discusses the implementation of change-detection and masking techniques in the updating of Landsat-derived land-cover maps. A baseline landcover classification was first created from a 1976 image, then the adjusted 1976 image was compared with a 1979 scene by the techniques of (1) multidate image classification, (2) difference image-distribution tails thresholding, (3) difference image classification, and (4) multi-dimensional chi-square analysis of a difference image. The union of the results of methods 1, 3 and 4 was used to create a mask of possible change areas between 1976 and 1979, which served to limit analysis of the update image and reduce comparison errors in unchanged areas. The techniques of spatial smoothing of change-detection products, and of combining results of difference change-detection algorithms are also shown to improve Landsat change-detection accuracies. A.L.W.

A84-13611* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NATURAL HYDROCARBON EMISSION ESTIMATES BASED ON LANDSAT DATA AS AN INPUT TO A REGIONAL OZONE PHOTOCHEMICAL MODEL
E. M. MIDDLETON, J. C. GERVIN (NASA, Goddard Space Flight Center, Eastern Regional Remote Sensing Applications Center, Greenbelt, MD), and J. SALOP (Virginia State Air Pollution Control Board, Virginia Beach, VA) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 293-302. refs

Landsat-derived forest cover data were employed with non-methane hydrocarbon (NMHC) emission rates in a model to quantify summer forest ozone production for the Tidewater Region of Virginia. The areal extent of the three major forest types - coniferous, deciduous, and mixed - were determined from Landsat

data on two adjacent scenes, using an unsupervised approach to spectral signature development. The forest type results from both data sets were verified in an extensive accuracy assessment and merged to provide regional statistics for total acreages, percent forest, and error rates. The Landsat statistics were incorporated into forest type emission factor equations to produce an estimated emission rate for natural hydrocarbons from forests. This estimate, along with measured rates for nitrogen oxides and NMHC from anthropogenic sources, was provided as input to computer simulations of atmospheric ozone generation for the Tidewater Region using a photochemical oxident model. Author

A84-14044
SAMPLE SURVEYS FROM LIGHT AIRCRAFT COMBINING VISUAL OBSERVATION AND VERY LARGE SCALE COLOUR PHOTOGRAPHY
M. NORTON-GRIFFITHS (Ecosystems, Ltd., Nairobi, Kenya; Arizona, University, Tucson, AZ), T. HART (Ecosystems, Ltd., Nairobi, Kenya), and M. PARTON (Arizona, University, Tucson, AZ) ITC Journal (ISSN 0303-2434), no. 1, 1983, p. 17-20. refs

A84-14592
LAND OBSERVATION SENSORS IN PERSPECTIVE
D. A. LANDGREBE (Purdue University, West Lafayette, IN) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Nov. 1983, p. 391-402. refs

The use of spaceborne sensors for gathering earth resources information has developed greatly in the last two decades. However, compared to what is possible from the space vantage point, the potential for further advancement is enormous. In this paper a generally applicable framework for the design of earth observational information systems is presented. It provides a perspective against which to judge and visualize how the further development of such technology could take place. The economic and sociological value of such information-gathering technology suggests that the further development of such technology should proceed. Author

A84-15606
REMOTE DETERMINATION OF THE COMPOSITION AND CONCENTRATION OF IMPURITIES BY SPECTROSCOPIC METHODS
V. I. PETROV (Optiko-Mekhanicheskaia Promyshlennost', vol. 50, Mar. 1983, p. 53-59) Soviet Journal of Optical Technology (ISSN 0038-5514), vol. 50, March 1983, p. 188-195. Translation. refs

The application of lidar technology to the remote sensing of atmospheric and water pollution is reviewed. The operating principles and instrument requirements of lidar techniques are summarized, and the kinds of results obtained with different systems are characterized, including differential absorption analysis, fluorescent lidars, Raman lidars, and Raman lidars using a resonant SRS signal. The potential use of nonlinear effects in Raman spectroscopy is considered. Absorption lidars are found to have the highest sensitivity (by several orders of magnitude) of the methods surveyed, but to be limited by low backscatter and the transparence of most impurities in the visible region. Fluorescence techniques can detect some organic compounds at very low concentrations in air or water but can only rarely identify impurities. Raman techniques suffer from low sensitivity (which can be improved somewhat by using resonant excitation) but can determine the composition of a contaminant in a complex system. T.K.

A84-16722
SOME URBAN MEASUREMENTS FROM LANDSAT DATA
B. FORSTER (New South Wales, University, Kensington, Australia) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Dec. 1983, p. 1693-1707. refs

Specific urban analysis models are developed using Landsat data acquired over the Sydney, Australia, metropolitan area in conjunction with supporting ground data and multiple linear regression analysis to predict urban reflectance, surface cover, housing density, average house value, and a residential quality index. An extended data analysis provided the ability to predict the average number of houses per pixel from reflectance data. It was shown that the average house value as a function of house size, local vegetative content, and other environmental features, in Sydney, can be substantially predicted from Landsat reflectance data. J.N.

A84-17029#
USE OF THE VANTAGE POINT OF SPACE TO PROTECT THE EARTH'S ENVIRONMENT
J. H. MCELROY and K. D. HODGKINS (NOAA, Washington, DC) IN: Colloquium on the Law of Outer Space, 25th, Paris, France, September 27-October 2, 1982, Proceedings . New York, American Institute of Aeronautics and Astronautics, 1983, p. 9-11.
(IAF PAPER 82-IISL-04)

Satellite studies of the earth's environment undertaken by the National Oceanic and Atmospheric Administration (NOAA) are briefly described. Programs to study the relationship between marine pollution and its efects on ocean organisms and man, the distribution and concentration of aerosols over the ocean, and the distribution and abundance of contaminants in estuarine, coastal, and shelf waters are ongoing. Studies of the composition of the stratosphere, the impact of halocarbon emissions on the ozone layer, the effect of climatic changes on the natural environment and world food supply, and date for weather forecasting are mentioned. Programs to monitor water resources, insolation, precipitation, and long-term geological changes are addressed. Plans for future satellite launchings are summarized. C.D.

A84-17805
ESTIMATING PARTICLE SIZES, CONCENTRATIONS, AND TOTAL MASS OF ASH IN VOLCANIC CLOUDS USING WEATHER RADAR
D. M. HARRIS (Alberta, University, Edmonton, Canada) and W. I. ROSE, JR. (Michigan Technological University, Houghton, MI) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Dec. 20, 1983, p. 10969-10983. refs
(Contract NSF EAR-82-05606)

Radar observations of the March 19, 1982 ash eruption of Mount St. Helens were used to estimate the volume of the ash cloud (2000 + or - 500 cu km), the concentration of ash (0.2-0.6 g/cu m), and the total mass of ash erupted (3-10 x 10 to the 11th g). Previously published ashfall data for the May 18, 1980 Mount St. Helens eruption were studied using an inversion technique to estimate 6-hr mean particle concentration (3 g/cu m), the size distribution, the total ashfall mass (5 x 10 to the 14th g), and radar reflectivity factors for the ash cloud. Because volcanic ash clouds with particle concentrations of at least 0.2 g/cu m are produced in very small (in terms of total ashfall mass) eruptions of duration less than 1 min, volcanic ash clouds must be considered an extremely serious hazard to in-flight aircraft, regardless of the eruption magnitude. V.L.

A84-19046
DIGITAL AND ANALOG TELEANALYSIS OF LANDSAT AND SIR-A LANDSCAPES OF THE AFRICAN SAHEL - THE CONTACT OF THE 'INTERIOR DELTA' OF THE NIGER AND THE PLATEAU OF BANDIAGARA IN MALI [TELEANALYSE NUMERIQUE ET ANALOGIQUE DE PAYSAGES DU SAHEL AFRICAIN PAR LANDSAT ET LE RADAR SIR-A - LE CONTACT DU 'DELTA INTERIEUR' DU NIGER ET DU PLATEAU DE BANDIAGARA AU MALI]
CL. BARDINET, M. BENARD, J.-M. MONGET (Paris, Ecole Nationale Superieure des Mines, Valbonne, France), and J. TRICART (Strasbourg I, Universite, Strasbourg, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 91, 1983, p. 21-35. In French. refs

N84-11562*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
LAND COVER CHANGE MONITORING WITHIN THE EAST CENTRAL LOUISIANA STUDY SITE: A CASE FOR LARGE AREA SURVEYS WITH LANDSAT MULTISPECTRAL SCANNER DATA
G. S. BURNS Jun. 1983 36 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract PROJ. AGRISTARS)
(E84-10031; NASA-TM-85469; DC-Y3-04418; NSTL/ERL-221; NAS 1.15:85469) Avail: NTIS HC A03/MF A01 CSCL 02C

Results established for four digital procedures developed for characterizing the radiometric changes between multidate LANDSAT spectral data sets into meaningful measures of land cover/use dynamics are documented. Each technique's performance was contrasted against digitized land use change maps, which were produced from contemporaneous, retrospective aerophoto coverage, in a cell by cell comparison over a one half by one degree area in east central Louisiana as a standard for comparison. The four techniques identify from 10.5 to 13.0% loss in area of forestland in a five year period; however, they differ more by how accurately this amount of change is distributed, the need for ancillary ground truth, and amount of usable information that is extractable. All require some method of digitally co-registering the two data sets. All are capable of providing tabular statistics as well as map products. Two are capable of detecting changes and identifying their locations. The other two, in addition to this, provide information to qualify land cover conditions at each end of the study interval. Author

N84-12556*# Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.
IDENTIFYING ENVIRONMENTAL FEATURES FOR LAND MANAGEMENT DECISIONS Annual Report
28 Oct. 1983 76 p refs ERTS
(Contract NAGW-95)
(E84-10016; NASA-CR-174543; NAS 1.26:174543) Avail: NTIS HC A04/MF A01 CSCL 04B

Pairs of HCMM day-night thermal infrared (IR) data were selected to examine patterns of surface temperature and thermal inertia (TI) of peninsular Florida. GOES and NOAA-6 thermal IR, as well as National Climatic Center temperatures and rainfall, were also used. The HCMM apparent thermal inertia (ATI) images closely correspond to the General Soil Map of Florida, based on soil drainage classes. Areas with low ATI overlay well-drained soils, such as deep sands and drained organic soils. Areas with high ATI overlay areas with wetlands and bodies of water. The HCMM ATI images also correspond well with GOES-detected winter nocturnal cold-prone areas. Use of HCMM data with Carlson's energy balance model shows both high moisture availability (MA) and high thermal inertia (TI) of wetland-type surfaces and low MA and low TI of upland, well-drained soils. Since soil areas with low TI develop higher temperatures during the day, then antecedent patterns of highest maximum daytime surface temperature can also be used to predict nocturnal cold-prone areas in Florida.
Author

N84-12579# European Space Agency, Paris (France).
REMOTE SENSING APPLICATIONS FOR ENVIRONMENTAL STUDIES
N. LONGDON, comp. and O. MELITA, comp. Jul. 1983 303 p refs Partly in ENGLISH and FRENCH Proc. of EARSeL/ESA Symp., Brussels, 26-28 Apr. 1983 sponsored by the Commission of the European Communities and Parliamentary Assembly of the Council of Europe
(ESA-SP-188; ISSN-0379-6566) Avail: NTIS HC A14/MF A01

Land and marine applications of remote sensing by aircraft and satellites for environmental studies were discussed. Thematic mapping, pollution monitoring, coastal ecology, crop inventory, and marine biology applications were considered.

N84-12580# Technische Univ. Munich, Garching (West Germany). Inst. for General and Applied Geodesy.
USE OF REMOTE SENSING METHODS FOR THE ECOLOGICAL MAPPING PROJECT OF THE EUROPEAN COMMUNITY
J. BODECHTEL and F. JASKOLLA *In* ESA Remote Sensing Appl. for Environ. Studies p 3-7 Jul. 1983
Avail: NTIS HC A14/MF A01

In order to examine the potential contribution of remote sensing to the collection of data for the ecological mapping of the European Community, environmental mapping requirements, and which indicators can be recorded or kept up-to-date by of remote sensing were studied. Test sites were investigated by aerial and satellite imagery. Based on LANDSAT-2 images and the LANDSAT-D, SPOT generation of satellites a significant impact on ecological mapping is predicted including the increased availability of data over the whole European territory in order to reduce the gap between the member states; ensured regular updating of data; and improved interregional and international comparability of data.
Author (ESA)

N84-12583# Centre National de la Recherche Scientifique, Verrieres-le-Buisson (France). Service d'Aeronomie.
REMOTE SENSING INSTRUMENTS FOR TRACE SPECIES MEASUREMENTS IN THE TROPOSPHERE AND STRATOSPHERE: A REVIEW
G. MEGIE *In* ESA Remote Sensing Appl. for Environ. Studies p 19-24 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Air and spaceborne passive sensors which use an external source such as the Sun, the Moon or a star to derive from the absorption properties of the atmosphere within a specific wavelength range the total content or altitude profile of a given species; and active sensors characterized by the existence of an internal source of light, either continuous or pulsed, are considered. The complementarity of these two types of sensors for atmospheric applications with respect to the various altitude regions to be sounded, and the importance of ground truth validation for global monitoring and trend analysis of atmospheric trace species, are emphasized. Author (ESA)

N84-12590# Consiglio Nazionale delle Ricerche, Florence (Italy). Ist. di Ricerca sulle Onde Elettromagnetiche.
THE ISTITUTO DI RICERCA SULLE ONDE ELETTROMAGNETICHE (IROE)-LIDAR REMOTE SENSING OF THE ENVIRONMENT
V. CAPPELLINI, F. CASTAGNOLI, M. MORANDI, L. PANTANI, I. PIPPI, B. RADICATI, L. STEFANUTTI, and C. SUSINI *In* ESA Remote Sensing Appl. for Environ. Studies p 69-78 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

A method of measuring the extinction coefficient in heavy fog based on the extrapolation of the extinction coefficient from lidar signatures by operating the lidar with different receiver apertures was developed. Stratospheric aerosol measurements are carried out regularly and the evolution of the volcanic cloud produced by the Mexican volcano El Chichon is followed. The use of lidar systems in remote sensing of land and sea surface was investigated, especially the analysis of oil films on the surface of natural waters by fluorescence lidars. A fluorescence lidar simulator was developed. A technique for identification of natural targets by differential reflectance lidar was developed. Author (ESA)

N84-12594# Ghent Univ. (Belgium). Lab. for Regional Geography and Landscape Science.
INVENTORING AND MONITORING OF LANDSCAPE AS A NATURAL AND CULTURAL RESOURCE
M. ANTROP *In* ESA Remote Sensing Appl. for Environ. Studies p 105-113 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

The utility of remote sensing imagery for landscape studies is evaluated. Significant holistic and structural aspects of the landscape can be derived directly from image characteristics. Visual image interpretation, in particular photomorphic image classification,

allows a fast and easy chorological and typological hierarchical landscape classification. Landscape units determined this way can be interpreted in ecological and geostructural perspective. Textural analysis is the most interesting quantitative interpretation technique for structural analysis of the landscape. The principal objectives for image interpretation for landscape studies are: updating of existing regional landscape classifications; hierarchical structurization of the landscape units and fitting of the microlevel units in the macrolevel ones, which are on a continental-European scale; detection of landscapes with high historical and cultural value; and detection and monitoring of zones with rapid changes and high intensity in land use. Author (ESA)

N84-12601# Eurosense B.V., The Hague (Netherlands). Remote Sensing Dept.

AN OPERATIONAL REMOTE SENSING METHODOLOGY FOR THE DETECTION, INVENTORY AND ENVIRONMENTAL MONITORING OF WASTE DISPOSAL SITES

J. L. VANGENDEREN, J. A. VANDEGRIEND (Provincial Government of South Holland), and H. T. C. VANSTOKKOM (Netherlands Remote Sensing Board) *In* ESA Remote Sensing Appl. of Environ. Studies p 149-156 Jul. 1983 refs

Avail: NTIS HC A14/MF A01

A classification of waste disposal sites was developed and used for the systematic interpretation of the remote sensing data of a 150 sq km test area. The devised methodology is described. The results of the ground truth confirm that using 1:10,000 color infrared aerial photography, it is possible to detect and locate all active waste disposal sites, and most former waste disposal sites. In most cases, remote sensing techniques cannot say whether the material being tipped in the waste disposal site is toxic or not. With active sites, it is only possible to determine the physical state of the waste disposal material. Whether this is detrimental to the environment or not can only be determined by indirect means (e.g., vegetation stress). With a few exceptions, it is impossible to say when the material was tipped. Accuracy tests show that the results are sufficiently reliable to enable remote sensing to be used in a cost-effective operational mode as part of regional environmental management activities. Author (ESA)

N84-12603# Dundee Univ. (Scotland). Carneige Lab. of Physics.

SATELLITE REMOTE SENSING, ENVIRONMENTAL MONITORING AND THE OFFSHORE OIL AND GAS INDUSTRIES

A. P. CRACKNELL, K. MUIRHEAD, R. D. CALLISON, and N. A. CAMPBELL *In* ESA Remote Sensing Appl. for Environ. Studies p 163-171 Jul. 1983 refs Sponsored by UK Science and Engineering Research Council and Manpower Services Commission

Avail: NTIS HC A14/MF A01

Monitoring of oil slicks using meteorological satellites and LANDSAT is described. Results from the Gulf of Mexico are presented. The use of TIROS-N data for the monitoring of gas flares from production platforms in the North Sea is described. Slicks are manifested more clearly in the visible than in the infrared spectral channels; reasons for this, in terms of the temperature and emissivity of both oil and water were explored. Difficulties associated with spatial resolution, spectral resolution, the frequency of coverage governed by orbital considerations, the common presence of cloud cover and the need for real-time access to, and processing of satellite data are discussed. Gas flares can be monitored successfully using the infrared band of the AVHRR on the TIROS-N satellites. With very few exceptions, it is possible to identify unambiguously the platform that is responsible for any given flare. Although it is possible to classify flares roughly into large, medium and small it is not possible to derive a reliable estimate, from the satellite data, for the quantity of gas being burned. Author (ESA)

N84-12613# Universidad Politecnica de Barcelona (Spain). Centre de Calcul.

MAPPING LAND USE IN CATALONIA (SPAIN) [UN ESSAI DE CARTOGRAPHIE DE L'UTILISATION DES SOLS EN CATALOGNE]

R. ARBIOL, O. VINAS, and J. M. CAMARASA (Generalitat de Catalunya, Barcelona) *In* ESA Remote Sensing Appl. for Environ. Studies p 241-247 Jul. 1983 refs In FRENCH; ENGLISH summary

Avail: NTIS HC A14/MF A01

A map of land use in a 32,000 sq km area of Spain was produced using LANDSAT imagery. A classification process which includes an unsupervised analysis of 87 scenes, 27 X 19 km, supervised analysis of small, homogeneous zones, and classification of all the pixels of each scene by the lowest distances was used. Agreement between the automatic classification and manual data from agronomical maps is excellent, in spite of snow cover of several zones. Author (ESA)

N84-12617# Eurosense Belfotop G.m.b.H., Huerth (West Germany).

THE SYNTHESIZED CLIMATIC FUNCTION MAP

S. HABERL and P. STOCK (Hommunalverband Ruhrgebiet, Essen, West Germany) *In* ESA Remote Sensing Appl. in Environ. Studies p 273-281 Jul. 1983 refs

Avail: NTIS HC A14/MF A01

Aircraft and balloon-borne multispectral scanner data were used for infrared thermography of an urban area in order to study the microclimate. The data were combined with ground truth data from weather stations to produce a climatic function map. Night and daytime thermal maps were compared, showing the heat loss relative to land use and type of material. Author (ESA)

N84-13631*# Natural Environment Research Council, London (England).

THE USE OF THEMATIC MAPPER DATA FOR LAND COVER DISCRIMINATION: PRELIMINARY RESULTS FROM THE UK SATMAP PROGRAMME

M. J. JACKSON, J. R. BAKER, J. R. G. TOWNSHEND, J. E. GAYLER, and J. R. HARDY 1983 17 p refs Prepared in cooperation with Reading Univ., England Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E84-10038; NASA-CR-174590; NAS 1.26:174590) Avail: NTIS HC A02/MF A01 CSCL 08B

The principal objectives of the UK SATMaP program are to determine thematic mapper (TM) performance with particular reference to spatial resolution properties and geometric characteristics of the data. So far, analysis is restricted to images from the U.S. and concentrates on spectra and radiometric properties. The results indicate that the data are inherently three dimensional compared with the two dimensional character of MSS data. Preliminary classification results indicate the importance of the near infrared band (TM 4), at least one middle infrared band (TM 5 or TM 6) and at least one of the visible bands (preferably either TM 3 or TM 1). The thermal infrared also appears to have discriminatory ability despite its coarser spatial resolution. For band 4 the forward and reverse scans show somewhat different spectral responses in one scene but this effect is absent in the other analyzed. From examination of the histograms it would appear that the full 8-bit quantization is not being effectively utilized for all the bands. M.G.

N84-13641*# Michigan State Univ., East Lansing. Center for Remote Sensing.
PHOTO INTERPRETATION KEY TO MICHIGAN LAND COVER/USE
W. R. ENSLIN, W. D. HUDSON, and D. P. LUSCH Apr. 1983 65 p ERTS
(Contract NGL-23-004-083)
(E84-10048; NASA-CR-174615; NAS 1.26:174615) Avail: NTIS HC A04/MF A01 CSCL 14E

A set of photo interpretation keys is presented to provide a structured approach to the identification of land cover/use categories as specified in the Michigan Resource Inventory Act. The designated categories are urban and; built up lands; agricultural lands; forest land; nonforested land; water bodies; wetlands; and barren land. The keys were developed for use with medium scale (1:20,000 to 1:24,000) color infrared aerial photography. Although each key is generalized in that it relies only upon the most distinguishing photo characteristics in separating the various land cover/use categories, additional interpretation characteristics, distinguishing features and background material are given. A.R.H.

N84-14568* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SIGNIFICANT RESULTS FROM THE HCMM PROGRAM
In its The Heat Capacity Mapping Mission (HCMM) Anthology p 169-236 1982 refs Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 08B

The major objectives of the HCMM program for applications in geology, agriculture, water studies, and the effects of climate on metropolitan areas are summarized. Results obtained by Principal Investigators in each of these disciplines are presented, discussed, and supported with figures and tables. In order to compare the types of observations and applications that can be derived from HCMM data with some remote sensing standard or framework for each discipline, the principal results already achieved with the LANDSAT system are included. A.R.H.

N84-15637*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
CLASSIFICATION AND AREA ESTIMATION OF LAND COVERS IN KANSAS USING GROUND-GATHERED AND LANDSAT DIGITAL DATA
G. A. MAY, M. L. HOLKO, and J. E. ANDERSON Oct. 1983 14 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with Dept. of Agriculture, Washington, D.C. Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract PROJ. AGRISTARS)
(E84-10068; NASA-TM-85518; NSTL/ERL-225; DC-Y3-04441; NAS 1.15:85518) Avail: NTIS HC A02/MF A01 CSCL 08B

Ground-gathered data and LANDSAT multispectral scanner (MSS) digital data from 1981 were analyzed to produce a classification of Kansas land areas into specific types called land covers. The land covers included rangeland, forest, residential, commercial/industrial, and various types of water. The analysis produced two outputs: acreage estimates with measures of precision, and map-type or photo products of the classification which can be overlaid on maps at specific scales. State-level acreage estimates were obtained and substate-level land cover classification overlays and estimates were generated for selected geographical areas. These products were found to be of potential use in managing land and water resources. M.G.

03

GEODESY AND CARTOGRAPHY

Includes mapping and topography.

A84-10471
STEREOPHOTOGRAMMETRY FOR MAP-MAKING AND ENGINEERING PROBLEMS [STEREOFOTOGRAMMETRIIA DLIA TSELEI KARTOGRAFIROVANIIA I RESHENIIA INZHENERNYKH ZADACH]
P. N. RAPASOV Moscow, Izdatel'stvo Nedra, 1983, 320 p. In Russian. refs

The combined use of ground and aerial stereophotogrammetry in making large- and medium-scale maps and in solving problems in engineering geodesy is discussed. The theory for ground and aerial stereophotogrammetry is reviewed, with certain aspects of the theory treated in a novel way. The discussion covers various applications of ground and aerial photogrammetric survey requiring minimum geodesic control and also some methods of photogrammetric processing that are characterized by high accuracy and efficiency. V.L.

A84-11184
TIDOC - AN EXAMPLE FOR LARGE-SCALE GEODETIC NETWORKS AND SATELLITE DOPPLER OBSERVATIONS
P. BALDI, F. J. LOHMAR (Bologna, Universita; Istituto Nazionale di Fisica Nucleare, Bologna, Italy), C. MARCHESINI (Bonn, Universitaet, Bonn, West Germany), and S. ZERBINI (Trieste, Universita, Trieste, Italy) Annales Geophysicae (ISSN 0755-0685), vol. 1, July-Oct. 1983, p. 315-320. Research supported by the Ministero della Pubblica Istruzione; Consiglio Nazionale delle Ricerche. refs
(Contract CNR-PSN-81,03,57,03)

A Doppler observation program, the Tyrrhenian Islands Doppler Observation Campaign (TIDOC), was carried out during the month of September 1981 in the Tyrrhenian Islands area in Italy. The objective of the TIDOC program was to compare the Doppler coordinates or chord length with both the data of the Italian national triangulation network and high-precision distance measurements performed in the same area by means of a geodimeter. The results obtained suggest that the Italian triangulation network would benefit from the establishment of Doppler stations which would constitute a tie to the European network. V.L.

A84-13195
INDICATRICES OF THE EARTH'S SURFACE REFLECTION FROM LANDSAT MSS DATA
H. OKAYAMA (Chiba University, Chiba, Japan) and I. OGURA (Tokyo, University, Tokyo, Japan) Applied Optics (ISSN 0003-6935), vol. 22, Nov. 15, 1983, p. 3652-3656. refs

A method of obtaining an indicatrix or a scattering diagram of the earth's surface is developed. When the earth's surface is regarded as a kind of irregular surface, the indicatrix of scattered radiation is a way of effective representation of its surface roughness. The indicatrices of radiation over the sands of a seashore, a downtown area of Tokyo, and some of its suburban areas are obtained from Landsat MSS data. The radiant intensity decreases within the range of 32 deg to 65 deg of scattering angles in accordance with the degree of urbanization. Experimental results obtained by a remote sensing simulator are compared with those of Landsat MSS data analysis. Author

A84-15328
VERY LONG BASELINE INTERFEROMETRY TECHNIQUES; INTERNATIONAL COLLOQUIUM, TOULOUSE, FRANCE, AUGUST 31-SEPTEMBER 2, 1982, PROCEEDINGS [TECHNIQUES D'INTERFEROMETRIE ATRES GRANDE BASE; COLLOQUE INTERNATIONAL, TOULOUSE, FRANCE, AUGUST 31-SEPTEMBER 2, 1982, EXPOSES]
Colloquium sponsored by the Centre National d'Etudes Spatiales. Toulouse, Cepadues-Editions, 1983, 488 p. In French and English.

Various topics on VLBI techniques are addressed. The subjects discussed include: mobile VLBI, radio telescopes, comparisons between VLBI and other systems, astrometry and earth orientation measurements, frequency standards and atomic clocks, VLBI mapping, and planned VLBI projects. C.D.

A84-15329
VERY LONG BASELINE INTERFEROMETRY FOR GEODESY AND GEOPHYSICS STATUS AND PROSPECTS
J. CAMPBELL (Bonn, Universitaet, Bonn, West Germany) IN: Very long baseline interferometry techniques; International Colloquium, Toulouse, France, August 31-September 2, 1982, Proceedings . Toulouse, Cepadues-Editions, 1983, p. 15-31; Discussion, p. 32. refs

The present paper reviews the technique of Very Long Baseline Interferometry as a tool for high precision measurements of relative point positions and spatial baseline orientation. The geodetic and geophysical applications of these measurements are discussed in relation to the objectives of global and regional programs of earth dynamics research. Following a description of newly developed instrumentation, some of the most interesting results recently obtained by the different groups involved in geodetic VLBI are shown. The systematic errors limiting the accuracy of VLBI baseline vector determinations are discussed and different approaches of error elimination are indicated. Finally an outlook is given on further instrumental developments and planned geodynamical observing programs. Author

A84-15330
COMPARISON OF VLBI AND CONVENTIONAL SURVEYING OF THE MADRID DEEP SPACE NETWORK ANTENNAS
A. RIUS (Instituto Nacional de Tecnica Aeroespacial, Madrid, Spain) and E. CALERO (Instituto Geografico Nacional, Madrid, Spain) IN: Very long baseline interferometry techniques; International Colloquium, Toulouse, France, August 31-September 2, 1982, Proceedings . Toulouse, Cepadues-Editions, 1983, p. 33-39. refs

Measurements of the relative positions between the three Madrid Space Station antennas using VLBI techniques and conventional geodetic methods are described and analyzed. The station characteristics, determined baseline and effective observation time, and solutions obtained from the data by VLBI are presented. The conventional geodesy procedure is described by stages, and the obtained values and their vectorial closures are given. All computations were made on reference ellipsoids with the coordinates transformed into an XYZ system to facilitate comparison. The differences in the distances measured with the two systems are at the centimeter level, a value comparable to the formal errors of the VLBI solutions and the geodetic closure. Comparison of the baseline azimuths as determined by the two methods shows that they are almost unaffected by VLBI systematic errors. C.D.

A84-15337* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
OPERATIONAL RADIO INTERFEROMETRY OBSERVATION NETWORK (ORION) MOBILE VLBI STATION
N. A. RENZETTI, C. J. VEGOS, G. S. PARKS, R. W. SNIFFIN, D. L. GANNON, H. G. NISHIMURA, P. A. CLEMENTS, R. P. MCKINNEY, F. J. MENNINGER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and N. R. VANDENBERG (Phoenix Corp., McLean, VA) IN: Very long baseline interferometry techniques; International Colloquium, Toulouse, France, August 31-September 2, 1982, Proceedings . Toulouse, Cepadues-Editions, 1983, p. 141-169.
(Contract NAS7-100)

The design and current status of the ORION mobile VLBI station is described. The station consists of a five-meter antenna, a receiving and recording system installed in a mobile antenna transporter, and an electronics transporter. The station is designed for field operation by a two-person crew at the rate of two sites per week. The various subsystems are described in detail, including the antenna, housing facilities for electronics and crew, microwave equipment, receiver, data acquisition subsystem, frequency and timing subsystem, phase calibration, monitoring and control, water vapor radiometer, and communications. C.D.

A84-15355
THE ATTAINMENT OF HIGHER QUALITY MAPS FROM VLBI
P. N. WILKINSON (Manchester, Victoria University, Jodrell Bank, Ches., England) IN: Very long baseline interferometry techniques; International Colloquium, Toulouse, France, August 31-September 2, 1982, Proceedings . Toulouse, Cepadues-Editions, 1983, p. 375-389. refs

The present investigation has the objective to show that the relatively low quality of current very long baseline interferometry (VLBI) maps is related to systematic errors in the visibility data. The noise statistics in synthesis maps are discussed, and the potential of hybrid mapping in VLBI is examined. A study is conducted of the fundamental limitations of hybrid-mapping, taking into account the limitations due to the instrument and the image construction technique, limits due to noise, the effect of systematic errors in the visibility data, and a specific example. It is concluded that, to first order, the size of the map which can be reliably constructed from VLBI-type data is set by the number of baselines. The quality of that map is determined by the quality of the data. G.R.

A84-18258#
THE IMPACT OF GRS 80 ON DMA PRODUCTS
C. F. LEROY (U.S. Defense Mapping Agency, Hydrographic/Topographic Center, Washington, DC) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 129-150. refs

It was decided to incorporate Geodetic Reference System 1980 (GRS 80) parameters wherever possible in the forthcoming World Geodetic System 1984 (WGS 84). Tests have been performed to evaluate the effect of adopting GRS 80 parameters in computations of the precise ephemeris for the Navy Navigation Satellite System, referencing the ephemeris to the satellite antenna rather than the center of mass, and other modifications. Test results are presented along with a simple chart illustrating the relationships among NWL 9D, NSWC 9Z-2, WGS 72, etc. It is shown that the test (NSWC 13Z) ephemeris statistically fits the tracking data better than does the NSWC 9Z-2 production ephemeris. B.J.

A84-18261#
PROBLEMS AND SOLUTIONS CONCERNING THE ESTABLISHMENT OF TRANSFORMATION FORMULAS BETWEEN THE TRANSIT SATELLITE SYSTEM AND THE SWEDISH GEODETIC SYSTEM
E. STENBORG (Sveriges Meteorologiska och Hydrologiska Institut, Norrkoping, Sweden) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 199-205.

A84-18266#
SPECTRAL ANALYSIS OF IAG TEST DATA
D. GELINAS (UniversiteLaval, Sainte-Foy, Quebec, Canada) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 321-333. refs

Spectral analysis of the pass-by-pass residuals in phi, lambda, and h coordinates was performed by the least squares method for the four stations of the International Association of Geodesy (IAG) test data set no. 1 (Georeceiver). These residuals, computed by the single point positioning program (DOPSPP) of the Royal Observatory of Belgium, come from the projection of the Guier components in the geocentric system. The analysis shows without contradiction the presence of periods in the residuals of the IAG test data; this is confirmed by the reduction of the residual time series quadratic norms. B.J.

A84-18271#
EFFECT OF THE ORIENTATION OF EARTH'S GRAVITY FIELD ON PRECISE SATELLITE EPHEMERIS COMPUTATION
E. COLQUITT and M. TANENBAUM (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 397-409.

For the precise computation of the orbit of near-earth satellites, it is necessary to model accurately the orientation of the terrestrial gravitational force with regard to the reference frame used in the orbit computation. In the present investigation the orbital effects of gravitational force evaluation are examined on the basis of two hypotheses in order to obtain a quantitative measure of the importance of the pole expansion hypothesis in precise satellite ephemeris computation. Orbital effects based on the hypothesis that the gravity field is attached to the crust (that is, that it rotates about the axis of symmetry pole) are compared to orbital effects based on the hypothesis that it rotates about the instantaneous spin axis pole. G.R.

A84-18277#
THE VARIABILITY OF THE TROPOSPHERIC RANGE CORRECTION DUE TO WATER VAPOR FLUCTUATIONS
D. S. COCO and J. R. CLYNCH (Texas, University, Austin, TX) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 475-495. refs
(Contract N00024-79-C-6358)

The correction that must be made in satellite-to-ground range measurements because of tropospheric water vapor along the line of sight is very nearly proportional to the total amount of water vapor along the line of sight. It is normally computed from a model based on surface meteorological measurements. Two problems are encountered, however, in estimating the tropospheric range correction due to water vapor from surface measurements. The first is the failure of the water vapor overhead to always correlate well with the surface measurements; the second is the difficulty in predicting horizontal variations in water vapor from surface measurements at a single site. Measurements made by a series of simultaneous radiosonde launches at seven stations with interstation distances of 60-200 km are used in addressing these problems. Depending on the time of day, the standard deviation of the residuals of the best zenith range correction model is found to vary from 3.9 to 5.4 cm. It is also found that the standard deviation of the interstation residuals for interstation distances of 60-200 km has approximately the same range of values. C.R.

A84-18280#
THE COORDINATES EVOLUTION OF A TRANET STATION OVER 9 YEARS
P. PAQUET (Observatoire Royal de Belgique, Brussels, Belgium) and V. DEHANT (Louvain, UniversiteCatholique, Louvain-la-Neuve, Belgium) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 539-555. refs

The TRANET network's Observatoire Royal de Belgique has been continuously performing Doppler observations of the TRANSIT satellites since June, 1972. On the basis of the precise ephemeris, a 10-day solution computed for satellite positions has been subjected to different spectral analysis methods. Attention is given to periodic variations, among the most characteristic of which is an annual component whose amplitude is modulated by a harmonic function. O.C.

A84-18284#
THE INDONESIAN REAP DOPPLER SATELLITE NETWORK
D. B. THOMSON (McElhanney Surveying and Engineering, Ltd., Vancouver, Canada) and IR. J. RAIS (Badan Koordinasi Survey dan Permetaan Nasional, Indonesia) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 609-622. refs

The Resource Evaluation Aerial Photography Project (REAP) was announced by the Government of the Republic of Indonesia in 1973. It was designed to create an institutional and physical capability in Indonesia to handle an accelerated program of natural resource development, particularly forest resources. The project area extends over 2100 km from east to west, from 107 deg 52 min E to 127 deg 5 min E. In the north-south direction it extends over 1740 km, from 5 deg 33 min N to 10 deg 11 min S. The greatest distance between any two stations is 2400 km. In all, 238 stations were established, 83 north of the equator and 155 south. The description of the work done to complete the project concentrates on problems encountered in transportation, communication, operations support, and schedule of operations. Some typical results are presented. C.R.

A84-18285#
AFRICAN DOPPLER SURVEY - ADOS
I. I. MUELLER (Ohio State University, Columbus, OH) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 637-656. refs

Basic aspects of the application of Doppler technique to geodesy are reviewed, and recommendations are made for the establishment of a Doppler network in Africa. The Doppler principle is summarized, and the US Navy Navigation Satellite System is briefly described. Geodetic receivers, sources of orbital information, satellite Doppler observing methods, and general accuracy specifications are considered. The general observation strategy for the African network and the projected field work are outlined. C.D.

A84-18286#
DOPPLER SATELLITE POSITIONING FOR GEOPHYSICAL SURVEY APPLICATIONS
R. L. WADE (Sheltech Houston, Houston, TX) and T. J. CRAGO (Sheltech Canada, Calgary, Alberta, Canada) IN: International *Geodetic Symposium on Satellite Doppler Positioning, 3rd*, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 683-697. refs

A description is presented of the numerous applications of Doppler satellite surveys for geophysical exploration. It is pointed out that over the past 15 years satellite Doppler techniques have become a significant element of the geophysical survey. However, these techniques must often be integrated with or supplemented by other survey systems. Reconnaissance exploration is considered, taking into account gravity control and arctic ice movement. Aspects of seismic exploration are discussed, giving attention to the problem of vertical and horizontal geodetic control, offshore stations, and integrated systems for offshore positioning. Other applications examined are related to exploration wells, resource mapping, and pipeline control. G.R.

A84-18287#
ANALYSIS OF POINT AND SEMISHORT ARC SOLUTIONS USING FORT DAVIS DOPPLER TEST SURVEY DATA
L. D. HOTHEM (NOAA, Gravity, Astronomy and Space Geodesy Div., Rockville, MD) and G. J. EDLER (U.S. Bureau of Land Management, Cadastral Mapping and Training Center, Denver, CO) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 699-717. refs

A special Doppler test survey on a 13-station geodetic network, located in the vicinity of Fort Davis, Texas, is described. The primary objective of the test was to derive more definitive estimates for the accuracy of establishing geodetic control by Doppler relative positioning methods for stations spaced from a few meters to about 125 kilometers apart. Observations were performed simultaneously in seven phases with four Doppler receivers. Between 40 and 100 passes were observed during each phase. Accuracy estimates for point and relative positioning coordinates were determined from comparisons with results of a special three-dimensional adjustment (program HAVAGO) of the terrestrial survey data. Author

A84-18289#
PRECISE SPACE GEODETIC BASELINE MEASUREMENTS OF SCANDINAVIA IN SUPPORT OF THE NASA CRUSTAL DYNAMICS PROGRAM
A. J. ANDERSON (Joint Institute for Laboratory Astrophysics, Boulder, CO; Uppsala, Universitet, Uppsala, Sweden) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 737-754. Sponsorship: Naturvetenskapliga Forskningsradet. refs
(Contract NFR-G-3114-113)

A84-18290#
EARTH MOTION MEASUREMENTS ARE NOW PRACTICAL WITH THE NEW JMR GEODETIC DOPPLER SURVEY SYSTEM
P. J. ICENBICE, JR. (JMR Instruments, Inc., Chatsworth, CA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 783-799. refs

The employment of satellite-Doppler survey techniques is often considered in the case of applications for baseline measurements over mountains, forests, or other difficult terrain. A reliable and accurate satellite-Doppler instrument was developed with the objective to obtain a final system capable of three to eight centimeters of precision over 50 kilometer baselines in a network. The idealized technology goal represents one part per million (1PPM). Attention is given to colocation field test results, the problem of synchronizing lock-on time at two separate points, computed lock-on time delay for the JMR-1, path delay differences, earthquake prediction research with satellite-Doppler survey systems, and the densification of the geodetic data base. G.R.

A84-18291#
A MULTI-STATION DOPPLER SURVEY FOR CRUSTAL MOTION IN PAPUA NEW GUINEA
P. V. ANGUS-LEPPAN (New South Wales, University, Sydney, Australia) and B. SLOANE (Division of National Mapping, Canberra, Australia) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 813-821. refs

A84-18292#
NAVY NAVIGATION SATELLITE SYSTEM STATUS
G. W. HOSKINS (U.S. Navy, Strategic Systems Project Office, Washington, DC) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 825-841. refs

It is pointed out that the Navy Navigation Satellite System (TRANSIT) provides a global basis for operational navigation and for Doppler surveying. TRANSIT is widely used throughout the U.S. Navy and by commercial shipping as a worldwide highly reliable and highly precise all-weather navigation system. The operational constellation contains currently six satellites. TRANSIT was developed to support the Polaris missile firing submarine and has been in continuous use by the U.S. Navy Strategic Systems Project Office since 1963. It was released for public use by Presidential directive in 1967. Attention is given to a systems overview, the operational satellite configuration, the Nova satellite configuration, the tracking network, and ionospheric refraction correction. The current status of TRANSIT is briefly examined. It is found that TRANSIT remains a reliable aid to all which utilize it. G.R.

A84-18293#
NOVA-1: THE NEWEST TRANSIT SATELLITE - A STATUS REPORT
A. EISNER, S. M. YIONOULIS, J. A. PLATT, R. E. JENKINS, J. C. RAY, and L. L. PRYOR (Johns Hopkins University, Laurel, MD) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 843-862.
(Contract N00024-81-C-5301)

Four of the five satellites of the Navy Navigation Satellite System (Transit) which are currently in orbit were designed in 1963 and have been in continuous service for the last 7-14 years. Nova-1 as the newest addition to Transit was launched on May 14, 1981. Nova-1 has a number of new features. One of these features is the single-axis DIScos COmpensation System (DISCOS) which continuously compensates for atmospheric drag and solar radiation perturbations to the along-track motion of the spacecraft.The Incrementally Programmable Synthesizer (IPS) represents a high-precision, digitally-controlled frequency device which is employed to adjust the high quality master oscillator operating frequency of the spacecraft to a precise 'constant' desired frequency. Attention is given to Nova-1 objectives and accomplishments. G.R.

A84-18294#
MINI-RANGER SATELLITE SURVEY SYSTEM
H. L. KENNEDY (Motorola, Inc., Government Electronics Div., Tempe, AZ) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 863-882.

The Mini-Ranger Satellite Survey System (MRSSS) was recently introduced by an American aerospace company as an addition to its family of position determining systems. The MRSSS consists of a receiver processor, antenna-preamplifier, and interconnecting

cables. A description is provided of the modules or assemblies which make up the signal receiving and processing circuitry, taking into account the antenna characteristics, the preamplifier, and the high and low channel receiver interface modules. Attention is given to the data processor features, the data processor, the front panel interface, the keypad, the display, the tape recorder, the audible alarm, the power supply, the reference oscillator, the Doppler time interval, computation accuracy, and the operator interface. G.R.

A84-18295#
THE TECHNOLOGY REVOLUTION IN SATELLITE-DOPPLER FIELD SYSTEMS
P. D. RODGERS (JMR Instruments, Inc., Chatsworth, CA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 883-902.

A description is provided of a new concept involving the utilization of current microprocessor technology to satisfy many of the surveyor's needs and requirements. This concept was implemented in a new instrument which integrates current design technology in C-MOS microprocessors, memory devices, and hybrid circuits with new performance innovations to obtain significant improvements with respect to portability, reliability, and automation. The restrictive characteristics of current single-purpose satellite-Doppler positioning instruments have been eliminated in the new versatile system which can be reprogrammed within seconds for accomplishing a variety of computational tasks. G.R.

A84-18296#
IT'S ABOUT TIME - TRANSIT TIME
R. HATCH (Magnavox Advanced Products and Systems Co., Torrance, CA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 903-915.

The present investigation is concerned with the basic time sensitivity characteristics of the Transit Navigation Satellite System. Attention is given to the measurement equation, aspects of time jitter sensitivity, questions of time bias sensitivity, problems of receiver induced time bias, and satellite clock induced time bias. It is found that some reduced sensitivity to time jitter can be obtained by reducing the frequency offset. Thus, in the MX 702 Navigation receivers, the offset frequency was reduced to 20 kilohertz. In the WRN-5 navigation receiver, the offset was reduced to 750 hertz and positive and negative cycles were counted. An approach is discussed for completely removing the effect of time jitter in the case of survey type receivers. G.R.

