

**NASA**

Earth Resources  
A Continuing  
Bibliography  
with Indexes

NASA SP-7041 (30)  
July 1981

National Aeronautics and  
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## ACCESSION NUMBER RANGES

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

*IAA* (A-10000 Series)

A81-19673 – A81-30424

*STAR* (N-10000 Series)

N81-15968 – N81-21997

# EARTH RESOURCES

**A Continuing Bibliography  
With Indexes  
Issue 30**

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced between April 1 and June 30, 1981 in

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



Scientific and Technical Information Branch

1981

**National Aeronautics and Space Administration**

Washington, DC

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# INTRODUCTION

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

This literature survey lists 480 reports, articles, and other documents announced between April 1 and June 30, 1981 in *Scientific and Technical Aerospace Reports (STAR)*, and *International Aerospace Abstracts (IAA)*.

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

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

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

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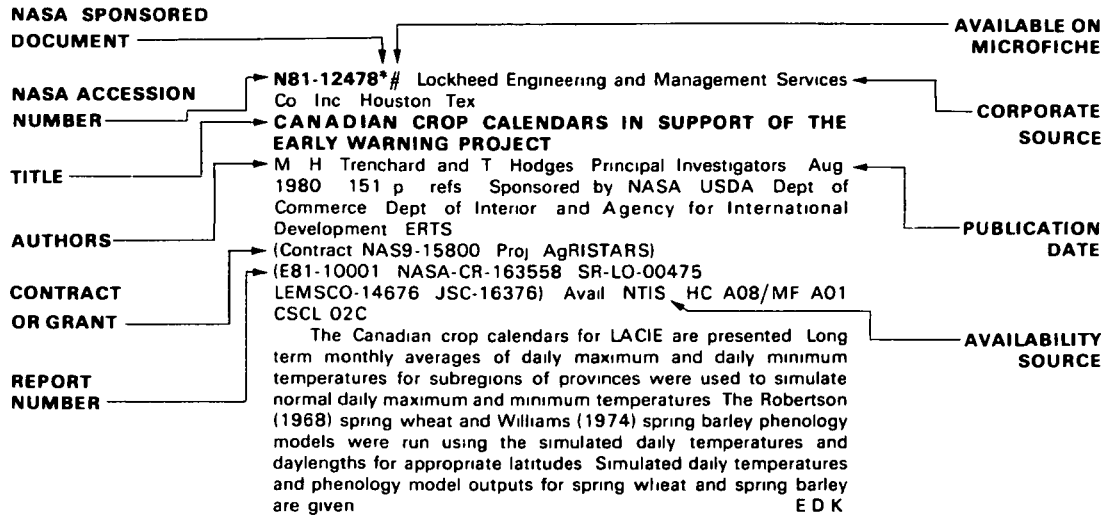
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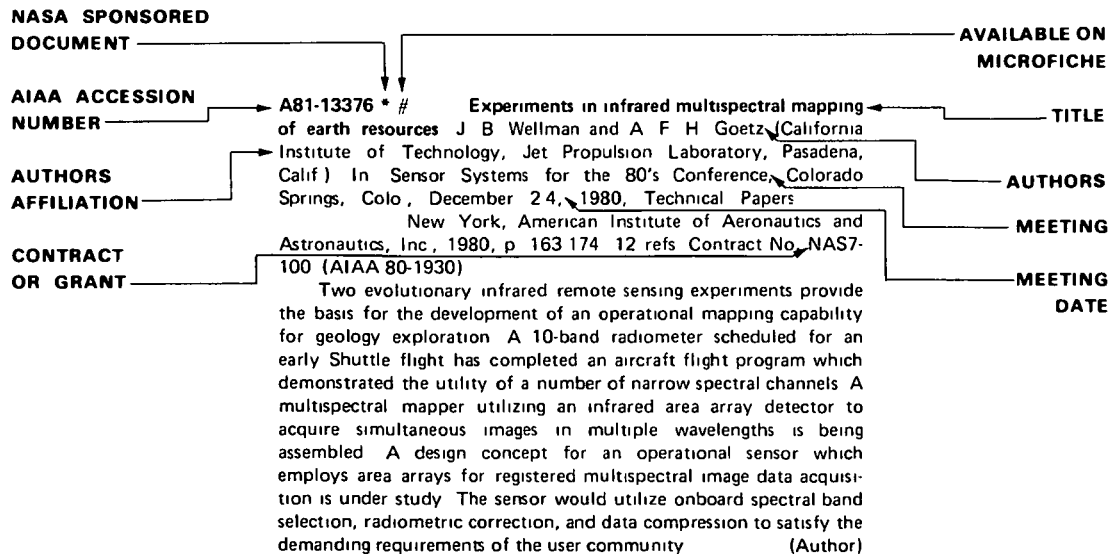
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## TYPICAL CITATION AND ABSTRACT FROM STAR