A84-18297*# Ohio State Univ., Columbus.
A COMPARISON OF GEODETIC DOPPLER SATELLITE RECEIVERS
B. ARCHINAL and I. I. MUELLER (Ohio State University, Columbus, OH) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 917-935. refs
(Contract NSG-5265)

A great number of geodetic Doppler satellite receivers of various types have been employed since early 1970s. In October and November 1979, a comparison was conducted of three more recent types of receivers, including the CMA-751, the JMR-1A, and the MX-1502. A description of the studies involved in conducting the comparison is presented, taking into account the preliminary results obtained on the basis of the processing of the collected data. Attention is given to tracking statistics, chord difference results, range rate measurement errors, residual tests, station position repeatability, and absolute differences to ground control. Recommendations for future comparisons are also provided. G.R.

A84-18298#
EVALUATION OF ELECTRAC RECEIVER AND OSCILLATOR EFFECTS ON DOPPLER DATA QUALITY AT TRANET STATION 128 OTTAWA
J. KOUBA and J. A. OROSZ (Department of Energy, Mines and Resources, Gravity and Geodynamics Div., Ottawa, Canada) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 937-952. refs

A description is provided of three different types of frequency standards commonly used in Doppler tracking. An error modelling approach is employed for rubidium and crystal oscillators in order to determine the effect of the oscillator errors on Doppler counting. Tables are presented showing the coefficients of Markov process approximations for rubidium and crystal oscillators, the effect of position correlation introduced by crystal oscillator errors on position variances, and the sample correlation coefficients for 30 sec continuously counted Doppler counts and different types of frequency standards. Attention is given to hardware improvements to the Ottawa TRANET station, and an analysis of hardware performance and Doppler data quality is discussed. G.R.

A84-18299#
INVESTIGATIONS ON THE EFFECT OF SMALL ANTENNA MOVEMENTS IN TRANSIT DOPPLER POSITIONING
D. EGGE (Hannover, Universitaet, Hanover, West Germany) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 953-968. Research supported by the Deutsche Forschungsgemeinschaft. refs

The situation is investigated where the receiving antenna of satellite Doppler ground instrumentation is subjected to small movements. The effect of different types of motion during a satellite pass is analyzed for raw Doppler counts as well as for horizontal (2D) single pass point positioning and (rigorous) translocation. The questions of motion sensitivity, role of additional information on the antenna motion, and length of the Doppler count used in the position fix are considered. Results follow simulations and controlled condition translocation measurements. Author

A84-18300#
THE FAULT ZONE MONITORING SYSTEM
E. E. WESTERFIELD and K. A. POTOCKI (Johns Hopkins University, Laurel, MD) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 969-989. refs

The present investigation is concerned with a satellite system for monitoring geophysical parameters at a very large number of ground sites. The considered system is both a communication link to each ground terminal, and a geodetic measuring system for determining three-dimensioning basline vectors within a dense matrix of Remote Terminal Units (RTUs). The system has one spacecraft in a 900 km circular polar orbit, requires a Master Control Station (MCS) for satellite control, and can accommodate 10,000 active (transmitting) RTUs. The proposed system would provide two essential factors for developing the information needed for research in crustal dynamics, including a means for obtaining dense sets of precise geodetic measurements, and an efficient communications link for recovering data from in situ sensors. G.R.

A84-18301#
NAVSTAR GLOBAL POSITIONING SYSTEM - 1982
C. R. PAYNE, JR. (U.S. Defense Mapping Agency, Los Angeles, CA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 993-1021. refs

The NAVSTAR Global Positioning System (GPS) is a space-based radio positioning navigation system which has the

potential of providing highly accurate three-dimensional position and velocity information along with Coordinated Universal Time (UTC) to an infinite number of suitably equipped users. In August 1979, entry into the GPS Full-Scale Engineering Development (FSED) phase was approved. The Phase II FSED will validate the system and establish its operability and supportability through Development and Initial Operational Test and Evaluation programs. A general system description is presented, taking into account the space segment, the control segment, and the user segment. Attention is given to navigation principles, navigation accuracy, aspects of full-scale engineering development, and the phase III navigation message. G.R.

A84-18302#
GLOBAL POSITIONING SYSTEM GEODETIC TRACKING PROGRAM
H. R. HEUERMAN (U.S. Defense Mapping Agency, Hydrographic/Topographic Center, Washington, DC) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1041-1056.

The present study is primarily concerned with the interrelationship between the development of a new satellite navigation system, the NAVSTAR Global Positioning System (GPS), and the development of its potential for geodetic applications. Recognizing the potential of the GPS in relation to mapping, charting, and geodesy, the Defense Mapping Agency (DMA) became a participant in the development of GPS in August 1974. In the context of the geodetic applications of GPS, DMA is mainly concerned with the static (point) positioning capabilities of GPS. In this connection DMA is conducting extensive field test programs to develop information which will provide the basis for the evaluation of GPS with respect to point positioning, taking into account the hardware/software items needed to maximize accuracy and precision for mapping, charting, and geodesy applications. The results of these efforts to date are extremely promising. G.R.

A84-18303#
RELATIVE POSITIONING TEST USING THE GLOBAL POSITIONING SYSTEM AND DOPPLER TECHNIQUES
R. J. ANDERLE and A. G. EVANS (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1061-1078. refs

Since 1963, observations of Navy Navigation Satellites have been used to determine geodetic positions to one meter accuracy. However, phase or Doppler measurements on reconstructed Global Positioning System (GPS) carrier signals can be made to cm precision. Equipment was obtained which is capable of subcentimeter measurement precision, although the measurement precision is masked by oscillator instability for integration times of the order of a minute or more. Questions regarding the available possibilities were studied with the aid of a relative positioning test which was conducted in the Washington, DC area in September 1980. For the best set of available oscillators, relative station positions on 28 km baselines were computed with a repeatability of 30 cm in height, 80 cm East, and 10 cm North based on a 1000 minute Doppler data span, or a maximum sequential satellite tracking span of 725 minutes. G.R.

A84-18304#
NAVSTAR/GPS SINGLE POINT POSITIONING USING PSEUDO-RANGE AND DOPPLER OBSERVATIONS
G. LACHAPELLE, N. BECK, and P. HEROUX (Sheltech Canada, Calgary, Alberta, Canada) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1079-1091. refs

Mathematical models currently used by Sheltech Canada to process GPS pseudo-range and Doppler observations in single point positioning mode and using fixed orbits, i.e., assuming errorless broadcast ephemerides, are described. Results obtained with a STI 5010 GPS geodetic receiver during seven days of 10 to 18 hours of simultaneous pseudo-range and Doppler observations are presented. The agreement between daily solutions is of the order of five to 10 m which thus constitutes a measure of broadcast orbit accuracy. The agreement between daily GPS solutions and previously derived Transit satellite Doppler coordinates is of the same order of magnitude with no apparent biases between the coordinate systems involved. Differences between pseudo-range and Doppler solutions are also of the order of five to 10 m and are expected to be mostly due to time synchronization (absolute versus relative) of and between GPS satellites. Author

A84-18305#
COLOCATION TEST RESULTS FROM EXPERIMENTAL GLOBAL POSITIONING SYSTEM GEODETIC RECEIVERS
A. G. EVANS, R. J. ANDERLE, and B. R. HERMANN (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1093-1102.

Similar GPS geodetic receivers were connected to either the same antenna or to antennas placed less than 10-m apart. The receivers were connected to either the same or independent clocks. The receivers measured Doppler data from the same GPS satellites. Using these data, relative position estimates were determined and compared with surveyed values. Subdecimeter estimation accuracies were obtained using a common clock and about .5-m accuracies were obtained for separate clocks. The vacuum Doppler range measurement accuracy of the receivers was found to be 1.2 cm. Author

A84-18306#
GPS GEODETIC RECEIVER SYSTEM
M. L. SIMS (U.S. Navy, Naval Surface Weapons Center, Dahlgren, VA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1103-1121.

An overview of the GPS geodetic receiver system is presented. The receiver system uses a single measurement channel to track four satellites both in code and carrier on L1 and L2 frequencies. The paper, under the hardware and software sections, discusses the system's flexibility to satisfy the special user. The system's specification, anticipated applications and testing schedule to find out if it meets the specification, are also discussed. Author

A84-18307#
AN ADVANCED NAVSTAR GPS GEODETIC RECEIVER
P. WARD (Texas Instruments, Inc., Lewisville, TX) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1123-1142.

A description is presented of the mechanical, electrical, and performance characteristics of an advanced NAVSTAR Global Positioning System (GPS) geodetic receiver. The receiver makes use of advanced large-scale integration (LSI) custom components and common modules made available from the third generation of GPS receiver development programs. Attention is given to a functional overview, a mechanical description, the basic receiver modules, the multiplex receiver front end, multiplex features, the ability of the receiver processor to directly derive ultraprecise digital code and carrier phase measurements, aspects of multiplex timing, and demand-actuated measurements. G.R.

A84-18308*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SERIES - SATELLITE EMISSION RANGE INFERRED EARTH SURVEYING
P. F. MACDORAN, D. J. SPITZMESSER, and L. A. BUENNAGEL (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1143-1164. NASA-supported research. refs

The Satellite Emission Range Inferred Earth Surveying (SERIES) concept is based on the utilization of NAVSTAR Global Positioning System (GPS) radio transmissions without any satellite modifications and in a totally passive mode. The SERIES stations are equipped with lightweight 1.5 m diameter dish antennas mounted on trailers. A series baseline measurement accuracy demonstration is considered, taking into account a 100 meter baseline estimation from approximately one hour of differential Doppler data. It is planned to conduct the next phase of experiments on a 150 m baseline. Attention is given to details regarding future baseline measurement accuracy demonstrations, aspects of ionospheric calibration in connection with subdecimeter baseline accuracy requirements of geodesy, and advantages related to the use of the differential Doppler or pseudoranging mode. G.R.

A84-18310*# Massachusetts Inst. of Tech., Cambridge.
ACCURACY OF RELATIVE POSITIONING BY INTERFEROMETRY WITH GPS DOUBLE-BLIND TEST RESULTS
C. C. COUNSELMAN, III, S. A. GOUREVITCH, T. A. HERRING, B. W. KING, I. I. SHAPIRO (MIT, Cambridge, MA), R. J. CAPPALLO, A. E. E. ROGERS, A. R. WHITNEY (Haystack Observatory, Westford, MA), R. L. GREENSPAN (Charles Stark Draper Laboratory, Inc., Cambridge, MA), R. E. SNYDER (Steinbrecher Corp., Woburn, MA) et al. IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1173-1176.
(Contract F19628-80-C-0400; F19628-81-K-0015; NAS5-25053; NSF AST-79-20168)

MITES (Miniature Interferometer Terminals for Earth Surveying) observations conducted on December 17 and 29, 1980, are analyzed. It is noted that the time span of the observations used on each day was 78 minutes, during which five satellites were always above 20 deg elevation. The observations are analyzed to determine the intersite position vectors by means of the algorithm described by Couselman and Gourevitch (1981). The average of the MITES results from the two days is presented. The rms differences between the two determinations of the components of the three vectors, which were about 65, 92, and 124 m long, were 8 mm for the north, 3 mm for the east, and 6 mm for the vertical. It is concluded that, at least for short distances, relative positioning by interferometry with GPS can be done reliably with subcentimeter accuracy. C.R.

A84-18314#
A GEOMETRIC APPROACH WITH THE NAVSTAR GLOBAL POSITIONING SYSTEM
M. KUMAR, P. J. FELL, and A. J. PILKINGTON (U.S. Defense Mapping Agency, Hydrographic/Topographic Center, Washington, DC) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1233-1246. refs

In order to exploit the geodetic capability of the NAVSTAR Global Positioning System (GPS), it is necessary to evaluate all the performance characteristics of the system. The latest NAVSTAR constellation, as conceived today, will consist of 18 satellites, three in each of the six orbital planes equally inclined in space. This configuration gives a capability of viewing four to seven satellites at any time practically anywhere on the earth's surface and, as such, opens the possibility of utilizing a geometric approach to establish geodetic positions. The present paper discusses this approach and includes some preliminary results of a simulated environment. Author

A84-18318#
OFFSHORE POSITIONING WITH AN INTEGRATED GPS/INERTIAL NAVIGATION SYSTEM
R. V. C. WONG and K. P. SCHWARZ (Calgary, University, Calgary, Alberta, Canada) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1275-1288. Research supported by Sheltech Canada. refs

The paper investigates the accuracy of offshore positioning by combining the current generation of GPS receivers with a state of the art inertial system. The integration of the two systems for offshore surveying combines the advantages of both: the capability of the GPS for near-instantaneous position fixes and the excellent interpolation accuracy of the inertial system between fixes. Such a system can be used with the present configuration of GPS-satellites and provides an economical solution to the offshore positioning problem in areas where conventional methods are not available or not accurate enough. The simulation study concentrates on two questions: the position accuracy achievable with different satellite configurations and the determination of optimal update intervals. Author

A84-18319#
INTERFEROMETRIC ATTITUDE DETERMINATION USING THE GLOBAL POSITIONING SYSTEM - A NEW GYROTHEODOLITE
A. K. BROWN, T. P. THORVALDSEN (Charles Stark Draper Laboratory, Inc., Cambridge, MA), and W. M. BOWLES (MIT, Cambridge, MA) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 2 . Las Cruces, NM, New Mexico State University, 1983, p. 1289-1302.

A GPS receiver can measure absolute position to 5 meters. However, it is possible to measure relative position more accurately by using interferometry on the GPS carrier to measure heading. Simulation has shown that a dynamically aided, three antennae, short baselength GPS interferometer can measure heading to an accuracy of 50 microrad. Relative position can be determined from this heading measurement by sighting onto control stations with a theodolite mounted on the interferometer. If the control stations were 1 km distant it would be possible to measure relative position, using a GPS interferometer, to within 5 cm. Author

A84-18492
RADIO-GEODESIC SYSTEMS IN AERIAL MAPPING [RADIOGEODEZICHESKIE SISTEMY V AEROS'EMKE]
V. N. BALANDIN Moscow, Izdatel'stvo Nedra, 1983, 144 p. In Russian. refs

The technical procedures associated with radio-geodesic measurements during the aerial mapping of land and water areas in cartographic, geological, geophysical, geographical, hydrological, and oceanographic studies are discussed. The radio-geodesic equipment and automated measuring systems used are described. Particular attention is given to the accuracy of radio-geodesic measurements and to the planning and organization of aerial mapping. V.L.

N84-10651# Analytic Sciences Corp., Reading, Mass.
ASSESSMENT OF MEANS FOR DETERMINING DEFLECTION OF THE VERTICAL Interim Technical Report, 1 Dec. 1981 - 31 May 1982
W. G. HELLER, A. R. LESCHACK, and S. F. CUSHMAN Fort Belvoir, Va. Army Engineer Topographic Labs. Aug. 1982 211 p refs
(Contract DAAK70-82-C-0011; DA PROJ. 4A7-62707-AF-55)
(AD-A131286; TASC-TR-4051-1; ETL-0303) Avail: NTIS HC A10/MF A01 CSCL 08E

This Interim Technical Report documents the first phase of a study of methods for determining deflections of the vertical. In

this phase, the astrogeodetic and gravimetric methods have been examined. The objectives of these investigations have been: assessment of the accuracy of alternative astrogeodetic procedures; identification and analysis of potential improvements in astrogeodetic instrumentation; documentation of the gravimetric method and identification of achievable accuracy; development of error models for astrogeodetic and gravimetric techniques. The second phase of this program will address techniques for determining deflections of the vertical from combinations of astrogeodetic, gravimetric, inertial, and gradiometric techniques.
Author (GRA)

N84-11528# Bonn Univ. (West Germany). Inst. fuer Geodaesie.
STUDIES OF SATELLITE GEODESY, VERY LONG BASELINE INTERFEROMETRY (VLBI) AND GEODETIC MEASURING TECHNIQUES [ARBEITEN ZUR SATELLITENGEODAESIE, VLBI UND GEODAETISCHEN MESSTECHNIK]
W. HOFMANN and H. ZETSCHE 1982 158 p refs In GERMAN; ENGLISH summary
(BONN-MITT-65; ISSN-0723-4325) Avail: NTIS HC A08/MF A01

An experiment to measure microkinematic processes on the surface of the Earth is presented. Interdisciplinary aspects of technical measurements on building sites are discussed. The precision and utilization of a digital barometer based on the piezoresistive principle are investigated. Variations of ocean surfaces are studied from ERS-1 altimeter data for repetitive orbits. Measuring methods using automatic seconds theodolites are presented. A geoid profile across the Alps is determined using Doppler measurements of the US Navy Navigation Satellite System. A hygrometer, a distance meter and an autoranger are tested. The Mark 3-VLBI data analysis system is discussed.

N84-11532# Bonn Univ. (West Germany). Inst. fuer Theoretische Geodaesie.
VARIATIONS OF OCEAN SURFACES FROM ERS-1 ALTIMETER DATA FOR REPETITIVE ORBITS [AENDERUNGEN DER OZEANOBERFLAECHE AUS DEN ERS-1 ALTIMETERDATEN FUER REPETITIVE]
K. R. KOCH and D. FRITSCH *In its* Studies of Satellite Geodesy, Very Long Baseline Interferometry (VLBI) and Geodetic Meas. Tech. p 33-38 1982 refs In GERMAN; ENGLISH summary
Avail: NTIS HC A08/MF A01

A distinction was made between geoid undulations and the levels of ocean surfaces in order to discern the geoid and to eliminate the errors of orbit calculation and altimeter measurements. Methods to eliminate the errors of the altimeter measurements of ERS-1 and the errors of the orbit computations for ERS-1, and to discriminate between the geoid undulations and the sea surface topography in the altimeter data are discussed. Author (ESA)

N84-11540 Deutsche Gesellschaft fuer Forschung und Technologie e.V., Bochum (West Germany).
THE ROLE OF THE GEOID IN HIGH PRECISION GEODESY AND OCEANOGRAPHY
C. RIZOLS 1982 66 p refs Sponsored by Alexander von Humboldt Foundation
(SER-A-96; ISBN-3-7696-8178-9; ISSN-0065-5309) Avail: Issuing Activity

The effect of sea surface topography on the Molodenskii boundary value problem (BVP); and the formulation of a free BVP solution to + or - 10 cm precision from surface gravity data that cannot be considered referenced to a unique vertical datum surface are discussed. The relevance of high precision BVP solutions from surface gravity data given that 70% of the Earth's surface has been measured by satellite altimetry is considered. The role of concepts such as the geoid and geodetic techniques such as altimetry in ocean dynamical studies is examined. The lack of a model of the Earth's gravity field with the precision required for satellite remote sensing of ocean dynamics, and the impossibility of defining the geocentric position of an altimetry satellite at the decimeter level globally on a routine basis are stressed.
Author (ESA)

N84-11541 Deutsche Gesellschaft fuer Forschung und Technologie e.V., Bochum (West Germany).
A CONTRIBUTION TO 3D-OPERATIONAL GEODESY. PART 3: OPERA, A MULTIPURPOSE PROGRAM FOR OPERATIONAL ADJUSTMENT OF GEODETIC OBSERVATIONS OF TERRESTRIAL TYPE
G. HEIN and H. LANDAU 1983 83 p refs Sponsored by Deutsche Forschungsgemeinschaft
(SER-B-264-PT-3; ISBN-3-7696-8557-1; ISSN-0065-5317) Avail: Issuing Activity

A program system that combines all geodetic measurements in one unified model is presented. It is shown that potential differences can be combined with other geodetic observations in order to build a three dimensional geodesy. Since astronomical observations can be interchanged with gravity measurements, the astronomical values in a combination of both types can be controlled. Separation of refraction influences from those of the plumbline deflections in the observations is improved. Extension to the fourth dimension is discussed. Author (ESA)

N84-12554 Bayerische Akademie der Wissenschaften, Munich (West Germany).
INVESTIGATION OF MATHEMATICAL MODELS TO COMBINE A TERRESTRIAL NETWORK WITH A SATELLITE NETWORK Ph.D. Thesis [UNTERSUCHUNG DER MATHEMATISCHEN MODELLE ZUR KOMBINATION EINES TERRESTRISCHEN NETZES MIT EINEM SATELLITENNETZ]
Z. ZHOU 1983 97 p refs In GERMAN; ENGLISH summary
(SER-C-274; ISBN-3-7696-9326-4; ISSN-0065-5325) Avail: Issuing Activity

Transformation models were investigated in order to transform a terrestrial geodetic network into a geocentric reference system (satellite network) and vice versa. Besides the transformation parameters (translation, rotation) the models also determine systematic scale and orientation errors of the terrestrial network. The theoretical models are proven by numerical examples.
Author (ESA)

N84-12669# Ohio State Univ., Columbus. Dept. of Geodetic Science and Surveying.
ACCURACY ESTIMATES OF GRAVITY POTENTIAL DIFFERENCES BETWEEN WESTERN EUROPE AND UNITED STATES THROUGH LAGEOS SATELLITE LASER RANGING NETWORK
D. P. HAJELA Feb. 1983 76 p
(Contract F19628-82-K-0022; AF PROJ. 2309)
(AD-A131838; OSU/DGSS-345; AFGL-TR-83-0132; SR-3) Avail: NTIS HCA05/MFA01 CSCL 08E

The presently attainable accuracy of connecting the vertical datums of regions, which are separated by oceans, has been investigated. The vertical datum connections are established through geocentric positions of laser tracking stations by estimating the geopotential at these stations, and also utilizing the geopotential differences between stations in each region obtained through leveling. The Western Europe-USA vertical datum connection has been examined in detail. Accuracy estimates of a few other datum connections are also given. Four stations in Western Europe and 14 stations in USA were considered in the Lageos satellite laser ranging (SLR) network (January 1982). The currently available accuracy estimates (December 1981) of the potential coefficients describing the earth's gravity field to degree 180 were used, along with gravity anomalies in a small area around each SLR station. Various anomaly spacing, data cap size, anomaly accuracy were tried to determine the effect on the accuracy of the vertical datum connection. It was found that anomaly spacing need not be more dense than 10 prime. Different accuracy estimates for the SLR station positions, and any displacement of the SLR coordinate system origin from the geocenter, were considered. The corresponding values for the vertical connection, if anomalies were used in a data cap of 1 deg radius, were 50 and 52 kgal/cm.
GRA

04

GEOLOGY AND MINERAL RESOURCES

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

N84-13633*# Georgia Univ., Athens. Dept. of Geography.
COMPARATIVE ASSESSMENT OF LANDSAT-4 MSS AND TM DATA QUALITY FOR MAPPING APPLICATIONS IN THE SOUTHEAST
R. WELCH 7 Jan. 1983 3 p Sponsored by NASA ERTS
(E84-10040; NASA-CR-174592; NAS 1.26:174592) Avail: NTIS HC A02/MF A01 CSCL 05B

The initial objectives of analyses of the MSS data are two-fold: (1) to evaluate the geodetic accuracy of CCT-P data of the test sites; and (2) to improve the geodetic accuracy by additional processing if the original data either do not meet pre-launch specifications or mapping requirements. The location of 45 ground control points (GCP) digitized from 35 U.S. Geological Survey 1:24,000 scale quadrangles (UTM coordinates) were identified in terms of pixel and scan line values. These 46 points are used to establish UTM position error vector distributions in the scene. As an initial check on the geometric reliability of the MSS data, 28 well-distributed GCPs were input to a program which compares the scaled image distances between all possible point pairs with the corresponding map distances and computes the distance differences; that is, the relative positional errors. The relative errors obtained from initial computations averaged about +/- 200 m. These errors could result from a number of sources, including misidentification of GCP locations, UTM coordinate errors introduced by the map digitizing process or errors resulting from data acquisition and geometric processing. M.G.

N84-14572*# Johns Hopkins Univ., Baltimore, Md.
GEOID ANOMALIES AND FRACTURE ZONES IN THE PACIFIC OCEAN
1984 11 p ERTS
(Contract NAG5-32)
(E84-10052; NASA-CR-174581; NAS 1.26:174581) Avail: NTIS HC A02/MF A01 CSCL 08B

The high degree and order geoid field in the Pacific is a superposition of fracture zone anomalies and hot-spot swell anomalies. A two-dimensional spectral analysis of this field reveals a very strong north-south wavenumber contribution with a dominant wavelength of about 2000 km, a much smaller contribution from east-west wavenumbers, and negligible contributions from other directions. One dimensional profiles were taken in order to appreciate the magnitudes of the north-south and east-west components. A calculated geoid anomaly using an idealized fracture zone model contains just about the same amount of power in the 2350 km band wavelength as does the north-south profile of the SEASAT geoid field. In an attempt to correlate plate age with geoid anomalies, a digitized age map of the Pacific was used to generate a synthetic geoid, which was subtracted from SEASAT. This procedure produces a residual geoid in which the fracture zone anomalies appear to be diminished, if not removed. A.R.H.

N84-15627*# Wisconsin Univ., Madison. Geophysical and Polar Research Center.
INVESTIGATION OF ANTARCTIC CRUST AND UPPER MANTLE USING MAGSAT AND OTHER GEOPHYSICAL DATA M.S. Thesis. Final Report, Sep. 1979 - Aug. 1983
C. R. BENTLEY and M. H. RITZWOLLER 1 Sep. 1983 141 p refs ERTS
(Contract NAS5-25977)
(E84-10055; NASA-CR-173136; NAS 1.26:173136) Avail: NTIS HC A07/MF A01 CSCL 08G

Data selection and reduction procedures are described by which scalar and vector magnetic anomaly maps are constructed. The scalar and vertical magnetic anomalies are believed to be generated mainly in the Earth's crust. The horizontal anomalies are believed to be mainly due to short-period field-aligned currents. The correlation of scalar magnetic anomalies with known oceanic structure is remarkable -- magnetic highs are associated with oceanic ridges and magnetic lows with abyssal plains. The correlation between anomalies and continental geology is not so clear. Author

A84-10888
IMPLICATIONS OF INFORMATION FROM LANDSAT-4 FOR PRIVATE INDUSTRY
J. R. EVERETT and J. D. DYKSTRA (Earth Satellite Corp., Chevy Chase, MD) IN: Space applications at the crossroads; Proceedings of the Twenty-first Goddard Memorial Symposium, Greenbelt, MD, March 24, 25, 1983 . San Diego, CA, Univelt, Inc., 1983, p. 109-115.
(AAS PAPER 83-163)

The broader spectral coverage and higher resolution of Landsat-4 Thematic Mapper (TM) data open the door for identification from space of spectral phenomena associated with mineralization and microseepage of hydrocarbon. Digitally enhanced image products generated from TM data allow the mapping of many major and minor structural features that mark or influence emplacement of mineralization and accumulation of hydrocarbons. These improvements in capabilities over multispectral scanner data should accelerate the acceptance and integration of satellite data as a routinely used exploration tool that allows rapid examination of large areas in considerable detail. Imagery of Southern Ontario, Canada as well as of Cement, Oklahoma and Death Valley, California is discussed. Previously announced in STAR as N83-26153 A.R.H.

A84-12126
AIRBORNE GAMMA-RAY SPECTROMETRY IN GEOLOGY [AEROGAMMA-SPEKTROMETRIIA V GEOLOGII]
L. N. VAVILIN, V. P. VOROBEV, A. V. EFIMOV, D. S. ZELENETSKII, A. V. MATVEEV, and V. V. FILIMONOV Leningrad, Izdatel'stvo Nedra, 1982, 272 p. In Russian. refs

The work examines aspects of the design and practical application of airborne gamma-ray spectrometry (AGS) for purposes of mineral exploration. The geological-geochemical, physical, and instrumental-methodological principles underlying this remote-sensing technique are described, and means of error reduction are considered. Methods of the geological interpretation of the data are examined along with features characterizing the application of AGS in solving geological problems. Finally, trends of further development are discussed. B.J.

A84-13029
IRON OXIDE GENESIS AND ITS INFLUENCE ON THE SPECTRAL REFLECTANCE PROPERTIES OF GOSSANS
G. ACCAME (Greenhorne and O'Mara, Inc., Riverdale, MD), B. ROBINSON, and L. BIEHL (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 225-232. Sponsorship: U.S. Bureau of Mines and U.S. Office of Surface Mining Reclamation and Enforcement. refs
(Contract USBM-G1106009; OSMRE-65106009)

X ray diffraction, goniometry and spectroradiometry were performed on gossans, iron-rich material produced by the weathering of iron-sulfide bearing rocks, to determine the usefulness of remote sensing for detecting minerals beneath the gossans. An analyses made of mine tailings revealed that goethite precipitated early and was followed by jarosite and hematite. It was concluded that spectral reflectance is a viable technique for evaluating local iron oxide mineralogy. However, Landsat data may be too coarse to be applied to specific areas. It is expected that increased remote sensing resolution will in the future permit mineral identification when combined with a data base of geochemical evolutionary processes. M.S.K.

A84-13033
DETECTION OF IRON ORE AT WADI EL-MUWEIH AREA DUE WEST OF QUSEIR, EGYPT USING DIGITAL PROCESSING OF LANDSAT DATA
M. E. HABIB and N. A. SHARARA (Assiut University, Assiut, Egypt) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 257-262. refs

A84-13120
LOCALIZED GEOMAGNETIC FIELD CHANGES NEAR ACTIVE FAULTS IN CALIFORNIA 1974-1980
P. M. DAVIS (California, University, Los Angeles, CA) and M. J. S. JOHNSTON Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 10, 1983, p. 9452-9460. Sponsorship: U.S. Geological Survey. refs
(Contract USGS-14-08-0001-19246)

A84-13345
ENHANCEMENT OF THE IMAGE RESOLUTION AND GEOLOGICAL INTERPRETATION - A STUDY OF MIXING LANDSAT RBV-MSS DATA ON MARSEILLE [AMELIORATION DE LA RESOLUTION DE L'IMAGE ET INTERPRETATION GEOLOGIQUE - ETUDE D'UN MIXAGE LANDSAT RBV-MSS SUR MARSEILLE]
J. CHOROWICZ (Paris VI, Universite, Paris, France), M. GUY, C. LALLEMAND, and G. LEGENDRE (Institut Francais de Petrole, Rueil-Malmaison, Hauts-de-Seine, France) Photo Interpretation (ISSN 0031-8523), vol. 21, May-June 1982, 24 p. In French, English, and Spanish.

A84-13609* Arkansas Univ., Fayetteville.
SHUTTLE IMAGING RADAR - GEOLOGIC APPLICATIONS
H. MACDONALD, L. BRIDGES, W. WAITE, and V. KAUPP (Arkansas, University, Fayetteville, AR) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 272-281. refs
(Contract JPL-954940)

The Space Shuttle, on its second flight (November 12, 1981), carried the first science and applications payload which provided an early demonstration of Shuttle's research capabilities. One of the experiments, the Shuttle Imaging Radar-A (SIR-A), had as a prime objective to evaluate the capability of spaceborne imaging radars as a tool for geologic exploration. The results of the experiment will help determine the value of using the combination of space radar and Landsat imagery for improved geologic analysis and mapping. Preliminary analysis of the Shuttle radar imagery with Seasat and Landsat imagery from similar areas provides evidence that spaceborne radars can significantly complement Landsat interpretation, and vastly improve geologic reconnaissance mapping in those areas of the world that are relatively unmapped because of perpetual cloud cover. Author

A84-13610
ANALYSIS OF FRACTURE TRACES AND LINEAMENTS IN TENNESSEE
P. M. MASUOKA (Tennessee, University, Knoxville, TN) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 282-292. Research supported by the Geological Society of America. refs

A84-13614* Cornell Univ., Ithaca, N.Y.
AN ANALYSIS OF SEASAT SAR FOR DETECTING GEOLOGIC LINEARS
S.-Y. YAN, W. R. PHILIPSON, and W. L. TENG (Cornell University, Ithaca, NY) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 435-442. refs
(Contract NGL-33-010-171)

The value of Seasat synthetic aperture radar (SAR) imagery for detecting geologic linears was assessed in a study of an 89,000 sq km section of New York's Adirondack Mountains. A photographic print of optically processed, 1:500,000 scale SAR imagery (one look direction) was analyzed visually, and the detected linears were compared to those recorded on a 1:250,000 scale geologic map. Eighty percent of the 4,170 km of mapped, geologic linears were detected with the SAR imagery. Moreover, nearly 6,900 km of unmapped linears were also detected. Of these, an estimated 90 percent could be observed on high altitude aerial photographs. The relationship between SAR image detection of linears and the different types of indicators (e.g., straight valleys or shorelines) is reported. Author

A84-14043
IDENTIFICATION OF TARGET AREAS FOR MICA PEGMATITES IN EASTERN INDIA USING PHOTO-INTERPRETATION
P. K. GUHA and S. CHAKRAVARTI (Geological Survey of India, Calcutta, India) ITC Journal (ISSN 0303-2434), no. 1, 1983, p. 13-16. refs

A84-14843
THE DEEP STRUCTURE OF THE EARTH'S CRUST ACCORDING TO SPACE IMAGES [GLUBINNAIA STRUKTURA ZEMNOI KORY NA KOSMICHESKIKH IZOBRAZHENIIAKH]
G. A. TUMANIAN (Upravlenie Geologii, Yerevan, Armenian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 32-39. In Russian. refs

A comparison of geophysical and geological data with results of the interpretation of space images of different scales made it possible to extend results of geological-geophysical profiling to the whole territory of Armenia and to construct a three-dimensional model of the crustal structure. It is noted that new trends in structural-tectonic division and in the investigation of mineral deposits can be revealed by the study of the deep structure of 'hidden' structure elements on the basis of the interpretation of remote-sensing images and, hence, by the clarification of the block structure of the granite-metamorphic basement. B.J.

A84-14844
INDICATION OF FACTORS OF THE DEVELOPMENT OF EXOGENIC PROCESSES ACCORDING TO SPACE IMAGES OF ARID TERRITORIES [INDIKATSIIA FAKTOROV RAZVITIIA EKZOGENNYKH PROTSESSOV PO KOSMICHESKIM SNIMKAM ARIDNYKH TERRITORII]
A. I. SVITNEV, M. I. BURLESHIN, and I. D. KOLESNIKOV (Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 40-48. In Russian. refs

The possibility of using space images of different levels of generalization for the indication of the geological-structural and climatic factors of the development of exogenic processes is examined. By way of example, attention is given to the study of the development of karst, aeolian, and landslide processes on the basis of space images of a local level of generalization for arid platform regions. B.J.

A84-14845
STRUCTURAL-GEOMORPHOLOGICAL INTERPRETATION OF LINEAMENTS DISCLOSED ON SPACE IMAGES AND REGULARITIES OF THE DISTRIBUTION OF MINERAL DEPOSITS [STRUKTURNO-GEOMORFOLOGICHESKAIA INTERPRETATSIIA LINEAMENTOV, VYIAVLENNYKH PO KOSMICHESKIM SNIMKAM, I ZAKONOMERNOSTI RAZMESHCHENIIA POLEZNYKH ISKOPAEMYKH]
A. E. FEDOROV and E. K. ELISTRATOVA (Proizvodstvennoe Geologicheskoe Ob'edinenie Aerogeologiia, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 49-59. In Russian. refs

A84-15297
FRACTURE DETECTION BY AIRBORNE MICROWAVE RADIOMETRY IN PARTS OF THE MISSISSIPPII EMBAYMENT, MISSOURI AND TENNESSEE
D. W. OLEARY, G. R. JOHNSON, and A. W. ENGLAND (Office of Energy and Marine Geology, Woods Hole, MA) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Dec. 1983, p. 509-523. refs

Airborne microwave radiometry is a promising remote sensing technique for detecting buried fractures in areas of low relief and uniform soil cover. The technique was applied to two areas in the alluvial part of the Mississippi embayment, near Blytheville, Missouri, and Ridgely, Tennessee, where faults and fractures have been reported. Microwave and infrared soil brightness temperatures were obtained from an aircraft flying along parallel lines. These data were digitized and the values mathematically converted to microwave emissivities. The complements of emissivity (absorptivity) along the flight lines were cross-correlated. Lines of high correlation represent lineaments on the ground defined by anomalously high moisture contents. In the Blythevile area, the orientation and positions of these lines correspond well to reported fracture patterns; in the Ridgely arrea, the major anomaly corresponds generally to the known trend of the Ridgely and Cottonwood Grove faults. Discrepancies in correspondence are, as yet, poorly understood. Author

A84-15921
SIDE-LOOKING RADAR, A TOOL FOR GEOLOGICAL SURVEYS
B. N. KOOPMANS (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) Remote Sensing Reviews (ISSN 0275-7257), vol. 1, pt. 1, 1983, p. 19-69. refs

Among the advantages of side-looking radar as a remote sensing system is its effectiveness in all types of weather. A brief historical survey discusses the mapping project over the Darien Province, Republic of Panama, in 1967 and the work done in Brazil in 1970. The factors that distinguish real aperture radars from synthetic aperture radars are discussed, along with the advantages and limitations of each. Attention is also given to the frequency band and polarization, to the look direction and depression angle, and to terrain orientation. It is noted that synoptic imagery allows for good recognition of large-scale structures and that SAR data are especially valuable for fracture and lineament studies. It is stressed that in the future, more use has to be made of digital storage and processing to widen the dynamic range of radar imagery. C.R.

A84-15953* Washington Univ., St. Louis, Mo.
DIGITAL IMAGE PROCESSING APPLIED TO ANALYSIS OF GEOPHYSICAL AND GEOCHEMICAL DATA FOR SOUTHERN MISSOURI
E. A. GUINNESS, R. E. ARVIDSON, C. E. LEFF, M. H. EDWARDS, and D. L. BINDSCHADLER (Washington University, St. Louis, MO) Economic Geology and Society of Economic Geologists, Bulletin (ISSN 0361-0128), vol. 78, 1983, p. 654-663. NASA-supported research. refs
(Contract NAG9-24)

Digital image-processing techniques have been used to analyze a variety of geophysical and geochemical map data covering southern Missouri, a region with important basement and strata-bound mineral deposits. Gravity and magnetic anomaly patterns, which have been reformatted to image displays, indicate a deep crustal structure cutting northwest-southeast through southern Missouri. In addition, geologic map data, topography, and Landsat multispectral scanner images have been used as base maps for the digital overlay of aerial gamma-ray and stream sediment chemical data for the 1 x 2-deg Rolla quadrangle. Results indicate enrichment of a variety of elements within the clay-rich alluvium covering many of the interfluvial plains, as well as a complicated pattern of enrichment for the sedimentary units close to the Precambrian rhyolites and granites of the St. Francois Mountains. V.L.

A84-16345
PETROLEUM EXPLORATION AND LANDSAT IMAGERY - A METHOD OF PRELIMINARY EVALUATION
M. HAYASHI (Idemitsu Oil Development, Co., Ltd., Tokyo, Japan) (Japanese Association of Petroleum Technologists, Journal, vol. 46, no. 6, p. 449-460) Energy Developments in Japan (ISSN 0161-8091), vol. 6, Dec. 8, 1983, p. 99-118. Translation. refs

Case studies of detection of geomorphological anomalies associated with hydrocarbon productive areas in Burma and the North China Basin through Landsat imagery are presented, integrating remote sensing data with geological and geophysical information. Discrimination of lineaments with tectonic origin in Landsat imagery is proposed when the role of faults is considered to be important for petroleum migration and accumulation. Landsat imagery is used to introduce a working hypothesis on the reconstruction of the geologic history of Burma. Predictions of new oil fields in the North China Basin are made for areas where subbasins with thicker sediments are developed, for areas adjacent to potential hydrocarbon kitchens, and for areas where circular features and lineaments are observed. J.N.

A84-18050#
THE APPLICATION OF SATELLITE POTENTIAL FIELD DATA TO REGIONAL GEOLOGICAL/GEOPHYSICAL STUDIES
R. D. REGAN (Colorado School of Mines, Golden, CO) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 22nd, Reno, NV, Jan. 9-12, 1984. 7 p. refs
(AIAA PAPER 84-0379)

Current and potential uses of satellite magnetic-field and gravity measurements in regional-scale geological and geophysical investigations are reviewed. The general aims of the satellite programs (such as Magsat) are indicated, and the principles of geological/geophysical surveying (e.g., for oil exploration) are introduced. Magnetic-anomaly studies and geomagnetic-field models, as well as geoids and gravitational-anomaly observations using satellite and aerial data are discussed. The two-satellite NASA Geopotential Research Mission planned for about 1994 is briefly characterized, and the use of Landsat-type image-processing techniques such as coloring, intercomparison, and perspective viewing for the analysis and display of geophysical data is proposed. D.G.

A84-18656
UTILIZATION OF SEISMICALLY RECORDED INFRASONIC-ACOUSTIC SIGNALS TO MONITOR VOLCANIC EXPLOSIONS: THE EL CHICHON SEQUENCE 1982 - A CASE STUDY
F. J. MAUK (Teledyne Geotech, Geophysical Research Dept., Garland, TX) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Dec. 10, 1983, p. 10385-10401. refs
(Contract DARPA ORDER 4246; F49620-81-C-0056)

A84-19047
GEOLOGICAL INTERPRETATION OF SIR-A RADAR IMAGES OF KEFALLINIA AND SOUTHERN AKARNANIA (WESTERN GREECE) [INTERPRETATION GEOLOGIQUE DES IMAGES-RADAR SIR-A DE L'ILE DE CEPHALONIE ET DU SUD DE L'AKARNANIE (GRECE OCCIDENTALE)]
D. SOREL and M. CUSHING (Paris XI, Universite, Orsay, Essonne, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 91, 1983, p. 37-45. In French. refs

N84-10645*# Washington Univ., St. Louis, Mo. Center for the Space Sciences.
STRUCTURE OF THE SAINT FRANCOIS MOUNTAINS AND SURROUNDING LEAD BELT, SOUTH EAST MISSOURI: INFERENCES FROM THERMAL IR AND OTHER DATA SETS Final Report
R. E. ARVIDSON, *Principal Investigator*, E. A. GUINNESS, and D. L. BINDSCHADLER Apr. 1983 78 p refs Original contains color imagery. Original imagery may be purchased from NASA Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
(Contract NAS5-26533)
(E84-10027; NASA-CR-170591; NAS 1.26:170591) Avail: NTIS HC A05/MF A01 CSCL 05B

Several digital data sets were registered to a common base map for southern Missouri. These registered data sets were examined in an attempt to improve our understanding of the crustal structure and the relationships between structure and Pb-Zn-Cu, Fe, Mn, and Ba ores in the area. Data included land station reading of gravity, geologic data, and Heat Capacity Mapping Mission (HCMM) images. The HCMM day infrared (IR) images of Missouri displayed linear features, which parallel a newly discovered NW-SE trending Bouguer gravity low. The structural pattern over the gravity low suggests vertical uplift of the low density crust via isostatic readjustment and consequent fracturing of the Paleozoic sedimentary cover. The presence of a gravity low is interesting because rifts are often sites of extensive mineralization. The HCMM thermal data were also examined in conjunction with digital topography, land use, and LANDSAT MSS data to understand the phenomena that produce linears on the HCMM day IR images. Finally, the kinds of information that can be extracted from day-night IR pairs are discussed. M.G.

N84-10683# Pennsylvania State Univ., University Park. College of Earth and Mineral Sciences.
LATERAL VARIATIONS IN GEOLOGIC STRUCTURE AND TECTONIC SETTING FROM REMOTE SENSING DATA Final Report, 16 Mar. 1980 - 30 Sep. 1982
S. S. ALEXANDER May 1983 231 p refs
(Contract AF-AFOSR-3340-77; AF PROJ. A032)
(AD-A130758; AFOSR-83-0610TR) Avail: NTIS HC A11/MF A01 CSCL 08G

The principal objective of this study was: (1) to assess the usefulness of remote sensing digital imagery, principally LANDSAT multispectral scanning (MSS) data, for inferring lateral variations in geologic structure and tectonic setting; and (2) to determine the extent to which these inferred variations correlate with observed variations in seismic excitation from underground nuclear explosion test sites in the Soviet Union. Soviet, French and U.S. test sites have been investigated to compare their geologic and tectonic responses as seen by LANDSAT. The characteristics of 'granite' intrusive bodies exposed at Semipalatinsk (Degelen), North Africa (Hoggar), NTS (Climax stock), and an analog site in Maine (Mt. Katahdin), have been studied in detail. The tectonic stress field inferred from the tectonic release portion of seismic signatures of explosions in these three areas is compared with local and regional fracture patterns discernable from imagery. The usefulness of satellite synthetic aperture radar (SAR) to determine geologic conditions and delineate fault (fracture) patterns is demonstrated by the analysis of SEASAT data for an area in the eastern United States. Algorithms to enhance structural boundaries and to use textures to identify rock types were developed and applied to several test sites. Author (GRA)

N84-11544*# Earth Satellite Corp., Chevy Chase, Md.
STUDY OF LANDSAT-D THEMATIC MAPPER PERFORMANCE AS APPLIED TO HYDROCARBON EXPLORATION Quarterly Progress Report, 7 Jun. - 7 Oct. 1983
7 Oct. 1983 3 p ERTS
(Contract NAS5-27384)
(E84-10003; NASA-CR-174518; NAS 1.26:174518; QPR-4) Avail: NTIS HC A02/MF A01 CSCL 08B

Activities in support of thematic mapper 'A'-tape analysis, field work in the Cement-Velma, Oklahoma areas, and continued interpretation and assessment of imagery of various test sites are reported. The objectives of the A-tape analysis are: (1) to examine the radiometric loss of data quality introduced by resampling to P-tape format; (2) to seek a better distriping of the image by replacing the NASA matching of radiometry to on-board calibration data with an EarthSat matching of the histograms for each of the sixteen detectors, processing separately for forward and backward scanner sweeps; and (3) to produce an image with improved appearance and improved radiometeric qualities. M.G.

N84-11557*# Earth Satellite Corp., Chevy Chase, Md.
CONTRIBUTION OF LANDSAT-4 THEMATIC MAPPER DATA TO GEOLOGIC EXPLORATION
J. R. EVERETT, J. D. DYKSTRA, and C. A. SHEFFIELD 1983 8 p Sponsored by NASA ERTS
(E84-10021; NASA-CR-174551; NAS 1.26:174551) Avail: NTIS HC A02/MF A01 CSCL 08B

The increased number of carefully selected narrow spectral bands and the increased spatial resolution of thematic mapper data over previously available satellite data contribute greatly to geologic exploration, both by providing spectral information that permits lithologic differentiation and recognition of alteration and spatial information that reveals structure. As vegetation and soil cover increase, the value of spectral components of TM data decreases relative to the value of the spatial component of the data. However, even in vegetated areas, the greater spectral breadth and discrimination of TM data permits improved recognition and mapping of spatial elements of the terrain. As our understanding of the spectral manifestations of the responses of soils and vegetation to unusual chemical environments increases, the value of spectral components of TM data to exploration will greatly improve in covered areas. M.G.

N84-11559*# Johns Hopkins Univ., Baltimore, Md. Dept. of Earth and Planetary Sciences.
ON GRAVITY FROM SST, GEOID FROM SEASAT, AND PLATE AGE AND FRACTURE ZONES IN THE PACIFIC
B. D. MARSH, J. G. MARSH, and R. G. WILLIAMSON (EG and G Washington Analytical Services Center, Inc., Riverdale, Md.) 1983 39 p refs Prepared in cooperation with NASA. Goddard Space Flight Center, Greenbelt, Md. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10025; NASA-CR-170593; NAS 1.26:170593) Avail: NTIS HC A03/MF A01 CSCL 08G

Data from an additional 50 satellite-to-satellite tracking (SST) passes were combined with earlier measurements of the high degree and order (n, m, 12) gravity in the central Pacific. A composite map was produced which shows good agreement with conventional GEM models. Data from the SEASAT altimeter was reduced and found to agree well with both the SST and the GEM fields. The maps are dominated especially in the east, by a pattern of roughly east-west anomalies with a transverse wavelength of about 2000 km. Further comparison with regional bathymetric data shows a remarkably close correlation with plate age. Each anomaly band is framed by those major fracture zones having large offsets. The regular spacing of these fractures seems to account for the fabric in the gravity fields. Other anomalies are accounted for by hot spots. The source of part of these anomalies is in the

lithosphere itself. The possible plume size and ascent velocity necessary to supply deep mantle material to the upper mantel without complete thermal equilibration is considered. A.R.H.

N84-12621# Mine Safety and Health Administration, Denver, Colo. Health and Safety Analysis Center.
USE OF AIRCRAFT IMAGERY IN EVALUATING GROUND STABILITY AT OPEN-PIT URANIUM MINES IN GAS HILLS, WYOMING
R. L. STAHL 1983 14 p refs
(DE83-903011; MSHA/IR-1131) Avail: NTIS HC A02/MF A01

Ground stability in open pit mining operations in the Gas Hills, Wyoming is evaluated. The approach uses aircraft imagery to identify geologic features, such as fractures and faults, that can affect ground stability in surface mines. Operators in the Gas Hills are using this technology as a mine planning and design tool to avoid or to minimizes the effects of fractures and faults on ground stability. This remote sensing tool is appealing because it is inexpensive, accurate, and one that permits rapid evaluation of a mining area on a local and regional scale. DOE

N84-13632*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
GEOLOGIC SURVEY IN THE SOUTH-CENTRAL REGION OF MATO GROSSO [CAMINHAMENTO GEOLOGICO NA REGIAO CENTRO-SUL DE MATO GROSSO]
N. D. J. PARADA, Principal Investigator and M. G. BALIEIRO Jul. 1983 189 p refs In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS
(E84-10039; NASA-CR-174591; NAS 1.26:174591) Avail: NTIS HC A09/MF A01 CSCL 05B

The field observations made in the Cuiaba Project area are described. Many geologic cross-sections were done in which the stratigraphic units and the geologic structures defined in the literature and observed in the LANDSAT MSS imagery were recognized. Author

N84-13643*# Geological Survey, Reston, Va.
EVALUATION OF RADIOMETRIC AND GEOMETRIC CHARACTERISTICS OF LANDSAT-D IMAGING SYSTEM Quarterly Report
J. SALISBURY, M. PODWYSOCKI, L. U. BENDER, and L. ROWAN, Principal Investigators Nov. 1983 4 p ERTS
(Contract NASA ORDER S-12407-C)
(E84-10050; NASA-CR-174616; NAS 1.26:174616; QR-2) Avail: NTIS HC A02/MF A01 CSCL 05B

With vegetation masked and noise sources eliminated or minimized, different carbonate facies could be discriminated in a south Florida scene. Laboratory spectra of grab samples indicate that a 20% change in depth of the carbonate absorption band was detected despite the effects of atmospheric absorption. Both bright and dark hydrothermally altered volcanic rocks can be discrimated from their unaltered equivalents. A previously unrecognized altered area was identified on the basis of the TM images. The ability to map desert varnish in semi-arid terrains has economic significance as it defines areas that are less susceptible desert erosional process and suitable for construction development. A.R.H.

N84-13656# Bureau of Mines, Pittsburgh, Pa.
CORRELATION OF LANDSAT AND AIR PHOTO LINEARS WITH ROOF CONTROL PROBLEMS AND GEOLOGIC FEATURES Report of Investigations
J. H. JANSKY and R. F. VALANE Jul. 1983 28 p refs
(PB83-250852; BM-RI-8777) Avail: NTIS HC A03/MF A01 CSCL 08I

A linear analysis for a new underground coal mine in Grant County, WV was conducted through the interpretation of LANDSAT imagery and high-altitude, color-infrared aerial photography, to identify areas of potentially unstable roof in advance of mining. The Bureau of Mines included this mine in its ongoing study of the correlation between geologic features and linears. Three years after the analysis, after mining had progressed through the plotted linears, the effectiveness of the linear plot in predicting areas of unstable roof was evaluated and the geology associated with the linears was defined. GRA

N84-15628*# Pennsylvania State Univ., University Park. Dept. of Geosciences.
COMBINED USE OF REMOTE SENSING AND SEISMIC OBSERVATIONS TO INFER GEOLOGICALLY RECENT CRUSTAL DEFORMATION, ACTIVE FAULTING, AND STRESS FIELDS Final Technical Report, 1 May 1980 - 30 Nov. 1982
S. S. ALEXANDER, Principal Investigator 30 Nov. 1982 248 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NAG5-49)
(E84-10057; NASA-CR-173138; NAS 1.26:173138) Avail: NTIS HC A11/MF A01 CSCL 08G

Characteristic traits for earthquakes associated with strike-slip motion in Central California and the Salton Sea area, as revealed in ground based studies and LANDSAT imagery, were compared. The mapped lineaments are found to be oriented in several dominant directions. One direction is the same as the trend of the San Andreas fault. The other directions differ from area to area and may reflect the stresses of earlier geologic processes. The pattern of lineament orientations is significantly LANDSAT MSS data, SEASAT synthetic aperture radar data, and magnetic field data from the South Mountain area west of Gettysburg, Pennsylvania were registered to match each other in spatial position and merged. Pattern recognition techniques were applied to the composite data set to determine its utility in recognizing different rock types and structures in vegetated terrain around South Mountain. With the use of a texture algorithm to enhance geologic features, a classification of the entire area was made. A test of the correlation between SAR tone and texture, LANDSAT tone and texture, and magnetic field data revealed no tone or texture measures linking any two of the original data sets. A.R.H.

N84-15630*# Miami Univ., Fla. School of Marine and Atmospheric Science.
MAGNETIC ANOMALIES IN EAST PACIFIC USING MAGSAT DATA Final Report, Jun. 1980 - Jul. 1983
C. G. A. HARRISON, Principal Investigator Sep. 1983 29 p
(E84-10060; NASA-CR-173141; NAS 1.26:173141) Avail: NTIS HC A03/MF A01 CSCL 08G

Methods for solving problems encountered in separating the core field from the crustal field are summarized as well as those methods developed for inverting total magnetic field data to obtain source functions for oceanic areas. Accounting for magnetization contrasts and the magnetization values measured in rocks of marine origin are also discussed. A.R.H.

N84-15631*# Pennsylvania State Univ., University Park. Dept. of Geosciences.
SYNTHESIS OF REGIONAL CRUST AND UPPER-MANTLE STRUCTURE FROM SEISMIC AND GRAVITY DATA Final Technical Report, 15 Jun. 1980 - 30 Nov. 1982
S. S. ALEXANDER and P. M. LAVIN, Principal Investigators 30 Nov. 1982 193 p refs ERTS
(Contract NAG5-77)
(E84-10061; NASA-CR-173142; NAS 1.26:173142) Avail: NTIS HC A09/MF A01 CSCL 08G

Analyses of regional gravity and magnetic patterns, LANDSAT images and geological information revealed two major lineaments crossing western Pennsylvania and parts of surrounding states. These lineaments are inferred to be expressions of fracture zones which penetrare deeply into the crust and possibly the upper mantle. The extensions of the Tyron-Mt. Union and the Pittsburgh-Washington lineaments bound a distinct crustal block (Lake Erie-Maryland block) over 100 km wide and probably more than 600 km in length. Evidence exists for the lateral displacement of this block at least 60 km northwestward during late Precambrian to Lower Ordovician time. Subsequent movements have been mainly vertical with respect to neighboring blocks. A possible crustal

block that passes through eastern Kentucky, proposed by a TVA study on tectonics in the southern Appalachians, was also investigated. Finally, the use of regional gravity and magnetic data in identifying major crustal structures beneath western Pennsylvania is discussed. M.G.

N84-15638# Bendix Field Engineering Corp., Grand Junction, Colo.
URANIUM ANOMALIES IN WYOMING AND PARTS OF ADJACENT STATES. NATIONAL URANIUM RESOURCE EVALUATION
C. S. GOODKNIGHT, J. R. LUDLAM, J. A. BURGER, R. E. DICKSON, R. D. DAYVAULT, J. J. DEXTER, and J. R. ANDERSON Dec. 1982 163 p refs
(Contract DE-AC13-76GJ-01664)
(DE83-005353; GJBX-3(83)) Avail: NTIS HC A08

Uranium anomalies in Wyoming and parts of adjacent states were identified. Data are from the hydrogeochemical and stream sediment reconnaissance (HSSR) and aerial radiometric reconnaissance (ARR) surveys for quadrangles and for smaller areas, data from individual quadrangle geologic evaluations (folios) for uranium favorability were also used. Multivariate statistical techniques were performed on the computer stored HSSR data. Machine generated maps and tables from statistical treatments of the HSSR and ARR data were the basis for screening for uranium anomalies. The maps were hand contoured, and uranium anomalies were chosen according to variable threshold values of data for each quandrangle. Areas designated as anomalous were evaluated by comparison to other NURE data, mainly the folios. The final anomalous areas were arranged in order of priority for each quadrangle according to the nature, magnitude, and amount of evidence corroborating the anomalous uranium concentrations. DOE

05

OCEANOGRAPHY AND MARINE RESOURCES

Includes sea-surface temperature, ocean bottom surveying imagery, drift rates, sea ice and icebergs, sea state, fish location.

A84-10251
DETERMINATION OF THE PRINCIPAL DIRECTION OF PROPAGATION OF SEA WAVES BY AN AIRBORNE RADAR METHOD [OPREDELENIE GLAVNOGO NAPRAVLENIIA RASPROSTRANENIIA MORSKIKH VOLN RADIOLOKATSIONNYM METODOM S LETATEL'NOGO APPARATA]
A. A. GARNAKERIAN Radiotekhnika i Elektronika (ISSN 0033-8494), vol. 28, Sept. 1983, p. 1871-1873. In Russian. refs

Airborne experiments were carried out over the Black Sea in 1981 and 1982 using a pulsed short-wave radar operating at a wavelength of 10 m. Results indicate that airborne short-wave radar measurements can be used to determine the principal propagation direction of sea waves, the degree of sea-wave anisotropy, and the angular distribution function of wave energy. B.J.

A84-10532
PROSPECTS FOR DETERMINATION BY MEANS OF AERIAL PHOTOGRAPHY OF THE THICKNESS OF AN OIL SLICK ON A WATER SURFACE [O VOZMOZHNOSTI OPREDELENIIA TOLSHCHINY NEFTIANOI PLENKI NA VODNOI POVERKHNOSTI PO AEROSNIMAKAM]
V. N. OVECHKIN (Moskovskii Institut Inzenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR) Geodeziia i Aerofotos'emka (ISSN 0536-101X), no. 3, 1983, p. 95-100. In Russian. refs

Measuring devices which are used to detect the presence of oil on the ocean surface are presented. Based on an empirical relationship for determining the thickness of an oil film from its volume, the grade of the spilled oil, and the time since the spill, it is shown that several methods of remote sensing are ineffective in detecting films with a thickness of less than 20-30 microns. Aerial photography which registers diffraction patterns of the spills can be utilized; the accuracy of this method of assessing film thickness is discussed. J.C.D.

A84-10894*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
TOPEX WATERSHED COMING IN OCEANOGRAPHY
G. C. CLEVEN, R. A. NEILSON, and C. A. YAMARONE, JR. (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Astronautics and Aeronautics (ISSN 0004-6213), vol. 21, Nov. 1983, p. 60-62, 65. refs

The NASA Ocean Topography Experiment (TOPEX) will use precision radar altimetry to determine topographic features of the global oceans from which currents may be deduced. TOPEX will coincide with the World Ocean Circulation Experiment (WOCE), which will be conducted at the end of this decade and shall involve ships, fixed and drifting buoys, aircraft observations, and satellite remote sensing, to resolve fundamental questions about the flow of water in the global ocean. TOPEX will contribute to WOCE the measurement of satellite height above the sea surface, and the precise radial position above a reference ellipsoid for the earth. The combination of these two measurements with the marine geoid yields the topographic data sought. Three years of topographic data, together with conventional oceanographic data and theoretical ocean models, will be needed to derive the mean and variable components of ocean circulation. O.C.

A84-11743#
DETERMINATION OF OCEAN REFLECTANCE BY MULTISPECTRAL REMOTE SENSING
B. PIESIK and G. ZIMMERMANN (Deutsche Akademie der Wissenschaften, Institut fuer Raumforschung, Berlin, East Germany) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 10 p. refs
(IAF PAPER 83-97)

The performance parameters and atmospheric correction procedures for data from the MKS spectrometer system on board the Intercosmos 21 satellite are described. The instrument comprises two multichannel spectrometers operating in the 415, 449, 483, 534, 570, 621, and 676 nm bands for one and 758, 760.6, 763, 766.4, 794.8, and 822.8 nm bands for the other. The system permits extraction of subsea surface temperatures in order to assay concentrations of suspended material such as phyoplankton. The measurements are made passively over cloud-free areas. Corrections are made for atmospheric aberrations in the upwelling radiance through a formulation that considers the solar input, the solar zenith angle, the refraction index air/water, the Rayleigh optical thickness, the aerosol and ozone optical thicknesses, ocean foam fraction and thickness, glitter, direct and diffuse components, and the reflectivity of the subsystems. A comparison made between satellite data and ground truth data for oligotrophic water showed good agreement. M.S.K.

A84-11745#
ERS-1 SYSTEM - SATELLITE AND PAYLOAD DESIGN
A. SETZER, U. B. PICKER, and E. H. VELTEN (Dornier System GmbH, Friedrichshafen, West Germany) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 9 p.
(IAF PAPER 83-116)

The design features and missions of the ESA ERS-1 satellite are described. The remote sensing spacecraft is intended to monitor coastal zones and global ocean processes and aid in the development and promotion of economical applications of remotely sensed sea surface, coastal zone, and off-shore activities data. Launched on the Ariane, ERS-1 will carry active microwave instrumentation, a radar altimeter, a laser retroreflector, an along-track scanning radiometer with a microwave sounder, and

precision range and range rate data equipment. Data transmission will be in the S- and X-bands. The instrumentation will obtain data on sea surface winds, wave spectra, wave modes, mesoscale topography, wave heights, sea surface temperature, cloud top temperature, land and sea ice radiances, atmospheric water vapor content, atmospheric liquid and rain, and the emissivities of land and ice. M.S.K.

A84-12503*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
OIL FILM THICKNESS USING AIRBORNE LASER-INDUCED OIL FLUORESCENCE BACKSCATTER
F. E. HOGE (NASA, Wallops Flight Center, Wallops Island, VA) Applied Optics (ISSN 0003-6935), vol. 22, Nov. 1, 1983, p. 3316-3318. refs

Remote airborne measurement of oil film thickness on ocean surface using laser-induced water Raman backscatter is discussed. It is pointed out that the theoretical model of oil fluorescence by Horvath et al. (1971) contains the necessary constituents to provide for the natural background fluorescence that is also induced by the laser during the course of an oil thickness experiment. How the various parameters of the model are obtained from typical airborne profile data is discussed, and it is shown that the water Raman backscatter may be used to assist further in the application of the data. The regions or water types over which the technique might be most useful or applicable are discussed. C.D.

A84-12518* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
RECENT PROGRESS IN THE APPLICATION OF SATELLITE ALTIMETRY TO OBSERVING THE MESOSCALE VARIABILITY AND GENERAL CIRCULATION OF THE OCEANS
L.-L. FU (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Reviews of Geophysics and Space Physics (ISSN 0034-6853), vol. 21, Nov. 1983, p. 1657-1666. NASA-supported research. refs

The application of GEOS-3 and Seasat altimeter data to the study of mesoscale variability and general circulation in the oceans is discussed in a survey of recent investigations. Seasat provided much more accurate measurements, but lasted only 3.5 months (compared to 3.5 years for GEOS-3). General-circulation studies are shown to be strongly dependent on an accurate geoid, which has not yet been developed; hence even large-wave-length (7000-km) mapping is of limited value. Geoid-independent methods allow the global mapping of mesoscale sea-surface height and geostrophic current and the analysis of their distribution in wavenumber space, at least to the limits allowed by the accuracy of the instruments. These studies demonstrate the feasibility of future satellite-altimeter measurements of variability over a wide range of periods and wavelengths, which if combined with improved mapping of the earth's gravity field) would permit the determination of the general circulation on scales as small as 200 km. D.G.

A84-13014
MAPPING AND MONITORING KELP RESOURCES IN MEXICO
S. ARREDONDO G., D. CHAPA B., and J. VALDES A. (Direccion General de Geografia, Mexico City, Mexico) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 85-93. refs

A scheme for automated processing of Landsat MSS data for monitoring of giant kelp resources in the Pacific is presented. Kelp is exploited commerically near Baja California mainly for the hydrophyllic colloid algin. Airborne MSS surveys of kelp farms compared with digitized ground truth revealed that kelp could be distinguished from land and water. Further studies of Landsat MSS data acquired during the height of the kelp growing season demonstrated the capability of determining the geographic location and extent of kelp beds to an accuracy of 96 percent. A full survey of the kelp beds was performed on a 1:100,000 scale with the Landsat MSS. Pattern recognition techniques permitted delineation of the kelp farms. Landsat MSS data are concluded a viable option for mapping the Pacific kelp farms. M.S.K.

A84-13152* Massachusetts Inst. of Tech., Cambridge.
ON DETERMINING THE LARGE-SCALE OCEAN CIRCULATION FROM SATELLITE ALTIMETRY
C.-K. TAI (MIT, Cambridge, MA) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9553-9565. refs (Contract NAG6-9; NSF OCE-80-18514)

It is contended that a spherical harmonic expansion of the difference between the altimeter-derived mean sea surface and the geoid estimate should reveal the large-scale circulation of the ocean surface layer when the low-degree terms are examined. Methods based on this principle are proposed and partially demonstrated over the Pacific Ocean with the aid of the mean sea surface derived from the Seasat altimeter and the Goddard Earth Model 9 earth gravity model. The preliminary results reveal a well-defined clockwise gyre in the North Pacific and a much less well defined counterclockwise gyre in the South Pacific. When the dynamic topography thus obtained is compared with Wyrtki's (1975) dynamic topography derived from hydrographic data, the agreement is found to be within the limit of geoid uncertainties and satellite orbital errors. C.R.

A84-13155#
EDDY ENERGY OF THE NORTHWEST ATLANTIC AND GULF OF MEXICO DETERMINED FROM GEOS 3 ALTIMETRY
B. C. DOUGLAS, R. E. CHENEY, and R. W. AGREEN (NOAA, National Ocean Service, Rockville, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9595-9603. refs

It is shown that repeated altimeter profiles of the sea surface are effective for obtaining an accurate estimate of eddy energy. By differencing pairs of GEOS 3 passes that have the same ground track, both mesoscale sea height variability and eddy kinetic energy are obtained. It is also shown that altimeter analyses such as this represent a fundamental improvement over previous determinations of variability from historical XBT files (expendable bathythermograph traces). Each pair of altimeter profiles provides the true sea surface height difference between the times the altimeter profiles were taken. Therefore only the temporal component of variability is observed. Since, however, XBT statistics are usually computed in 2-degree boxes, they include additional spatial variability in regions of large horizontal shear simply due to the gradient across the box. This has led to overestimations of Gulf Stream variability when interpreted as time variability, especially between Florida and Cape Hatteras, where sea height gradients and velocity shear are large but meander activity is small. C.R.

A84-13156*# National Oceanic and Atmospheric Administration, Miami, Fla.
FITTING OF SATELLITE AND IN-SITU OCEAN SURFACE TEMPERATURES RESULTS FOR POLYMODE DURING THE WINTER OF 1977-1978
G. A. MAUL and N. J. BRAVO (NOAA, Atlantic Oceanographic and Meteorological Laboratory, Miami, FL) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9605-9616. NASA-supported research. refs

For the period considered, December 1977 through February 1978, bivariate Gaussian discriminant function cloud identification revealed that more than 93 percent of the 8-km resolution GOES infrared pixels were cloud contaminated. Cloud-free in-situ calibration points were distributed in nonrandom groups; this resulted in systematic errors when using least squares techniques. Surfaces and regression lines were least squares fitted between satellite and in-situ data; use was also made of differences and ratios. The best results were achieved with a regression in the form of the infrared radiative transfer equation; but this was no better than + or - 0.9 K. Because of extensive cloudiness, the linear regressions were seldom useful, and temperature ratios with + or - 1.3 K experimental errors best represent the applicability of GEOS data to sea surface temperatures. C.R.

A84-13158* Skidaway Inst. of Oceanography, Savannah, Ga.
OBSERVATIONS OF A LOOP CURRENT FRONTAL EDDY INTRUSION ONTO THE WEST FLORIDA SHELF
T. PALUSZKIEWICZ, L. P. ATKINSON (Skidaway Institute of Oceanography, Savannah, GA), E. S. POSMENTIER (Southampton College, Southampton, NY), and C. R. MCCLAIN (NASA, Goddard Space Flight Center, Greenbelt, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9639-9651. Research supported by the Minerals Management Service. refs

Data were examined to determine the structure of this intrusion (April 1-7, 1982) and to investigate its effects on water masses in the outer shelf region. A frontal eddy, made up of a warm filament separated from the main current by a region of cooler water, propagated southeastward at 30 cm/s, intruding onto the shelf near 26 deg N between April 4 and 6. It was found from temperature-salinity (T-S) properties that water in the filament was Loop Current water that had been contiguous with Loop Current water 80 m deeper in the main body of the current. It is noted that water in the cold region was Continental Edge water, a transitional water mass with cooler, fresher T-S characteristics. Under this region, upwelling of deeper Loop Current water occurred, and elevated nutrient concentrations were found in the upwelled dome under the cold region. C.R.

A84-13159
WIND MEASUREMENTS FROM AN ARRAY OF OCEANOGRAPHIC MOORINGS AND FROM F/S METEOR DURING JASIN 1978
R. A. WELLER, R. E. PAYNE (Woods Hole Oceanographic Institution, Woods Hole, MA), W. G. LARGE (National Center for Atmospheric Research, Boulder, CO), and W. ZENK (Kiel, Neue Universitaet, Kiel, West Germany) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9689-9705. Research supported by the National Research Council of Canada and Deutsche Forschungsgemeinchaft. refs
(Contract N00014-74-C-0152; N00014-76-C-0197; N00014-76-C-0046; NR PROJECT 082-400; NR PROJECT 083-207)

An overview is provided of the instrumentation deployed on the JASIN oceanographic buoys and of the wind data collected during the experiment. A quantitative analysis of the variability of the wind data is made. Significant differences in mean winds were found, and so the ability of the instruments used in JASIN to make accurate wind measurements is reevaluated. The literature on anemometer performance is surveyed, wind tunnel tests are conducted, and an intercomparison experiment is carried out. Discussion of the JASIN data in the light of the reevaluation is presented, and conclusions are drawn about the appropriateness of using data from the buoys to calibrate the Seasat sensors. C.R.

A84-13161
SATELLITE OBSERVED BEHAVIOR OF THE TERRA NOVA BAY POLYNYA
D. D. KURTZ and D. H. BROMWICH (Ohio State University, Columbus, OH) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9717-9722. refs
(Contract NSF DPP-79-25040; NSF DPP-81-00142)

Infrared satellite images indicate that a polynya, surrounded by a zone of loose pack ice, persisted in Terra Nova Bay, Antarctica through the winter of 1979; the feature may recur each year. The affected region (polynya and loose pack) occupied roughly 25000 sq km of the western Ross Sea. Throughout the winter the area of open water fluctuated quasi-periodically with a period of 15-20 days. Average polynya area was 1000 sq km, maximum area was approximately 5000 sq km. Fluctuations were associated with the magnitude of the zonal geostrophic wind, with a closing polynya being related to strong, persistent easterlies. An open, or opening, polynya was linked with persistent westerly or weak easterly winds and the probable descent of adiabatically warming, drift-bearing air from the plateau. This air enters Terra Nova Bay through the Reeves Glacier valley, probably as katabatic surface winds. Polynya formation was probably due to the action of these winds on the coastal pack ice, while areal fluctuations reflected the interplay between the katabatic winds and synoptic scale motions advecting ice toward and away from the bay. Author

A84-13163*# Naval Research Lab., Washington, D. C.
PARAMETRIC DEPENDENCE OF OCEAN WAVE-RADAR MODULATION TRANSFER FUNCTIONS
W. J. PLANT, W. C. KELLER (U.S. Navy, Naval Research Laboratory, Washington, DC), and A. CROSS (NASA, Langley Research Center, Hampton, VA) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9747-9756. refs
(Contract NR PROJECT 389-187)

Microwave techniques at X and L band were used to determine the dependence of ocean-wave radar modulation transfer functions (MTFs) on various environmental and radar parameters during the Marine Remote Sensing experiment of 1979 (MARSEN 79). These MIF are presented, as are coherence functions between the AM and FM parts of the backscattered microwave signal. It is shown that they both depend on several of these parameters. Besides confirming many of the properties of transfer functions reported by previous authors, indications are found that MTFs decrease with increasing angle between wave propagation and antenna-look directions but are essentially independent of small changes in air-sea temperature difference. However, coherence functions are much smaller when the antennas are pointed perpendicular to long waves. It is found that X band transfer functions measured with horizontally polarized microwave radiation have larger magnitudes than those obtained by using vertical polarization. C.R.

A84-13164
ANALYSIS OF MARSEN X BAND SAR OCEAN WAVE DATA
R. A. SHUCHMAN, J. D. LYDEN, D. R. LYZENGA, E. S. KASISCHKE (Michigan, Environmental Research Institute, Ann Arbor, MI), W. ROSENTHAL, H. GUNTHER, and H. LINNE (Max-Planck-Institut fuer Meteorologie; Hamburg, Universitaet, Hamburg, West Germany) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9757-9768. refs
(Contract N00014-76-C-1048; N00014-81-C-0692)

Analysis of X band SAR imagery collected during the MARSEN experiment indicates that the APD-10 SAR system imaged both range- and azimuth-traveling gravity waves. However, only the near-edge portion of the APD-10 imagery provided reliable spectral wave estimates. Numerous motion artifacts, which manifest themselves as azimuth-oriented streaks, are visible on the data and are believed to be caused by breaking waves. Because of the large platform velocity, the APD-10 SAR data are relatively insensitive to wave enhancement adjustments performed during the processing of SAR signal histories. A modulation transfer function to relate SAR-derived spectra to in situ measurements has been developed. The transfer function is smaller and falls off more rapidly with wave number for azimuth-traveling waves than for range-traveling waves. This is a consequence of the smaller inherent modulation for azimuth-traveling waves and the degraded resolution in the azimuth direction as a result of motion effects and agrees, at least qualitatively, with theoretical predictions. Author

A84-13165
ANALYSIS OF SCATTERER MOTION EFFECTS IN MARSEN X BAND SAR IMAGERY
D. R. LYZENGA and R. A. SHUCHMAN (Michigan, Environmental Research Institute, Ann Arbor, MI) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9769-9775. refs
(Contract N00014-81-C-0692)

Synthetic aperture radar X band images collected over the North Sea during the 1979 Marsen experiment show numerous apparent point scatterers imaged with a degraded resolution in the along-track direction. The observed resolution of these features is consistent with a scatterer coherence time of the order of 0.01 s or a vertical acceleration of the order of 5 m/sq s. Observations of the resolution as a function of the processor integration time

tend to support the coherence time explanation. Similar coherence times have been measured for breaking waves by conventional high-resolution radars, suggesting that the same phenomena may be responsible for the features observed on the synthetic aperture radar imagery. Author

A84-13166
THE TWO-SCALE RADAR WAVE PROBE AND SAR IMAGERY OF THE OCEAN
W. J. PLANT and W. C. KELLER (U.S. Navy, Naval Research Laboratory, Washington, DC) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9776-9784. refs

A two-scale formulation of oceanic backscatter of microwave radiation which has previously been applied to the dual-frequency scatterometer, is applied here to the two-scale radar wave probe and SAR imagery of the ocean. A two-scale radar wave probe is a microwave system which coherently detects signals scattered from a very small patch of the ocean surface. It is shown that a SAR image may be described as a convolution of the AM part of the output of a two-scale wave probe with the power spectrum of the FM part of the output. Thus SAR images are not faithful reproductions of cross-section variations over the surface. Distortions occur as a result of variable surface velocities. Examples of this distortion are derived from two-scale wave probe data taken in the Gulf of Mexico. Application of a focusing correction does not remove the distortion from the simulated image of a nearly sinusoidal, azimuth-traveling wave. Large V/R0 ratios minimize the distortion, however (where V is the speed of an aircraft or spacecraft carrying the antenna and R0 is the distance from the antenna to the mean surface at the center of the footprint).
Author

A84-13167* *Jet Propulsion Lab., California Inst. of Tech.*, Pasadena.
L BAND SAR OCEAN WAVE OBSERVATIONS DURING MARSEN
A. JAIN and O. H. SHEMDIN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Nov. 20, 1983, p. 9792-9808. refs
(Contract NAS7-100)

The five-sided flight pattern made it possible to view the same ocean surface patch from five different directions. The results obtained from analyzing radar and in situ measurements indicate that the focus dependence for optimum imaging is that for a surface moving with a speed that is approximately equal to the wave phase velocity. The finding also suggest that azimuthally traveling waves can be visible as range traveling waves when the necessary focus adjustments are made in the SAR processor and that the visibility of azimuthally travelling waves does not improve with decreasing integration time. What is more, the spectra and images of azimuthally traveling waves do not show observable distortions compared with those for range traveling waves. C.R.

A84-13373
THE DYNAMICS OF OCEAN TIDES [DINAMIKA OKEANSKIKH PRILIVOV]
G. I. MARCHUK and B. A. KAGAN Leningrad, Gidrometeoizdat, 1983, 360 p. In Russian. refs

The fundamentals of the static and dynamic theory of tides are discussed. The general features of the ocean tides are described, along with methods for their analysis. Empirical data obtained from satellite altimetry and from gravimetric measurements of tidal variations in the gravitational force are presented. Results obtained recently on one of the fundamental problems of ocean dynamics - the spectral problem for oceans having realistic contours - are analyzed, as are current attempts to study the tides analytically and numerically. Also presented are results from theoretical studies on modeling the global interaction between ocean and earth tides, parameterizing shelf effects, and allowing for these effects in global models of the tides. Special attention is given to the energetics of the ocean tides, in particular, the dissipation of tidal energy. The results obtained from laboratory and in-situ measurements and numerical modeling of the vertical structure of the benthic boundary layer in tidal flows are summarized. C.R.

A84-13550#
COMMENTS ON 'ON THE SYNTHETIC APERTURE RADAR IMAGING OF OCEAN SURFACE WAVES'
W. J. PLANT (U.S. Navy, Naval Research Laboratory, Washington, DC) IEEE Journal of Oceanic Engineering (ISSN 0364-9059), vol. OE-8, Oct. 1983, p. 300; Reply, p. 300, 301. refs

A84-13909
COMPARISON BETWEEN CZCS DATA FROM 10 JULY 1979 AND SIMULTANEOUS IN SITU MEASUREMENTS FOR SOUTH-EASTERN SCOTTISH WATERS
S. M. SINGH, A. P. CRACKNELL, and J. A. CHARLTON (Dundee, University, Dundee, Scotland) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, Oct.-Dec. 1983, p. 755-784. Research supported by the Science and Engineering Research Council and Department of the Environment. refs

A method for the analysis of coastal zone color scanner (CZSC) data when simultaneous in situ measurements are available is applied to data obtained in July 10, 1979 in the vicinity of the Tay Estuary and St. Andrews Bay, Scotland. Atmospheric contributions to the signal reaching the satellite are considered, and atmospheric correction factors and in-flight calibration constants are applied to the data to obtain the subsurface upwelling radiance in the first four CZCS bands. Comparisons between upwelling radiances and in situ data obtained at five locations by various algorithms results in many good correlation coefficients, however with different parameters than those obtained by other investigators. Various previously unaccounted-for oceanic factors influencing the upwelling radiance are then considered, including temperature, salinity, wavelength and the refractive index of water, and it is shown that such factors can lead to an error in the determination of chlorophyll-like pigment concentrations as large as that due to the inherent signal-to-noise ratio. The replacement of solar irradiances with the recently revised values is shown to have a significant effect on the parameters of the chlorophyll algorithms.
A.L.W.

A84-14620*# National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va.
AIRBORNE DETECTION OF OCEANIC TURBIDITY CELL STRUCTURE USING DEPTH-RESOLVED LASER-INDUCED WATER RAMAN BACKSCATTER
F. E. HOGE (NASA, Wallops Flight Center, Wallops Island, VA) and R. N. SWIFT (EG&G Washington Analytical Services Center, Inc., Pocomoke City, MD) Applied Optics (ISSN 0003-6935), vol. 22, Dec. 1, 1983, p. 3778-3786. refs

Airborne laser-induced, depth-resolved water Raman backscatter is useful in the detection and mapping of water optical transmission variations. This test, together with other field experiments, has identified the need for additional field experiments to resolve the degree of the contribution to the depth-resolved, Raman-backscattered signal waveform that is due to (1) sea surface height or elevation probability density; (2) off-nadir laser beam angle relative to the mean sea surface; and (3) the Gelbstoff fluorescence background, and the analytical techniques required to remove it. When converted to along-track profiles, the waveforms obtained reveal cells of a decreased Raman backscatter superimposed on an overall trend of monotonically decreasing water column optical transmission. O.C.

A84-14779
THE DIFFERENTIATION OF SNOW COVER FROM FOG OR LOW STRATUS IN HIGH-RESOLUTION (AVHRR) WEATHER-SATELLITE IMAGES [DIE UNTERSCHEIDUNG ZWISCHEN SCHNEEBEDECKUNG DES ERDBODENS UND NEBEL/HOCHNEBEL IN HOCHAUFLOESENDEN /AVHRR/-WETTERSATELLITENBILDERN]
R. F. PAULUS (Amt fuer Wehrgeophysik, Traben-Trarbach, West Germany) Meteorologische Rundschau (ISSN 0026-1211), vol. 36, Oct. 1983, p. 220-222. In German.

The problem of discriminating snow cover without clouds from ground fog or low stratus clouds on satellite pictures is considered. It is shown that comparison of AVHRR images from channels 2 (0.725-1.10 microns) and 3 (3.55-3.93 microns) of the NOAA-series obtained at low sun angles can be of value: black-appearing areas in the channel-3 image are fog/low stratus and can be marked as such on the channel-2 image, so that only the remaining white areas can be snow cover. Sample images are provided and discussed in detail. T.K.

A84-14834
OPTIMIZATION OF WORKING WAVELENGTHS IN THE PROBLEM OF DETERMINING THE PARAMETERS OF THE OCEAN-ATMOSPHERE SYSTEM ON THE BASIS OF RADIOTHERMAL MICROWAVE MEASUREMENTS [OPTIMIZATSIIA RABOCZIKH DLIN VOLN V ZADACHE OPREDELENIIA PARAMETROV SISTEMY OKEAN-ATMOSFERA PO RADIOTEPLOVYM SVCH-IZMERENIIAM]
B. L. NOVAK, IU. G. TROKHIMOVSKII, and V. S. ETKIN (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR) Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana (ISSN 0002-3515), vol. 19, Sept. 1983, p. 944-949. In Russian. refs

Consideration is given to methods of selecting the optimal set of working wavelengths for determining parameters of the sea surface and atmosphere on the basis of radiothermal radiation in the range from 0.2 cm to 60 cm. The optimal wavelengths are derived from the condition whereby the greatest possible error in determining the parameters is minimized. The calculations are made both with and without a priori information on the parameters. The optimal set of wavelengths significantly reduces the errors incurred in determining the parameters. C.R.

A84-14835
A DETERMINATION OF THE EMITTANCE OF THE SEA SURFACE ON THE BASIS OF SATELLITE RADIOMETRIC POLARIZATION MEASUREMENTS UNDER CONDITIONS OF CLOUDINESS [OPREDELENIE IZLUCHATEL'NOI SPOSOBNOSTI MORSKOI POVERKHNOSTI PO DANNYM RADIOMETRICHESKIKH POLIARIZATSIONNYKH IZMERENII S ISZ PRI NALICHII OBLACHNOSTI]
A. A. VLASOV and IU. K. SHESTOPALOV Akademiia Nauk SSSR, Izvestiia, Fizika Atmosfery i Okeana (ISSN 0002-3515), vol. 19, Sept. 1983, p. 950-955. In Russian. refs

Methods are proposed for determining the emittance of the sea surface and the total absorption of radiothermal radiation in clouds on the basis of polarization measurements. Results are presented from the digital processing of microwave radiometric information obtained from the satellite Cosmos 1151. The methods eliminate the effect of cloudiness and make it possible to determine the emittance of a smooth sea surface with a precision no worse than 0.003. C.R.

A84-14840
STUDY OF THE RADIANCE STRUCTURE OF A SATELLITE IMAGE OF THE SEA OF OKHOTSK [ISSLEDOVANIE IARKOSTNOI STRUKTURY SPUTNIKOVOGO IZOBRAZHENIIA OKHOTSKOGO MORIA]
G. A. GRISHIN, IU. M. GEKTIN, A. S. SELIVANOV, G. K. KOROTAEV, and V. V. PANENKO (Akademiia Nauk Ukrainskoi SSR, Morskoi Gidrofizicheskii Institut, Sevastopol; Simferopol'skii Gosudarstvennyi Universitet, Simferopol, Ukrainian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 3-10. In Russian. refs

A84-14842
ROUTE MEASUREMENTS OF SEA ROUGHNESS USING AIRBORNE SIDE-LOOKING RADAR [TRASSOVYE IZMERENIIA MORSKOGO VOLNENIIA SAMOLETNYM LOKATOROM BOKOVOGO OBZORA]
F. V. BUNKIN, K. I. VOLIAK, G. A. LIAKHOV, V. V. PANENKO, and I. V. SHUGAN (Akademiia Nauk SSSR, Institut Obshchei Fiziki, Moscow; Simferopol'skii Gosudarstvennyi Universitet, Simferopol, Ukrainian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 22-31. In Russian. refs

A84-14854
COMPREHENSIVE RADIOPHYSICAL INVESTIGATIONS OF ICE COVERS [KOMPLEKSNYE RADIOFIZICHESKIE ISSLEDOVANIIA LEDOVYKH POKROVOV]
V. P. SHESTOPALOV, B. E. KHMYROV, A. I. KALMYKOV, IU. A. SINITSYN, F. G. BASS, V. A. KOMIAK, V. N. TSYMBAL, and S. A. SHILO (Akademiia Nauk Ukrainskoi SSR, Institut Radiofiziki i Elektroniki, Kharkov, Ukrainian SSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 272, no. 3, 1983, p. 598-600. In Russian. refs

A comprehensive approach is outlined for investigating ice covers by radiophysical methods and for constructing a model for the scattering and radiation of centimeter and millimeter radio waves by ice. The approach involves the simultaneous use of data from active radar and data on the radiothermal self-radiation by ice. The combined use of radiolocation and radiometric methods, which are underlain by inherently different but mutually complementary physical processes, makes it possible to resolve the ambiguities encountered when the data from either of the methods are interpreted separately. The distribution of the intensity of the electromagnetic field is described by a system of linear integro-differential equations analogous to kinetic equations. C.R.

A84-14861
RESONANCE PHENOMENA OF HIGHER ORDERS IN THE INTRINSIC AND SCATTERED MICROWAVE RADIATION OF THE SEA SURFACE [REZONANSNYE IAVLENIIA VYSSHIKH PORIADKOV V SOBSTVENNOM I RASSEIANNOM SVCH-IZLUCHENII MORSKOI POVERKHNOSTI]
I. V. CHERNYI and V. S. ETKIN (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovanii, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 272, no. 4, 1983, p. 852-854. In Russian. refs

Resonance phenomena of higher orders in the intrinsic and scattered microwave radiation fields of the sea surface were investigated experimentally in the North Pacific using an 8-mm-band radiometer-scatterometer mounted on a gyrostabilized platform. It is shown that the radiometric and scatterometric signals are both determined by the resonance conditions of the radiation and scattering of electromagnetic waves by the sea surface up to the fourth order inclusively. Thus, the combined use of active and passive means makes it possible to identify resonance phenomena of higher orders and to monitor changes in the spatial components of high seas. V.L.

A84-14865
VARIABILITY OF THE RADIATION BALANCE OF THE NORTH ATLANTIC ACCORDING TO SATELLITE DATA [IZMENCHIVOST' RADIATSIONNOGO BALANSA SEVERNOI ATLANTIKI PO DANNYM SPUTNIKOVYKH IZMERENII]
G. I. MARCHUK, K. IA. KONDRATEV, and V. V. KOZODEROV (Akademiia Nauk SSSR, Otdel Vychislitel'noi Matematiki, Moscow, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 272, no. 5, 1983, p. 1099-1102. In Russian. refs

A84-16072
MICROWAVE REMOTE SENSING OF OIL SLICK ON WATER SURFACE
B. ZHAO, W. ZHAO, and J. DU (Beijing University, Beijing, People's Republic of China) Scientia Sinica, Series A - Mathematical, Physical, Astronomical and Technical Sciences (ISSN 0253-5831), vol. 26, Sept. 1983, p. 978-989. refs

Microwave reflective and emissive properties of oil slick on water surface were examined. Microwave dielectric constants of oil and water, and reflectivities of an oil slick on the water surface at two microwave bands were experimentally measured. The experimental results are consistent with theoretical predictions. On this basis, the relation between microwave radiation of oil slick on a water surface and the thickness of the oil slick, and principles of microwave surveying of an oil slick on a water surface are discussed. According to analysis of the results, the thickness of oil slick can be surveyed by measuring the difference between s polarization brightness temperatures of the oil slick and a clear water surface or the radiation brightness temperature polarity. Since the thickness of oil slick on the sea is mostly smaller than 2 mm, a microwave radiometer in the 1.2-1.6 cm band has better resolution in remote sensing the thickness of an oil slick. Instruments working in the millimeter band have higher sensitivity in surveying the thickness of an oil slick. Author

A84-16733
ANALYSIS OF SEASAT-SYNTHETIC APERTURE RADAR (SAR) IMAGERY OF THE OCEAN USING SPATIAL FREQUENCY RESTORATION TECHNIQUES (SFRT)
I. B. S. CONTEH (Imperial College of Science and Technology, London, England) IN: Pictorial data analysis; Proceedings of the Advanced Study Institute, Bonas, France, August 1-12, 1982 . Berlin and New York, Springer-Verlag, 1983, p. 405-447. refs

The digital processing of SAR images obtained by Seasat is reviewed, with a focus on the spatial-frequency-restoration technique (SFRT) for determining the dominant wavelength and direction of ocean waves. The history of Seasat-A, the general principles of focused and unfocused SAR systems, and the operational parameters of the 25-m-resolution Seasat-A SAR are examined. Eleven currently used digital processors are presented in a table and characterized in detail; the range-compression and time-domain azimuth-compression processes are described; and the advantages of digital processing over optical methods are listed. The primary problem in extracting ocean-wave data from SAR images by discrete-Fourier-transform methods such as SFRT is identified as leakage to truncation and sampling. The quantitative calculation of maximum obtainable SAR resolution (equal to half the physical length of the real-aperture antenna) is explained in an appendix. T.K.