## TYPICAL CITATION AND ABSTRACT FROM IAA



# EARTH RESOURCES

*A Continuing Bibliography (Issue 30)*

JULY 1981

01

## AGRICULTURE AND FORESTRY

Include crop forecasts crop signature analysis soil identification disease detection harvest estimates range resources timber inventory forest fire detection and wildlife migration patterns

**A81-22074** Automatic classification of reforested pine and eucalyptus using Landsat data Y E Shimabukuro, P H Filho, N F Koffler, and S C Chen (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil) *Photogrammetric Engineering and Remote Sensing*, vol 46, Feb 1980, p 209-216 7 refs

**A81-22075 \*** Experimental relations between airborne and ground measured wheat canopy temperatures J P Millard (NASA, Ames Research Center, Moffett Field, Calif) R J Reginato, S B Idso, R D Jackson (Science and Education Administration, Phoenix, Ariz), R C Goettelman (LFE Corp, Richmond, Calif), and M J LeRoy (DCA Corp, Palo Alto, Calif) *Photogrammetric Engineering and Remote Sensing*, vol 46, Feb 1980, p 221-224 11 refs

Experiments using ground based measurements of canopy temperatures have shown that plant temperatures are good indicators of plant water stress, and thus are useful for assessing water requirements and predicting yields An intensive 23-day airborne and ground-measurement program was conducted in Phoenix, Arizona in 1977 to compare airborne-acquired wheat canopy temperatures with simultaneous ground measurements For canopies that covered at least 85 percent of the soil surface, airborne measurements differed from ground measurements of plant temperature by less than 2 C Regardless of the amount of plant cover, the airborne measurements were virtually identical to ground-nadir measurements, and thus represent a combination of plant temperature and solid background temperature (Author)

**A81-22279** Microwave backscatter dependence on surface roughness, soil moisture, and soil texture III - Soil tension M C Dobson and F Ulaby (Kansas, University, Lawrence, Kan) *IEEE Transactions on Geoscience and Remote Sensing*, vol GE-19, Jan 1981, p 51-61 16 refs

Results are presented of an experimental program to determine the impact of soil texture on radar response to soil moisture present within nonvegetated soil surfaces These findings extend previous reports which document the experimental relationship between the radar backscattering coefficient and soil moisture for bare soil and soil under crop canopies In confirmation of previous results, the sensitivity of the radar backscattering coefficient to surface gravimet-

ric or volumetric soil moisture is shown to be inversely related to clay content of the soil As a result, gravimetric or volumetric moisture indicators exhibit poor performance in moisture estimation algorithms for complex mult textured soils However, estimation algorithms incorporating some knowledge of soil water retention as a function of soil matric potential, or tension, display strong correlation with radar response, typically with the linear correlation coefficient approximately equal to 0.8, and are shown to be relatively independent of soil texture These findings are shown to be consistent with soil dielectric properties (Author)

**A81-22280** Application of strong fluctuation random medium theory to scattering from vegetationlike half space L Tsang (Texas A & M University, College Station, Tex) and J A Kong (MIT, Cambridge, Mass) *IEEE Transactions on Geoscience and Remote Sensing*, vol GE 19, Jan 1981, p 62-69 28 refs NSF Grant No ENG-78-23145, Contract No F19628-80-C-0052

A model for vegetation scatter is developed using the theory of electromagnetic wave propagation in random media with strong permittivity fluctuations In applying the strong fluctuation theory, the singularity of the dyadic Green's function is taken into account Backscattering coefficients are computed using the distorted Born approximation and illustrated as a function of incidence angle, frequency and moisture content of the vegetation The mixing formula of deLoor (1968) was used in estimating the permittivity of leaves The correlation function of Fung and Fung (1977) and of Fung and Ulaby (1978) is used for the random medium (Author)