A84-16743
SATELLITE IMAGERY - EVOLUTION OF A HURRICANE-LIKE CYCLONE IN THE MEDITERRANEAN SEA
H. BILLING, W. TONN (Berlin, Freie Universitaet, Berlin, West Germany), and I. HAUPT Beitraege zur Physik der Atmosphaere (ISSN 0005-8173), vol. 56, Nov. 1983, p. 508-510.

The development of a fully developed cyclone with a central eye was traced using IR data from the NOAA 7 satellite in a stereographic format. The storm occurred in January 1982, beginning with the movement of upper level troughs from the eastern Atlantic to the Mediterranean Sea, followed by a stationary long wave trough remaining over the Mediterranean and northern Africa. Short wave troughs moved vorticity and cold air southward from western Europe. The subtropical jet in front of the big trough intensified and warm air advection increased. Shipboard instrumentation recorded 985 mb pressure and 50 kn wind velocity at the center of the cyclone. Channel 4 (10.3-11.3 microns) and channel 5 (11.5-12.5 microns) data indicated an SST of 16-20 C. M.S.K.

A84-17213* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SYNTHETIC APERTURE RADAR OBSERVATION OF OCEAN ROUGHNESS FROM ROLLS IN AN UNSTABLE MARINE BOUNDARY LAYER
T. W. THOMPSON, W. T. LIU (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and D. E. WEISSMAN (Hofstra University, Hempstead, NY) Geophysical Research Letters (ISSN 0094-8276), vol. 10, Dec. 1983, p. 1172-1175. NASA-supported research. refs

Simultaneous synthetic aperture radar (SAR) and cloud photographic observations of the Atlantic Ocean off the coast of Florida were made from a high-altitude aircraft when there was an unstable marine boundary layer. The synthetic aperture radar images show unusual kilometer-sized features on the ocean surface which are related to clouds. The ocean near shore was cloud-free and had no radar features, while from 30 to 330 km offshore there were clouds and prominent kilometer-sized features in the SAR image. These radar features are most prominent when the radar was looking upwind, are less prominent when the radar was looking downwind, and disappear entirely when the radar was looking crosswind. Since ocean radar echo strengths are believed to be controlled primarily by ocean waves satisfying the Bragg relation, these radar features most likely resulted from local enhancements of short gravity waves with 17- to 34-cm wavelengths, which in turn are surface expressions of roll convections in a kilometer-thick unstable marine boundary layer. Author

A84-18051#
OPTICAL REMOTE SENSING OF THE OCEAN
W. A. HOVIS (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 22nd, Reno, NV, Jan. 9-12, 1984. 5 p.
(AIAA PAPER 84-0380)

A historical overview of optical remote sensing of the ocean is presented, dating from the 1960's. Now ocean temperatures are routinely sensed by instruments such as the Advanced Very High Resolution Radiometer (AVHRR) on the NOAA satellites, to absolute accuracies of 1 C or better using multichannel sensors with resolutions of 1 km. In the 1970's, microwave instruments were included on satellites such as Nimbus, permitting sensing of temperature and ice locality regardless of weather conditions. Suites of Coastal Zone Color Scanners (CZCSs) now measure reflected sunlight and determine pigment concentrations and water clarity; the system is nearly operational for advising fishermen about wind speeds, wave heights, ocean temperatures, and ocean color to help them find optimum areas for fishing. Global measurements of this type are carried out to determine the fishing productivity of fishing areas. Microwave radiometers provide routine ice cover measurements. Finally, major ocean events such as the recent El Nino off South America are tracked by satellite to determine their effects on climatology. D.H.

A84-18202* Miami Univ., Coral Gables, Fla.
NIMBUS 7 CZCS - REDUCTION OF ITS RADIOMETRIC SENSITIVITY WITH TIME
H. R. GORDON, J. W. BROWN (Miami University, Coral Gables, FL), O. B. BROWN, R. H. EVANS (Miami University, Miami, FL), and D. K. CLARK (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) Applied Optics (ISSN 0003-6935), vol. 22, Dec. 15, 1983, p. 3929-3931. refs
(Contract NAS5-22963)

Preliminary results are described for an effort to quantify the sensitivity decay of a radiometry sensor (the Coastal Zone Color Scanner or CZCS aboard Nimbus 7). The method used in the study is to (1) compute the water-leaving radiance for imagery acquired in regions where this radiance is known or can be independently estimated, and (2) adjust the sensor calibration to force agreement between the two radiances. Decay factors for orbit numbers from 0 to 20,000 are plotted, and surface and space measurements are compared for the Gulf Stream and the Northern

Sargasso Sea at different seasons. The fact that a seasonal variability in the chlorophyll a concentration in the Sargasso Sea was found in the sensor analysis (apparently the first such satellite observation) increases confidence in the method. D.H.

A84-18502
RADIO GLACIOLOGY [RADIOGLIATSIOLOGIIA]
V. BOGORODSKII, CH. BENTLI, and P. GUDMANDSEN Leningrad, Gidrometeoizdat, 1983, 312 p. In Russian. refs

The results of active radar investigations of the structure of the ice sheets and glaciers obtained over a period of three decades are summarized. Attention is given to the structure and physical state of glaciers, the propagation of electromagnetic waves in ice, the equipment used for radar investigations of glaciers, and data acquisition and processing in the remote sounding of glaciers. Important new data are presented on the electromagnetic characteristics of the ice sheets of Antarctica, Greenland, and Arctica. V.L.

A84-19045
APPLICATION OF RADAR IMAGES FROM THE SIR-A EXPERIMENT TO THE STUDY OF A COASTAL ZONE - SHERBRO ISLAND IN SIERRA LEONE [APPORT DES IMAGES RADAR DE L'EXPERIENCE SIR-A AL'ETUDE D'UNE ZONE COTIERE - L'ILE SHERBRO EN SIERRA LEONE]
J. MALACAMP (Ouagadougou, Centre Regional de Teledetection, Ouagadougou, Upper Volta) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 91, 1983, p. 11-19. In French.

N84-10718*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANTARTIC SEA ICE, 1973 - 1976: SATELLITE PASSIVE-MICROWAVE OBSERVATIONS
H. J. ZWALLY, J. C. COMISO, C. L. PARKINSON, W. J. CAMPBELL (Geological Survey, Takoma, Wash.), F. D. CARSEY (Jet Propulsion Lab., California Inst. of Tech., Pasadena), and P. GLOERSEN Washington 1983 216 p refs Original document contains color illustrations
(NASA-SP-459; NAS 1.21:459; LC-83-600167) Avail: NTIS HC A10/MF A01; SOD HC $21.00 CSCL 08L

Data from the Electrically Scanning Microwave Radiometer (ESMR) on the Nimbus 5 satellite are used to determine the extent and distribution of Antarctic sea ice. The characteristics of the southern ocean, the mathematical formulas used to obtain quantitative sea ice concentrations, the general characteristics of the seasonal sea ice growth/decay cycle and regional differences, and the observed seasonal growth/decay cycle for individual years and interannual variations of the ice cover are discussed. The sea ice data from the ESMR are presented in the form of color-coded maps of the Antarctic and the southern oceans. The maps show brightness temperatures and concentrations of pack ice averaged for each month, 4-year monthly averages, and month-to-month changes. Graphs summarizing the results, such as areas of sea ice as a function of time in the various sectors of the southern ocean are included. The images demonstrate that satellite microwave data provide unique information on large-scale sea ice conditions for determining climatic conditions in polar regions and possible global climatic changes. J.M.S.

N84-11555*# Delaware Univ., Newark. Coll. of Marine Studies.
***EVALUATION OF SPATIAL, RADIOMETRIC AND SPECTRAL* THEMATIC MAPPER PERFORMANCE FOR COASTAL STUDIES Quarterly Status and Technical Progress Report, 1 Jul. - 30 Sep. 1983**
V. KLEMAS, Principal Investigator 30 Sep. 1983 4 p ERTS (Contract NAS5-27580)
(E84-10018; NASA-CR-174545; NAS 1.26:174545) Avail: NTIS HC A02/MF A01 CSCL 05B

An area along the southeastern shore of the Chesapeake Bay was subsetted from TM imagery. The subsetted image was then enhanced and classified using an ERDAS 400 system. Results obtained were compared with a chart showing the distribution of both Zolsters marina and Rupplia martime in the Vaucluse Shores and which supports a large community of SAV. Radiative transfer models describing the irradiance reflectance of a water column containing SAV are being refined. Radiative transfer theory was used to model upwelling radiance for an orbiting sensor viewing an estuarine environment. Upwelling radiance was calculated for a clear maritime atmosphere, an opticaly shallow estuary of either clear or turbid water, and one of three bottom types: vegetation, sand, or mud using TM bands 1, 2, and 3 and MSS bands 4 and 5. A spectral quality index was defined similar to the equation for apparent contrast and used to evaluate the relative effectiveness of TM and MSS bands in detecting submerged vegetation. A.R.H.

N84-11565# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
MAPS OF FAVORABLE AREAS FOR TUNA FISHING IN THE SOUTHWESTERN ATLANTIC PREPARED FROM SATELLITE DATA
M. D. M. ABDON Sep. 1983 49 p refs Presented at the 8th Regular Meeting of the Commission ICCAT, Madrid, Nov. 1983
(INPE-2891-PRE/410) Avail: NTIS HC A03/MF A01

Surface temperature intervals suitable for large fish catch of the tuna species: Thunnus albacares, Thunnus alalunga and Thunnus obesus were previously defined for the Southwestern Atlantic. The ranges in temperature were located on thermal infrared images from the SMS-2 satellite and maps of favorable areas for tuna fishing based on these ranges, were prepared for the period February-July, 1980. In the development of these maps, infrared images received from the SMS-2 satellite were automatically processed by computer in the Image-100 System. Comparisons were made between fishing areas and tuna CPUE data for the years 1980, 1981 and 1982. The favorable areas for fishing of the yellowfin tuna were found distributed all over the study area. The favorable areas for fishing of the albacore and the bigeye tuna appeared in the southern part of the study area, mainly in regions where the Malvinas Current occurs. Author

N84-11682 Texas A&M Univ., College Station.
ON SURFACE CIRCULATION OF THE EASTERN NORTH PACIFIC Ph.D. Thesis
D. E. HAGAN 1982 299 p refs
Avail: Univ. Microfilms Order No. DA8306776

A qualitative and statistical study of the trajectory data for 51 satellite-reporting, drogued drifters in the Eastern North Pacific has shown that there are distinct seasonal differences in the patterns of surface flow. The drift observations extend across the region 30 to 55 N, 170 to 130 W from June, 1976 through October, 1978, a period characterized by anomalous intensities and locations for the North Pacific high and Aleutian low atmospheric pressure cells. Composite and seasonal trajectory descriptions indicate that the large scale flow field had a stronger northward component in the winter of 1976 to 77 than in the following winter of 1977 to 78. Cluster analyses demonstrate high coherence and north-south symmetry in the flow system. Mesoscale eddy features are prevalent in summer and well-defined anticyclonic meanders are shown to persist at more southern latitudes and to dampen at more northern latitudes. Dissert. Abstr.

N84-12584# Ecole Normale Superieure, Paris (France).
CONTRIBUTION OF SATELLITE REMOTE SENSING TO *KNOWLEDGE OF THE LITTORAL FROM THE MOUTH OF THE* LOIRE TO THAT OF THE GIRONDE (FRANCE) [CONTRIBUTION DE LA TELEDETECTION SATELLITAIRE A LA CONNAISSANCE DU LITTORAL DE L'EMBOUCHURE DE LA LOIRE A CELLE DE LA GIRONDE]
F. CUO *In* ESA Remote Sensing Appl. for Environ. Studies p 27-29 Jul. 1983 refs In FRENCH
Avail: NTIS HC A14/MF A01

The contribution of LANDSAT, NOAA, Tiros N, SEASAT, Nimbus 7, HCMM, and METEOSAT data to the study of coastal water and geomorphology is outlined. Combined with numerical models, these data enable coastal dynamics to be explained. Temperature

data offer insights into the kinematics of coastal water. Side-looking radar data are used to study the direction of surges, which explain coastal evolutions recorded by active and passive visible and near IR scanners. Perspectives for environmental effects and pollution monitoring are outlined. Author (ESA)

N84-12585# European Space Agency, Paris (France).
CONTRIBUTIONS OF REMOTE SENSING SATELLITE TRACKING TECHNIQUES TO MARINE ENVIRONMENT MONITORING AND MARINE APPLICATIONS
G. DUCHOSSOIS *In its* Remote Sensing Appl. for Environ. Studies p 31-34 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

The state-of-the-art of remote sensing satellite techniques for the monitoring of marine geophysical parameters such as waves, winds, sea surface temperature, and the current and potential utilization of satellite data for marine applications where knowledge and monitoring of sea-state conditions is essential (ship routing, off-shore activities, fisheries, oil pollution), are reviewed. Commercial possibilities are outlined. Results from oceanic missions show the feasibility of measuring marine geophysical parameters from space with adequate accuracy and in a continuous and reliable way. Author (ESA)

N84-12586# Joint Research Centre of the European Communities, Ispra (Italy).
MARINE REMOTE SENSING ACTIVITIES OF THE JOINT RESEARCH CENTER, ISPRA, ITALY
S. CAMAGNI, S. GALLIDEPARATESI, R. GILLOT, G. MARACCI, W. MEHL, N. OMENETTO, A. PEDRINI, G. ROSSI, P. SCHLITTENHARDT, B. STURM et al. *In* ESA Remote Sensing Appl. for Environ. Studies p 35-49 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Remote sensing of the propagation of anthropogenic pollutants in estuarine and coastal areas; evaluation of chlorophyll concentrations for fishery application; optical diagnosis of oil pollution; and multisensor oil slick detection and assessment exercises in the Mediterranean and in the North Sea are described. The JRC programs are designed to confirm that aerospace data present many advantages over conventional measurement techniques for detection, monitoring and/or prediction of particular situations of fishery and marine pollution in the European Community and associated countries. Author (ESA)

N84-12591# Centre National pour l'Exploitation des Oceans, Brest (France). Centre Oceanologique de Bretagne.
APPLICATION OF HIGH RESOLUTION SATELLITE DATA TO COASTAL ZONES: SPOT SIMULATIONS DURING ECOLOGICAL SURVEY OF THE BRITANNY COAST [APPLICATION DES DONNEES SATELLITAIRES HAUTE RESOLUTION A L'OBSERVATION DU MILIEU LITTORAL LE CAS DES SIMULATIONS SPOT DANS LE CADRE DE LA VEILLE ECOLOGIQUE DES COTES BRETONNES]
L. LOUBERSAC *In* ESA Remote Sensing Appl. for Environ. Studies p 79-85 Jul. 1983 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A14/MF A01

Typical digital image processing methodologies based upon simulated SPOT data were developed in order to extract intertidal and infratidal zones from original images, to establish quantitative assessment of different features and to inventory resources to be exploited or protected. An example from a coastline study is presented. Author (ESA)

N84-12604# European Space Agency, Paris (France).
TWO DIFFERENT ASPECTS OF PHYTOPLANKTON BLOOM SEEN BY SATELLITE (CZCS) IN THE WESTERN ENGLISH CHANNEL [DEUX ASPECTS DIFFERENTS DES FLORAISONS DE PHYTOPLANCTON VUS PAR SATELLITE (CZCS) EN MANCHE OCCIDENTALE]
C. DUPOUY (ORSTOM, Bondy, France) *In* ESA Remote Sensing Appl. for Environ. Studies p 173-177 Jul. 1983 refs In FRENCH; ENGLISH summary Sponsored by CNRS, CNES and French Ministry of the Environment
Avail: NTIS HC A14/MF A01

Two images recorded during summer by the CZCS on NIMBUS 7 over the English Channel are presented. They provide a synpotic view of very large patterns of complex shape related differently in June and July to the thermal front. Spectral signatures measured during two oceanographic campaigns at the same time as the images allow the development of an algorithm for determination of chlorophyll concentration in the zone. Corresponding hydrologic and biological data prove that the two observed phytoplankton blooms have a different type (diatoms/dinoflagellates) and probably do not have the same implications on the marine food chain. Author (ESA)

N84-12605# Bergen Univ. (Norway). Inst. of Geophysics.
APPLICATION OF REMOTE SENSING FOR STUDIES, MAPPING AND FORECASTING OF EDDIES ON THE NORWEGIAN CONTINENTAL SHELF
O. M. JOHANNESSEN, J. A. JOHANNESSEN, and B. A. FARRELLY *In* ESA Remote Sensing Appl. for Environ. Studies p 179-187 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

An integrated remote sensing/in situ observational study of the Norwegian continental shelf is recommended. A series of waves exists on this front, with a wavelength of 100 km and a wave width of 50 km. These waves develop into eddies which propagate northwards with a speed of 0.2 to 0.3 knots and with an orbital speed of more than 3 knots. The strong currents associated with these eddies interfere with oil drilling operations. Active sensors, similar to those of ERS-1 (ESA satellite) are advocated, for example the SIR-B SAR to be launched by a space shuttle in 1984. Land or platform based high frequency radar is also advocated. Author (ESA)

N84-12606# Ministere de l'Environment et du Cadre de Vie, Neuilly (France).
ACTUAL STATE AND RECENT EVOLUTION OF THE FRENCH COAST OBSERVED BY REMOTE SENSING USING LANDSAT RECORDINGS [ETAT ACTUEL ET EVOLUTION RECENTE DE L'ENVIRONNEMENT DU LITTORAL FRANCAIS OBSERVE PAR TELEDETECTION A PARTIR DES ENREGISTREMENTS LANDSAT]
M. LENCO *In* ESA Remote Sensing Appl. for Environ. Studies p 189-195 Jul. 1983 In FRENCH
Avail: NTIS HC A14/MF A01

LANDSAT images of the French coast provided physical, cartographic, and numerical information for an environmental survey of a maritime zone 5 km wide, and a 20 km wide coastal strip. False color composites (1:100,000) from bands 4,5 and 7 were produced for the recent past and 5 years ago. Two map series were obtained: one showing biophysically homogeneous zones, nature of coastline, physical characteristics of ocean surface; and the other showing land use, The latter series has 40 catagories describing present situation and changes occuring in the past 5 years, with numerical results by administrative department and in strips parallel to the coast. Author (ESA)

N84-12607# Ministere de l'Environment et du Cadre de Vie, Neuilly (France). Direction de la Prevention des Pollutions.
REMOTE SENSING APPLIED TO MARINE POLLUTION CONTROL
J. M. MASSIN *In* ESA Remote Sensing Appl. for Environ. Studies p 197-202 Jul. 1983
Avail: NTIS HC A14/MF A01

The requirements of a remote sensing sensing system to monitor marine pollution, particularly oil pollution, are outlined, and a study of the possibilities offered by remote sensing in setting up models to anticipate pollution movements at sea is proposed. Multisensor systems with real time display and interactive processing of data on board surveillance aircraft are advocated. Research and development of the sensor and its software should be undertaken simultaneously. Standardization of computer languages, data handling, and reporting is urged, to facilitate international cooperation. Author (ESA)

N84-12608# Technical Univ. of Denmark, Lyngby. Inst. of Electromagnetics.
INTRODUCTORY STUDIES OF NATURAL CONTAMINATION AND MANMADE POLLUTION IN DANISH WATERS
A. NIELSEN (National Agency of Environmental Protection, Charlottenlund, Denmark), P. HANSEN, A. MALMGREN (Academy of Technical Sciences, Hoersholm, Denmark), and V. HANSEN (Danish Inst. for Fisheries and Marine Research, Hirtsnals) *In* ESA Remote Sensing Appl. in Environ. Studies p 203-210 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

A satellite-aircraft system for surveying oil spills and plankton blooms is outlined. Retrieval of chlorophyll concentration from airborne multispectral scanner measurements is described. A plankton bloom in the Baltic Sea observed by LANDSAT is discussed. Observation of plankton blooms requires frequent coverage with a medium resolution satellite sensor, such as the coastal zone color scanner or the multispectral scanner on MOS-1. Direct acquisition of data from satellites is preferred, but may be too expensive. Meteorological data and physical, chemical, and biological measurements can be obtained from existing sources. Aircraft-borne cameras and multispectral scanners can supplement satellite coverage in cloudy conditions. Author (ESA)

N84-12609# Technical Univ. of Denmark, Lyngby.
PASSIVE RADIOMETRY AND OTHER REMOTE SENSING DATA INTERPRETATION FOR OIL SLICK THICKNESS ASSESSMENT, IN AN EXPERIMENTAL CASE
N. SKOU, F. TOSELLI (Joint Research Centre of the European Communities), and A. WADSWORTH (Inst. Francais du Petrole, Rueil-Malmaison, France) *In* ESA Remote Sensing Appl. in Environ. Studies p 221-216 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Oil spills in the Mediterranean Sea were monitored by remote sensing. Three microwave radiometers (5, 17 and 34 GHz) with profiling and imaging modes were flown over 5 slicks spreading out from original surfaces of 20,000 sqm each. Infrared and sea truth measurements were also made. The slick thickness obtained by the radiometers indicates oil volumes in fair agreement with the quantities spilled. With the imaging mode, areal extent of the oil is directly depicted in just one pass. Oil thickness is measured with sufficient accuracy to assess the total oil volume in the slick. Aircraft navigation is straightforward due to a reasonable swath width of the imaging radiometer. In the low flying profiling mode, oil thickness is measured with great accuracy and resolution. Detailed thickness distributions within the oil slick can be measured. Navigation is delicate over limited sized slicks. The measured profiles must be superimposed semiautomatically on imagery of the oil slick taken simultaneously from the same aircraft
Author (ESA)

N84-12611# Centre d'Etudes Techniques de l'Equipment, Aix-en-Provence (France).
OPERATIONAL UTILIZATION OF REMOTE SENSING IN A STUDY OF THE IMPACT OF DISPOSAL OF URBAN WASTE AT SEA [UTILISATION OPERATIONNELLE DE LA TELEDETECTION DANS LE CADRE D'UNE ETUDE D'IMPACT D'UN REJET URBAIN EN MER]
C. VALERIO *In* ESA Remote Sensing Appl. in Environ. Studies p 223-227 Jul. 1983 refs In FRENCH; ENGLISH summary
Avail: NTIS HC A14/MF A01

Airborne quantitative photographic remote sensing links with other means to collect data on the effects of sewage discharge into the sea are shown. Since there are two possible polluting sources for the beach (the river and the sewage) two different dye tracers were used simultaneously in the same marine zone to evaluate the individual influence of both sources. Results show that both sources contribute significantly to beach pollution, and illustrate the usefullness of remote sensing for studying the interactions. Author (ESA)

N84-12612# Institut Francais du Petrole, Rueil-Malmaison.
RADAR BATHYMETRY : A REVIEW
A. WADSWORTH and P. PIAU *In* ESA Remote Sensing Appl. for Environ. Studies p 229-238 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Use of imaging radar (SAR or SLAR) to provide information on sea bottom features, corresponding to morphology of the sea floor, in shallow waters, is described. It is shown how, with the same kind of imaging radar, valuable information can be extracted on significant bottom features, in the case of medium depths. The possibility of having a rough but almost real bathymetry, in the deepest seas, when using altimeter data, is depicted. An interpretation of the mechanism of the visualization of bathymetry by an imaging radar is discussed. Author (ESA)

N84-12616# Catania Univ. (Italy). Inst. of Machinery.
REMOTE SENSING ANALYSIS OF OIL POLLUTION IN AUGUSTA BAY, SICILY
A. L. GERACI and T. CALTABIANO *In* ESA Remote Sensing Appl. in Environ. Studies p 261-271 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Simultaneous acquisition of data from infrared photography and thermal infrared imagery was used to study oil pollution in a Mediterranean bay. Conventional 35 mm cameras and an airborne thermovision system were used. Highly polluted areas and illegally discharging vessels are clearly discernible. Infrared photography and thermal infrared imagery must be used in conjunction with each other to provide accurate interpretation of the data.
Author (ESA)

N84-13661# National Oceanic and Atmospheric Administration, Seattle, Wash.
A SATELLITE STUDY OF OCEAN INTERNAL WAVES
C. SAWYER Mar. 1983 75 p refs
(PB83-248708; NOAA-TM-ERL-PMEL-48; CONTRIB-634; NOAA-83081106) Avail: NTIS HC A04/MF A01 CSCL 08C

Ocean internal-wave slicks over the eastern U.S. continental shelf imaged by the satellite LANDSAT are described and analyzed. This study confirms generation by semidiurnal tides, locates the site of generation at the edge of the continental shelf, and establishes the time of generation near the time of maximum flood current. Characteristics such as wavepacket extent, water depth, and packet lifetime are quantitatively described. The wavelength spectrum derived from spacing of slicks observed near generation is far from a smooth 'universal spectrum.' Slick visibility is discussed in terms of modification of surface-wave amplitude by the near-surface current system of the internal waves. From uniformly spaced series of packets, and from similar packet images recorded on successive days, the median lifetime of slick packets is found to be two to three tidal cycle. Author (GRA)

N84-13749# Naval Ocean Research and Development Activity, Bay St. Louis, Miss. Remote Sensing Branch.
A POSITION PAPER: MESOSCALE OCEANOGRAPHY FROM GEOSAT *Final Report*
J. L. MITCHELL Aug. 1983 28 p
(AD-A132292; NORDA-TN-226) Avail: NTIS HCA03/MFA01 CSCL 08J

The secondary mission of GEOSAT is oceanography. Several Navy elements, (OP-952, OP-02, and ONR) have a direct interest in seeing that every possible attempt is made to maximize the return of information on the oceanic mesoscale from GEOSAT derived sea surface topography. During the nominal, essentially geodetic, GEOSAT mission attempts to obtain meaningful mesoscale information will be severely hampered due to two critical considerations: (1) The non-repeating nature of the satellite groundtracks during its nominal mission will allow for recovery of geoid uncontamination mesoscale topography in only a very few isolated regions with little mesoscale information in over 99% of the global oceans and; (2) The severe temporal undersampling of the oceanic mesoscale will not allow for the desired synoptic realization of non-stationary mesoscale fields. The best way of meeting requirements for GEOSAT's secondary mission is to remaneuver the satellite into an appropriate orbit with exactly repeating ground-tracks at the completion of its nominal, geodetic mission. It is likely (at above the 50% level of probability) that GEOSAT will survive an additional two years beyond completion of its nominal mission. Studies have already been performed to assess the technical feasibility of such an extended, exact repeat mission (the GEOSAT-ERM), and no major technical difficulties are foreseeable. At a cost of roughly $2M annually the GEOSAT-ERM represents the Navy's most cost effective possibility for obtaining critical global mesoscale information. Author (GRA)

N84-14658# Naval Postgraduate School, Monterey, Calif.
A STATISTICAL APPROACH FOR DETERMINING SUBSURFACE THERMAL STRUCTURE FROM SEA SURFACE TEMPERATURE IN THE NORTHEAST PACIFIC OCEAN M.S. Thesis
T. A. HOWELL Jun. 1983 194 p
(AD-A132204; AD-E750839; NPS68-83-003) Avail: NTIS HCA09/MFA01 CSCL 08J

Bathythermograph data acquired from the research vessel USNS SILAS BENT along a meridional track in the Northeast Pacific during September 1977 were statistically analyzed to determine possible associations between the subsurface thermal structures and sea surface temperature. Strongly correlated variables (thermocline gradients, mixed layer depth, and locations of the seasonal and main thermoclines) within the vertical temperature profile were used in linear regression methods to form empirical relationships. The generated equations then are utilized to define the subsurface thermal structure from only an input of sea surface temperature. Comparison tests with temporally and spatially removed BT data were conducted with results indicating successful application within a water mass domain with uniformly changing characteristics. GRA

N84-14659# Woods Hole Oceanographic Institution, Mass.
LONG TERM UPPER OCEAN STUDY (LOTUS) AT 34 DEG N, 70 DEG W: METEOROLOGICAL SENSORS, DATA AND HEAT FLUXES FOR MAY-OCTOBER 1982 (LOTUS-3 AND LOTUS-4)
C. DESER, R. A. WELLER, and M. G. BRISCOE Sep. 1983 71 p
(Contract N00014-76-C-0197)
(AD-A133883; WHOI-83-32) Avail: NTIS HCA04/MFA01 CSCL 04B

Meteorological data have been gathered from a moored surface buoy at 34 deg N, 70 deg W in the Long Term Upper Ocean Study (LOTUS) experiment. The meteorological results from the first year of LOTUS are encouraging; the data returned form redundant sensors agree closely. Surface heat fluxes calculated from the observations show the annual cycle of heat transfer to the mixed layer. This report documents the meteorological sensors on the LOTUS-3 (May 1982-October 1982) and LOTUS-4 (November 1982-March 1983) surface buoys. It describes in detail the telemetry of the meteorological data via the ARGOS satellite system. The measurements returned from LOTUS-3 are presented and evaluated. Monthly heat fluxes at the sea surface are computed using the bulk formulas and compared with the long-term means. The errors in the heat fluxes have been estimated. GRA

N84-15640# Lamont-Doherty Geological Inst., Palisades, N. Y.
GEOPHYSICAL DATA FROM DRIFTING ICE STATIONS FRAM 4 AND TRISTEN
W. TIEMANN, J. ARDAI, B. ALLEN, T. O. MANLEY, and Y. KRISTOFFERSEN Dec. 1982 99 p
(Contract N00014-76-C-0004)
(AD-A133370; LDGO-82-3) Avail: NTIS HCA05/MFA01 CSCL 08L

This report contains satellite navigation positioning, precision depth recorder (PDR) measurements, ice floe azimuths, and magnetic declinations collected by the Lamont Group at the FRAM IV drifting ice station. Gravity measurements at FRAM IV, taken by Yngve Kristoffersen of the Norsk Polarinstitutt, are incorporated into this report. Satellite navigation positioning and PDR data from the drifting ice station TRISTEN are also included in this report. Data are presented in the form of tables and figures with a brief description of the instrument and methods used in the obtaining and reducing the data prior to each section. Author (GRA)

N84-15646# Advisory Group for Aerospace Research and Development, Neuilly-Sur-Seine (France).
PROPAGATION FACTORS AFFECTING REMOTE SENSING BY RADIO WAVES
Loughton Aug. 1983 399 p refs In ENGLISH and FRENCH Symp. held in Oberammergau, West Germany, 24-28 May 1983
(AGARD-CP-345; ISBN-92-835-0257-4) Avail: NTIS HC A17/MF A01

The purpose of the symposium was to survey progress in the field, and to bring together scientists and engineers working the different wavelength regions to encourage cross fertilization and to enable performance comparisons between systems. Satellite system factors and high frequency system factors are discussed. Radar tracking ice mapping, over the horizon radar, and backscattering are among the topics discussed.
R.J.F.

N84-15649# Marconi Co. Ltd., Chelmsford (England).
OCEAN WAVE IMAGING BY SAR
S. ROTHERAM *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 20 p Aug. 1983 refs
Avail: NTIS HC A17/MF A01

SAR imagery of the sea surface contains wave-like features. The direct imaging problem is to describe the image of a given sea surface. Four approaches are given. These are linear imaging, Fourier series, functional expansion and asymptotic methods. Of particular interest is the loss of wave modulations due to nonlinear velocity bunching. The image power spectrum is analyzed using functional expansions and the azimuthal banding is explained by stochastic nonlinear velocity bunching. The theoretical results agree closely with SEASAT data and some examples are given. The inverse sea imaging problem is to describe the sea surface corresponding to a given image. Some preliminary results using linear inversion techniques are given. R.J.F.

N84-15654# Rome Air Development Center, Hanscom AFB, Mass. Electromagnetic Sciences Div.
HF OVER-THE-HORIZON MAPPING OF THE GREENLAND ICECAP
G. S. SALES *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 12 p Aug. 1983
Avail: NTIS HC A17/MF A01

Continuous observation of the Greenland area using a high frequency over-the-horizon Sounding system in the North Atlantic region produced a data base for the analysis of backscatter reflectivity at high frequencies (6-30 MHz) from the Greenland Icecap. The proximity of these observations to the auroral region generated the additional complication of excess losses due to

D-region absorption. This statistical data base produced a mapping of the icecap thickness, with backscatter reflectivities that vary from -5 dB to -15 dB below the signals returned from the surrounding sea water. A statistically meaningful daytime absorption of the order of 5 dB was measured over Greenland. At night the significantly increased auroral absorption and atmospheric noise, reduced the system's sensitivity, making mapping impossible.
R.J.F.

N84-15656# Science Research Council, Chilton (England).
IONOSPHERIC FACTORS AFFECTING THE PERFORMANCE OF HF SKY-WAVE SEA-STATE RADARS
P. A. BRADLEY, E. N. BRAMLEY, A. J. GIBSON, and J. W. KING *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 10 p Aug. 1983 refs
Avail: NTIS HC A17/MF A01

This paper contains an assessment, partly theoretical and partly based on observations, of the impact of various ionospheric factors on the usefulness of the HF sky-wave sea-state radar technique. The points discussed include the following: (1) The ionospheric propagation modes available will not permit all parts of the ocean which it is desired to investigate to be illuminiated at all times in such a way that good-quality Doppler spectra are obtained. Es-mode propagation generally results in good-quality Doppler spectra from which information about the sea waves can be inferred, but F-mode propagation yields poor spectra which can only be used to deduce the surface wind direction. (2) Doppler shifts associated with vertical ionospheric motions give spectral contamination which limits the amount of information that can be derived. Spectral contamination also arises under conditions of multi-mode propagation and when high- and low-angle rays are present. (3) Lack of knowledge of the height of reflection of the sky-wave signals means that the area of ocean probed cannot be located accurately. (4) The azimuthal spreading (arising because of the antenna beam width) and range spreading (caused by ionospheric tilts and corrugations and associated with the finite radar pulse width) both result in Doppler contamination of the returned signals. Author

N84-15671# Science Applications, Inc., San Diego, Calif.
SATELLITE MEASUREMENTS OF MARINE AEROSOLS
M. GRIGGS *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 5 p Aug. 1983 refs
(Contract N00014-77-C-0489; N00228-82-C-6199; MO-A01-78-00-4092)
Avail: NTIS HC A17/MF A01

The ability to measure atmospheric aerosols over ocean surfaces was demonstrated using several different satellite sensors. LANDSAT data originally showed that a linear relationship exists between the upwelling visible radiance and the aerosol optical thickness. Analysis of NOAA-6 AVHRR data obtained at several different locations, in coincidence with ground truth measurements, show that the Channel 1 (0.65 microns) radiances can be used to determine the aerosol optical thickness. The good agreement between the results at different locations suggests that the technique could be used in an operational system. A technique using Channel 1 and Channel 2 (0.86 microns) radiances to determine the aerosol size distribution is discussed, and, in spite of uncertainties in the satellite and ground truth data, a preliminary analysis shows that useful estimates of the size distribution can be obtained. Author

N84-15674# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
REMOTE SENSING OF ATMOSPHERIC PRESSURE AND SEA STATE FROM SATELLITES USING SHORT-PULSE MULTICOLOR LASER ALTIMETERS
C. S. GARDNER, B. M. TSAI, and J. B. ABSHIRE *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 11 p Aug. 1983 refs Prepared in cooperation with Illinois Univ., Urbana
(Contract NSG-5049)
Avail: NTIS HC A17/MF A01 CSCL 20E

Short pulse multicolor laser ranging systems are currently being developed for satellite ranging applications. These systems use Q-switched pulsed lasers and streak tube cameras to provide timing accuracies approaching a few picoseconds. Satellite laser ranging systems was used to evaluate many important geophysical phenomena such as fault motion, polar motion and solid earth tides, by measuring the orbital perturbations of retroreflector equipped satellites. Some existing operational systems provide range resolution approaching a few millimeters. There is currently considerable interest in adapting these highly accurate systems for use as airborne and satellite based altimeters. Potential applications include the measurement of sea state, ground topography and atmospheric pressure. This paper reviews recent progress in the development of multicolor laser altimeters for use in monitoring sea state and atmospheric pressure. Author

N84-15746# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
AN ANALYSIS OF AIRCRAFT DATA COLLECTED IN THE ALBORAN SEA DURING DONDE VA?, 6 - 18 OCTOBER 1982 Final Report
P. E. LA VIOLETTE and J. L. KERLING Jul. 1983 122 p
(AD-A133995; NORDA-TN-222) Avail: NTIS HCA06/MFA01 CSCL 08J

During the period 6-18 October 1982, a U.S. Navy aircraft flew a series of oceanographic survey flights over the Alboran Sea as part of a multi-platformed international experiment called Donde Va? The purpose of the flights was to measure the surface and subsurface temperature distribution, the short-term surface flow, and the atmospheric conditions during the period of the intensive field investigations. This technical note describes these flights and presents the analyses of the Precision Radiation Thermometer (PRT-5), the Airborne Expendable Bathythermograph (AXBT), the sonobuoy drift, and the Inertial Navigation System (INS) wind data. Author (GRA)

N84-15747# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
SNOW THICKNESS AND BRIGHTNESS TEMPERATURE ON MULTI-YEAR ICE Final Report, period ending FY 1980
A. W. LOHANICK Nov. 1982 15 p
(AD-A133940; NORDA-TN-171) Avail: NTIS HCA02/MFA01 CSCL 08L

The 33 GHz brightness temperature (Tb) of a 40-meter strip of multi-year ice was obtained using a sled-mounted radiometer. Snow accumulations along the strip varied from 0 to 40 cm. After the snow was removed, Tb was re-measured. Detailed comparisons of snow depth vs. change in Tb show that snow thickness or snow water equivalent alone are not sufficient to describe the emissivity of the snow pack. Author (GRA)

N84-15749# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
THE ADVECTION OF SUBMESOSCALE THERMAL FEATURES IN THE ALBORAN SEA GYRE
P. E. LAVIOLETTE Sep. 1983 39 p
(AD-A133877; NORDA-TN-240) Avail: NTIS HCA03/MFA01 CSCL 08J

Continuous monitoring of these cold-water features using satellite imagery is possible because of the twice-daily (every 12-hours) spacing of the NOAA-7 coverage of the area. After registration to a mercator projection and atmospheric correction,

analysis of the displacement of the cold water features in successive imagery show their apparent origin to be just east of Gibraltar, their movement at average speeds of 0.4 m/sec around the Gyre, and their apparent reentrainment into the incoming Atlantic water east of Gibraltar. The NIMBUS-7 CZCS imagery supplements the analysis by adding details of the movement and to the theory on where the cold-water features originate. During the fifteen-day period, nine cold-water features were thermally distinct enough to be tracked for several days. Aircraft and ship oceanographic data collected during the period show the cold surface features were associated with upwelled water from greated than 100 meters depth and based on temperature and salinity data, appear to be of Atlantic origin. Sonobuoy drift data indicate the features were part of the incoming Atlantic jet. While the speed of the features varied from day-to-day ranging from 0.2 to 0.6 m/sec, comparison with meteorological data does not indicate that these differences were related to variations in direction or strength of the wind. It is hypothesized from the limited amount of data available at this time that the features are associated with the tidal movement exiting the Strait of Gibraltar. GRA

N84-15750# Naval Ocean Research and Development Activity, Bay St. Louis, Miss.
SHORT-TERM MEASUREMENTS OF SURFACE CURRENTS ASSOCIATED WITH THE ALBORAN SEA DURING DONDE VA?
P. E. LAVIOLETTE Sep. 1983 36 p
(AD-A133812; NORDA-TN-241) Avail: NTIS HCA03/MFA01
CSCL 08C

During the period 6 through 18 October 1982, six flights by a U.S. Navy research aircraft were made over the Alboran Sea Gyre as part of the Donde Va? experiment. During five of these flights, sonobuoys were dropped in a linear pattern designed to show the temporal and spatial variability of the current which constitute the gyre. A normal deployment consisted of approximately 15 sonobuoys dropped along the longitudinal line 4 deg 45 min W from the Spanish coast to within 30 km of the Moroccan coast. During the following four hours, the sonobuoys were located twice, their positions noted, and their individual drift speeds and directions derived. Aircraft precision radiation temperature and aircaft expendable bathythermograph data were collected concurrently with the sonobuoy drops to determine the thermal structure of the water during the drift period. Inertial navigation winds as well as other meteorological data, were also collected by the aircraft. Analysis of these data show that the cold (aprox 17 C) outer portion of the Alboran Sea Gyre was the main constituent of the jet. These cold waters reached speeds of greater than 1.2 m/sec as compared to average speeds of 0.6 m/sec for the warmer water of the gyre. Examination of the aircraft meteorological meaurements as well as data relating to the short-term atmospheric conditions i.e., for the 12-day period of the study) did not indicate that meteorological factors had a major influence on the speed of the currents or the position of the gyre during the period of study. Author (GRA)

N84-15754# Washington Univ., Seattle. Applied Physics lab.
XCP MEASUREMENTS OFF CALIFORNIA IN OCTOBER 1982: CRUISE REPORT AND PRELIMINARY RESULTS Final Report
E. A. DASARO Aug. 1983 33 p
(Contract N00014-82-C-0038)
(AD-A133051; APL-UW-8310) Avail: NTIS HCA03/MFA01
CSCL 08C

Sixty nine profiles of horizontal velocity and temperature from the surface to about 800 m were made using the Expendable Current Profiler (XCP) during De Steiguer cruise 1212, 7-18 October 1982. The XCP's were deployed in a 6 day time series behind a drogued buoy and in a 275 n.mi. zigzag spatial survey. Satellite infrared images were used to locate a cruise area away from strong mesoscale features. The measurements were designed to estimate the horizontal coherence function of the near-inertial frequency internal wave field for comparison with similar measurements made in the Sargasso Sea. It was found that the near-inertial waves are a dominant feature of the velocity field. Significant coherence exists between nearby profiles. It will, therefore, be possible to compute a correlation function for these data as planned. A near-surface feature with peak-to-peak velocities of 70 cm/s was observed and partially surveyed. Author (GRA)

06

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.

A84-11631
GLACIER MONITORING BY SATELLITE
A. DELLA VENTURA, A. RAMPINI (CNR, Istituto di Fisica Cosmica, Milan, Italy), R. RABAGLIATI (IBM Italia S.p. A., Mestre, Italy), and R. SERANDREI BARBERO (CNR, Istituto per lo Studio della Dinamica delle Grandi Masse, Venice, Italy) Nuovo Cimento C, Geophysics and Space Physics, vol. 6C, Mar.-Apr. 1983, p. 211-222. refs

A multitemporal analysis on the Mount Disgrazia glaciers was performed by using the 1975, 1978 and 1980 MSS Landsat images. On these images the glaciers were completely described in their boundaries and surface features. Fixed structures were used along their boundaries as fiducial points of the ground control table for the multitemporal comparison of the glaciers. This makes is possible to estimate the glacier surface changes due to frontal displacements as well as the changes in the snow-covered area due to the displacements of the snow transient line. The procedure is possible since the recordings of Landsat satellites are continuous in space and time. It gives completeness to the individual data on the galciers as provided by the field measurements and it makes the management of the water resources possible. Author

A84-13049
REGIONAL EVAPOTRANSPIRATION MODELING OF OKLAHOMA'S LITTLE WASHITA DRAINAGE BASIN
S. J. WALSH and S. J. STADLER (Oklahoma State University, Stillwater, OK) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 389-398. Research supported by the Oklahoma State University. refs

A84-13087
USING LANDSAT DATA TO ESTIMATE RESERVOIR STORAGE
S. F. SHIH (Florida, University, Belle Glade, FL) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 321-326. Research supported by the St. Jonns River Water Management District.

A technique using Landsat data was developed to estimate lake storage volume and was applied to Lake Washington and Lake Harris in central Florida. A number of Landsat scenes including the lakes of interest were selected to correspond with a wide range of lake stages as measured over the past nine years. Lake surface area was then measured from the Landsat data, and when properly averaged, was used with the change in lake level to estimate the change in lake volume. Thus, the uses can directly correlate change in lake stage with available water volume. For instance, eight cloud free dates were chosen for Lake Washington. The water surface was measured from Landsat along with the lake stage that ranged from 3.23 to 4.83 m. The results indicated that the water surface varied from 1,027 hectares at the stage 3.23 m to 1,153 hectares at the stage 4.83 m. The ground truth measurement of water surface was 1,152 hectares around the stage 4.83 m. This is slightly lower than 1,153 hectares as estimated

from Landsat data. The difference seems to be negligible in practical application. Thus, the techniques developed in this study are quite applicable to solve the problem of lake storage volume. Author

A84-13348
A THEORY OF CURRENT AND COLORATION, BY TIMED SEQUENCES OF AERIAL PHOTOGRAPHY [COURANTOLOGIE ET COLORATION, PAR PHOTOGRAPHIES AERIENNES CHRONOSEQUENTIELLES]
C. ARMENGAU and B. SEGALA (Centre d'Etude et de Recherches Geologiques et Hydrologiques, Montpellier, France) Photo Interpretation (ISSN 0031-8523), vol. 21, July-Aug. 1982, 14 p. In French, English, and Spanish.

The results of continuous aerial photography of the mouth of a river entering the ocean downstream from a refinery are reported. Attention was given to the effect of a return flow on the behavior of a rhodamine dye tracer injected into the effluents, the interactions of water masses with different qualities, the evolution of the plume as it entered the coastal waters, and the output of the river as it surged into the sea. Other dynamic characteristics of the exiting plume were examined through both photography and specular reflection. The overflights were performed at 1200 ft, 500 m, 1000 m, 2000 m, and 6000 m. Consideration was also given to tidal effects on the plume evolution. M.S.K.

A84-13604* National Aeronautics and Space Administration, Washington, D. C.
FLOODPLAIN MANAGEMENT APPLICATIONS OF LANDSAT DATA FOR THE UPPER MISSISSIPPI RIVER BASIN
J. C. GERVIN (NASA, Washington, DC), Y.-C. LU (NASA, Goddard Space Flight Center, Eastern Regional Remote Sensing Applications Center, Computer Sciences Corp., Greenbelt, MD), and P. D. SOYKE (U.S. Army, Rock Island, IL) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 159-169.

A84-13910* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NIGHT-TIME OBSERVATIONS OF SNOW USING VISIBLE IMAGERY
J. L. FOSTER (NASA, Goddard Space Flight Center, Hydrological Sciences Branch, Greenbelt, MD) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, Oct.-Dec. 1983, p. 785-791. refs

Consideration is given to the possibility of increasing the frequency of satellite snow cover observations in the visible range by using the light reflected off the moon as an illumination source for nighttime observations. Images obtained at night by DMSP satellites orbiting in the noon-midnight plane are presented which were obtained at various phases of the moon. It is concluded that DMSP visible imagery can be used to detect snow cover during those periods when the moon is over the local horizon and is between the first quarter phase and the last quarter phase, which amounts to around five additional days a month allowing for cloud cover. The high frequency of observation of a given area provided by a light-sensitivity imager would be an important feature of a dedicated water-resources satellite. A.L.W.

A84-14557
AN INSTRUMENT FOR THE MEASUREMENT OF PRECIPITATION RATE BY NEAR-INFRARED EXTINCTION
F. J. NEDVIDEK, Z. KUCEROVSKY, and E. BRANNEN (Western Ontario, University, London, Canada) Journal of Climate and Applied Meteorology (ISSN 0733-3021), vol. 22, Sept. 1983, p. 1581-1586. Research supported by the Natural Sciences and Engineering Research Council of Canada. refs

The design, construction and performance of a near-infrared atmospheric precipitation sensing device is described. An infrared light emitting diode was used to generate a sensing beam of 0.92 micron wavelength. The collimated sensing beam traversed an atmospheric path from the transmitter-receiver unit to a remotely positioned corner retroreflector. A phase sensitive detector was used for demodulation. A reference signal was obtained from the sensing beam using a beam splitter. Refractive optics were used for collimation and signal collection. In field tests, calibration curves for extinction versus the rate of rainfall and the rate of snowfall were obtained for path lengths of 100 and 50 m. Experimental results for the rainfall calibration curve produced smaller extinctions than predicted theoretically, with a maximum difference of 3 dB/km occurring at a rain rate of 80 mm/h. Results for rainfall and snowfall experiments coincided with the findings of other authors to within approximately + or - 20 percent. Author

A84-14595* Kansas Univ. Center for Research, Inc., Lawrence.
MICROWAVE EMISSION FROM AN IRREGULAR SNOW LAYER
H. J. EOM, K. K. LEE, and A. K. FUNG (University of Kansas Center for Research, Inc., Lawrence, KS) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Nov. 1983, p. 423-437. refs
(Contract NAG5-163)

Emission from an irregular snow layer is modeled by a layer of Mie scatterers using the radiative transfer method. Comparisons are made with measurements showing snow wetness effects and rough air-snow boundary effects. For convenience of reference, theoretical model behavior is also illustrated. Author

A84-14596* National Oceanic and Atmospheric Administration, Miami, Fla.
ZENITH ANGLE EFFECTS IN MULTICHANNEL INFRARED SEA SURFACE REMOTE SENSING
G. A. MAUL (NOAA, Atlantic Oceanographic and Meteorological Laboratory, Miami, FL) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Nov. 1983, p. 439-451. refs
(Contract NASA ORDER S-71095-B)

Several approaches to infrared multichannel sea surface temperature retrievals propose using a universal set of constants. It is shown that the single-channel multiangle technique (i.e., GOES and NOAA) and the multichannel single-angle technique (NOAA-n) are similar concepts with a common derivation from radiative transfer theory. It is also shown that the linear correlation factor between surface temperature minus satellite temperature in one channel versus the difference in satellite temperatures in two channels is not independent of the difference in satellite sensed equivalent blackbody temperature. The 3.7-micron, 11-micron, and 12-micron channels on the NOAA-n AVHRR can be used in combination to compute atmospheric transmissivity and average atmospheric temperature, but a better combination would be substituting three 0.5-micron-wide channels centered on 11.25 micron, 11.75 micron, and 12.25 micron. A triple window multispectral scanner in the 11-12.5 micron region allows determination of diffuse surface reflectance which can bias sea surface temperatures - 0.4 K + or - 0.3 K. Author

A84-14846
APPLICATION OF REMOTE-SENSING DATA TO THE PRELIMINARY ESTIMATION OF GROUND-WATER FLOW [PRIMENENIE DISTANTSIONNOI INFORMATSII PRI PROGNOZOI OTSENKE PODZEMNOGO STOKA]
R. G. DZHAMALOV and IU. L. OBEDKOV (Akademiia Nauk SSSR, Institut Vodnykh Problem, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 60-66. In Russian. refs

Problems and methods of the hydrogeological interpretation of space imagery are examined. Different types of geofiltrational media (i.e., media of ground-water flow) are briefly characterized, and a technique for the identification of these types of media on the basis of image structure is described. It is shown that the identification of geofiltrational media is one way to acquire quantitative information about ground-water flow and ground-water resources using space imagery. B.J.

A84-15199
INTERACTIVE ADJUSTMENT OF AUTOMATIC SATELLITE DERIVED PRECIPITATION ESTIMATES
J. F. MOSES (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) IN: Conference on Hydrometeorology, 5th, Tulsa, OK, October 17-19, 1983, Preprints. Boston, MA, American Meteorological Society, 1983, p. 174-181.

Data treatment techniques used by meteorologists in deciding to issue flash flood and excessive precipitation watches using GOES satellite imagery as a basis for the advisories are detailed. Estimates are prepared every half-hour on the image processing computer, the Interactive Flash Flood Analyzer (IFFA). It has been found that the heaviest rainfall is asociated with the highest cloud tops, rapidly growing thunderstorm anvils, stationary clusters, and overshooting cloud domes. An algorithms has been defined for estimating precipitation amounts between two consecutive images in rainfall areas with rates higher than 0.25 in./hr. Computational and areal constraints limit analyses to two or three isohyets around a cloud top, with highest estimates assigned to the coldest cloud tomps. The IFFA locates cloud domes and growth, and then projects the expected height of the convection. Analyses examples are provided for thunderstorms over Mississippi and Louisiana over a two-day period. M.S.K.

A84-15200
OPERATIONALLY DETECTING FLASH FLOOD PRODUCING THUNDERSTORMS WHICH HAVE SUBTLE HEAVY RAINFALL SIGNATURES IN GOES IMAGERY
L. E. SPAYD, JR. and R. A. SCOFIELD (NOAA, National Environmental Satellite, Data, and Information Service, Washington, DC) IN: Conference on Hydrometeorology, 5th, Tulsa, OK, October 17-19, 1983, Preprints. Boston, MA, American Meteorological Society, 1983, p. 190-197. refs

A84-16721
GENERATION OF THE SNOWLINE
A. K. BAGCHI (Kwara State College of Technology, Ilorin, Nigeria) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Dec. 1983, p. 1679-1689. Research supported by the Indian Space Research Organization. refs

A method of determination of daily snowline altitude in mountainous terrain, which is applicable in areas where the snowline may be assumed to follow a contour, is presented. The method is based on a combined use of Landsat images and hydrometeorological data. A possible application area includes the generation of streamflow in snowfed rivers where the model needs data regarding daily snowcovered area. However, the method will prove useful only in models that assume the area above the snowline to be completely covered with snow, e.g., the Swedish HBV model. The methodology has been developed for a Himalayan basin with considerable rainfall during snowmelt. Author

N84-10652# Environmental Research Inst. of Michigan, Ann Arbor. Applications Div.
MULTI-TEMPORAL ANALYSIS OF LANDSAT IMAGERY FOR BATHYMETRY Final Report, 6 Jun. 1981 - 30 Sep. 1982
F. J. TANIS, R. HIEBER, and F. J. THOMSON May 1983 101 p refs
(Contract N00014-81-C-2334)
(AD-A130648; ERIM-155500-2-F) Avail: NTIS HC A06/MF A01 CSCL 08J

A multi-temporal processing procedure has been developed for the Defense Mapping Agency/HTC Digital Image Processing System (DIPS). The purpose of this procedure is to extract hydrographic information from multi-data LANDSAT and other types of remote sensing data. Water depth variations from multiple remote sensing observations can be analyzed to identify the sources of variations. When such variations can be removed from the data the multi-temporal data set can yield an improved estimate of water depth. Six available LANDSAT scene dates had been previously processed to provide an independent set of predicted water depths for the Bahamas Photobathymetric Calibration Area. Geographical locations of ship survey soundings were used to extract pixel locations from the six registered scene dates. Relationships between these predicted water depths and the measured depths were analyzed using standard statistical methods. Results aided the development of processing procedures and a best estimator of water depth for LANDSAT multi-temporal data. Multi-temporal processing (MTP) software was written to perform similar operations on the DIPS. Preprocessing steps are suggested to remove unwanted spatial noise from multi-date LANDSAT data. Author (GRA)

N84-11545*# California Univ., Santa Barbara. Dept. of Geography.
LANDSAT-D INVESTIGATIONS IN SNOW HYDROLOGY Quarterly Progress Report, 1 Jul. - 30 Sep. 1983
J. DOZIER 30 Sep. 1983 2 p ERTS
(Contract NAS5-27463)
(E84-100004; NASA-CR-174519; NAS 1.26:174519) Avail: NTIS HC A02/MF A01 CSCL 08L

Progress on the registration of TM data to digital topographic data; on comparison of TM, MSS and NOAA meteorological satellite data for snowcover mapping; and on radiative transfer models for atmospheric correction is reported. Some methods for analyzing spatial contiguity of snow within the snow covered area were selected. The methods are based on a two-channel version of the grey level co-occurence matrix, combined with edge detection derived from an algorithm for computing slopes and exposures from digital terrain data. M.G.

N84-11548*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
AIRCRAFT REMOTE SENSING OF SOIL MOISTURE AND HYDROLOGIC PARAMETERS, TAYLOR CREEK, FLORIDA, AND LITTLE RIVER, GEORGIA, 1979 DATA REPORT
T. J. JACKSON, T. J. SCHMUGGE, L. H. ALLEN, JR. (Florida Univ., Gainesville), P. ONEILL, R. SLACK (EPA, Athens, Ga.), J. WANG, and E. T. ENGMAN Sep. 1981 39 p refs Prepared in cooperation with Agricultural Research Service, Beltsville, Md. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10010; NASA-TM-85468; NAS 1.15:85468; ARR-NE-13)
Avail: NTIS HC A03/MF A01 CSCL 08H

Experiments were conducted to evaluate aircraft remote sensing techniques for hydrology in a wide range of physiographic and climatic regions using several sensor platforms. The data were collected in late 1978 and during 1979 in two humid areas--Taylor Creek, Fla., and Little River, Ga. Soil moisture measurements and climatic observations are presented as well as the remote sensing data collected using thermal infrared, passive microwave, and active microwave systems. Author

N84-11553*# Utah Univ., Salt Lake City. Center for Remote Sensing and Cartography.
LAND USE INVENTORY OF SALT LAKE COUNTY, UTAH FROM COLOR INFRARED AERIAL PHOTOGRAPHY 1982
K. P. PRICE, R. D. WILLIE, D. J. WHEELER, and M. K. RIDD Jul. 1983 25 p refs ERTS
(Contract NAGW-95)
(E84-10015; NASA-CR-174530; NAS 1.26:174530; CRSC-83-2)
Avail: NTIS HC A02/MF A01 CSCL 08B

The preparation of land use maps of Salt Lake County, Utah from high altitude color infrared photography is described. The primary purpose of the maps is to aid in the assessment of the effects of urban development on the agricultural land base and water resources. The first stage of map production was to determine the categories of land use/land cover and the mapping unit detail. The highest level of interpretive detail was given to the land use categories found in the agricultural or urbanized portions of the county; these areas are of primary interest with regard to the consumptive use of water from surface streams and wells. A slightly lower level of mapping detail was given to wetland environments; areas to which water is not purposely diverted by man but which have a high consumptive rate of water use. Photos were interpreted on the basis of color, tone, texture, and pattern, together with

features of the topographic, hydrologic, and ecological context. M.G.

N84-11558*# Minnesota Univ., St. Paul. Space Science Center.
A STUDY OF MINNESOTA LAND AND WATER RESOURCES USING REMOTE SENSING Final Report
31 Dec. 1982 72 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NGL-24-005-263)
(E84-10023; NASA-CR-174547; NAS 1.26:174547) Avail: NTIS HC A04/MF A01 CSCL 08H

A pilot study of 60 lakes in Minnesota shows that LANDSAT data correlate very well with the Carlson trophic state index which is derived from measurements in the field. Nimbus satellite data reveal improvement in water quality in Lake Superior since the dumping of taconite tailings stopped in 1980. A feasibility study of using color infrared photography as a near real time tool for soil and crop management in corn and soybean areas of the state generated strong interest from farmers and agribusiness firms. The state geological survey had success in the use and applications of LANDSAT images. Subtleties of changes in vegetation, soil, and topography are such that ground water presence and depth to water table are nearly always impossible to qualify except for broad scale applications. Bedrock and structural differences as shown in lineaments offer great potential for resolution of some kinds of geologic studies. A synergistic concept is to be used to search for mineral resources in the northeastern part of the state. A.R.H.

N84-11569*# Resource Consultants, Inc., Fort Collins, Colo.
SNOWPACK GROUND-TRUTH MANUAL Final Report
E. B. JONES May 1983 107 p refs
(Contract NAS5-26802)
(NASA-CR-170584; NAS 1.26:170584) Avail: NTIS HC A06/MF A01 CSCL 08L

As remote sensing increasingly becomes more of an operational tool in the field of snow management and snow hydrology, there is need for some degree of standardization of "snowpack ground truth" techniques. This manual provides a first step in standardizing these procedures and was prepared to meet the needs of remote sensing researchers in planning missions requiring ground truth as well as those providing the ground truth. Focus is on ground truth for remote sensors primarily operating in the microwave portion of the electromagnetic spectrum; nevertheless, the manual should be of value to other types of sensor programs. This first edition of ground truth procedures must be updated as new or modified techniques are developed. Author

N84-12555*# EROS Data Center, Sioux Falls, S. Dak.
LANDSAT 4 INVESTIGATIONS OF THEMATIC MAPPER AND MULTISPECTRAL SCANNER APPLICATIONS Quarterly Report
D. T. LAUER, Principal Investigator 30 Jun. 1983 2 p ERTS
(Contract NASA ORDER S-10757-C)
(E84-10006; NASA-CR-174521; NAS 1.26:174521) Avail: NTIS HC A02/MF A01 CSCL 08B

Progress in the investigation of the quality and performance of LANDSAT 4 TM data is reported. Average mean brightness values were computed for each band and a look-up table was designed to place the values at about 1.0 density on the straight line portion of the film's H and D curve. Manual interpretation of bands 5 and 7 indicated these data to be good sources for determining locations of dugouts and small ponds as water sources. M.G.

N84-12593# International Inst. for Aerial Survey and Earth Sciences, Enschede (Netherlands).
MAJOR WATER CONSERVATION AND RECLAMATION PROJECTS IN THE JIANGHAN PLAIN AND SURROUNDINGS, HUBEI PROVINCE, CHINA
I. WOLDAI *In* ESA Remote Sensing Appl. for Environ. Studies p 93-101 Jul. 1983 refs Sponsored by Netherlands Organization for the Advancement of Pure Research (ZWO)
Avail: NTIS HC A14/MF A01

Major water conservation and reclamation projects in the Jianghan Plain were analyzed using sequential images, false color composites and computer compatible tapes. Landforms and land use units were mapped. A dense network of canals and dikes and water retention basins was identified, mostly unrecorded in published maps. The diversional canals and dikes altered the pattern of flood devastation and siltation in the area. The reclamation of additional land around the low-lying lakes for cultivation was possible. Author (ESA)

N84-12597# Ghent Univ. (Belgium). Lab. for Regional Geography and Landscape Studies.
INTERPRETABILITY OF WETLAND ON SEASAT-A IMAGERY IN THE POLDERLAND OF FLANDERS: A STRUCTURAL APPROACH
H. DUFOURMONT *In* ESA Remote Sensing Appl. for Environ. Studies p 129-132 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Visual interpretation of wetland in the polderland of Flanders was tested using SEASAT-A radar imagery. An approach based upon Gestalt-laws was chosen. This method results in a structural and hierarchical interpretation. The degree of detail increases gradually from high to low order hierarchical levels, so that previous interpretation steps offer a possibility of control for more detailed interpretation. Author (ESA)

N84-12598# Geological Survey of Greenland, Copenhagen (Denmark).
GLACIOLOGICAL APPLICATIONS OF LANDSAT IMAGES IN CONNECTION WITH HYDROPOWER INVESTIGATIONS IN WEST GREENLAND
H. H. THOMSEN *In* ESA Remote Sensing Appl. for Environ. Studies p 133-136 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

Digital image-processing of LANDSAT data (MSS) was started in connection with mapping of the hydroelectric potential of West Greenland. The Greenland ice sheet offers special problems in delineating individual ice streams. Geometrically corrected and contrast stretched LANDSAT images were used to detect flowline patterns, crevasse patterns and supraglacial streams, all of which can be related to ice and meltwater drainage. Mapping of the subglacial topography was attempted by studying shadow patterns on LANDSAT images taken under conditions of low Sun angle. Results show that digital image-processing of LANDSAT data is useful for mapping ice surface features, which can be used directly in glaciological-hydrological investigations and as a basis for planning of detailed investigations. Author (ESA)

N84-13639*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
APPLICATION OF REMOTE SENSING TO HYDROLOGICAL PROBLEMS AND FLOODS [APLICACIONES DE LOS SENSORES REMOTOS A PROBLEMAS HIDROLOGICOS E INUNDACIONES]
N. D. J. PARADA, *Principal Investigator and* E. M. L. M. NOVO Oct. 1983 18 p refs In PORTUGUESE; ENGLISH summary Presented at Aplicaciones de Los Sensores Remotos en Hidrometeorol. y en Preparacion para Afrontar Desastres Rurales, Bogota, 13-24 Jun. 1983 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10046; NASA-CR-174513; NAS 1.26:174513; INPE-2896-PRE/415) Avail: NTIS HC A02/MF A01 CSCL 08H

The main applications of remote sensors to hydrology are identified as well as the principal spectral bands and their advantages and disadvantages. Some examples of LANDSAT data applications to flooding-risk evaluation are cited. Because hydrology studies the amount of moisture and water involved in each phase of hydrological cycle, remote sensing must be emphasized as a technique for hydrological data acquisition. A.R.H.

N84-13745# Nebraska Univ., Lincoln. Climatology Program.
SATELLITE OBSERVATIONS OF VARIATIONS IN SOUTHERN HEMISPHERE SNOW COVER
K. F. DEWEY and R. HEIM, JR. Jun. 1983 25 p refs
(PB83-252908; NOAA-83082301; NOAA/TR/NESDIS-1) Avail: NTIS HC A02/MF A01 CSCL 04B

Northern Hemisphere snow cover is currently digitized on an operational basis. Therefore, a research effort was initiated to investigate the extent and variation in Southern Hemsiphere snow cover. The synoptic climatology of Southern Hemisphere snow cover was examined and it was concluded that there should be sufficient amounts of snow to warrant satellite monitoring. Defense Military Satellite Program (DMSP) imagery was analyzed and weekly snow cover maps were generated for the period 1974 through 1980. The snow cover of Australia, New Zealand, and Africa was too infrequent. Therefore, only South American snow cover was digitized and analyzed through the creation of several 7-year snow cover climatologies. Author (GRA)

N84-15632*# Virginia Polytechnic Inst. and State Univ., Blacksburg. Dept. of Electrical Engineering and Computer Science.
SPATIAL REASONING TO DETERMINE STREAM NETWORK FROM LANDSAT IMAGERY Final Technical Report
R. M. HARALICK, S. WANG, *and* D. B. ELLIOTT 1983 16 p refs ERTS
(Contract NAG5-131)
(E84-10063; NASA-CR-175123; NAS 1.26:175123) Avail: NTIS HC A02/MF A01 CSCL 08G

In LANDSAT imagery, spectral and spatial information can be used to detect the drainage network as well as the relative elevation model in mountainous terrain. To do this, mixed information of material reflectance in the original LANDSAT imagery must be separated. From the material reflectance information, big visible rivers can be detected. From the topographic modulation information, ridges and valleys can be detected and assigned relative elevations. A complete elevation model can be generated by interpolating values for nonridge and non-valley pixels. The small streams not detectable from material reflectance information can be located in the valleys with flow direction known from the elevation model. Finally, the flow directions of big visible rivers can be inferred by solving a consistent labeling problem based on a set of spatial reasoning constraints. Author

N84-15639# Massachusetts Inst. of Tech., Cambridge.
GROWTH PROCESSES OF SNOW Ph.D. Thesis. Final Report, 1 Nov. 1979 - 28 Feb. 1983
K. W. K. LO Hanscom AFB, Mass. AFGL May 1983 193 p (Contract F19628-80-C-0021; AF PROJ. 2310)
(AD-A133136; AFGL-TR-83-0105) Avail: NTIS HCA09/MFA01 CSCL 08L

The growth of snow in winter storms is studied via observational and theoretical techniques. A new flight procedure termed the Advecting Spiral Descent (ASD) was employed by AFGL's instrumented C-130 aircraft to observe the height evolution of snow size spectra. These observations reveal that snow growth goes through three distinct stages: a vapor deposition stage, an aggregation stage and a secondary ice particle production stage. Theoretical models are used to simulate the observations of snow growth. These indicate that the secondary ice crystal production is due to the collisional breakup of snowflakes. Author (GRA)

N84-15645# North Carolina State Univ., Raleigh. Water Resources Research Inst.
USE OF LANDSAT MSS (MULTISPECTRAL SCANNER) DIGITAL DATA IN WATER QUALITY MAPPING OF THE NEUSE RIVER ESTUARY, NORTH CAROLINA
K. SIAMAK and H. M. CHESHIRE May 1983 41 p refs
(Contract DI-14-34-0001-2135)
(PB83-256750; UNC-WRRI-83-193; W83-03916; OWRT-A-125-NC(1)) Avail: NTIS HC A03/MF A01 CSCL 08H

LANDSAT multispectral scanner (MSS) digital data, and high resolution panoramic photography obtained from the Environmental Protection Agency's Enviropod were combined with surface measurements for water quality mapping of the Neuse River estuary, North Carolina. This constitutes the first effort to use LANDSAT digital data for mapping water quality parameters in this geographic area. The water quality parameters of interest included salinity, chlorophyll a, turbidity and total suspended solids. Temperature data were also recorded on site. The approach involved acquisition of water quality samples from boats at 75 sample sites simultaneous with LANDSAT satellite overpass. The results include a series of color-coded maps, each pertaining to one of the water quality parameters, along with the statistical summaries. GRA

07

DATA PROCESSING AND DISTRIBUTION SYSTEMS

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

A84-10549
AERIAL SURVEY DESIGN - A SYSTEMS-ANALYTIC PERSPECTIVE
L. D. MAXIM and L. HARRINGTON (Everest Consulting Associates, Inc., Princeton Junction, NJ) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Oct. 1983, p. 1425-1435. refs

Attention is given to a five-step, systems analysis-inspired process for efficient aerial survey design. The five steps are: (1) identification of survey objectives; (2) enumeration of survey options; (3) the screening of alternative surveys to identify detailed analysis candidates; (4) the evaluation of the candidates chosen; and (5) the selection of an overall survey plan. Note is also taken of the mathematical and statistical models characteristically employed by the present method. O.C.

A84-10550
IMPACT OF GEOMETRY ON HEIGHT MEASUREMENTS FROM MLA DIGITAL IMAGE DATA
R. WELCH (Georgia, University, Athens, GA) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Oct. 1983, p. 1437-1441. refs

Geometric factors involving base/height (B/H) ratio, sensor attitude, pixel size, and correlation accuracy, significantly influence the possibility of obtaining reliable height measurements from digital stereo data recorded with fore-and-aft-pointing multispectral linear array sensors. Attention is given to the specific problem of achieving 20-m contours meeting U.S. National Map Accuracy Standards, which require the correlation of better-than-10-m resolution stereo data (acquired at a B/H ratio of 1.0 from an altitude of 700-900 km) to within approximately 0.25 pixel. Sensor attitude, moreover, must be known to within 1 arcsec. A graphic presentation is made of height error, contour interval, B/H ratio, correlation accuracy/precision, and sensor attitude interrelationships. O.C.

A84-11993#
AN INTERACTIVE PROCEDURE FOR CLASSIFYING MULTIVARIATE REMOTE SENSING IMAGE DATA [EIN INTERAKTIVES VERFAHREN ZUR KLASSIFIKATION VON MULTIVARIATEN FERNERKUNDUNGS-BILDDATEN]
E. BLUM Zuerich, Eidgenoessische Technische Hochschule, Doktor der Naturwissenschaften Dissertation, 1982, 111 p. In German. refs

An interactive classification procedure with a high degree of flexibility and high speed is presented. Flexibility is guaranteed by a modular software structure in the form of individual functions which all operate with standardized input and output and are implemented for interactive use to provide continuous user control. The classification routine is principally based on the classical parallelepiped method with additional oblique boundaries in a second step providing optimal separation for overlapping classes. The classification parameters are defined interactively with previously digitized training sample data being shown for three selected variables in the form of a 3-D rotatable scattergram. The points belonging to the class of interest are distinguished from the rest of the observations by color. The method is applied to multitemporal Landsat data and to multispectral data collected by a scanner. C.D.

A84-12785
A COMPARISON OF SAR BRIGHTNESS LEVELS AND URBAN LAND-COVER CLASSES
F. M. HENDERSON (New York, State University, Albany, NY) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Nov. 1983, p. 1585-1591. refs

The effectiveness of satellite SAR imagery for urban land-cover mapping was assessed in terms of the effects of filtering and averaging techniques and the agreement between urban land-cover classes and SAR signal return based on brightness levels. The Seasat L-band data for a pass over Harrisberg, PA was investigated in the study at 1:51,000 and 1:145,000 scales. Both visual interpretation of black and white images and semi-automated machine/visual interpretations were made of digital images. Seven color-coded classes were defined, and the mix of land cover in each density slice was examined. A total of 33 images covering 100 x 100 km areas were used. Each image was subjected to linear contrast stretch, averaging with three pixel filter windows, and density slicing. B/W images that underwent the linear contrast stretch and maximum enlargement furnished the best identifications when manually interpreted. Texture was more readily identifiable on 3 x 3 filtered images, rather than 5 x 5 or 7 x 7 filtered images. Tone alone was insufficient for making correct classifications of land cover. M.S.K.

A84-13004
MACHINE PROCESSING OF REMOTELY SENSED DATA: NATURAL RESOURCES EVALUATION; PROCEEDINGS OF THE NINTH INTERNATIONAL SYMPOSIUM, PURDUE UNIVERSITY, WEST LAFAYETTE, IN, JUNE 21-23, 1983
D. C. MCDONALD, ED. and D. B. MORRISON, ED. Symposium sponsored by the American Society of Agronomy, Crop Science Society of America, IEEE, et al. New York, Institute of Electrical and Electronics Engineers, 1983, 440 p.

Processing and imaging techniques, ground truth trials, and theoretical and experimental investigations of the applications of remote sensing in resource surveys are presented. An assessment is made of the data base on current resources and instrumentation, the information requirements presently in existence, and data processing and management. Agricultural applications of remote sensing are explored, as are natural resource evaluation and image feature analysis and transformation. Programs for international and domestic technology transfer are discussed, and consideration is devoted to scene simulation and modelling. Image enhancement techniques are defined, as are methods of supervised and unsupervised classifications of satellite imagery. Note is taken of Thematic Mapper data processing, existing geographic data systems, and the role of remote sensing for resource evaluation in the future. M.S.K.

A84-13006
AN ALGORITHM FOR INTERPOLATION OF DIGITAL IMAGERIES USING PIECE WISE HYPERSURFACE APPROXIMATION
A. D. KULKARNI (National Remote Sensing Agency, Hyderabad, India) and K. SIVARAMAN (College of Engineering, Trivandrum, India) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 26-30. refs

A hypersurface approximation is used in an algoriithm for interpolation by piecewise polynomial approximation in image processing. The approximation is applied to a quadratic surface in two-dimensional space or the digital image function in the neighborhood of the point to be interpolated by means of orthogonal polynomial basis functions. The polynomials permit the interpolation kernel to be evaluated, and thereby the algorithm. The efficiency of the algorithm is on par with a cubic convolution algorithm while the time accuracy is comparable with spline interpolation methods. M.S.K.

A84-13007
A SUCCESSFUL APPROACH IN THREE-DIMENSIONAL PERCEPTION OF STEREO LANDSAT-MSS IMAGES OVER CORDILLERAN RELIEF
R. SIMARD and V. G. KRISHNA (Canada Centre for Remote Sensing, Ottawa, Canada) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 31-40. refs

Stereo images from Landsat MSS may be obtained on overlapping areas acquired from adjacent orbits. A methodology has been developed for extracting the parallax information from such images using a two stage image correlation technique to obtain digital elevation models. Algorithms and methodology used to model the terrain are described. The results, obtained using this technique for two test sites covering 3500 square kilometres, are presented. Author

A84-13008
ATMOSPHERIC CORRECTION ANALYSIS ON LANDSAT DATA OVER THE AMAZON REGION
L. A. VIEIRA DIAS, J. R. DOS SANTOS, and A. R. FORMAGGIO (Instituto de Pesquisas Espaciais, Sao Josedos Campos, Brazil) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 41-45. refs

The Amazon Region natural resources were studied in two ways and compared. A Landsat scene and its attributes were selected, and a maximum likelihood classification was made. The scene was atmospherically corrected, taking into account Amazonic peculiarities revealed by (ground truth) of the same area, and the subsequent classification. Comparison shows that the classification improves with the atmospherically corrected images. Previously announced in STAR as N83-25001 Author

A84-13011* Purdue Univ., Lafayette, Ind.
ESTIMATION OF A REMOTE SENSING SYSTEM POINT-SPREAD FUNCTION FROM MEASURED IMAGERY
C. D. MCGILLEM, P. E. ANUTA, E. MALARET (Purdue University, West Lafayette, IN), and K. B. YU (Virginia Polytechnic Institute and State University, Blacksburg, VA) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 62-68.
(Contract NAAS5-26859)

A general approach to identifying the point spread function (PSF) of a remotely sensed scene is demonstrated in terms of a step function for an abrupt change in the gray level along the row or column of the image data. The estimate of the PSF is made in terms of a finite sum of basis functions, employing a sequence of rectangular pulses covering the spatial extent of the PSF. The approximation, if narrow impulses are employed, provides accurate fidelity to the PSF. The method becomes practical when the geometrical structure of the scene elements producing the measured response is known. The field boundary is obtained through consideration of the differing intensities on each side of the boundary, which is a step discontinuity. The mathematical procedure for the technique is provided, together with a sample problem from Landsat-4 Thematic Mapper data. Atmospheric blurring and electronic effects on the overall PSF and the cubic convolution resampling effects are noted. M.S.K.

A84-13018* DBA Systems, Inc., Melbourne, Fla.
COMPUTER ANALYSIS OF X-BAND RADAR DATA
D. J. KNOWLTON (DBA Systems, Inc., Melbourne, FL) and R. M. HOFFER (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 119-127. refs
(Contract NAS9-15889)

The effectiveness of using currently available computer techniques for interpretation of MSS data to interpret SAR imagery for forest monitoring was assessed. Data were gathered with NASA's airborne APQ-102 dual-polarized, X-band SAR in a flight at 60,000 ft. Microdensitometry was employed to digitize the HH- and HV-polarized imagery. A ground spatial resolution of 15 m was obtained, control points were identified, a second order biquadratic transformation was applied to compensate for orientation, and rms errors were calculated. A second data set was taken with 30 m resolution in order to simulate thematic mapper operation. Classification was performed with pixel-by-pixel and textural classification algorithms. A statistical analysis was also carried out to find any significant differences between classifiers in a data set for a given classifier. Each polarization featured an independent distortion which required appropriate preprocessing to correct. Further studies are recommended with multiple frequencies viewing and multiple polarizations and look angles to define the actual forest classifications that can be made with the SAR imagery. M.S.K.

A84-13019* Computer Sciences Corp., Silver Spring, Md.
SEGMENTATION OF REMOTELY SENSED DATA USING PARALLEL REGION GROWING
J. C. TILTON (Computer Sciences Corp., Silver Spring, MD) and S. C. COX (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 130-137. refs

The improved spatial resolution of the new earth resources satellites will increase the need for effective utilization of spatial information in machine processing of remotely sensed data. One promising technique is scene segmentation by region growing. Region growing can use spatial information in two ways: only spatially adjacent regions merge together, and merging criteria can be based on region-wide spatial features. A simple region growing approach is described in which the similarity criterion is based on region mean and variance (a simple spatial feature). An effective way to implement region growing for remote sensing is as an iterative parallel process on a large parallel processor. A straightforward parallel pixel-based implementation of the algorithm is explored and its efficiency is compared with sequential pixel-based, sequential region-based, and parallel region-based implementations. Experimental results from on aircraft scanner data set are presented, as is a discussioon of proposed improvements to the segmentation algorithm. Author

A84-13020
NONPARAMETRIC MINIMUM ERROR RATE FEATURE TRANSFORMATION WITH APPLICATION TO RESOURCE CLASSIFICATION
S. ARUNKUMAR (Indian Institute of Technology, Bombay, India) and R. SUPNEKAR (Tata Burroughs, Ltd., Bombay, India) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 138-145. Research supported by the Indian Institute of Technology. refs

A nonparametric feature transformation technique is presented for dimensionality reduction in remotely sensed resources imagery evolution. A stochastic gradient algorithm is formulated to yield an asymptotically optimal linear transformation that minimizes the Bayes error rate in the transformed image. The algorithm is used with supervised samples and updated at each sensed point without evaluation of the decision function. Examples are provided of an application to Landsat data sets with two, five, and eight classes in order to demonstrate the robustness of the algorithm. M.S.K.

A84-13022
GENERALIZED TEXTURE MEASURES FOR CLASSIFICATION AND IMAGE QUALITY ASSESSMENT OF REMOTE SENSING IMAGES
J. C. A. VAN DER LUBBE (Nationaal Lucht- en Ruimtevaart Laboratorium, Amsterdam, Netherlands) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 160-169. refs

Two generalized classes of statistical measures are presented for measuring textures of remotely sensed imagery. The techniques include evaluation of entropy and the angular second moment, and involve concepts involved in the statistical examination of concentration and diversity. The entropy and second angular moment characaterize the evenness or unevenness of gray-level distributions and therefore measure the inhomogeneity of the subimage. The properties of the concentration and diversity measures are analyzed. Alteration of the parameters defining the properties of the concentration and diversity measures is demonstrated to allow obtaining other textural features. The methods are shown useful for Landsat MSS data, except where

images with relatively small and bounded textural regions. Another application in assessing remotely sensed image quality is indicated. M.S.K.

A84-13023* Environmental Research Inst. of Michigan, Ann Arbor.
EFFECTS OF PREPROCESSING LANDSAT MSS DATA ON DERIVED FEATURES
T. M. PARRIS and R. C. CICONE (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: Machine proceeding of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 170-178. refs
(Contract NAS9-16538)

Important to the use of multitemporal Landsat MSS data for earth resources monitoring, such as agricultural inventories, is the ability to minimize the effects of varying atmospheric and satellite viewing conditions, while extracting physically meaningful features from the data. In general, the approaches to the preprocessing problem have been derived from either physical or statistical models. This paper compares three proposed algorithms; XSTAR haze correction, Color Normalization, and Multiple Acquisition Mean Level Adjustment. These techniques represent physical, statistical, and hybrid physical-statistical models, respectively. The comparisons are made in the context of three feature extraction techniques; the Tasseled Cap, the Cate Color Cube. and Normalized Difference. Author

A84-13035
EDGE AND LINEAR FEATURE ENHANCEMENT BY KRIGING FILTERING
K. CONRADSEN and G. NILSSON (Danmarks Tekniske Hojskole, Lyngby, Denmark) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 272-278. Research supported by the Commission of the European Communities, Statens Naturvidenskabelige Forskningsrad, and Otto Monsteds Foundation.

A filtering technique for enhancing linear features in Landsat images is presented and applied to sample images. The two-dimensional method models the scene as the result of a stationary random field and determines the minimum-mean-standard-error solution to the problem; the filter is then based on the difference between the actual value of a pixel and the value predicted from the random field by a kriging-type approach. The mathematical theorems and corollaries on which the filter is based are proved, the method is applied to a 400 x 400-pixel channel-7 Landsat image (pixel size 50 x 50 m), and the correlation-function variables and filter weights are presented in table. The method is shown to give better enhancement of linear features than standard Laplacian filtering. D.G.

A84-13036
THE CALIBRATION OF LANDSAT MSS DATA AS AN ANALYSIS TOOL
L. A. BARTOLUCCI and S. M. DAVIS (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 279-287. refs

The application of calibration data from Landsat MSS scans to the identification of earth-surface materials is discussed and illustrated on the basis of the LARSYS program (Phillips, 1969). The maximum and minimum values from the Landsat internal-lamp and blackbody readings are used to compute 'absolute' in-band radiances from the digital counts in different areas of the Landsat scene. Plots of different ground-cover types, bare ground, and water in different locations are shown, and hints for their interpretation are provided. D.G.

A84-13037
ITERATIVE CLASSIFICATION USING AUTOMATIC TRAINING DATA SELECTION
H. SHIMODA, T. HOSOMURA, K. FUKUE, K. KOIDE, and T. SAKATA (Tokai University, Tokyo, Japan) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 290-294.

An algorithm for the automatic modification of training data for maximum-likelihood-method digital processing of Landsat images is presented. Spectrally pure categories are selected iteratively using a residual image; this approach prevents later misclassifications by producing training data with probability-density functions similar to a normal distribution. The algorithm is applied to urban and forest images, and classification accuracy is found to be significantly improved over that of a simple maximum-likelihood method. In the urban image, 78 categories were classified (starting with training data from nine classes) in 5 hrs, compared with 25 hrs by conventional methods. D.G.

A84-13038
A FLEXIBLE CLUSTERING PROCEDURE FOR USE IN AN UNSUPERVISED CLASSIFICATION OF LANDSAT DATA
W. Y. CHEN (Shandong, University, Jinan, People's Republic of China) and W. G. COLLINS (Aston, University, Birmingham, England) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 295-302.

An unsupervised classification procedure for Landsat MSS data is presented. A clustering algorithm based on specific criteria (minimum number of cluster members, maximum distance and variance of cluster members, and minimum feature-space distance of cluster centers) is employed to achieve clarity, self-adjustability, optimum choice of cluster centers, and self-checking. Flow charts, scatter diagrams, and classification maps from sample images are provided. D.G.

A84-13039
THE EVALUATION OF THE SPATIAL ACCURACY OF COMPUTER CLASSIFICATION
S. E. PIPER (Natal, University, Natal, Republic of South Africa) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 303-310. refs

For some time the Remote Sensing Industry has been concerned at the lack of standards for evaluating classifications. It is suggested that a good measure of classification accuracy should be site-specific and should take account of both the errors of omission and commission. Furthermore it is suggested that a 'good' measure should be one for which the probability distribution is known and for which one can make statements of statistical significance. The Jaccard coefficient is proposed and it is shown that it meets the aforementioned criteria. Lastly it is strongly recommended that the precise nature of an analyst's method of measuring accuracy be explicitly stated along with the associated statistical significance. Author

A84-13040
CATEGORY ANALYSIS OF THE CLASSIFICATION ERROR MATRIX
G. H. ROSENFIELD and K. FITZPATRICK-LINS (U.S. Geological Survey, Reston, VA) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 311-313. refs

The interpretation of classification-error matrices arising from accuracy evaluations of thematic classifications such as land-use and land-cover maps is discussed in a summary of recent analytical

investigations. The emphasis is on the incorporation of information from the entire matrix (rather than the diagonals only) and on the identification of systematic patterns of misclassification. Consideration is given to alternative ways of evaluating overall accuracy and category comparability. D.G.

A84-13041
FACTORIAL ANALYSIS OF CORRESPONDENCES APPLIED TO LANDSAT DATA
B. M. RACHED (Ecole Nationale d'Ingenieurs, Tunis, Tunisia) IN: *Machine processing of remotely sensed data: Natural resources* evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 314-319.

The application of the factorial analysis of correspondences (FAC) developed by Benzecri (1976) to the classification of Landsat data is discussed. Both the reduction of composite images derived from Landsat images and ancillary (geographic-data-base) data and the analysis of data arrays derived from the classified image are described. The mathematical principles of FAC are outlined, and the applications are illustrated with flow charts and diagrams. It is shown that FAC allows the same information to be obtained from fewer MSS bands, that ancillary data improve image dimensionality, and that FAC facilitates the interpretation and application of Landsat data. D.G.

A84-13042
THE EFFECT OF FEATURE SCALING ON THE CLUSTERING OF LANDSAT MSS DATA
L. A. BARTOLUCCI, S. M. DAVIS, and P. H. SWAIN (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 320-328. refs

Nonsupervised classification by clustering has been shown to be a very important tool in the analysis of satellite remote sensing data. However, clustering algorithms which use Euclidean distance as a measure of similarity are highly sensitive to scaling differences among the variables which participate in the clustering process. Since the Landsat MSS spectral bands have different ranges and different calibration functions, this scaling sensitivity is likely to have a significant impact on the results of clustering Landsat MSS data, as is demonstrated by the experiments described in this paper. A rescaling strategy for Landsat MSS data is recommended which seems to give appropriate relative weights to the four spectral bands. Author

A84-13044* National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.
DEVELOPMENT OF THE JSC THEMATIC MAPPER QUICK-LOOK PREPROCESSING CAPABILITY
J. R. GILBERT (NASA, Johnson Space Center, Houston, TX) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 341-346. refs

The development of a preprocessing unit for Landsat Thematic Mapper (TM) data for the Earth Observations Data Laboratory at Johnson Space Center is reported. The background of the project is sketched, including the greatly increased data-handling requirements compared to MSS, the influence of the JPL VICAR system on the system design, and the completeness of the GSFC SCROUNGE (LASLIB) TM data tapes. The design approach and realization are discussed, and the performance and transportability of the preprocessor programs (totaling about 2000 lines of source code in FORTRAN and IBM Assembly languages) are indicated. The system is able to read the TM image tapes, extract areas of interest to particular studies, and register the extracted imagery to suitable references. Ancillary programs include image enhancement, rotation, filtering and pixel-size modification. D.G.

A84-13045* Purdue Univ., Lafayette, Ind.
FEATURE SELECTION METHODOLOGIES USING SIMULATED THEMATIC MAPPER DATA
M. E. DEAN and R. M. HOFFER (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 347-356. refs
(Contract NAS9-15889)

The present investigation is concerned with the determination of the intrinsic dimensionality of a simulated Thematic Mapper data set. In addition, the effectiveness and sensitivity of 'standard' statistics separability measures (i.e., transformed divergence) is evaluated in comparison to eigenvectors for identifying the optimum subset of the original Thematic Mapper Simulator (TMS) bands for classifying the various cover types. TMS data were collected on May 2, 1979 by NASA's NS001 aircraft multispectral scanner over a bottomland forested area in South Carolina near the city of Camden. It is found that the eigenvectors and eigenvalues of a covariance matrix from a multispectral scanner system (MSS) data set can be obtained without having to actually transform the data. G.R.

A84-13046* Environmental Research Inst. of Michigan, Ann Arbor.
THE THEMATIC MAPPER TASSELED CAP - A PRELIMINARY FORMULATION
E. P. CRIST (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 357-364. refs
(Contract NAS9-16538)

A transformation is described which rotates Thematic Mapper data (excluding the thermal band) in a manner analogous to that used in the MSS Tasseled Cap Transformation, thus providing a direct view of the planes of data dispersion and a direct association of spectral features with physical scene characteristics. This TM Tasseled Cap Transformation includes MSS-equivalent Greenness and Brightness features, as well as at least one additional important feature. The new feature, tentatively termed 'Wetness', offers promise of enhanced ability to assess soil conditions, monitor vegetative development, and delineate cover classes. Relationships between scene characteristics and spectral variation in the transformed data space are discussed based on both simulated and actual TM data. Author

A84-13050
QUANTITATIVE PLANIMETRIC ACCURACY ASSESSMENT OF THE ORURO LANDSAT DIGITAL MOSAIC
C. R. VALENZUELA, T. L. PHILLIPS, L. A. BARTOLUCCI, and C. E. BROCKMANN (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 399-408. refs

For the Oruro Department in Bolivia, a digital mosaic of seven Landsat MSS (multispectral scanner system) frames was created. The present investigation is concerned with a quantitative assessment of the cartographic accuracy of the Oruro digital mosaic. The methodology employed in the assessment is discussed, taking into account the random selection of 35 topographic maps at a scale of 1:50,000, and the identification of checkpoints in both the topographic maps and the digital mosaic. It was found that the pictorial quality of the mosaic is excellent. The planimetric accuracy of the mosaic is limited by the quality of the Oruro Landsat frame, and the use of 1:150,000 scale topographic maps for obtaining the ground control points utilized in the creation of the mosaic. G.R.

A84-13066
PROBABILISTIC RELAXATION ON MULTITYPE DATA
H. M. KALAYEH and D. A. LANDGREBE (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 122-129. refs

In the present investigation, the probabilistic relaxation technique suggested by Zucker and Mohammed (1978) is applied to the remote sensing data as a postclassifier. The suggested algorithm usually decreases the labeling error (improving phase), passes through a turning point, and increases the labeling error (deterioration phase). The algorithm is modified on the basis of the assumption that the transition probabilities are slowly varying over the scene, and a method for estimating the transition probabilities is suggested. The obtained experimental results suggest that the modified algorithm does not exhibit a deterioration phase anymore. G.R.

A84-13067
A BINARY TREE FEATURE SELECTION TECHNIQUE FOR LIMITED TRAINING SAMPLE SIZE
M. J. MUASHER and D. A. LANDGREBE (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 130-137. refs

It is pointed out that a number of different classifiers are currently employed in remote sensing applications. Most of these classifiers are based on a 'single-stage' approach. However, in recent years, the need for more powerful techniques has been felt. At present, a feature selection algorithm is used in cases in which the number of features is larger than the amount which can be considered. The present investigation provides a feature selection algorithm which takes into account the number of training samples used in estimating class statistics. The use of the algorithm in a binary tree classification procedure is illustrated, giving attention to the prediction of the best feature subset to be used at each node. The procedure is particularly useful in cases in which the Hughes phenomenon occurs. G.R.

A84-13088
AN AUTOMATED METHOD FOR PRODUCING REFLECTANCE-ENHANCED LANDSAT IMAGES
F. J. AHERN, D. M. BENNETT, F. E. GUERTIN, K. P. B. THOMSON (Canada Centre for Remote Sensing, Ottawa, Canada), and G. FEDOSEJEVS (Intera Environmental Consultants, Ltd., Ottawa, Canada) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 328-336. refs

An automated method is described for producing a controlled, contrast-enhanced rendition of Landsat data, in which MSS band 4 is displayed as blue, MSS 5 as green, and MSS 7 as red. The two key steps in the method are: a reliable means of transforming Landsat MSS data from radiance units to reasonably accurate reflectance units, and a contrast stretch between fixed reflectance limits whose values are determined by independent studies for each particular class of application. Enhancements optimized for forestry and rangeland and a standard enhancement for all snow- and ice-free Canadian scenes have been developed; an automated system to produce them is being implemented. Geological interpretation generally requires a custom enhancement. D.H.

A84-13089* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
EVALUATING THE RADIANCE TRANSFORMATION FOR NORMALIZING LANDSAT DATA
E. M. MIDDLETON (NASA, Goddard Space Flight Center, Greenbelt, MD) and Y. C. LU (Computer Sciences Corp., Silver Spring, MD) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 337-341. refs

A technique is examined for improving the comparability of Landsat multisppectral scanner (MSS) data acquired on different dates. The technique involves conversion of digital brightness counts to relative radiance values measured in energy units (milliwatts per square centimeter-steradian). The statistical data of signature from 23 land cover (or biomass) classifications derived from all three Landsats were compared before and after the radiance normalization. Significant convergence occurred among the data sets for mean spectral values and the variances associated with each of seven major land cover types for MSS bands 4, 5, and 7. Overall, the variance attributed to the sensor component was reduced from 5.39 to 2.69 percent, with the largest decrease occurring in band 4 (14.4 percent to 3.7 percent). D.H.

A84-13090
AUTOMATED TERRAIN ANALYSIS
L. G. S. THOMPSON (U.S. Military Academy, West Point, NY) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 342-346. refs

Research is described in the area of automated terrain analysis. The concept is to have the terrain analyst, rather than pore over outdated maps, query the computer using state-of-the-art digital image processing techniques to quickly arrive at sound conclusions about the terrain he is concerned with. Categorizing pixels is essentially a boundary problem, either strictly numerical size or probabilistic. A comparison, using Landsat data, was made between the performance characteristics of a four-dimensional parallelepiped (numerical boundary) and the maximum likelihood (probabilistic) decision strategies. The results of that comparison and of a preliminary test of the automated terrain analysis system, using both Landsat and low-altitude, high-resolution multispectral digital data, are presented. One conclusion is that an automated terrain analysis system based on Landsat data as presently configured is probably not possible anywhere. D.H.

A84-13094
COMPARISON OF EDGE DETECTION METHODS FOR LANDSAT IMAGERY
P. E. ANUTA and F. DAVALLOU (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 363-366. refs

A84-13095
AN APPLICATION OF THE UNH DIGITAL IMAGE PROCESSING SYSTEM
P. E. BRUNS, P. AUGUSTA, K. OLSON (New Hampshire, University, Durham, NH), and J. SZAJGIN (Technicolor Graphics Services, Inc., Sioux Falls, SD) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 367-373. refs

A digital image processing system developed for research and training purposes at the University of New Hampshire was tested on data from a subscene of coastal New Hampshire, scan digitized from high altitude infrared photography using an Optronics P-1700 microdensitometer. Spectra characteristics of nine cover types were first derived from three subscenes. Comparison to field data showed

an overall 74 percent accuracy in classifying the pixels of a fourth test subscene. Author

A84-13111
PARALLEL PROCESSING CONCEPTS FOR REMOTE SENSING APPLICATIONS
B. W. SMITH, H. J. SIEGEL, and P. H. SWAIN (Purdue University, West Lafayette, IN) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 520-526. refs

For remote sesing applications, a proposed architecture described as MuRSS (Multiminicroprocessor Remote Sensing System) to be employed in an SIMD (Single Instruction stream/Multiple Data stream) machine is discussed. Such a machine typically consists of a control unit, N processors, N memory modules, and an interconnection network. The MuRRS architecture, with as many as 1024 processors, is considered extremely well suited to the execution of window-based (e.g., image correlation) and pixel-based (e.g., maximum likelihood classification) types of operations. Topics covered include how such a system can be applied to smoothing, maximum likelihood classification, contextual classification, and image correlation. D.H.

A84-13112
INTERACTIVE CLUSTERING ON A HIGH-SPEED IMAGE DISPLAY SYSTEM
P. H. SWAIN, S. M. DAVIS (Purdue University, West Lafayette, IN), and R. J. CLOUTHIER (/OMTAL/ 3M Corp., Pasadena, CA) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 527-532. Research sponsored by COMTAL/3M Corp.

An interactive implementation of cluster analysis for remote sensing image processing is described. It uses a Comtal Vision One/20 image display system with a random-access display refresh memory which can accommodate up to sixteen 512 x 512-pixel, 8-bits/pixel images. The clustering algorithm is a basic Isodata-type interactive algorithm. When the clustering convergence process has terminated, the analyst may view the results, applying various enhancements made available by the system (histogram equalization, pseudocolor display), to evaluate the results and to determine the ground cover types of the resulting cluster classes. Displays of Landsat data in three channels and a sample results image from clustering are shown. D.H.

A84-13113
IBM 7350 IMAGE PROCESSING SYSTEM - A TOOL FOR EARTH RESOURCES DATA PROCESSING
W. NIBLACK (IBM France S.A., Paris, France) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 533-537.

A84-13349* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SEASAT IMAGES OF THE RHONE VALLEY FROM VALENCE TO AVIGNON (FRANCE) [IMAGES SEASAT DE LA VALLEE DU RHONE DE VALENCE AAVIGNON /FRANCE/]
PH. REBILLARD, C. ELACHI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and H. DABROWSKI (Institut Dolomieu, Grenoble, France) Photo Interpretation (ISSN 0031-8523), vol. 21, July-Aug. 1982, 9 p. In French, English, and Spanish. refs

A84-13395#
THE PART TAKEN BY FOREIGN STATIONS IN THE UTILIZATION OF THE FRENCH REMOTE SENSING SATELLITE SPOT
G. CALES (Centre National d'Etudes Spatiales, Toulouse, France) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 5 p.
(IAF PAPER 83-132)

The SPOT satellite's instrumental and orbital characteristics are outlined, and attention is given to the general organization of the ground operations systems. SPOT will travel in a sun-synchronous orbit, covering the entire globe with a revisit every 26 days. Imagery will include 10-m resolution in the panchromatic band, 20-m resolution in the spectral bands, and a 60-km swath. The imagery can be transmitted to foreign customers who either own their own receivers or have contracted with the SPOT Company. The foreign SPOT station receives an ephemeris of the SPOT orbit, the selection of the views are made, and the satellite is programmed to perform the imaging and data transmission. Data are transmitted at 50 Mbit/sec to automated tracking antennas. Limitation on the actual data capabilities for different latitudes are discussed. M.S.K.

A84-13601
AMERICAN CONGRESS ON SURVEYING AND MAPPING AND AMERICAN SOCIETY OF PHOTOGRAMMETRY, FALL CONVENTION, HOLLYWOOD, FL, SEPTEMBER 19-23, 1982, TECHNICAL PAPERS
F. S. CARDWELL, ED., R. BLACK, ED., and B. M. COLE, ED. Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, 450 p.

Topics discussed include the cartographic applications of current radar systems, mapping in support of national energy concerns, private surveying practice in the US, and the geologic applications of Shuttle imaging radar. Papers are presented on current research directions in the national mapping program; on an automated approach to large sample area crop inventory based on color and topology; on the spectral reflectance of some plant indicators of saline and nonsaline soils; and on terrestrial photogrammetry as a tool for archaeoastronomical investigation. Attention is also given to the systems analysis and design of an interactive digital terrain modeling system, to a systems approach to spatial data handling, to floodplain management applications of Landsat data for the Upper Mississippi River basin, and to land partitioning by the double meridian distance method. C.R.

A84-13833
SCENE-ANALYTICAL EVALUATION OF DIGITIZED AERIAL IMAGES WITH TREE STRUCTURES [SZENENANALYTISCHE AUSWERTUNG VON DIGITALISIERTEN LUFTBILDERN MIT BAUMSTRUKTUREN]
P. HABERAECKER (Messerschmitt-Boelkow-Blohm GmbH, Munich, West Germany) and R. THIEMANN (Industrieanlagen-Betriebsgesellschaft mbH, Ottobrunn, West Germany) Deutsche Arbeitsgemeinschaft fuer Mustererkennung, Symposium, 5th, Universitaet Karlsruhe, Karlsruhe, West Germany, Oct. 11-13, 1983. 7 p. In German. refs
(MBB-VA-749-83-OE)

The development and preliminary application of a digital-image analysis algorithm are reported. Aerial photographs of scale 1:32,000 are drum-scanned and digitized as 2048 x 2048 pixels (so that each pixel corresponds to about 4 x 4 m on the ground) in three color ranges. Each image is then divided into four 512 x 512-pixel trees which are in turn analyzed using a bottom-up quad-tree algorithm (Pavlidis, 1982; Samet, 1982) employing a predetermined homogeneity coefficient. Software for the reconstruction of images (allowing differentiation of homogeneous areas at any level of the coefficient), neighbor finding, interactive inspection of the subsegments, and classification of terrain features (water, forest, roadways, farmland, and settlements) is characterized, and some sample images are shown. T.K.

A84-13911
PRELIMINARY ANALYSIS OF LANDSAT-4 THEMATIC MAPPER PRODUCTS
J. R. G. TOWNSHEND, J. R. GAYLER, J. R. HARDY (Reading, University, Reading, Berks., England), M. J. JACKSON, and J. R. BAKER (Natural Environment Research Council, Thematic Information Services, Swindon, Wilts., England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, Oct.-Dec. 1983, p. 817-828. Sponsorship: Natural Environment Research Council. refs
(Contract NERC-F60/G6/03)

A preliminary analysis of Thematic Mapper products, from scenes of part of Michigan and the Mississippi valley near the Arkansas-Missouri border is presented. Results show that the range of digital values for the visible bands in particular is very narrow relative to the available 255 digital counts. The visible bands in particular are very strongly correlated for the sub-scenes examined. Principal component analysis reveals the Thematic Mapper bands have an overall three dimensional structure. However, examination of individual cover categories reveals that most of the bands appear to have separate discriminatory value. Author

A84-14700
THEORETICAL STUDY OF PRECISION IN THE CARTOGRAPHIC EXPLOITATION OF A SCANNING SATELLITE - APPLICATION TO SPOT [ETUDE THEORIQUE DE LA PRECISION DANS L'EXPLOITATION CARTOGRAPHIQUE D'UN SATELLITE ADEFILEMENT - APPLICATION ASPOT]
H. GUICHARD (Institut Geographique National, Paris, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 90, 1983, p. 15-26. In French.

The mapping accuracy which will be obtainable with a heliosynchronous satellite such as SPOT, with 10-m resolution and + or - 27-deg side-looking capability is investigated analytically. The rectification equations relating the column and line coordinates of a SPOT image to projection coordinates are derived, taking the satellite orbit, attitude, and scanning characteristics into account. Control points are used to determine the equation coefficients, allowing the reconstruction of a single image with the help of a digital terrain model, or altimetric mapping from two images at different viewing angles. The only critical parameter affecting accuracy is found to be greater-than-first-order time variation of the satellite attitude; this can be corrected for by applying the onboard attitude measurements provided by SPOT. T.K.

A84-14775
CLASSIFICATION OF HCMM IMAGERY - OBTAINING INFORMATION CONCERNING THE GEOMORPHOLOGIC STRUCTURE [KLASSIFIZIERUNG VON HCMM-AUFNAHMEN - GEWINNUNG VON INFORMATIONEN ZUR NATURRAEUMLICHEN GLIEDERUNG]
W. SCHMITT-RENNEKAMP (Berlin, Technische Universitaet, Berlin, West Germany) Bildmessung und Luftbildwesen (ISSN 0006-2421), vol. 51, Nov. 1983, p. 217-223. In German. Research supported by the Deutsche Forschungsgemeinschaft. refs

The determination of the geomorphologic structure of Germany during and after the Second World War is briefly considered, taking into account also an interpretation of aerial photography in 1973. New possibilities for the study of geomorphologic structures have now been provided by methods based on the evaluation of satellite imagery. Suitable satellite imagery for West Germany has been obtained in connection with the Landsat program. Additional information is now provided by the Seasat and the Heat Capacity Mapping Mission (HCMM) satellites. Attention is given to a handbook of the geomorphological structure of Germany, the properties and the potential of the HCCM scenes, the available data and the areas studied, the applied procedures of data processing, and the results of the classification of the HCMM satellite imagery. G.R.

A84-14848
AUTOMATED SEARCH FOR CONTROL IMAGES ON PHOTOGRAPHS OF THE EARTH'S SURFACE USING SPECTRAL ANALYSIS [AVTOMATIZIROVANNYI POISK OPORNYKH IZOBRAZHENII NA FOTOSNIMKAKH POVERKHNOSTI ZEMLI PRI POMOSHCHI SPEKTRAL'NOGO ANALIZA]
D. K. TKHABISIMOV (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), Sept.-Oct. 1983, p. 93-99. In Russian. refs

The fast Fourier-Bessel transformation was used for the machine search for control images on space photographs of the earth's surface. Shifts and turns on a plane were taken as the admissible transformations of the control images; the coherence function of fragments of the photograph is invariant with respect to these admissible transformations. The Laplace operator is used to increase the relative energy of the control images. The image processing was carried out on the SITRIM-80 special-purpose complex. B.J.

A84-15298
CHROMATICITY OF PATH RADIANCE AND ATMOSPHERIC CORRECTION OF LANDSAT DATA
J. C. MUNDAY, JR. (Collee of William and Mary, Gloucester Point, VA) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Dec. 1983, p. 525-538. refs

A method of processing Landsat data is discussed which adjusts for variations in atmospheric path radiance over water bodies. Based on ratio-normalized Landsat radiances, it has properties analogous to color mixtures in a chromaticity diagram; hence it is termed 'chromaticity' analysis. Atmospheric correction is accomplished on a Landsat 'chromaticity' diagram by moving data points toward a standard locus, along a line from a projection point. If the standard locus contains data free of an aerosol contribution, and the projection point is the pure aerosol 'chromaticity,' the method enables substantial correction for the effect of aerosols. Author

A84-15920
INTRODUCTION AND SOME GENERAL ASPECTS OF IMAGE FORMATION IN RADAR REMOTE SENSING
G. P. DE LOOR (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Physisch Laboratorium TNO, The Hague, Netherlands) Remote Sensing Reviews (ISSN 0275-7257), vol. 1, pt. 1, 1983, p. 3-18. refs

A84-15922
PHOTOGRAMMETRIC ASPECTS OF REMOTE SENSING WITH IMAGING RADAR
F. W. LEBERL (Graz, Technische Universitaet, Graz, Austria) Remote Sensing Reviews (ISSN 0275-7257), vol. 1, pt. 1, 1983, p. 71-158. Sponsorship: Bundesministerium fuer Wissenschaft und Forschung. refs
(Contract BMFWF-6,931/3-27/1980)

The geometric properties of SLR images are reviewed, along with the radargrammetry methods that have been developed. The topic is arranged according to the basic radargrammetric units of the single image, stereo model and image block. The results show that radar blocks have led so far to modest accuracies. It is noted that with a ground resolution of, say, 10 to 25 m, a coordinate error of more than + or - 100 m is attained with an extremely sparing use of ground control points. The accuracies achieved, however, will remain modest unless three conditions are met. The first is that the imaging be with better internal stability of the sensing device. The second is that the sensor position and attitude be less affected by short periods and high frequency disturbances and be measured with higher accuracy. The third is that the stereo configurations be optimized for high accuracy. C.R.

A84-15923
INTRODUCTION TO THE USE OF RADAR IN REMOTE SENSING
L. KRUL (Delft, Technische Hogeschool, Delft, Netherlands) Remote Sensing Reviews (ISSN 0275-7257), vol. 1, pt. 1, 1983, p. 159-178.

The basic principles are expounded, and problems encountered in observing distributed targets are treated. Particular attention is given to the means by which geometric resolution can be improved. Side-looking radar and synthetic aperture radar are described in detail. It is noted that images produced by SLR and SAR systems will exhibit speckle, resulting from the vector addition of signals originating from the different picture elements within a resolution cell. The resultant signal will exhibit a random character as a function of time, both in the along-track and in the across-track direction. C.R.

A84-16323
A TOMOGRAPHIC FORMULATION OF SPOTLIGHT-MODE SYNTHETIC APERTURE RADAR
D. MUNSON, JR., J. D. OBRIEN, and W. K. JENKINS (Illinois, University, Urbana, IL) IEEE, Proceedings (ISSN 0018-9219), vol. 71, Aug. 1983, p. 917-925. refs
(Contract N00014-79-C-0424)

Spotlight-mode synthetic aperture radar (spotlight-mode SAR) synthesizes high-resolution terrain maps using data gathered from multiple observation angles. This paper shows that spotlight-mode SAR can be interpreted as a tomographic reconstruction problem and analyzed using the projection-slice theorem from computer-aided tomography (CAT). The signal recorded at each SAR transmission point is modeled as a portion of the Fourier transform of a central projection of the imaged ground area. Reconstruction of a SAR image may then be accomplished using algorithms from CAT. This model permits a simple understanding of SAR imaging, not based on Doppler shifts. Resolution, sampling rates, waveform curvature, the Doppler effect, and other issues are also discussed within the context of this interpretation of SAR. Author

A84-16370
THERMAL IMAGING NOW AND IN THE FUTURE
G. S. HOPPER (Texas Instruments, Inc., Equipment Group, Dallas, TX) IN: Optical systems engineering III; Proceedings of the Conference, Los Angeles, CA, January 20, 21, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 138-142.

The historical development, the state of the art, and the main aspects of advanced programs in thermal imaging are briefly addressed. Progress from the original modified strip mapper to the current standard common module FLIR is summarized. The functioning of the common module system is described and varieties of its design for different applications are mentioned. Research efforts to produce a hybrid staring array and a monolithic mercury cadmium telluride staring focal plane are discussed. C.D.

A84-16719
MULTIPLE SCENE PRECISION RECTIFICATION OF SPACEBORNE IMAGERY WITH VERY FEW GROUND CONTROL POINTS
D. E. FRIEDMANN, J. P. FRIEDEL, K. L. MAGNUSSEN, R. KWOK, and S. RICHARDSON (MacDonald Dettwiler and Associates, Ltd., Richmond, British Columbia, Canada) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Dec. 1983, p. 1657-1667. Research supported by the Industrial Research Assistance Program and Canada Centre for Remote Sensing. refs

A correction method is presented as an improvement to the present process of precision geometric correction for remote sensing data employing a pseudo-physical model of the spacecraft position and attitude parameters to reduce the number of ground control points (GCPs). Reduction is achieved by processing multiple scenes and by physically modeling the Landsat-2 spacecraft. Results show that ten scenes of Landsat-2 imagery can be precision-rectified with only four GCPs with an accuracy of approximately 0.5 pixels achieved after 4 to 9 GCPs. It is concluded that this method, in combination with the latest resampling technology, will make the operational production of geocoded precision imagery products feasible and economical even in poorly mapped areas. J.N.

A84-16720
ASSESSING LANDSAT CLASSIFICATION ACCURACY USING DISCRETE MULTIVARIATE ANALYSIS STATISTICAL TECHNIQUES
R. G. CONGALTON, R. G. ODERWALD, and R. A. MEAD (Virginia Polytechnic Institute and State University, Blacksburg, VA) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Dec. 1983, p. 1671-1678. Research supported by the Nationwide Forestry Applications Program. refs

Discrete multivariate analysis techniques have been used to evaluate the accuracy of land-cover classifications from Landsat digital imagery. Error matrices or contingency tables were taken from the literature and then analyzed using three techniques. The first technique permitted direct comparison of corresponding cell values in different matrices by 'normalizing' each matrix through a process called 'iterative proportional fitting'. The second technique provided a method of testing for significant differences between error matrices which vary by only a single variable. The third technique allowed for multivariable comparisons between matrices to be made and is the most powerful of the techniques. It was concluded that these techniques could help researchers better evaluate variables or factors affecting classification accuracy. Author

A84-16731
SATELLITE IMAGE UNDERSTANDING THROUGH SYNTHETIC IMAGES
E. CATANZARITI (Napoli, Universita, Naples, Italy) IN: Pictorial data analysis; Proceedings of the Advanced Study Institute, Bonas, France, August 1-12, 1982 . Berlin and New York, Springer-Verlag, 1983, p. 370-383. Sponsorship: Consiglio Nazionale delle Ricerche. refs
(Contract CNR-80,02199,02)

The use of synthetic images in the interpretation of Landsat scenes is discussed and illustrated. Landsat band 4, 5, and 7 images of a forested area of Vancouver Island obtained in summer and winter are analyzed with the help of a ground-truth map and a digital terrain map (DTM). A synthetic image is generated from the DTM by the method of Horn (1977), assuming a Lambertian ground surface of constant albedo, illuminated only by the sun, and quantitatively compared with the real image by regression analysis; this allows the estimation of the actual albedo and the generation of an improved synthetic image, which is successively corrected (by the same process) to account for atmospheric transmission effects and sky illumination. Preliminary results indicate the potential of more sophisticated models accounting for a larger number of parameters. T.K.

A84-16732
A DIFFUSION MODEL TO CORRECT MULTI-SPECTRAL IMAGES FOR THE PATH-RADIANCE ATMOSPHERIC EFFECT
J. LIRA and A. OLIVER (Universidad Nacional Autonoma de Mexico, Villa Obregon, Mexico) IN: Pictorial data analysis; Proceedings of the Advanced Study Institute, Bonas, France, August 1-12, 1982 . Berlin and New York, Springer-Verlag, 1983, p. 385-403. Research supported by the Direccion General de Geografia del Territorio Nacional. refs

A mathematical model of atmospheric path-radiance effects is developed and applied to the enhancement of multispectral satellite (Landsat) images. The first-order model is based on the diffusion equation for a model atmosphere defined by the Rayleigh cross section for clear and dry air and by approximate cross sections for varying levels of aerosol contamination. The physical principles of the interaction of radiation with the atmosphere, atmospheric scattering (AS), AS at long wavelengths, and AS as a diffusive

phenomenon are discussed, and formulas are derived for different atmospheric conditions. A trial application using all four bands of an MSS image of an arid area in Mexico shows that a pure Rayleigh cross section is inadequate for even apparently very clear air. Good qualitative improvement is demonstrated in a sample image, but further statistical analysis is required. T.K.

A84-18267#
NEW DEVELOPMENTS IN DOPPLER DATA REDUCTION AND INFORMATION MANAGEMENT AT INSTITUT GEOGRAPHIQUE NATIONAL
C. BOUCHER (Institut Geographique National, Saint-Mande, Val-de-Marne, France) IN: International Geodetic Symposium on Satellite Doppler Positioning, 3rd, Las Cruces, NM, February 8-12, 1982, Proceedings. Volume 1 . Las Cruces, NM, New Mexico State University, 1983, p. 335-351. refs

The new system implemented at IGN for the processing and management of satellite Doppler data (measurement, station description, and coordinates) includes data entry modules, preprocessing modules, single point and short arc reduction modules, and station coordinate data base modules. Results concerning reduction software refinements are presented using test data sets. In addition, information is provided concerning data standardization and the station data base, with reference to the Subcommission on Standards of IAG Commission VIII and to the European Space Station Location Working Group. B.J.

N84-10641*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
THE EFFECTS OF SOLAR INCIDENCE ANGLE OVER DIGITAL PROCESSING OF LANDSAT DATA
N. D. J. PARADA, Principal Investigator and E. M. L. M. NOVO Sep. 1983 12 p refs Presented at the 17th Intern. Symp. on Remote Sensing of Environ., Ann Arbor, Mich., 9-13 May 1983 Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10007; NASA-CR-174522; NAS 1.26:174522; INPE-2867-PRE/401) Avail: NTIS HC A02/MF A01 CSCL 04A

A technique to extract the topography modulation component from digital data is described. The enhancement process is based on the fact that the pixel contains two types of information: (1) reflectance variation due to the target; (2) reflectance variation due to the topography. In order to enhance the signal variation due to topography, the technique recommends the extraction from original LANDSAT data of the component resulting from target reflectance. Considering that the role of topographic modulation over the pixel information will vary with solar incidence angle, the results of this technique of digital processing will differ from one season to another, mainly in highly dissected topography. In this context, the effects of solar incidence angle over the topographic modulation technique were evaluated. Two sets of MSS/LANDSAT data, with solar elevation angles varying from 22 to 41 deg were selected to implement the digital processing at the Image-100 System. A secondary watershed (Rio Bocaina) draining into Rio Paraiba do Sul (Sao Paulo State) was selected as a test site. The results showed that the technique used was more appropriate to MSS data acquired under higher Sun elevation angles. Topographic modulation components applied to low Sun elevation angles lessens rather than enhances topography. M.G.

N84-10644*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
EVALUATION OF LANDSAT-4 TM AND MSS GROUND GEOMETRY PERFORMANCE WITHOUT GROUND CONTROL Quarterly Progress Report
N. A. BRYANT and A. ZOBRIST 11 Oct. 1983 4 p ERTS
(Contract NAS7-918)
(E84-10022; NASA-CR-174546; NAS 1.26:174546) Avail: NTIS HC A02/MF A01 CSCL 05B

LANDSAT thematic mapper P-data of Washington, D.C., Harrisburg, PA, and Salton Sea, CA were analyzed to determine magnitudes and causes of error in the geometric conformity of the data to known earth-surface geometry. Several tests of data geometry were performed. Intra-band and inter-band correlation and registration were investigated, exclusive of map-based ground truth. Specifically, the magnitudes and statistical trends of pixel offsets between a single band's mirror scans (due to processing procedures) were computed, and the inter-band integrity of registration was analyzed. M.G.

N84-11539 Wisconsin Univ., Madison.
EVALUATION OF CONTROLLING LOW ALTITUDE AERIAL PHOTOGRAPHY USING HIGH ALTITUDE AEROTRIANGULATION Ph.D. Thesis
S. D. JOHNSON 1983 461 p
Avail: Univ. Microfilms Order No. DA8306682

Analytical aerotriangulation is a method of densifying ground control by photogrammetric methods. Variations in procedures include forming assemblies of strip, stereomodel, or photographic units. Coordinate transformation functions are used to assemble the units into strips or blocks. When redundant measurements are available, a least squares is used to simultaneously fit the photogrammetric units to one another, and to the known ground control positions. A fundamental problem in aerotriangulation is to maximize the distance bridged between known control points while controlling the propagation of errors in the photogrammetric assembly. Applications of photogrammetry, especially in highway mapping and engineering, often result in high and low altitude photography being used for the same project. Procedures are developed for transferring aerotriangulated pass points from high altitude photography to low altitude photography. Their photogrammetrically derived coordinates are used as supplemental control for the low altitude photography. Dissert. Abstr.

N84-11543*# Rochester Inst. of Tech., N. Y. Coll. of Graphic Arts and Photography.
LANDSAT 4 BAND 6 DATA EVALUATION Quarterly Report
15 Jun. 1983 3 p ERTS
(Contract NAS5-27323)
(E84-10001; NASA-CR-174516; NAS 1.26:174516; QR-3) Avail: NTIS HC A02/MF A01 CSCL 05B

Computer modelled atmospheric transmittance and path radiance values were compared with empirical values derived from aircraft underflight data. Aircraft thermal infrared imagery and calibration data were available on two dates as were corresponding atmospheric radiosonde data. The radiosonde data were used as input to the LOWTRAN 5A code. The aircraft data were calibrated and utilized to generate analogous measurements. The results of the analysis indicate that there is a tendancy for the LOWTRAN model to underestimate atmospheric path radiance and overestimate atmospheric transmittance. M.G.

N84-11549*# California Univ., Davis. Dept. of Electrical and Computer Engineering.
LANDSAT-D THEMATIC MAPPER IMAGE DIMENSIONALITY REDUCTION AND GEOMETRIC CORRECTION ACCURACY Quarterly Status and Technical Progress Report, 3 Jun. - 3 Sep. 1983
G. E. FORD, Principal Investigator 3 Sep. 1983 7 p ERTS
(Contract NAS5-27577)
(E84-10011; NASA-CR-174526; NAS 1.26:174526) Avail: NTIS HC A02/MF A01 CSCL 08B

When principal component analysis of a subscene of a section of the Sacramento River showed lower correlation among the TM spectral components that were observed for the MSS spectral components, principal component analysis was applied to a LANDSAT 2 MSS subscene of the same area for comparison purposes. Correlation coefficient matrices indicate the pairwise similarity and correlation of the data for the spectral components. The principal components transformation matrix, indicates the weights applied to the original components to generate the transformed components. The first two TM components can be described as visible and near infrared. For the MSS data, the first transformed component is roughly the average of the four original

components. The second transformed component is roughly the difference between the visible and infrared components. Tables show that 97.0% of the variance in an MSS image is contained in only two transformed components. A.R.H.

N84-11550*# Rochester Inst. of Tech., N. Y. School of Photographic Arts and Sciences.
LANDSAT 4 BAND 6 DATA EVALUATION Quarterly Report
15 Sep. 1983 8 p ERTS
(Contract NAS5-27323)
(E84-10012; NASA-CR-174527; NAS 1.26:174527; QR-4) Avail: NTIS HC A02/MF A01 CSCL 14B

Multiple altitude TM thermal infrared images were analyzed and the observed radiance values were computed. The data obtained represent an experimental relation between preceived radiance and altitude. A LOWTRAB approach was tested which incorporates a modification to the path radiance model. This modification assumes that the scattering out of the optical path is equal in magnitude and direction to the scattering into the path. The radiance observed at altitude by an aircraft sensor was used as input to the model. Expected radiance as a function of altitude was then computed down to the ground. The results were not very satisfactory because of somewhat large errors in temperature and because of the difference in the shape of the modeled and experimental curves. A.R.H.

N84-11552*# Arizona Univ., Tucson.
LANDSAT-4 THEMATIC MAPPER MODULATION TRANSFER FUNCTION (MTF) EVALUATION Progress Report, 15 Jun. - 15 Sep. 1983
R. SCHOWENGERDT, Principal Investigator 16 Sep. 1983 20 p Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10014; NASA-CR-174529; NAS 1.26:174529) Avail: NTIS HC A02/MF A01 CSCL 08B

A power spectrum (PS) analysis technique was used to compare thematic mapper (TM) A and P-tape data for a Washington, DC scene in two orthogonal directions, along scan and along track. The resulting effective modulation transfer functions (MTF) between the A and P data are repeatable from area to area and consistent with theoretical expectations. The average x-direction (along scan) MTF calculated with the PS technique is compared to the MTF of the cubic convolution resampling function used to create P data from A data. The two curves are nearly identical, indicating that the major factor affecting the image quality of P data relative to A data is the cubic convolution resampling. M.G.

N84-11554*# EROS Data Center, Sioux Falls, S. Dak.
LANDSAT 4 INVESTIGATIONS OF THEMATIC MAPPER AND MULTISPECTRAL SCANNER APPLICATIONS Quarterly Report
D. T. LAUER, Principal Investigator 24 Oct. 1983 3 p ERTS
(Contract NASA ORDER S-10757-C)
(E84-10017; NASA-CR-174544; NAS 1.26:174544) Avail: NTIS HC A02/MF A01 CSCL 14B

The utility of TM data natural resource assessment was evaluated with emphasis on manual interpretation and digital classification. The improved spatial resolution of TM data, as compared with MSS data, aided in the location of roads, small stock ponds, and many other land features, permitting positive identification of landmarks. With the TM, there was more efficient manual interpretation of land use, better identification of resource types, and improved assessment of the ecological status of natural vegetation. Band 5 and band 7 aided in defining water resources, wetland vegetation resources, and other terrain features. Results from TM and TM simulator data suggest that the coefficient of variation for major land cover types is less for TM data than for equivalent MSS data. Although the amount of information in bands 5 and 7 is small, it is unique since the same information cannot be derived from the MSS four-band spectral region. A.R.H.

N84-11560*# Canada Centre for Remote Sensing, Ottawa (Ontario).
CCRS PROPOSAL FOR EVALUATING LANDSAT-D MSS AND TM DATA Progress Report, 2 May - 2 Sep. 1983
W. M. STROME, J. CIHLAR, D. G. GOODENOUGH, F. E. GUERTIN, Principal Investigator, and A. B. COLLINS 3 Oct. 1983 105 p refs Sponsored by NASA ERTS
(E84-10026; NASA-CR-174549; NAS 1.26:174549;
CCRS-5089-3(917)) Avail: NTIS HC A06/MF A01 CSCL 05B

Accomplishments in the evaluation of LANDSAT 4 data are reported. The objectives of the Canadian proposal are: (1) to quantify the LANDSAT-4 sensors and system performance for the purpose of updating the radiometric and geometric correction algorithms for MSS and for developing and evaluating new correction algorithms to be used for TM data processing; (2) to compare and access the degree to which LANDSAT-4 MSS data can be integrated with MSS imagery acquired from earlier LANDSAT missions; and (3) to apply image analysis and information extraction techniques for specific user applications such as forestry or agriculture. M.G.

N84-11561*# California Univ., Berkeley. Remote Sensing Research Program.
ANALYSIS OF THE QUALITY OF IMAGE DATA ACQUIRED BY THE LANDSAT-4 THEMATIC MAPPER AND MULTISPECTRAL SCANNERS Quarterly Status and Technical Progress Report, 1 Jul. - 30 Sep. 1983
R. N. COLWELL, Principal Investigator 11 Oct. 1983 6 p refs ERTS
(Contract NAS5-27377)
(E84-10028; NASA-CR-174550; NAS 1.26:174550; QSTPR-3)
Avail: NTIS HC A02/MF A01 CSCL 05B

The geometric quality of the TM and MSS film products were evaluated by making selective photo measurements such as scale, linear and area determinations; and by measuring the coordinates of known features on both the film products and map products and then relating these paired observations using a standard linear least squares regression approach. Quantitative interpretation tests are described which evaluate the quality and utility of the TM film products and various band combinations for detecting and identifying important forest and agricultural features. M.G.

N84-11567# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
DIGITAL TRANSMISSION AND VISUALIZATION OF METEOROLOGICAL SATELLITE IMAGES [TRANSMISSAO DIGITAL E VISUALIZACAO DE IMAGENS DE SATELITES METEOROLOGICOS]
J. C. MURA, J. C. P. DEGARRIDO, and P. P. G. CAMILLI Jul. 1983 17 p refs In PORTUGUESE; ENGLISH summary Presented at the 35th Ann. Meeting of SBPC, Belem-Pa., Brazil, 6-13 Jul. 1983
(INPE-2809-PRE/367) Avail: NTIS HC A02/MF A01

The Image Analysis Unit (UAI) is an apparatus that is used to make easy the extraction of information every half an hour from the GOES meteorological satellites imagery received at Instituto de Pesquisas Espaciais (INPE). These images can simply be shown in a video monitor and/or enhanced and animated according to the needs. To enable external users to access INPE's resources in real time, it has developed a system of transmission through a normal telephone line that allows the acquisition of the images in a Remote Unit (UAI-R). These images can be stored in the 1 Mybte memory of the Remote Unit whose capacity is of 4 images. The transmission and reception system is controlled by an 8085 microprocessor. Some applications in the areas of meteorology, hydrology and oceanography are mentioned. Author

N84-12557*# Texas A&M Univ., College Station. Dept. of Mathematics.
PROCEEDINGS OF THE NASA SYMPOSIUM ON MATHEMATICAL PATTERN RECOGNITION AND IMAGE ANALYSIS Final Report, 16 Jul. 1982 - 15 Jul. 1983
L. F. GUSEMAN, JR. 1983 608 p refs Symp. held in Houston, Tex., 1-3 Jun. 1983 Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NAS9-16664)
(E83-10032; NASA-CR-171696; NAS 1.26:171696) Avail: .NTIS HC A99/MF A01 CSCL 05B

The application of mathematical and statistical analyses techniques to imagery obtained by remote sensors is described by Principal Investigators. Scene-to-map registration, geometric rectification, and image matching are among the pattern recognition aspects discussed.

N84-12558*# *Virginia Polytechnic Inst. and State Univ.*, Blacksburg. Dept. of Electrical Engineering and Computer Science.
RELATIVE ELEVATION DETERMINATION FROM LANDSAT IMAGERY Final Report
R. M. HARALICK and S. WANG *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 3-51 1983 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

In LANDSAT imagery, spectral and spatial information can be used to detect the drainage network as well as the relative elevation model in mountainous terrain. To do this, the mixed information of material reflectance and topographic modulation in the original LANDSAT imagery must be first separated. From the material reflectance information, big visible rivers can be detected. From the topographic modulation information, ridges and valleys can be detected and assigned relative elevations. Finally, a relative elevation model can be generated by interpolating values for nonridge and nonvalley pixels. Author

N84-12559*# *National Aeronautics and Space Administration.* Lyndon B. Johnson Space Center, Houston, Tex.
ESTIMATING LOCATION PARAMETERS IN A MIXTURE MODEL Final Report
R. P. HEYDORN and R. BASU *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 55-76 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

Mixture models of the form h = sum to M terms, one for each positive integer from 1 to N lambda sub j f (j) sub theta sub j where theta sub j is a translation parameter are considered. An approach is discussed which makes use of a Caratheodory theorem on the trigonometric moment problem to determine M and theta sub j j = 1,2,...,M. This theorem is also applied to show that translates of many common distributions lead to identifiable mixtures. Author

N84-12560*# Rice Univ., Houston, Tex.
MULTIVARIATE DENSITY ESTIMATION AND REMOTE SENSING Final Report
D. W. SCOTT *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 77-92 1983 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

Current efforts to develop methods and computer algorithms to effectively represent multivariate data commonly encountered in remote sensing applications are described. While this may involve scatter diagrams, multivariate representations of nonparametric probability density estimates are emphasized. The density function provides a useful graphical tool for looking at data and a useful theoretical tool for classification. This approach is called a thunderstorm data analysis. Author

N84-12561*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
AUTOREGRESSIVE MODELS FOR USE IN SCENE SEGMENTATION Final Report
M. NARAGHI *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 93-122 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

A scene segmentation approach is presented which is based on generating autoregressive field models for each scene component (class) from its a priori spatial statistics. A methodology is also described for using these models in achieving optimal segmentation of a scene. The derivations are presented for the case of single band imagery, however, the method is believed to be extendable to multispectral data. Author

N84-12562*# Houston Univ., Tex. Dept. of Mathematics.
MIXTURE MODELS FOR DEPENDENT OBSERVATIONS Final Report
C. PETERS *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 123-142 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

Parametric mixture models appropriate for data presented in homogeneous blocks of varying sizes from several unidentified source populations are considered. For most applications, the data elements within each block are dependent. Models are proposed for multivariate normal data incorporating two types of dependence, exchangeability of elements within blocks, and a Markov structure for blocks. The consequences of assuming exchangeability, when in fact the Markov structure holds, are explored. Computational problems for each model are considered, and results of a simple test of the exchangeability hypothesis for LANDSAT data are presented. Author

N84-12564*# Texas A&M Univ., College Station. Center for Approximation Theory.
SPLINE CLASSIFICATION METHODS Final Report
L. F. GUSEMAN, JR. and L. L. SCHUMAKER *In its* Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 167-190 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 12A

The use of spline functions in the development of classification algorithms is discussed. A method is formulated for producing spline approximations to univariate density functions when each density function is described by a histogram of measurements. The resulting approximations are then incorporated into a Bayesian classification procedure for which the probability of misclassification can be readily computed. Some preliminary numerical results are presented to illustrate the method. Author

N84-12565*# Texas A&M Univ., College Station. Dept. of Statistics.
QUANTILE DATA ANALYSIS OF IMAGE DATA Final Report
E. PARZEN *In its* Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 191-242 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

Quantile data analysis and functional statistical inference methods are introduced and applied to provide representations of spectral data which may lead to simple statistical discriminators effective for the estimation of ground truth from satellite spectral measurements. To estimate the ground truth of a pixel, the probability of each possible ground truth is estimated, given observed (estimated) quantile theoretic statistical characteristics of the multispectral image data corresponding to the pixel and its neighboring pixels. A strategy for determining which statistical characteristics discriminate best is described. Results are reported of quantile data analysis of an extensive collection of training files of image data. Author

N84-12566*# Texas A&M Univ., College Station.
DISCRIMINATION RELATIVE TO MEASURES OF NON-NORMALITY
W. B. SMITH and E. P. SHINE *In its* Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 243-276 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 12A

The robustness of discriminant functions to nonnormality is investigated. The performance of procedures relative to measures of the difference between the actual distribution of the observations and the usual assumption of normal densities is assessed. For example, the two population, mixed distributions problem with equal costs of misclassification are considered. The parameters are estimated by maximum likelihood and recently proposed robust methods. Author

N84-12567*# Texas A&M Univ., College Station.
REPEATED-MEASURES ANALYSIS OF IMAGE DATA Final Report
H. J. NEWTON *In its* Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 277-194 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

It is suggested that using a modified analysis of variance procedure on data sampled systematically from a rectangular array of image data can provide a measure of homogeneity of means over that array in single directions and how variation in perpendicular directions interact. The modification of analysis of variance required to account for spatial correlation is described theoretically and numerically on simulated data. Author

N84-12568*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
SAR SPECKLE NOISE REDUCTION USING WIENER FILTER Final Report
T. H. JOO and D. N. HELD *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 295-310 1983 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
Avail: NTIS HC A99/MF A01 CSCL 09C

Synthetic aperture radar (SAR) images are degraded by speckle. A multiplicative speckle noise model for SAR images is presented. Using this model, a Wiener filter is derived by minimizing the mean-squared error using the known speckle statistics. Implementation of the Wiener filter is discussed and experimental results are presented. Finally, possible improvements to this method are explored. M.G.

N84-12569*# Maryland Univ., College Park.
IMAGE MATCHING USING GENERALIZED HOUGH TRANSFORMS Final Report
L. S. DAVIS, F. P. HU, V. HWANG, and L. KITCHEN *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 311-326 1983 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

An image matching system specifically designed to match dissimilar images is described. A set of blobs and ribbons is first extracted from each image, and then generalized Hough transform techniques are used to match these sets and compute the transformation that best registers the image. An example of the application of the approach to one pair of remotely sensed images is presented. M.G.

N84-12570*# LNK Corp., Silver Spring, Md.
ANALYSIS OF SUBPIXEL REGISTRATION ACCURACY Final Report
D. LAVINE, L. N. KANAL, C. A. BERENSTEIN, E. SLUD, and C. HERMAN *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 327-412 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

Geometric and probabilistic models for subpixel accuracy are developed. The geometric models bound the error in offset estimation using the pixels in an observed digital straight line. One probabilistic model bounds the estimate of error offset for continuous images. The other model bounds the error for discrete images given that one is in the correct pixel. Author

N84-12572*# National Aeronautics and Space Administration. National Space Technology Labs., Bay Saint Louis, Miss.
PROGRESS IN THE SCENE-TO-MAP REGISTRATION INVESTIGATION Final Report
D. D. DOW *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 485-506 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

The geometric accuracy of the scene-to-map registration process for P-format LANDSAT MSS data for scenes from Kansas and Louisiana/Mississippi is discussed. Large scale row and column bias values and row and column standard deviation values were measured for the P-format data sets indicating a poor georegistration accuracy for these geometrically corrected LANDSAT MSS scenes. Experimental work is underway with A-format LANDSAT MSS scenes from the same locations to examine the influence of the number of ground control points and the spatial distribution of ground control points on geometric registration accuracy. An early conclusion from this work is that the root mean square approach for assessing how well the ground control points fit the mapping equations measures a different aspect of georegistration accuracy than does the approach of evaluating the bias (offset) and standard deviation using independently chosen ground reference points. M.G.

N84-12573*# Hunter Coll., New York. Dept. of Geology and Geography.
RELATING SPATIAL PATTERNS IN IMAGE DATA TO SCENE CHARACTERISTICS Final Report
A. H. STRAHLER and C. E. WOODCOCK *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 507-542 1983 refs Presented at the 17th Intern. Symp. on Remote Sensing of the Environ., Ann Arbor, Mich., May 1983 Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NAS9-16664)
Avail: NTIS HC A99/MF A01 CSCL 05B

In remote sensing, the primary goal is accurate scene inference, in which characteristics of the scene are inferred from the image data. More effective inference of scene characteristics can be accomplished through the use of techniques that use explicit models of spatial pattern. Spatial patterns in image data are functionally related to the size and spacing of elements in the scene and to the spatial resolution of the image data. At resolutions where variance is high, scene inference techniques should rely heavily on data from the spatial domain. As variance decreases, effective scene inference will increasingly rely on spectral data. Author

N84-12574*# SRI International Corp., Menlo Park, Calif. Artificial Intelligence Center.
SHAPE FROM SHADING: AN ASSESSMENT Final Report
G. B. SMITH *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 543-576 1983 refs ERTS
(Contract NAS9-16664; MDA903-83-C-0027)
Avail: NTIS HC A99/MF A01 CSCL 05B

Previous efforts to recover surface shape from image irradiance are reviewed in order to assess what can and cannot be accomplished. The informational requirements and restrictions of these approaches are considered. In dealing with the question of what surface parameters can be recovered locally from image shading, it is shown that, at most, shading determines relative surface curvature, i.e., the ratio of surface curvature measured in orthogonal image directions. The relationship between relative surface curvature and the second derivatives of image irradiance is independent of other scene parameters, but insufficient to determine surface shape. This result places in perspective the difficulty encountered in previous attempts to recover surface orientation from image shading. M.G.

N84-12575*# Kansas Univ. Center for Research, Inc., Lawrence. Telecommunications and Information Sciences Lab.
THE INFLUENCE OF SENSOR AND FLIGHT PARAMETERS ON TEXTURE IN RADAR IMAGES Final Report
V. S. FROST, K. S. SHANMUGAN, and J. C. HOLTZMAN *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 577-608 1983 refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. ERTS
Avail: NTIS HC A99/MF A01 CSCL 17I

Texture is known to be important in the analysis of radar images for geologic applications. It was previously shown that texture features derived from the grey-level co-occurrence matrix (GLCM) can be used to separate large scale texture in radar images. The influence of sensor parameters, specifically the spatial and radiometric resolution and flight parameters, i.e., the orientation of the surface structure relative to the sensor, on the ability to classify texture based on the GLCM features is investigated. It was found that changing these sensor and flight parameters greatly affects the usefulness of the GLCM for classifying texture on radar images. M.G.

N84-12596# Ghent Univ. (Belgium). Lab. for Regional Geography and Landscape Studies.
MEASURING LANDSCAPE INFORMATION CONTENT AND DISTRIBUTION ON A SAR-580 IMAGE
H. DEGROOF *In* ESA Remote Sensing Appl. for Environ. Studies p 123-127 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

An information theoretical approach to measure and evaluate the information content of an optically processed SAR-image is presented. The radar image is considered as a database for visual interpretation. It is shown that an interpretation key, elaborated according to the principles of conventional air photointerpretation and applied to the image, results in considerable loss of information. The elaboration of several interpretation keys, adapted for different subimages, gives a significant increase of information. The subimages were constructed relative to the system characteristics of SAR-580 and were oriented perpendicular to scan direction. The variation in information content shows a normal distribution across track. The subimages were evaluated according to their information content. Three classes were determined: low, moderate, and high information content zone. Author (ESA)

N84-13627*# Reading Univ. (England). Dept. of Geography.
THE UNITED KINGDOM SATMAP PROGRAM Progress Report
J. R. TOWSHEND, J. CUSHNIE, P. ATKINSON, J. HARDY, A. WILSON, A. HARRISON, J. BAKER, and M. JACKSON 1983 46 p Prepared in cooperation with Natural Environment Research Council, Swindon, England Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10002; NASA-CR-174517; NAS 1.26:174517) Avail: NTIS HC A03/MF A01 CSCL 05B

Data from test tapes from the United States (specifically the August Arkansas scene) and the first tape of the UK test site which came from ESRIN are analyzed. Methods for estimating spatial resolution are discussed and some preliminary results are included. The characteristics of the ESRIN data are examined and the utility of the various spectral bands of the thematic mapper for land cover mapping are outlined. A.R.H.

N84-13629*# Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.
LANDSAT 4 IMAGE DATA QUALITY ANALYSIS Quarterly Progress Report, 10 Aug. - 9 Nov. 1983
P. E. ANUTA 9 Nov. 1983 5 p ERTS
(Contract NAS5-26859)
(E84-10036; NASA-CR-174588; NAS 1.26:174588; LARS-CR-110983) Avail: NTIS HC A02/MF A01 CSCL 05B

A comparative analysis of TM and MSS data was completed and the results indicate that there are half as many separable spectral classes in the MSS data than in TM. In addition, the minimum separability between classes was also much less in MSS data. Radiometric data quality was also investigated for the TM by computing power spectrum estimates for dark-level data from Lake Michigan. Two significant coherent noise frequencies were observed, one with a wavelength of 3.12 pixels and the other with a 17 pixel wavelength. The amplitude was small (nominally .6 digital count standard deviation) and the noise appears primarily in Bands 3 and 4. No significant levels were observed in other bands. Scan angle dependent brightness effects were also evaluated. M.G.

N84-13630*# Systems and Applied Sciences Corp., Silver Spring, Md.
THE USE OF LINEAR FEATURE DETECTION TO INVESTIGATE THEMATIC MAPPER DATA PERFORMANCE AND PROCESSING
C. M. GURNEY 1983 15 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NAS5-27393)
(E84-10037; NASA-CR-174589; NAS 1.26:174589) Avail: NTIS HC A02/MF A01 CSCL 08B

The geometric and radiometric characteristics of thematic mapper data through analysis of linear features in the data are investigated. The particular aspects considered are: (1) thematic mapper ground IFOV; (2) radiometric contrast between linear features and background; (3) precision of system geometric correction; (4) band-to-band registration; and (5) potential utility of TM data for linear feature detection especially as compared to MSS data. It is shown that TM data may be used to estimate TM pixel size and to illustrate band-band mis-registration. Further, the geometry and radiometry of the data are sufficiently precise to allow accurate estimation of the widths of linear features. In optimum conditions features one quarter of a pixel in width may be accurately measured. These results have considerable potential for applications for hydrological and topographic mapping. M.G.

N84-13640*# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
RISE IN THE FREQUENCY OF CLOUD COVER IN LANDSAT DATA FOR THE PERIOD 1973 TO 1981 [LEVANTAMENTO DA FREQUENCIA DE COBERTURA DE NUVENS EM DADOS DO LANDSAT NO PERIODO DE 1973 A 1981]
N. D. J. PARADA, Principal Investigator, F. J. MENDONCA, and G. C. NETO Sep. 1983 75 p In PORTUGUESE; ENGLISH summary Sponsored by NASA ERTS
(E84-10047; NASA-CR-174614; NAS 1.26:174614; INPE-2882-RPE/443) Avail: NTIS HC A04/MF A01 CSCL 04B

Percentages of cloud cover in LANDSAT imagery were used to calculate the cloud cover monthly average statistic for each LANDSAT scene in Brazil, during the period of 1973 to 1981. The average monthly cloud cover and the monthly minimum cloud cover were also calculated for the regions of north, northeast, central west, southeast and south, separately. Author

N84-14563* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE HEAT CAPACITY MAPPING MISSION (HCMM) ANTHOLOGY
N. M. SHORT and L. M. STUART, JR., Principal Investigators 1982 268 p refs Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
(E84-10051; NASA-SP-465; NAS 1.21:465) Avail: SOD HC $24.00 CSCL 08B

The analysis and interpretation of thermal imagery is explained in this tutorial which reviews and evaluates a program that surveyed reflected solar radiation and thermal emission from the Earth's surface with a spatial resolution of 600 meters.

N84-14564* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTRODUCTION: HISTORICAL PERSPECTIVE ON THE HCMM PROGRAM
In its The Heat Capacity Mapping Mission (HCMM) Anthology p 1-6 1982 Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 08B

When some thermal radiation sensitive devices on U.S. meteorological satellites generated low resolution images showing temperature variations on Earth's land and sea surfaces during the middle 1960's, interest was aroused in the potential of thermal sensing in geology, agriculture, soil moisture, ground water, water temperature, and vegetation applications. The concept of using the property of thermal inertia to identify materials, particularly those of a geologic nature can be traced to the same time period that marks the flight of the first LANDSAT - Spacecraft systems and their performance, and capabilities are reviewed as well as achievements in hydrology, geology, agriculture, pedology, and urban climate effects applications. A.R.H.

N84-14565* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRINCIPLES OF THERMAL REMOTE SENSING
In its The Heat Capacity Mapping Mission (HCMM) Anthology p 7-14 1982 refs Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 08B

The remote sensing of temperature is performed by sensing radiation emitted from solids, liquids, and gases in the thermal infrared region of the spectrum, in which thermal emission is dominant over reflected solar energy. For Earth resources applications, thermal sensing of solids and liquids is performed in two "windows" of the atmosphere where atmospheric absorption and emission are at a minimum. Temperature measurement, intrinsic thermal properties, factors in interpreting thermal data, the use of thermal inertia, and the measurements obtained by the heat capacity mapping radiometer are discussed. A.R.H.

N84-14566* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
INTERPRETATION OF HCMM IMAGES: A REGIONAL STUDY
In its The Heat Capacity Mapping Mission (HCMM) Anthology p 15-62 1982 refs Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 08B

Potential users of HCMM data, especially those with only a cursory background in thermal remote sensing are familiarized with the kinds of information contained in the images that can be extracted with some reliability solely from inspection of such standard products as those generated at NASA/GSFC and now achieved in the National Space Science Data Center. Visual analysis of photoimagery is prone to various misimpressions and outright errors brought on by unawareness of the influence of physical factors as well as by sometimes misleading tonal patterns introduced during photoprocessing. The quantitative approach, which relies on computer processing of digital HCMM data, field measurements, and integration of rigorous mathematical models, can usually be used to identify, compensate for, or correct the contributions from at least some of the natural factors and those associated with photoprocessing. Color composite, day-IR, night-IR and visible images of California and Nevada are examined. A.R.H.

N84-14567* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
A GALLERY OF HCMM IMAGES
In its The Heat Capacity Mapping Mission (HCMM) Anthology p 63-168 1982 Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 08B

A gallery of what might be called the "Best of HCMM" imagery is presented. These 100 images, consisting mainly of Day-VIS, Day-IR, and Night-IR scenes plus a few thermal inertia images, were selected from the collection accrued in the Missions Utilization Office (Code 902) at the Goddard Space Flight Center. They were selected because of both their pictorial quality and their information or interest content. Nearly all the images are the computer processed and contrast stretched products routinely produced by the image processing facility at GSFC. Several LANDSAT images, special HCMM images made by HCMM investigators, and maps round out the input. A.R.H.

N84-14574*# Rochester Inst. of Tech., N. Y. Coll. of Graphic Arts and Photography.
LANDSAT 4 BAND 6 DATA EVALUATION Quarterly Report
15 Dec. 1983 4 p ERTS
(Contract NAS5-27323)
(E84-10054; NASA-CR-174582; NAS 1.26:174582; QR-5) Avail: NTIS HC A02/MF A01 CSCL 05B

Satellite data collected over Lake Ontario were processed to observed surface temperature values. This involved computing apparent radiance values for each point where surface temperatures were known from averaged digital count values. These radiance values were then converted by using the LOWTRAN 5A atmospheric propagation model. This model was modified by incorporating a spectral response function for the LANDSAT band 6 sensors. A downwelled radiance term derived from LOWTRAN was included to account for reflected sky radiance. A blackbody equivalent source radiance was computed. Measured temperatures were plotted against the predicted temperature. The RMS error between the data sets is 0.51K.
A.R.H.

N84-14576# Forschungsinstitut fuer Informationsverarbeitung, Karlsruhe (West Germany).
COINCIDENT EXTRACTION OF LINE OBJECTS FROM STEREO IMAGE PAIRS Final Technical Report, Feb. 1982 - Sep. 1983
H. KAZMIERCZAK, M. STIES, R. LUBKOWITZ, and M. BOHNER Sep. 1983 119 p Original contains color illustrations
(Contract DAJA37-82-C-0243; DA PROJ. 1T1-61102-BH-57)
(AD-A133892; FIM-115) Avail: NTIS HCA06/MFA01 CSCL 20F

A procedure for the automatic extraction of line objects from stereo pairs of aerial images (e.g., objects as roads, rivers, railroads and multilane highways) has been developed and implemented on a DEC VAX 11/780 computer. The procedure and its main functions are described in summary and in detail. A detailed documentation of the various test results is included as well as assessment and conclusions. GRA

N84-14727# Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).
NUMERICAL PROBLEMS FOR THE IMPLANTATION OF AN INPE ATMOSPHERIC CORRECTION SYSTEM FOR LANDSAT IMAGES [PROBLEMAS NUMERICOS PARA A IMPLANTACAO DO SISTEMA DE CORRECAO ATMOSFERICA DO INPE PARA IMAGENS LANDSAT]
L. A. V. DIAS Jul. 1983 12 p refs Presented at the 1st Regional Applied and Computational Math. Meeting, Sao Jose dos Campos, Brazil, Feb. 1983 Submitted for publication
(INPE-2801-PRE/361) Avail: NTIS HC A02/MF A01

The numerical problems tackled when an atmospheric correction system was implemented are described. There are two types of problems, results accuracy, and excessive number of operations. The accuracy problem is solved by using the Burroughs B-6800 to compute the atmospheric transmittance. To reduce the number of operations, the use of precalculated tables is introduced, instead of actually doing the operations. Author

N84-15642# SRI International Corp., Menlo Park, Calif.
IMAGE UNDERSTANDING RESEARCH AND ITS APPLICATION TO CARTOGRAPHY AND COMPUTER-BASED ANALYSIS OF AERIAL IMAGERY Final Report, 5 Sep. 1979 - 30 Sep. 1983
M. A. FISCHLER and A. J. HANSON Sep. 1983 107 p
(Contract MDA903-79-C-0588; DARPA ORDER 3862)
(AD-A133495) Avail: NTIS HCA06/MFA01 CSCL 20F

The authors' principal objective in this research program has been to obtain solutions to fundamental problems in computer vision that have broad military relevance, particularly in the areas of cartography and photo interpretation. Now-completed research has been directed towards developing automated techniques for stereo-compilation, delineation of linear features, scene partitioning, image matching, and image to database correspondence. In addition to their own research, the authors have designed and implemented an integrated testbed system that incorporates results of research produced throughout the Image Understanding community. This system provides a coherent framework for demonstration and evaluation of the accomplishments of DARPA's Image Understanding program, thereby facilitating transfer of this technology to appropriate military organizations. GRA

N84-15816# Gaertner (W. W.) Research, Inc., Stamford, Conn.
MULTISPECTRAL DATA PROCESSING SYSTEM (MDPS) Final Technical Report, 15 Dec. 1980 - 31 Dec. 1982
Mar. 1983 61 p
(Contract F30602-81-C-0035; AF PROJ. 3205)
(AD-A133426; RADC-TR-83-60) Avail: NTIS HCA04/MFA01 CSCL 09B

This report summarizes the research performed in the design and specification of the computer system architecture and software required for the Multispectral Data Processing System (MDPS). The objective of the MDPS is the efficient processing of large volumes of digital bathymetric data (collected by remote multispectral sensor) representing depths and bottom features of shallow water coastal areas, navigable channels and bays, and offshore shallow reefs. The MDPS includes the data recording and processing portions of an airborne active/passive bathymetric system which can be used by the Defense Mapping Agency for the production and maintenance of navigation charts. Also discussed are Hardware and Software Requirements; Cost Analysis; and Error Analysis. GRA

N84-16071*# Systems and Applied Sciences Corp., Hyattsville, Md.
FGGE/SBUV TAPE SPECIFICATION AND SHIPPING LETTER DESCRIPTION
D. HAN and H. LO Greenbelt, Md. NASA. Goddard Space Flight Center Mar. 1983 39 p
(Contract NAS5-26753)
(NASA-CR-170482; NAS 1.26:170482; SSD-T-4-8234-006-82)
Avail: NTIS HC A03/MF A01 CSCL 05B

The FGGE/SBUV Level 2C data set consists of 12 9-track data tapes, each of which contains total ozone and ozone profile data for one calendar month grouped in files containing the data in a 6 hour synoptic time block. The data flow and quality checks in the production of this data set are described as well as the format of the data tapes and the accompanying shipping documents. A.R.H.

08

INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

A84-10756
A NEW GENERATION AIRBORNE SYNTHETIC APERTURE RADAR (SAR) SYSTEM
J. R. BENNETT and R. A. DEANE (McDonald, Dettwiler and Associates, Ltd., Richmond, British Columbia, Canada) IN: Radar-82; Proceedings of the International Conference, London, England, October 18-20, 1982 . London, Institution of Electrical Engineers, 1982, p. 20-23.

An urgent need for airborne SAR systems exists in the Canadian north where offshore oil and gas exploration and drilling operations are constantly threatened by the annual fluctuations of the ice pack. The present investigation is concerned with the performance and the conceptual design of a SAR system which is being developed in response to this need. The full prototype SAR will be a two-frequency transmit, four channel receive system with two polarizations received for each transmitted frequency. The first delivered system will have a single C-band transmitter and two receive channels with provision for the later addition of an X-band transmitter and two X-band receive channels. G.R.

A84-10886* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
PRELIMINARY EVALUATION OF THEMATIC MAPPER SENSOR CHARACTERISTICS RELATIVE TO LAND COVER/LAND USE DISCRIMINATION
D. L. WILLIAMS, J. R. IRONS, B. L. MARKHAM, R. F. NELSON, D. L. TOLL (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, MD), R. S. LATTY (Maryland, University, College Park, MD), and M. L. STAUFFER (Computer Sciences Corp., Silver Spring, MD) IN: Space applications at the crossroads; Proceedings of the Twenty-first Goddard Memorial Symposium, Greenbelt, MD, March 24, 25, 1983 . San Diego, CA, Univelt, Inc., 1983, p. 67-78. refs
(AAS PAPER 83-159)

Preliminary experimental results of airborne thematic mapper (TM) data taken to quantify the effect of three major TM sensor parameters, spectral, spatial, and radiometric resolution, six months after launch of Landsat-4 are reported. The flight took place on Nov. 2, 1982 over Washington, D.C., and data gathered were compared with ground reference data from color airborne photography on a 1:40,000 scale. Analyses proceeded by deleting one band from each of four data sets, thus making the data equivalent to MSS data. Attention was directed to land cover/use classes in a quick-look format. A per-pixel maximum likelihood scheme was found to increase the recognition and dicrimination categorization capabilities. Finer spatial resolution, however, impeded classification due to increased within-class variability of the field-center pixels, which also incresed class overlap in the spectral data base. Improved data analyses techniques are therefore needed to exploit the available higher spatial resolution of the TM. D.H.K.

A84-11275
THE STATE OF THE ART ON PHOTOGRAMMETRY AND REMOTE SENSING [ETAT DE L'ART SUR LA PHOTOGRAMMETRIE ET LA TELEDETECTION]
L. LAIDET (Centre National d'Etudes Spatiales, Toulouse, France) and A. BAUDOIN (Institut Geographique National, Paris, France) (International Astronautical Federation, International Astronautical Congress, 33rd, Paris, France, Sept. 27-Oct. 2, 1982) Acta Astronautica (ISSN 0094-5765), vol. 10, Sept. 1983, p. 651-655. In French.

The Symposium of Commission VII of the International Society of Photogrammetry and Remote Sensing recently established working groups for examining the methodology of data interpretation, obtaining and exploiting nonphotographic data, automating interpretation, and defining applications of diverse earth sciences within photogrammetric and remote sensing fields. Particular attention was given to treatment of visible and IR radiation within the confines of multi-sensor, -scales, -temporal, and -treatment characteristics. Consideration was given to the use of radar, particularly SAR, to agriculture, land use, oceanography, and polar zone studies. Note was taken of the effects of the inclination of the surface viewed, the radiometric properties of sampled objects, and polarization of upwelling light. Areas of aplication for identifying and categorizing renewable and nonrenewable resources, environmental monitoring, and coastal zone monitoring were discussed. It was concluded that the organization of available data and scanning patterns are the area deserving greatest concern, rather than technical problems with present instrumentation. M.S.K.

A84-13009
FAST GEOMETRIC CORRECTION OF NOAA AVHRR
Y. TOZAWA (IBM Japan, Tokkyo Scientific Center, Tokyo, Japan) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 46-53.

Geometric correction, i.e., mapping coordinates of a sensed image into a displayed image, for the Advanced Very High Resolution Radiometer (AVHRR) on board the NOAA satellites is discussed. The nominally used technique is to locate a ground control point, a factor that becomes occasionally difficult if the scene is entirely of a section of the ocean. Equations are presented for mapping the satellite image onto a Mercator projection using orbital data. The earth rotation is accounted for in terms of an equation of spherical trigonometry. Error magnitudes are calculated and found to be negligible at the latitudes normally viewed. M.S.K.

A84-13043* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE ROLE OF SPATIAL, SPECTRAL AND RADIOMETRIC RESOLUTION ON INFORMATION CONTENT
J. S. BUIS, W. ACEVEDO, R. C. WRIGLEY, and D. A. ALEXANDER (NASA, Ames Research Center, Moffett Field, CA) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 330-338. refs

The results of a factorial experiment to evaluate the effects of spatial, spectral, and radiometric resolution on training-data spectral separability and classification accuracy are reported. Aircraft scanner data from five flightlines at 19.8 km over California including croplands, rangeland, forest, water, and urban areas were systematically degraded over a range approximately from Landsat MSS to Thematic Mapper specifications. Reference data were collected on the ground and from aerial photography. The degradations, training-site delineation, data-analysis procedures, and accuracy-assessment techniques are described; the results are presented in tables and graphs and discussed. It is found that while accuracy was increased by higher spectral resolution in 70 percent of the cases and uniformly by increased radiometric resolution, it was decreased by higher spatial resolution. This phenomenon is attributed to classification methods. D.G.

A84-13084* Environmental Research Inst. of Michigan, Ann Arbor.
COMPARISON OF LANDSAT MSS, NIMBUS 7 CZCS, AND NOAA 6/7 AVHRR FEATURES FOR LAND USE ANALYSIS
R. C. CICONE and M. D. METZLER (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 291-297. refs
(Contract NAS9-16538)

Spectral characteristics of the Coastal Zone Color Scanner (CZCS) on board Nimbus 7, the Advanced Very High Resolution Radiometer (AVHRR) on NOAA 6 and 7 and the Multispectral Scanner (MSS) on Landsat 1-3 are analyzed to comparatively assess their utility for land use analysis through remote sensing. The examination of simulated in-band radiances suggests that each sensor would respond to incident radiation reflected from a typical agricultural scene in a highly comparable manner, with most of the variation captured in two physically related variables. Several measures of green vegetation are examined and features are proposed for crop condition assessment with consideration of the course resolution characteristics of AVHRR and CZCS. Author

A84-13086* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
MULTISENSOR DATA ANALYSIS AND ITS APPLICATION TO MONITORING OF CROPLAND, FOREST, STRIP MINES AND CULTURAL TARGETS
S. T. WU (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 313-320. refs

Seasat L-band and aircraft X-band dual polarized synthetic aperture (SAR) data of the Western Kentucky Coal Region were examined, preprocessed and combined with Landsat Multispectral Scanner (MSS) data to form a seven-band multisensor data set.

Analysis of classified data sets show that the three-band SAR data contain moderate discrimination accuracy for the strip mine class but low accuracy for the residential class. The four-band MSS data contain low classification accuracy for the strip mine and residential classes. The integrated five-band SAR/MSS data show that significant improvement in classification accuracy is obtained for both strip mine and residential classes. D.H.

A84-13096
GEOMETRICAL AND ATMOSPHERIC CONSIDERATIONS OF NOAA AVHRR IMAGERY
R. J. BROWN, M. BERNIER (Canada Centre for Remote Sensing, Ottawa, Canada), and G. FEDOSEJEVS (Intera Environmental Consultants, Ltd., Ottawa, Canada) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 374-381. Research supported by the Statistics Canada, Canadian West Board, and Agriculture Canada. refs

The Advanced Very High Resolution Radiometer (AVHRR) has two channels in the visible and the near-infrared portions of the electromagnetic spectrum that correspond closely to bands 5 and 7 of the Landsat MSS. Since the NOAA-6 and NOAA-7 spacecraft are altitudes of 800 to 850 km and the AVHRR has a scan angle of approximately + or - 56 deg, it is possible to acquire daily coverage of a particular area. The AVHRR has an instantaneous field of view of approximately 1.1 km. It thus becomes possible to acquire a synoptic view of a large area, analyze it for anomalies, and direct further detailed analysis using Landsat MSS data. The problems in interpretation arising from the wide swath width and low resolution are discussed. Procedures are outlined for correcting for the path radiance effects and variations in reflectances due to varying scan angles. C.R.

A84-13114
ADVANCED SENSOR SYSTEMS - THEMATIC MAPPER AND BEYOND
R. A. HOLMES (General Motors Corp., Engineering and Management Institute, Flint, MI) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 540-545. refs

Advanced sensor systems operating from earth orbit are overviewed. Thematic Mapper (launch date: July 1982 aboard Landsat-4) offers new spectral data with a resolution of 30 meters for its ground image field of view. The French SPOT system is being built for a mid-1980s launch and will feature rapid data delivery and a guaranteed ten year service continuity. The Japanese MOS and LOS systems are under development for launches in the second half of this decade. NASA-Goddard Space Flight Center has received completed design studies for a multispectral linear array sensor. Results of a study to identify fundamental research issues in electromagnetic sensors and signal handling show that ample technology is available to design systems to meet user needs; the major problem is to get the user to state those needs in a manner that will lead to rational system design. D.H.

A84-13605
A THERMAL INFRARED SURVEY OF SELECTED SITES IN THE CASCADE MOUNTAIN RANGE OF CALIFORNIA, OREGON, AND WASHINGTON SURVEYED: JULY 1981
D. L. HAWLEY and S. B. BREWSTER, JR. (EG&G, Inc., Multispectral Remote Sensing Dept., Las Vegas, NV) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 195-201.

A84-13606
MEIS II - AN OPERATIONAL MULTISPECTRAL AIRBORNE PUSHBROOM SCANNER
B. W. HREBENYK (MacDonald, Dettwiler and Associates, Ltd., Richmond, British Columbia, Canada) IN: American Congress on Surveying and Mapping and American Society of Photogrammetry, Fall Convention, Hollywood, FL, September 19-23, 1982, Technical Papers . Falls Church, VA, American Congress on Surveying and Mapping and American Society of Photogrammetry, 1982, p. 202-211. refs

The new Multispectral Electro-optical Imaging Scanner (MEIS II) is a compact and rugged eight-channel pushbroom scanner which comes complete with real-time airborne processing electronics. The scanner uses solid-state linear detector arrays of 1728 elements located in the focal plane of the imaging lenses. Spectral bands are selected by placing interchangeable optical filters in front of each lens allowing quick configuration for any combination of spectral bands and/or polarizations. The principal advantages of MEIS II are very high radiometric sensitivity and improved signal-to-noise ratio enabling narrow band imaging, lens selectable spatial resolution for improved operational flexibility, increased reliability through elimination of all moving parts, and reduction of size, weight and power requirements. Author

A84-15403
LASER REMOTE SENSING: FUNDAMENTALS AND APPLICATIONS
R. M. MEASURES (Toronto, University, Toronto, Canada) New York, Wiley-Interscience, 1984, 521 p. refs

The applications of lasers to studies of the earth and its atmosphere are discussed. Electromagnetic theory is outlined, including concepts of elastic scattering. Spectroscopy, basic radiation processes, and inelastic scattering are discussed in terms of quantum descriptions of atoms and molecules. The interaction and propagation of radiation is discussed, including the radiative transfer equation with and without scattering. Fundamentals of lasers are reviewed, briefly describing the types of lasers relevant to remote sensing. Basic methods of using lasers in remote sensing are addressed, including the systems involved and the problem of SNR. The basic remote sensing equations are derived and the analysis and interpretation of the signals obtained through laser remote sensing are treated. Atmospheric and hydrospheric laser remote sensing applications are broadly reviewed. C.D.

A84-15666*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE NEXT GENERATION MICROWAVE SOUNDER FOR WEATHER SATELLITES
J. C. SHIUE (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: NTC '82; National Telesystems Conference, Galveston, TX, November 7-10, 1982, Conference Record . New York, Institute of Electrical and Electronics Engineers, Inc., 1982, p. C4.4.1-C4.4.7.

Microwave sounders are multichannel microwave radiometers for measuring atmospheric temperature (or humidity) profiles. These devices are also known as microwave spectrometers because a sounder typically has a number of channels measuring the spectral shape of an absorption line. Each channel of the sounder responds essentially to a given layer of the atmosphere. The characteristics of currently employed microwave sounders on satellites are briefly examined, and new features expected in connection with the introduction of the next generation sounders are discussed. There will probably be an increase in the number of oxygen channels with the objective to extend the weighting function height coverage into the stratosphere and to improve the temperature retrieval accuracy. Other features are to be related to better surface resolution, auxiliary channels, and water vapor sounding. G.R.

A84-15787
OBTAINING ORTHOPHOTOIMAGES WITH TOPOKART-ORTOFOT-B DEVICES ON THE BASIS OF MKF-6 SPACE PHOTOGRAPHS [POLUCHENIE ORTOFOTOIZOBRAZHENII NA PRIBORAKH TOPOKART-ORTOFOT-B PO KOSMICHESKIM SNIMKAM MKF-6]
B. A. NOVAKOVSKII Geodeziia i Kartografiia (ISSN 0016-7126), Sept. 1983, p. 35-39. In Russian.

The paper describes the procedure for obtaining orthophotos of multispectral images (obtained with the MKF-6 camera on Soyuz-22) using a system consisting of the Topokart-B general-purpose stereo mapping instrument and the Ortofot-B orthophotoprojector. An example involving the orthophototransformation of a series of stereopairs of space photographs of the Pamir-Alay region is presented. B.J.

A84-15952* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REMOTE SENSING FOR EXPLORATION - AN OVERVIEW
A. F. H. GOETZ, B. N. ROCK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), and L. C. ROWAN (U.S. Geological Survey, Reston, VA) Economic Geology and Society of Economic Geologists, Bulletin (ISSN 0361-0128), vol. 78, June-July 1983, p. 573-590. NASA-supported research. refs

The use of remote sensing in resource exploration is reviewed, with emphasis placed on new developments in high spectral resolution remote-sensing techniques for mineralogic and vegetation mapping. Topics discussed include aerial photography and satellite remote sensing, concepts and principles of spectral data collection, spectral properties of rocks and minerals, spectral properties of vegetation, and botanical aspects of geochemical stress. The discussion also covers applications of Landsat multispectral scanner data to lithologic and geobotanic studies and the future development of data acquisition and data interpretation techniques. V.L.

A84-16114
POSITION LOCATION FROM SENSORS WITH POSITION UNCERTAINTY
M. WAX (Stanford University, Stanford, CA) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. AES-19, Sept. 1983, p. 658-662. refs
(Contract F49620-79-C-0058; DAAG29-81-K-0057)

A statistical analysis of a mixed-mode position-location system with sensors position uncertainty is described. Expressions for the maximum likelihood estimator and its error statistics, under 'small errors' assumption, are derived. Author

A84-16367
SMEAR VELOCITY IN ELLIPTIC ORBITS
W. K. UTT (Honeywell Systems and Research Center, Minneapolis, MN) IN: Optical systems engineering III; Proceedings of the Conference, Los Angeles, CA, January 20, 21, 1983 . Bellingham, WA, SPIE - The International Society for Optical Engineering, 1983, p. 121-126. refs

The effect of elliptic orbit motion on the blurring in an optical sensor was evaluated. The magnitude of the uncompensated relative velocity, the smear velocity, can influence the selection of an orbit for the mission as well as the signal processing requirements. A model of the orbital kinematics and the optical projection effects for a surveillance spacecraft was developed in order to determine the smear velocity. The center of the sensor's field of view (CFOV) is assumed to be directed to track a point of interest on the earth's surface in order to reduce the relative motion. Two different modes of tracking the point are considered: two-axis tracking and three-axis tracking. The lateral variation of the smear velocity across the field of view (FOV) was analyzed. This effect, in conjunction with the frame time, contributes to the smearing or blurring of the image. Author

A84-18514*# Florida Univ., Gainesville.
MERITS OF SUPPLEMENTAL GROUND-BASED MEASUREMENTS OF LIGHTNING ELECTRIC FIELDS IN THE INTERPRETATION OF AIRBORNE MEASUREMENTS
W. H. BEASLEY and M. J. MASTER (Florida, University, Gainesville, FL) IN: International Aerospace Conference on Lightning and Static Electricity, Oxford, England, March 23-25, 1982, Proceedings. Volume 1 . Abingdon, Oxon, England, Culham Laboratory, 1982, p. A11-1 to A11-7. refs
(Contract NSF ATM-81-03013; NSF ATM-79-02627; NGR-10-005-169; N00014-81-K-0177)

Calculations are presented which indicate that airborne recordings of the electric fields from lightning will be difficult to interpret without correlated continuous broadband electric field measurements at a ground-based station. Furthermore, through application of the results in Master et al. (1981), field measurements made at altitudes above ground may be calibrated by comparison with ground-based measurements of the same discharge. The requirements of the electric-field recording systems sufficient for identification, characterization, and calibration of airborne field measurements are discussed. Author

A84-19013
THERMAL RADIO EMISSION FROM NATURAL FORMATIONS WITH SPATIALLY VARIABLE ELECTROPHYSICAL PROPERTIES [RADIOTOPLINNO IZL'CHVANE NA PRIRODNI OBRAZUVANIIA S PROSTRANSTVENO-PROMENLIVI ELEKTROFIZICHESKI PARAMETRI]
T. G. NAZRSKI and D. N. MISHEV (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia za Kosmicheski Izsledvaniia, Sofia, Bulgaria) B'lgarsko Geofizichno Spisanie (ISSN 0323-9918), vol. 9, no. 4, 1983, p. 117-124. In Bulgarian. refs

Models of a smooth water surface, a plane layered water-ice system, and even homogeneous soil with spatially variable electrophysical properties are described. Expressions are derived for determining the brightness temperature of these models in the case of microwave emission. Relationships are obtained determining the temperature dynamics of a spaceborne radiometer system for measuring microwave emission from natural formations with spatially variable electrophysical properties. The proposed models were used in the development of the microwave radiometer system for the Meteor-Priroda satellite. B.J.

A84-19044* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
THE SIR-A RADAR OF THE AMERICAN SPACE SHUTTLE - TECHNICAL CHARACTERISTICS AND OVERVIEW OF FRENCH EXPERIMENTS [LE RADAR SIR-A DE LA NAVETTE SPATIALE AMERICAINE CARACTERISTIQUES TECHNIQUES ET PRESENTATION DES EXPERIENCES FRANCAISES]
CH. ELACHI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), L. LAIDET (Centre National d'Etudes Spatiales, Toulouse, France), and G. WEECKSTEEN (Bureau de Recherches Geologiques et Minieres, Orleans, France) Societe Francaise de Photogrammetrie et de Teledetection, Bulletin (ISSN 0244-6014), no. 91, 1983, p. 5-9. In French. refs

The scientific instruments comprising the OSTA-1 package flown on the second Shuttle mission (November 12-14, 1981) are listed, and the Shuttle Imaging Radar (SIR-A) experiments are examined in detail: SIR-A operated for 8 h and obtained images covering more than 10 million sq km at 40-m resolution. The images were recorded on photographic film and processed in holographic form at JPL, and data for Southern Europe and parts of Africa were distributed to French scientists by the Groupement pour le Developpement de la Teledetection Aerospatiale. The main areas of research were environmental studies and geology, and the SIR-A images were used in combination with aerial photography, thematic maps, and Landsat images. The technical specifications of the SIR-B radar planned for STS-17 in 1984 are compared with those of SIR-A and Seasat SAR in tables. T.K.

A84-19205
STUDY OF THE COLOUR PROPERTIES OF THE UNDERLYING SURFACE BY DATA OF THE BULGARIA-1300-II COMPLEX
D. N. MISHEV and P. V. PETROV (B'lgarska Akademiia na Naukite, Tsentralna Laboratoria za Kosmicheski Izsledvaniia, Sofia, Bulgaria) *Bolgarskaia Akademiia Nauk, Doklady* (ISSN 0366-8681), vol. 36, no. 9, 1983, p. 1059-1062.

Underlying surface color properties were investigated using data from the SMP-32 multichannel spectrometric system of the Bulgaria-1300-II research apparatus set mounted on the Meteor-Priroda-31 satellite. A decrease in the number of spectrometric channels for applied comparative measurements on the earth's surface was suggested by the absence of stimuli with a high degree of metamerism with respect to the source and to the standard observers. The exact determination of the color coordinates, i.e. the coordination of multispectral video data with eye of the interpreter, makes, within certain spatial limits, for a natural illumination of images from other reproducible systems accompanying the spectrometering. J.N.

N84-10648*# Science Applications, Inc., Dayton, Ohio.
A STOCHASTIC ATMOSPHERIC MODEL FOR REMOTE SENSING APPLICATIONS Final Report, 1 Jul. 1982 - 1 Jul. 1983
R. E. TURNER Aug. 1983 33 p refs
(Contract NAS1-17006)
(NASA-CR-172181; NAS 1.26:172181; SAI-83-002-DAY) Avail: NTIS HC A03/MF A01 CSCL 05B

There are many factors which reduce the accuracy of classification of objects in the satellite remote sensing of Earth's surface. One important factor is the variability in the scattering and absorptive properties of the atmospheric components such as particulates and the variable gases. For multispectral remote sensing of the Earth's surface in the visible and infrared parts of the spectrum the atmospheric particulates are a major source of variability in the received signal. It is difficult to design a sensor which will determine the unknown atmospheric components by remote sensing methods, at least to the accuracy needed for multispectral classification. The problem of spatial and temporal variations in the atmospheric quantities which can affect the measured radiances are examined. A method based upon the stochastic nature of the atmospheric components was developed, and, using actual data the statistical parameters needed for inclusion into a radiometric model was generated. Methods are then described for an improved correction of radiances. These algorithms will then result in a more accurate and consistent classification procedure. Author

N84-11376# Technical Univ. of Denmark, Lyngby. Electromagnetics Inst.
ON THE ASSESSMENT OF ERRORS DUE TO ANTENNA PATTERN IMPERFECTIONS: EXECUTIVE SUMMARY Final Report
F. S. PEDERSEN and I. MUNKSTRUP Jan. 1982 15 p refs
(Contract ESA-4479/80/F/DD/SC)
(TUD-R-253; ESA-CR(P)-1575-ANNEX) Avail: NTIS HC A02/MF A01

The relative influence of radiometer parameters such as antenna sidelobe level, antenna cross polarization level and radiometer sensitivity on the measurement of the brightness temperature of the environment and on the estimation of physical parameters was studied in order to optimize specifications of the subsystems in a complete radiometer system. A nonrotational symmetrical pattern for the cross polarized patterns with two main lobes and sine squared theta variations in the theta plane is proposed. Brightness temperature is restored from the output of the two antenna ports by compensating the signal in the far-off sidelobes and in the spillover lobes, and by decoupling of the mixing of polarizations. The influence of cross polarization level on physical parameter estimation is almost eliminated, and sidelobe level influence is reduced. Author (ESA)

N84-11551*# Environmental Research Inst. of Michigan, Ann Arbor. Infrared and Optics Div.
INVESTIGATION OF RADIOMETRIC PROPERTIES OF THE LANDSAT-4 MULTISPECTRAL SCANNER Final Report, 22 Jul. 1982 - 21 Aug. 1983
W. A. MALILA, Principal Investigator and D. P. RICE Aug. 1983 54 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NAS5-27254)
(E84-10013; NASA-CR-174528; NAS 1.26:174528; ERIM-163200-3-F) Avail: NTIS HC A04/MF A01 CSCL 14B

The radiometric data quality of the LANDSAT 4 multispectral scanner (MSS) was examined using several LANDSAT 4 frames. It was found that LANDSAT 4 MSS produces high-quality data of the caliber experienced with previous LANDSATS. For example, the detector equalization procedure worked well, leaving a residual banding effect of about 0.3 digital counts RMS, close to the theoretical minimum value of quantization error. Nevertheless, artifacts of the data were found, two of which were not experienced in previous MSS data. A low-level coherent noise effect was observed in all bands, with a magnitude of about 0.5 digital counts and a frequency of approximately 28 KHz (representing a wavelength of about 3.6 pixels); a substantial increase in processing complexity would be required to reduce this artifact in the data. Also, a substantial scan-length variation (of up to six pixels) was noted in MSS data when the TM sensor was operating; the LANDSAT 4 correction algorithms being applied routinely by the EROS Data Center to produce a p-type data should remove most of this variation. Between-satellite calibrations were examined in paired LANDSAT 3 and LANDSAT 4 MSS data sets, which were closely matched in acquisition time and place. Radiometric comparisons showed that all bands were highly linear in digital counts, and a well-determined linear transformation between the MSS's was established. M.G.

N84-11570# Naval Ocean Research and Development Activity, Bay St. Louis, Miss. Ocean Science and Technology Lab.
ASSESSMENT OF POTENTIAL SSM/I (SPECIAL SENSOR MICROWAVE/IMAGER) ICE PRODUCTS IN LIGHT ESMR (ELECTRICALLY SCANNING MICROWAVE RADIOMETER) AND SMMR (SCANNING MICROWAVE SPECTROMETER) ICE CLASSIFICATION ALGORITHMS Final Report
D. T. EPPLER Jun. 1983 35 p refs
(AD-A130961; NORDA-TN-220) Avail: NTIS HC A03/MF A01 CSCL 08L

The Special Sensors Microwave/Imager (SSM/I) will be launched aboard a DMSP satellite in FY-85. Spatial resolution of the high frequency 85.5 GHz channel is substantially better than the highest resolution obtained from ESMR and SMMR sensors (approximately 30 km), Data received from this channel will improve the accuracy with which ice edges and bodies of open water within the pack can be located. The cell size for which total ice concentration can be estimated also will be reduced. However, estimates of multi-year ice concentration, of thin ice types, and the character of ice in the marginal ice zone will not be improved over SMMR estimates by virtue of these higher frequency data. Enhanced estimates of these parameters must come from development of improved ice classification algorithms. Improved ground truth information from which satellite data can be interpreted and verified is critical if classification algorithms are to be improved. Specifically, data that document radiometric signatures of wet and snow-covered ice surfaces that occur during summer and autumn months are needed to improve estimates of multi-year concentrations during melt and freeze-up. Brightness temperature data that describe the transition from open water to thick first-year ice are required for improved discrimination of thin ice types. Ground truth data that correlate marginal ice zone conditions with low-resolution imagery from satellite-borne microwave sensors are needed to improve estimates of conditions with the marginal ice zone. GRA

N84-12571*# Purdue Univ., Lafayette, Ind.
SIMULATION ASPECTS IN THE STUDY OF RECTIFICATION OF SATELLITE SCANNER DATA Final Report
E. M. MIKHAIL and F. C. PADERES, JR. *In* Texas A and M Univ. Proc. of the NASA Symp. on Math. Pattern Recognition and Image Analysis p 413-484 1983 refs ERTS
Avail: NTIS HC A99/MF A01 CSCL 05B

Complete sensor/platform modelling is derived and used for the generation of synthetic data and for rectification studies of satellite scanner data. All satellite position and sensor attitude parameters are recovered. Rectification accuracy improves marginally when using more than 25 control points, and is highly sensitive to errors in image point identification. Author

N84-12589# Technische Univ. Munich, Garching (West Germany). Geowissenschaftliche Fernerkundung.
THE MODULAR OPTOELECTRONIC SCANNER (MOMS) ON STS-7, JUNE 83
J. BODECHTEL *In* ESA Remote Sensing Appl. for Environ. Studies p 65-68 Jul. 1983
Avail: NTIS HC A14/MF A01

The Modular Optoelectronic Multispectral Scanner (MOMS) designed for regional and global optical remote sensing applications is presented. The SPAS STS-7 flight serves the technological space verification of the sensor and the demonstration of geoscientific and application-oriented experiments in worldwide distributed areas. The MOMS is a pushbroom, modular, sensor. It employs the dual lens principle for scan line extensions beyond one CCD array (up to six arrays per focal plane possible), and operates in the 0.5 to 2.3 micron range. Focal length is 237 mm; 6912 pixels per line; resolution = 20 x 20 m at 300 km altitude; total field of view = 26.2 deg (140 km); radiometric resolution = 128 gray levels (7 bit) Author (ESA)

N84-12592# Canada Centre for Remote Sensing, Ottawa (Ontario).
REMOTE SENSING USING THE AIRBORNE MEIS 2 MULTIDETECTOR ELECTRO OPTICAL IMAGING SCANNER
S. M. TILL, W. D. MCCOLL, and R. A. NEVILLE *In* ESA Remote Sensing Appl. for Environ. Studies p 87-92 Jul. 1983 refs
Avail: NTIS HC A14/MF A01

A pushbroom imaging scanner, MEIS 2, which uses charged coupled device linear array detectors, with spectral response covering the visible and near infrared regions was developed. It has a low noise-equivalent radiance and high spatial resolution, and combines flexibility of operation with real-time data processing. Flight trials demonstrate the capabilities of MEIS 2 for monitoring and mapping the environment. Applications include resource classification, vegetation stress analysis, and passive bathymetry, as well as digital cartography and terrain mapping. Author (ESA)

N84-12631# Federal Geodetic Control Committee, Rockville, Md. Instrument Subcommittee.
TEST AND DEMONSTRATION OF MACROMETER (TM) MODEL V-1000 INTERFEROMETRIC SURVEYOR
L. D. HOTHEM and C. J. FRONCZEK May 1983 41 p refs
(PB83-239103; FGCC-IS-83-2; NOAA-83072201) Avail: NTIS HC A03/MF A01 CSCL 08E

An interferometric surveying system which uses radio signals from the satellites of the Global Positioning system (GPS) to determine three dimensional relative positions of survey stations without requiring interstation visibility was demonstrated. Macrometer model V-1000 receivers and the model P-1000 data processor were tested in order to assess the accuracies of Macrometer determinations of base line lengths, azimuths, and ellipsoidal height differences, the FGCC used terrestrial surveys as standards for comparison. The coordinates for the test network were obtained from a special adjustment of the U.S. Transcontinental Traverse. GRA

N84-13628*# Agricultural Research Center, Beltsville, Md. Hydrology Lab.
INFORMATION CONTENT OF DATA FROM THE LANDSAT 4 THEMATIC MAPPER (TM) AND MULTISPECTRAL SCANNER (MSS) Progress Report
J. C. PRICE 1983 4 p ERTS
(Contract NASA ORDER S-10772-C)
(E84-10034; NASA-CR-174586; NAS 1.26:174586; PR-4) Avail: NTIS HC A02/MF A01 CSCL 05B

Simultaneous data acquisition by the LANDSAT 4 thematic mapper and the multispectral scanner permits the comparison of the two types of image data with respect to engineering performance and data applications. Progress in the evaluation of information content of matching scenes in agricultural areas is briefly reported. M.G.

N84-13636*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
ANALYSIS OF MULTISPECTRAL SCANNER (MSS) AND THEMATIC MAPPER (TM) PERFORMANCE (PRE-LAUNCH AND POST-LAUNCH)
J. L. BARKER 1983 112 p Presented at the 5th Meeting of the LANDSAT Tech. Working Group (LTWG), 28-30 Sep. 1983 ERTS
(E84-10043; NASA-TM-85481; NAS 1.15:85481) Avail: NTIS HC A06/MF A01 CSCL 08B

Tables and graphs show the results of the spectral, radiometric, and geometric characterization of LANDSAT 4 sensors associated with imagery and of the imagery associated with sensors and processing. Specifications for the various parameters are compared with the photoflight and flight values. A.R.H.

N84-13637*# Arizona Univ., Tucson. Optical Sciences Center.
IN-FLIGHT ABSOLUTE RADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER
K. R. CASTLE, R. G. HOLM, C. J. KASTNER, J. M. PALMER, P. N. SLATER, M. DINGUIRARD (Centre d'Etudes et de Recherches de Toulouse), C. E. EZRA (Agricultural Research Service, Phoenix, Ariz.), R. D. JACKSON (Agricultural Research Service, Phoenix, Ariz.), and R. SAVAGE (Atmospheric Sciences Lab., White Sands Missile Range, N. Mex.) 1983 10 p refs ERTS
(Contract NAS5-27382; DI-12-14-50001-38)
(E84-10044; NASA-CR-174611; NAS 1.26:174611) Avail: NTIS HC A02/MF A01 CSCL 08B

The TM multispectral scanner system was calibrated in an absolute manner before launch. To determine the temporal changes of the absolute radiometric calibration of the entire system, spectroradiometric measurements of the ground and the atmosphere were made simultaneously with TM collections over White Sands, New Mexico. By entering the measured values in an atmospheric radiative transfer program, the radiance levels of the in four of the spectral bands of the TM were determined. Tables show values for the reflectance of snow at White Sands measured by a modular 8 channel radiometer, and values for exoatmospheric irradiance within the TM passbands, calculated for the Earth-Sun distance using a solar radiometer. A.R.H.

N84-13638*# Arizona Univ., Tucson. Optical Sciences Center.
SPECTRORADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER AND MULTISPECTRAL SCANNER SYSTEM Quarterly Report, 1 Aug. - 1 Nov. 1983
P. N. SLATER, Principal Investigator and J. M. PALMER 1 Nov. 1983 16 p refs ERTS
(Contract NAS5-27382)
(E84-10045; NASA-CR-174612; NAS 1.26:174612; QR-4) Avail: NTIS HC A02/MF A01 CSCL 08B

The design of a spectroradiometer under construction for atmosheric and and surface measurements at White Sands, New Mexico is described. The instrument's observation capability encompasses (1) measuring the solar radiance at a number of wavelengths as a function of air mass for Langley plot analysis in order to generate the optical depth; (2) measuring the ground radiance to determine the absolute ground reflectance; and (3)

measuring the sky radiance as a method of checking the accuracy of the radiative transfer program. A.R.H.

N84-14162# Joint Publications Research Service, Arlington, Va.
COSMONAUTS USE NEW INSTRUMENTS FOR EARTH STUDY
A. IVAKHNOV *In its* USSR Rept.: Space, No. 25 (JPRS-84946) p 13-15 14 Dec. 1983 Transl. into ENGLISH from Izv. (Moscow), 18 Jul. 1983 p 2
Avail: NTIS HC A07

Tests performed onboard the space station, for Earth observation are described. The eqipment, cameras and spectrometers, the spectrometer-camera, are outlined. E.A.K.

N84-14569* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
SUMMARY AND OVERVIEW
In its The Heat Capacity Mapping Mission (HCMM) Anthology p 237-244 1982 Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 08B

The merits, shortcomings, and future outlook of thermal IR remote sensing are appraised from a philosophical and speculative point of view in the light of the HCMM experiments. Two key questions stemming from HCMM addressed are: thermal remote sensing from space platforms now on a solid foundation in terms of demonstrated applications of real utility as well as theory, and where should NASA's research be focused in thermal remote sensing and are the potential applications sufficient to justify inclusion of thermal sensors in later generations of Earth resources satellites. A.R.H.

N84-14570* National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
THE HCMM SYSTEM: DEVELOPMENT AND PERFORMANCE
L. M. STUART, JR. *In its* The Heat Capacity Mapping Mission (HCMM) Anthology p 245-260 1982 Original contains color imagery. Original imagery may be purchased from NASA. Goddard Space Flight Center, (code 601), Greenbelt, Md. 20770. Domestic users send orders to "Attn: National Space Science Data Center"; non-domestic users send orders to "Attn: World Data Center A for Rockets and Satellites". HCMM
Avail: SOD HC $24.00 CSCL 14B

The structure and history of the heat capacity mapping mission program is reviewed and the spacecraft is described including engineering specifications, instrument design, data handling, and image characteristics. A.R.H.

N84-14573*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
LANDSAT-4 SENSOR PERFORMANCE
J. L. BARKER and F. J. GUNTHER (Computer Sciences Corp., Silver Spring, Md.) 1983 35 p refs Presented at Pecora 8 Remote Sensing Symp., Sioux Falls, S.D., 4 Oct. 1983 Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(Contract NAS5-24350)
(E84-10053; NASA-TM-85459; NAS 1.15:85459) Avail: NTIS HC A03/MF A01 CSCL 14B

Preflight and in-orbit sensor and data measurements indicate that TM meets or exceeds most specifications. Measured spectral band edges meet instrument specifications in 12 out of 14 cases; there is ample dynamic range. The signal-to-noise ratio exceeds specifications, except for band 3, channel 4; and band 7 channel 7 is very noisy but still meets specifications. The modulation transfer function of channel 4, band 2, is smaller than specified. Registration errors between the primary focal plane (PFP) and the cold focal plane (CFP) are about 0.75 pixels along-scan and 0.2 pixels across scan. Forward and reverse scan discontinuities, are well within ground-processing capabilities to rectify. Instrument gain variability, up to 7% for band 5, requires use of the internal calibration (IC) system to assure radiometric accuracy. Preliminary applications evaluation of image contents indicates that TM provides much better definition of edges than MSS. A.R.H.

N84-14901 Messerschmitt-Boelkow-Blohm G.m.b.H., Ottobrunn (West Germany). Unternehmensbereich Apparate.
MODULAR OPTOELECTRONIC MULTISPECTRAL SCANNER (MOMS). DIGITAL IMAGE STORAGE [MODULARER OPTOELEKTRONISCHER MULTISPEKTRAL SCANNER (MOMS) DIGITALE SPEICHERUNG DER BILDER]
M. HOFFMANN, H. LISTMANN, and D. MEISSNER 14 May 1982 9 p In GERMAN; ENGLISH summary Presented at 6th Arbeitskreis Telemetrie e.v.s Telemetriekonf., Garmisch-Partenkirchen, West Ger., 10-14 May 1982
(MBB-UA-686-82-OE) Avail: Issuing Activity

An imaging instrument for remote sensing to be used on space platforms (Shuttle Pallet Satellite-SPAS, Spacelab, satellites) is presented. The mapping principle is based on electrical scanning with high resolution linear photoarrays (push broom principle, charge coupled devices technology). The scanning is done in several pixel-coincide spectral channels between 0.45 and 1.05 microns by combining several similar modules. Almost any line length can be obtained using the double-lens principle (at present 6912 pixels). The signals are real-time corrected for the different dark signals, for the different sensitivities of the single elements, and for each lens transmittance. The digitized and corrected data are stored on a high density digital recorder. Author (ESA)

N84-14976# Naval Research Lab., Washington, D. C.
A COMPREHENSIVE DESCRIPTION OF THE MISSION SENSOR MICROWAVE IMAGER (SSM/I) ENVIRONMENTAL PARAMETER EXTRACTION ALGORITHM
R. C. LO 30 Sep. 1983 57 p
(AD-A134052; NRL-MR-5199) Avail: NTIS HCA04/MFA01 CSCL 12A

The Mission Sensor Microwave/Imager (SSM/I) is a passive microwave radiometric system designed to provide retrievals of the environmental parameters including sea surface wind, precipitation, atmospheric moisture content, soil moisture and sea ice conditions. It is a joint Navy/Air Force project developed by Hughes Aircraft Company under the direction of the Navy Space Systems Activity (NSSA) and the Air Force Space Division to be flown on the Defense Meteorological Satellite Program. The Space Sensing Applications Branch of the Naval Research Laboratory has served as a technical consultant to NSSA beginning in fiscal year 1982. Description of the environmental parameter retrieval technique, the geophysical model, the radiative transfer model and the parameter retrieval algorithms are presented. This information is designed to provide a comprehensive view of the SSM/I environmental parameter extraction algorithm for those individuals who have an interest in the geophysical data products from the SSM/I. GRA

N84-15526# Computer Sciences Corp., Huntsville, Ala.
SUPPORT FOR THE NAVAL RESEARCH LABORATORY ENVIRONMENTAL PASSIVE MICROWAVE REMOTE SENSING PROGRAM Final Contractor Report
M. F. HARTMAN 29 Apr. 1983 23 p
(Contract N00173-80-C-0265)
(AD-A133330; CSC/TR-83/6003) Avail: NTIS HCA02/MFA01 CSCL 17I

This document summarizes the data acquisition, reduction, and processing support CSC provided Code 7911 of the Naval Research Laboratory (NRL) under contract N00173-80-C-0265. The support for the NRL Environmental Passive Microwave Remote Sensing Program included acquisition, implementation, and evaluation of Scanning Multichannel Microwave Radiometer (SMMR) processing algorithms; Environmental Transfer Function development and verification; aircraft data acquisition; and aircraft data processing. Author (GRA)

N84-15527# Georgia Inst. of Tech., Atlanta. Engineering Experiment Station.
FAR INFRARED RADIOMETRIC SPECTROMETER (FIRRS) Final Report, 5 Nov. 1979 - 30 May 1983
R. A. BOHLANDER, D. R. LAMM, J. W. LARSEN, and M. J. SINCLAIR Hanscom AFB, Mass. AFGL 29 Jul. 1983 61 p
(Contract F19628-80-C-0031; AF PROJ. ILIR)
(AD-A133552; GIT/EES-A-2519; AFGL-TR-83-0137) Avail: NTIS HCA04/MFA01 CSCL 14B

This report describes a Far Infrared Radiometric Spectrometer (FIRRS) that will be used to survey radiation in the 0.17 to 1.7 mm wavelength band seen looking down from an aircraft. The instrument was built by the Engineering Experiment Station of Georgia Institute of Technology for the U.S. Air Force Geophysics Laboratory. The instrument is intended for use on an AFGL NKC-135A aircraft. An important initial purpose of the FIRRS will be to determine the effects of atmospheric attenuation and emission. The instrumentation will have two survey functions: (1) It will measure and calibrate the electromagnetic intensity spectrum received when flying over various terrain and atmospheric conditions; (2) Variations in the scene as the aircraft flies along will cause fluctuations in signal, often called clutter, which will also be analyzed. It is important to determine typical levels of background radiation and its clutter to be able to assess future applications of the far infrared wavelength band. After consideration of alternative spectrometer types, two were selected for inclusion in the FIRRS: a rapid-scanning Michelson interferometer, and a series of narrow-band interference filters. These will be used in different regimes determined by the bandwidth in temporal frequency of the clutter. Both will give high thorough efficiency. Radiation will be collected by a telescope with an aperture of 190 mm diameter, and will be detected by liquid helium-cooled bolometers and photoconductors. GRA

N84-15633*# Arizona Univ., Tucson. Optical Sciences Center.
IN-FLIGHT ABSOLUTE RADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER
K. R. CASTLE, R. G. HOLM, C. J. KASTNER, J. M. PALMER, P. N. SLATER, M. DINGUIRARD (Centre d'Etudes et de Recherches de Toulouse), C. E. EZRA (Agricultural Research Service, Phoenix, Ariz.), R. D. JACKSON (Agricultural Research Service, Phoenix, Ariz.), and R. SAVAGE (Atmospheric Sciences Lab.) 1984 10 p refs ERTS
(Contract NAS5-27382; DI-12-14-5001-38)
(E84-10064; NASA-CR-173144; NAS 1.26:173144) Avail: NTIS HC A02/MF A01 CSCL 14B

In order to determine temporal changes of the absolute radiometric calibration of the entire TM system in flight spectroradiometric measurements of the ground and the atmosphere were made simultaneously with TM image collections over the White Sands, New Mexico area. By entering the measured values in an atmospheric radiative transfer program, the radiance levels in four of the spectral bands of the TM were determined, band 1:0.45 to 0.52 micrometers, band 2:0.53 to 0.61 micrometers band 3:0.62 to 0.70 micrometers and 4:0.78 to 0.91 micrometers. These levels were compared to the output digital counts from the detectors that sampled the radiometrically measured ground area, thus providing an absolute radiometric calibration of the entire TM system utilizing those detectors. A.R.H.

N84-15634*# National Aeronautics and Space Administration. *Goddard Space Flight Center, Greenbelt, Md.*
SPECTRAL CHARACTERIZATION OF THE LANDSAT THEMATIC MAPPER SENSORS
B. L. MARKHAM and J. L. BARKER 1983 47 p refs Presented at the LANDSAT-4 Sci. Characterization Early Results Symp., NASA. Goddard Space Flight Center, 22-24 Feb. 1983 ERTS
(E84-10065; NASA-TM-85515; NAS 1.15:85515) Avail: NTIS HC A03/MF A01 CSCL 14B

Data collected on the spectral characteristics of the LANDSAT-4 and LANDSAT-4 backup thematic mapper instruments, the protoflight (TM/PF) and flight (TM/F) models, respectively, are presented and analyzed. Tests were conducted on the instruments and their components to determine compliance with two sets of spectral specifications: band-by-band spectral coverage and channel-by-channel within-band spectral matching. Spectral coverage specifications were placed on: (1) band edges--points at 50% of peak response, (2) band edge slopes--steepness of rise and fall-off of response, (3) spectral flatness--evenness of response between edges, and (4) spurious system response--ratio of out-of-band response to in-band response. Compliance with the spectral coverage specifications was determined by analysis of spectral measurements on the individual components contributing to the overall spectral response: filters, detectors, and optical surfaces. M.G.

N84-15648*# Jet Propulsion Lab., California Inst. of Tech., Pasadena.
REMOTE SENSING WITH SPACEBORNE SYNTHETIC APERTURE IMAGING RADARS: A REVIEW
J. B. CIMINO and C. ELACHI *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 16 p Aug. 1983 refs
(Contract NAS7-100)
Avail: NTIS HC A17/MF A01 CSCL 17I

A review is given of remote sensing with Spaceborne Synthetic Aperture Radars (SAR's). In 1978, a spaceborne SA was flown on the SEASAT satellite. It acquired high resulution images over many regions in North America and the North Pacific. The acquired data clearly demonstrate the capability of spaceborne SARs to: image and track polar ice floes; image ocean surface patterns including swells, internal waves, current boundaries, weather boundaries and vessels; and image land features which are used to acquire information about the surface geology and land cover. In 1981, another SAR was flown on the second shuttle flight. This Shuttle Imaging Radar (SIR-A) acquired land and ocean images over many areas around the world. The emphasis of the SIR-A experiment was mainly toward geologic mapping. Some of the key results of the SIR-A experiment are given. R.J.F.

N84-15651*# Kansas Univ., Lawrence. Remote Sensing Lab.
RADAR AND INFRARED REMOTE SENSING OF TERRAIN, WATER RESOURCES, ARCTIC SEA ICE, AND AGRICULTURE
A. W. BIGGS *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 22 p Aug. 1983 refs
Avail: NTIS HC A17/MF A01

Radar range measurements, basic waveforms of radar systems, and radar displays are initially described. These are followed by backscatter from several types of terrain and vegetation as a function of frequency and grazing angle. Analytical models for this backscatter include the facet models of radar return, with range-angle, velocity-range, velocity-angle, range, velocity, and angular only discriminations. Several side-looking airborne radar geometries are presented. Radar images of Arctic sea ice, fresh water lake ice, cloud-covered terrain, and related areas are presented to identify applications of radar imagery. Volume scatter models are applied to radar imagery from alpine snowfields. Short pulse ice thickness radar for subsurface probes is discussed in fresh-water ice and sea ice detection. Infrared scanners, including multispectral, are described. Diffusion of cold water into a river, Arctic sea ice, power plant discharges, volcanic heat, and related areas are presented in thermal imagery. Multispectral radar and infrared imagery are discussed, with comparisons of photographic, infrared, and radar imagery of the same terrain or subjects. R.J.F.

N84-15672# Tetra Tech, Inc., Pasadena, Calif.
TECHNIQUES FOR MEASURING RADIANCE IN THE AIR AND SEA
W. H. WELLS *In* AGARD Propagation Factors Affecting Remote Sensing by Radio Waves 17 p Aug. 1983 refs
Avail: NTIS HC A17/MF A01

Measurements of scattered sunlight often employ simple radiometers that are incapable of scanning azimuth phi and zenith angle theta. Instead, they measure integral moments of the radiance. Consider a set of N+1 meters designed to measure

moments lambda sub 1 through lambda sub N+1. If each meter is judiciously designed, then the lambda sub j may be processed quite simply to deduce inherent properties of the scattering medium, namely N moments of the volume scattering function. In the optimum design, each meter has an angular response that approximates a polynomial of degree N in cos theta. The theory of these meters is based on Boltzmann's equation of radiative transfer expressed in terms of spherical harmonics, a form in which this equation is particularly simple. Author

09

GENERAL

Includes economic analysis.

A84-10883
SPACE APPLICATIONS AT THE CROSSROADS; PROCEEDINGS OF THE TWENTY-FIRST GODDARD MEMORIAL SYMPOSIUM, GREENBELT, MD, MARCH 24, 25, 1983
J. H. MCELROY, ED. and E. L. HEACOCK, ED. (NOAA, Washington, DC) Symposium sponsored by AAS, AIAA, American Society for Aerospace Education, et al. San Diego, CA, Univelt, Inc. (Science and Technology Series. Volume 55), 1983, 308 p.

NASA's accomplishments in space exploration in the quarter century since NASA was formed are reviewed and the directions that could be taken in the near future are examined. The increases in spacefaring capabilities that were gained in the interval covering the Mercury program to near-operational status for the STS are discussed, as are the historical, current, and future NASA aeronautical research programs. Comparisons are made between the data available from the multispectral scanner and the thematic mapper on board Landsat-4, particularly for land cover/use applications. Attention is given to promising avenues for new classification schemes for the enhanced spectral range of the thematic mapper. D.H.K.

A84-11746#
ESA'S PLANS FOR FUTURE EARTH OBSERVATION PROGRAMMES
J. N. DE VILLIERS (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 7 p.
(IAF PAPER 83-117)

The planning and supporting activities which could lead to expanded remote sensing programs, based on concepts developed for the ESA Meteosat and ERS-1 programs, are described. An Ocean Color Monitor (OCM) was explored during the development of the ERS-1, and would feature 13 band viewing of an 800 km swath with 800 m resolution. Updates on the design include linear detecting arrays to eliminate scanning hardware, a concept which would require addition of a mechanism to view calibration sources. An all-weather satellite is being examined for forestry, agriculture, water resources, geology, cartography, and land use management applications, with emphasis on making three or four sightings during a growing season. The satellite would need 2-channel wide swath SAR, a high resolution push broom optical imaging system, and an imaging microwave radiometer. For meteorology, a spacecraft with imaging capability in the visible, water vapor, and thermal IR ranges would be required, capabilities that could also serve for climatological monitoring. Further developments would be needed to orbit a spacecraft which could measure gravitational anomalies and continental drift. M.S.K.

A84-13025*
REMOTE SENSING TECHNOLOGY TRANSFER AT THE NASA TECHNOLOGY APPLICATION CENTER, UNIVERSITY OF NEW MEXICO
R. W. GONZALES and M. A. FINK (NASA, Technology Applications Center, Albuquerque, NM) IN: Machine processing of remotely sensed data: Natural resources evaluation; Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 187-190.

A84-13026* National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
NASA TECHNOLOGY TRANSFER IN THE SOUTHWEST STATES - ARIZONA, COLORADO, NEVADA AND UTAH
S. D. NORMAN and D. L. PETERSON (NASA, Ames Research Center, Moffett Field, CA) IN: Machine processing of remotely sensed data: Natural resources evaluation: Proceedings of the Ninth International Symposium, West Lafayette, IN, June 21-23, 1983 . New York, Institute of Electrical and Electronics Engineers, 1983, p. 194-200. refs

Features of the NASA Regional Application Program for providing state and local land management agencies an opportunity to assess the usefulness of emerging remote sensing technology are described. The Program guidelines necessitated configuring software for local facilities, assuring that the aggncy involved furnished manpower, and applying the technology to local needs. The study focused on the southwestern U.S., particularly for purposes of water management, federal/state ownership/policy, energy development, environmental impact issues, timber and range inventory, fire control, and urban expansion. Demonstration projects were conducted in various topics, according to the state surveyed, with the success of the projects determined by the willingness of the agencies to continue with the technology, which happened in several cases. M.S.K.

A84-13117* Jet Propulsion Lab., California Inst. of Tech., Pasadena.
INFORMATION PROCESSING OF EARTH RESOURCES DATA
A. L. ZOBRIST and N. A. BRYANT (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Machine processing of remotely sensed data: Crop inventory and monitoring; Proceedings of the Eighth International Symposium, West Lafayette, IN, July 7-9, 1982 . New York, Institute of Electrical and Electronics Engineers, 1982, p. 557-562. refs
(Contract NAS7-100)

Current trends in the use of remotely sensed data include integration of multiple data sources of various formats and use of complex models. These trends have placed a strain on information processing systems because an enormous number of capabilities are needed to perform a single application. A solution to this problem is to create a general set of capabilities which can perform a wide variety of applications. General capabilities for the Image-Based Information System (IBIS) are outlined in this report. They are then cross-referenced for a set of applications performed at JPL. Author

N84-11093*# National Aeronautics and Space Administration, Washington, D. C.
AERONUATICS AND SPACE REPORT OF THE PRESIDENT, 1982 ACTIVITIES Final Report
1983 100 p refs
(NASA-TM-85454; NAS 1.15:85454) Avail: NTIS HC A05/MF A01

Achievemens of the space program are summerized in the area of communication, Earth resources, environment, space sciences, transportation, aeronautics, and space energy. Space program activities of the various deprtments and agencies of the Federal Government are discussed in relation to the agencies' goals and policies. Records of U.S. and world spacecraft launchings, successful U.S. launches for 1982, U.S. launched applications and scientific satellites and space probes since 1975, U.S. and Soviet manned spaceflights since 1961, data on U.S.

space launch vehicles, and budget summaries are provided. The national space policy and the aeronautical research and technology policy statements are included. J.M.S.

N84-12576*# National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.
EARTH RESOURCES LABORATORY RESEARCH AND TECHNOLOGY Annual Report, 1983
15 Nov. 1983 63 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS
(E84-10033; NASA-TM-85476; NAS 1.15:85476) Avail: NTIS HC A04/MF A01 CSCL 05B

The accomplishments of the Earth Resources Laboratory's research and technology program are reported. Sensors and data systems, the AGRISTARS project, applied research and data analysis, joint research projects, test and evaluation studies, and space station support activities are addressed. M.G.

N84-12587# Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse (France). SPOT Image.
SPOT POTENTIAL APPLICATIONS: AN OVERVIEW OF THE RESULTS OF THE SIMULATION CAMPAIGNS
J. P. LEGORGEU and J. C. RIVEREAU *In* ESA Remote Sensing Appl. for Environ. Studies p 51-56 Jul. 1983 refs In FRENCH
Avail: NTIS HC A14/MF A01

The use of the SPOT satellite for rural, urban, and coastal zone studies was simulated. For agriculture and land use, SPOT's high resolution is well adapted to European parcelling conditions (2 ha). The 10 m resolution is adequate for urban planning requirements. In coastal zones, ocean dynamics, strands under shallow water, and marine vegetation can be studied. The SPOT images can replace medium and large scale aerial photographs for thematic mapping. Author (ESA)

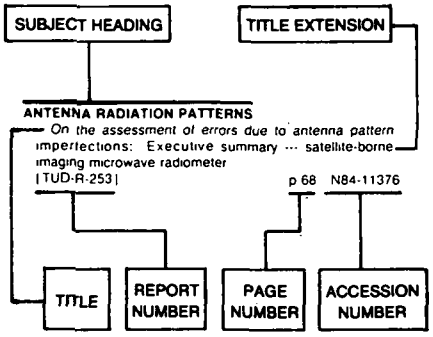
N84-13747# National Oceanic and Atmospheric Administration, Washington, D. C. National Earth Satellite Service.
SATELLITE ACTIVITIES OF NOAA (NATIONAL ENVIRONMENTAL SATELLITE DATA AND INFORMATION SERVICE) 1982
Jul. 1983 28 p
(PB83-252510; NOAA-83082302) Avail: NTIS HC A03/MF A01 CSCL 04B

Satellite data are used to assess the impact of natural factors and human activities on global food and fuel supplies and on environmental quality. The data also are used to observe and forecast weather conditions, issue warnings of severe weather, and assist community-preparedness programs for weather-related disasters; to prepare charts and coastal maps and for geodetic research; to improve assessment and conservation of marine life; to meet the needs of public and private users including scientists; and for research to improve the nation's environmental service.
Author (GRA)

N84-13748# National Oceanic and Atmospheric Administration, Washington, D. C. National Environmental Satellite, Data, and Information Service.
ECONOMIC BENEFITS OF OPERATIONAL ENVIRONMENTAL SATELLITES
W. J. HUSSEY Mar. 1983 45 p
(PB83-252932; NOAA-83082409) Avail: NTIS HC A03/MF A01 CSCL 04B

Satellite observations of the atmosphere on a global scale began 23 years ago. In the intervening period, satellite sensors and operational techniques for the use of the data have evolved to a high degree of proficiency. This paper identifies and attempts to quantify, to the extent possible, many of the current benefits and uses being derived from the United States Operational Environmental Satellite System. The benefits discussed herein are evidence that the operational environmental satellite has earned its place as an irreplaceable weather and ocean observing tool.
Author (GRA)

Typical Subject Index Listing



The subject heading is a key to the subject content of the document. The title is used to provide a description of the subject matter. When the title is insufficiently descriptive of the document content, the title extension is added, separated from the title by three hyphens. The (NASA or AIAA) accession number and the page number are included in each entry to assist the user in locating the abstract in the abstract section (of this supplement). If applicable, a report number is also included as an aid in identifying the document. Under any one subject heading, the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

B

C

D

E

F

G

H

I

IMAGE ENHANCEMENT

IMAGE FILTERS

IMAGE MOTION COMPENSATION

IMAGE PROCESSING

IMAGE RECONSTRUCTION

IMAGE RESOLUTION

IMAGERY

IMAGING TECHNIQUES

IMPURITIES

INCIDENCE

K

L

M

N

O

P

Q

R

S

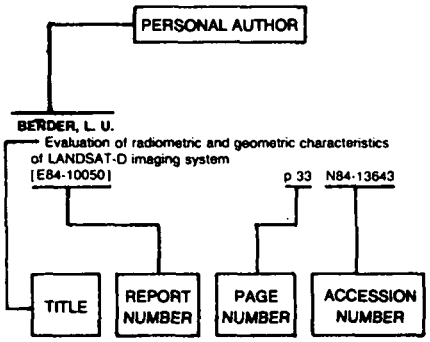
T

U

V

W

Typical Personal Author Index Listing



Listings in this index are arranged alphabetically by personal author. The title of the document provides the user with a brief description of the subject matter. The report number helps to indicate the type of document listed (e.g., NASA report, *translation, NASA contractor report*). The page and accession numbers are located beneath and to the right of the title. Under any one author's name the accession numbers are arranged in sequence with the AIAA accession numbers appearing first.

A

ABDON, M. D. M.
Maps of favorable areas for tuna fishing in the southwestern Atlantic prepared from satellite data
[INPE-2891-PRE/410] p 40 N84-11565

ABSHIRE, J. B.
Remote sensing of atmospheric pressure and sea state from satellites using short-pulse multicolor laser altimeters p 44 N84-15674

ACCAME, G.
Iron oxide genesis and its influence on the spectral reflectance properties of gossans p 29 A84-13029

ACEVEDO, W.
The role of spatial, spectral and radiometric resolution on information content p 65 A84-13043

AGREEN, R. W.
Eddy energy of the Northwest Atlantic and Gulf of Mexico determined from GEOS 3 altimetry p 35 A84-13155

AHERN, F. J.
An automated method for producing reflectance-enhanced Landsat images p 54 A84-13088

AJAI, MR.
Spectral assessment of leaf area index, chlorophyll content, and biomass of chickpea p 11 A84-16724

ALEXANDER, D. A.
The role of spatial, spectral and radiometric resolution on information content p 65 A84-13043

ALEXANDER, S. S.
Lateral variations in geologic structure and tectonic setting from remote sensing data
[AD-A130758] p 32 N84-10683
Combined use of remote sensing and seismic observations to infer geologically recent crustal deformation, active faulting, and stress fields
[E84-10057] p 33 N84-15628
Synthesis of regional crust and upper-mantle structure from seismic and gravity data
[E84-10061] p 33 N84-15631

ALLEN, B.
Geophysical data from drifting ice stations FRAM 4 and TRISTEN
[AD-A133370] p 43 N84-15640

ALLEN, L. H., JR.
Use of thermal inertia determined by HCMM to predict nocturnal cold prone areas in Florida
[E84-10005] p 12 N84-11546
Aircraft remote sensing of soil moisture and hydrologic parameters, Taylor Creek, Florida, and Little River, Georgia, 1979 data report
[E84-10010] p 47 N84-11548

ALLEN, R. D.
Integration of Landsat data into the crop estimation program of USDA's Statistical Reporting Service (1972-1982) p 3 A84-13056

ANDERLE, R. J.
Relative positioning test using the Global Positioning System and Doppler techniques p 26 A84-18303
Colocation test results from experimental Global Positioning System geodetic receivers p 26 A84-18305

ANDERSON, A. J.
Precise space geodetic baseline measurements of Scandinavia in support of the NASA Crustal Dynamics Program p 24 A84-18289

ANDERSON, H. N.
Regional aquifer system assessment through Landsat digital image analysis p 8 A84-13100

ANDERSON, J. E.
Classification and area estimation of land covers in Kansas using ground-gathered and LANDSAT digital data
[E84-10068] p 21 N84-15637

ANDERSON, J. R.
Uranium anomalies in Wyoming and parts of adjacent *states. National Uranium Resource Evaluation*
[DE83-005353] p 34 N84-15638

ANGLADE, I.
A comparative study by image treatment for some parameters affecting the behavior of moisture of bare soils p 9 A84-13346

ANGUS-LEPPAN, P. V.
A multi-station Doppler survey for crustal motion in Papua New Guinea p 24 A84-18291

ANTROP, M.
Inventoring and monitoring of landscape as a natural and cultural resource p 19 N84-12594

ANUTA, P. E.
Estimation of a remote sensing system point-spread function from measured imagery p 51 A84-13011
Comparison of edge detection methods for Landsat imagery p 54 A84-13094
LANDSAT 4 image data quality analysis
[E84-10036] p 62 N84-13629

ARBIOL, R.
Mapping land use in Catalonia (Spain) p 20 N84-12613

ARCHINAL, B.
A comparison of geodetic Doppler satellite receivers p 25 A84-18297

ARDAI, J.
Geophysical data from drifting ice stations FRAM 4 and TRISTEN
[AD-A133370] p 43 N84-15640

ARMENGAU, C.
A theory of current and coloration, by timed sequences of aerial photography p 46 A84-13348

ARREDONDO G., S.
Mapping and monitoring kelp resources in Mexico p 35 A84-13014
Computer-aided inventory of sugar cane in Mexico p 8 A84-13101

ARUNKUMAR, S.
Nonparametric minimum error rate feature transformation with application to resource classification p 51 A84-13020

ARVIDSON, R. E.
Digital image processing applied to analysis of geophysical and geochemical data for southern Missouri p 31 A84-15953
Structure of the Saint Francois Mountains and surrounding lead belt, south east Missouri: Inferences from thermal IR and other data sets
[E84-10027] p 32 N84-10645

ASLAM, A.
Radar remote sensing for crop classification and canopy condition assessment: Ground-data documentation
[E84-10020] p 12 N84-10643

ATKINSON, L. P.
Observations of a loop current frontal eddy intrusion onto the west Florida shelf p 36 A84-13158

ATKINSON, P.
The United Kingdom SATMaP program
[E84-10002] p 62 N84-13627

AUGUSTA, P.
An application of the UNH digital image processing system p 54 A84-13095

AYYANGAR, R. S.
Role of multispectral data in assessing crop management and crop yield p 7 A84-13078

B

BADHWAR, G. D.
A comparison of simulated thematic mapper data and multispectral scanner data for Kingsbury County, South Dakota p 5 A84-13068
An initial model for estimating soybean development stages from spectral data p 6 A84-13075
A comparative study of the thematic mapper and Landsat *spectral bands from field measurement data* p 7 A84-13081
Profile modeling for crop discrimination p 8 A84-13105

BAGCHI, A. K.
Generation of the snowline p 47 A84-16721

BAKER, J.
The United Kingdom SATMaP program
[E84-10002] p 62 N84-13627

BAKER, J. R.
Preliminary analysis of Landsat-4 Thematic Mapper products p 56 A84-13911
The use of thematic mapper data for land cover discrimination: Preliminary results from the UK SATMaP programme
[E84-10038] p 20 N84-13631

BAKER, T. C.
Update on a system for large area crop inventory from remotely sensed data p 4 A84-13059
Development, test and evaluation of a computerized procedure for using Landsat data to estimate spring small grains acreage p 4 A84-13060
SSG-4 - An automated spring small grains proportion estimator p 5 A84-13063

BALANDIN, V. N.
Radio-geodesic systems in aerial mapping p 27 A84-18492

BALDI, P.
TIDOC - An example for large-scale geodetic networks and satellite Doppler observations p 21 A84-11184

BALIEIRO, M. G.
Geologic survey in the south-central region of Mato Grosso
[E84-10039] p 33 N84-13632

BARDINET, CL.
Digital and analog teleanalysis of Landsat and SIR-A landscapes of the African Sahel - The contact of the 'interior delta' of the Niger and the plateau of Bandiagara in Mali p 18 A84-19046

BARISANO, E.
SAR 580: Images for agricultural and forest survey. First results in middle Belgium p 13 N84-12595

BARKER, J. L.
Analysis of multispectral scanner (MSS) and Thematic Mapper (TM) performance (pre-launch and post-launch)
[E84-10043] p 69 N84-13636
LANDSAT-4 sensor performance
[E84-10053] p 70 N84-14573
Spectral characterization of the LANDSAT thematic mapper sensors
[E84-10065] p 71 N84-15634

C

D

E

F

G

H

I

J

K

L

M

N

O

P

R

S

T

U

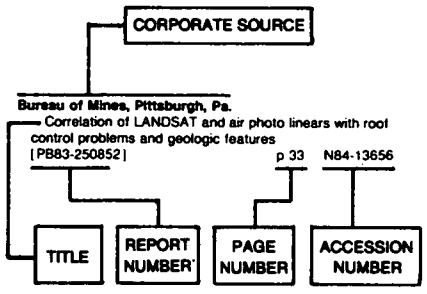
V

W

Y

Z

Typical Corporate Source Index Listing



The title of the document is used to provide a brief description of the subject matter. The page number and the accession number are included in each entry to assist the user in locating the abstract in the abstract section. If applicable, a report number is also included as an aid in identifying the document.

F

G

H

I

J

K

L

M

N

O

P

R

S

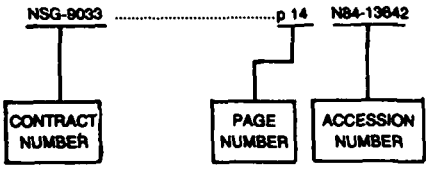
T

U

V

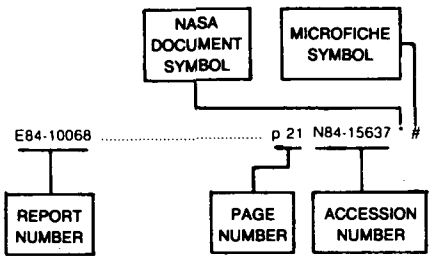
W

Typical Contract Number Index Listing



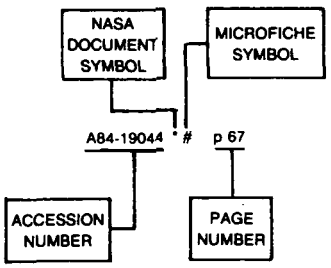
Listings in this index are arranged alphanumerically by contract number. Under each contract number, the accession numbers denoting documents that have been produced as a result of research done under that contract are arranged in ascending order with the AIAA accession numbers appearing first. The accession number denotes the number by which the citation is identified in the abstract section. Preceding the accession number is the page number on which the citation may be found.

Typical Report/Accession Number Index Listing



Listings in this index are arranged alphanumerically by report number. The page number indicates the page on which the citation is located. The accession number denotes the number by which the citation is identified. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

Typical Accession Number Index Listing



Listings in this index are arranged alphanumerically by accession number. The page number listed to the right indicates the page on which the citation is located. An asterisk (*) indicates that the item is a NASA report. A pound sign (#) indicates that the item is available on microfiche.

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA SP-7041(41)		

4. Title and Subtitle	5. Report Date
EARTH RESOURCES A Continuing Bibliography (Issue 41)	April 1984
	6. Performing Organization Code
7. Author(s)	8. Performing Organization Report No.
	10. Work Unit No.
9. Performing Organization Name and Address National Aeronautics and Space Administration Washington, D.C. 20546	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

This bibliography lists 475 reports, articles and other documents introduced into the NASA scientific and technical information system between January 1 and March 31, 1984. Emphasis is placed on the use of remote sensing and geophysical instrumentation in spacecraft and aircraft to survey and inventory natural resources and urban areas. Subject matter is grouped according to agriculture and forestry, environmental changes and cultural resources, geodesy and cartography, geology and mineral resources, hydrology and water management, data processing and distribution systems, instrumentation and sensors, and economical analysis.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Bibliographies Earth Resources Remote Sensors	Unclassified - Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	136	$12.00 HC

*For sale by the National Technical Information Service, Springfield, Virginia 22161 NASA-Langley, 1984

PUBLIC COLLECTIONS OF NASA DOCUMENTS

DOMESTIC

NASA distributes its technical documents and bibliographic tools to eleven special libraries located in the organizations listed below. Each library is prepared to furnish the public such services as reference assistance, interlibrary loans, photocopy service, and assistance in obtaining copies of NASA documents for retention.

CALIFORNIA
University of California, Berkeley
COLORADO
University of Colorado, Boulder
DISTRICT OF COLUMBIA
Library of Congress
GEORGIA
Georgia Institute of Technology, Atlanta
ILLINOIS
The John Crerar Library, Chicago
MASSACHUSETTS
Massachusetts Institute of Technology, Cambridge
MISSOURI
Linda Hall Library, Kansas City
NEW YORK
Columbia University, New York
OKLAHOMA
University of Oklahoma, Bizzell Library
PENNSYLVANIA
Carnegie Library of Pittsburgh
WASHINGTON
University of Washington, Seattle

NASA publications (those indicated by an '*' following the accession number) are also received by the following public and free libraries:

CALIFORNIA
Los Angeles Public Library
San Diego Public Library
COLORADO
Denver Public Library
CONNECTICUT
Hartford Public Library
MARYLAND
Enoch Pratt Free Library, Baltimore
MASSACHUSETTS
Boston Public Library
MICHIGAN
Detroit Public Library
MINNESOTA
Minneapolis Public Library and Information Center
NEW JERSEY
Trenton Public Library
NEW YORK
Brooklyn Public Library
Buffalo and Erie County Public Library
Rochester Public Library
New York Public Library
OHIO
Akron Public Library
Cincinnati and Hamilton County Public Library
Cleveland Public Library
Dayton Public Library
Toledo and Lucas County Public Library
TEXAS
Dallas Public Library
Fort Worth Public Library
WASHINGTON
Seattle Public Library
WISCONSIN
Milwaukee Public Library

An extensive collection of NASA and NASA-sponsored documents and aerospace publications available to the public for reference purposes is maintained by the American Institute of Aeronautics and Astronautics, Technical Information Service, 555 West 57th Street, 12th Floor, New York, New York 10019.

EUROPEAN

An extensive collection of NASA and NASA-sponsored publications is maintained by the British Library Lending Division, Boston Spa, Wetherby, Yorkshire, England. By virtue of arrangements other than with NASA, the British Library Lending Division also has available many of the non-NASA publications cited in *STAR*. European requesters may purchase facsimile copy of microfiche of NASA and NASA-sponsored documents, those identified by both the symbols '#' and '*'. from: ESA - Information Retrieval Service, European Space Agency, 8-10 rue Mario-Nikis, 75738 Paris CEDEX 15, France.

National Aeronautics and
Space Administration

Washington, D.C.
20546

Official Business
Penalty for Private Use, $300

THIRD-CLASS BULK RATE

Postage and Fees Paid
National Aeronautics and
Space Administration
NASA-451

NASA

POSTMASTER: If Undeliverable (Section 158 Postal Manual) Do Not Return