**A81-22800** Remote sensing and soil studies - A brief review K Lulla (Indiana State University, Terre Haute, Ind) *Remote Sensing Quarterly*, vol 2, July 1980, p 4-20 25 refs

This paper highlights the major applications of remotely sensed data to soil studies The information was obtained from various remote sensing publications Discussion of applications in studies of soil mapping, soil moisture, soil organic matter and clay content is the main theme of this paper Also, applicability of LANDSAT MSS data to problem soils is discussed Potentials and problem areas of this rapidly developing technology are briefly pointed out with reference to soil studies (Author)

**A81-23030** Aerial photographic techniques for soil conservation research P R Stephens, D L Hicks, and N A Trustrum (Ministry of Works and Development, Auckland Science Centre, Palmerston North, New Zealand) *Photogrammetric Engineering and Remote Sensing*, vol 47, Jan 1981, p 79-87 12 refs

Aerial photographic equipment and techniques used for soil conservation research in New Zealand are described The equipment includes a large format aerial survey camera, for panchromatic aerial photography, and four 70-mm Hasselblad cameras mounted together for multispectral and multiemulsion aerial photography Both systems are operated from a modified Cessna 206 aircraft (Author)



## 01 AGRICULTURE AND FORESTRY

**A81-23036**      **Photogrammetric cadastral surveys and GLO corner restoration** D Karns (Washington State, Dept of Natural Resources, Olympia, Wash) *Photogrammetric Engineering and Remote Sensing*, vol 47, Feb 1981, p 193-198 8 refs

An operational cadastral survey procedure using photogrammetric techniques has been developed as an alternative and supplement to conventional ground surveys. The procedure provides good accuracy and helps reduce costs and strengthen the legal position of any survey. The photogrammetric technique used also establishes a third order (1:5,000) or better control network to reduce further the cost of completing surveys on the ground using conventional methods.

V L

**A81-23040 \***      **Spectral characteristics of wetland habitats** C L Ernst-Dottavio (NASA, Goddard Space Flight Center, Greenbelt, Md), R M Hoffer, and R P Mroczynski (Purdue University, West Lafayette, Ind) *Photogrammetric Engineering and Remote Sensing*, vol 47, Feb 1981, p 223-227 13 refs

**A81-23540 #**      **Remote sensing and agriculture - A national program in Italy** C de' Fabritius (Ministero dell'Agricoltura e delle Foreste, Rome, Italy) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980. Some changes will be made in instrumentation, but present services and capabilities will not be affected. (Author)

**A81-23544 #**      **Investigation of remote sensing of soil moisture** R-H Zhang (Academia Sinica, Geography Institute, Peking, Communist China) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 121-133 5 refs

Remote sensing techniques for the quantitative estimation of soil moisture over large areas are discussed. A measurement of the spectral characteristics of typical soils (0.1-1.1 microns) of different moisture content indicated that the near-infrared spectral reflectivity is well correlated with soil moisture. A correlation equation is derived and used to prepare a soil-moisture classification map with an error of 10-15 percent as compared with actual field measurements. A method for calculating the magnitude of the surface infrared radiation through the positive transmittance-density values within the 10.3-11.4 micron region and a new index for quantitative estimates of soil moisture are proposed. A soil moisture map prepared with this new index had an error of approximately 10 percent as compared to actual measurement.

L S

**A81-23561 #**      **Premature leaf senescence as an indicator for geobotanical prospecting with remote sensing techniques** M R Schwaller and S J Tkach (Michigan, University, Ann Arbor, Mich) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 347-358 32 refs. Research sponsored by the U.S. Geological Survey.

A study has been carried out to test a new method for geobotanical prospecting with remote sensing based on the hypothesis that chlorophyll breakdown and the concomitant onset of fall color changes in deciduous trees is hastened under the influence of heavy metal enrichment in the soil. It is found that premature senescence anomalies (as indicated by leaf collection and aerial photographs) coincide with areas of soil copper anomalies. However, premature leaf senescence is also found in areas with low soil metal concentration indicating one possible difficulty with this technique.

V L

**A81-23563 \* #**      **Use of Landsat data in soil and agricultural land use studies** F C Westin and T M Brandner (South Dakota State University, Brookings, S Dak) In International Symposium

on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 389-397 6 refs. Research supported by the South Dakota State University, U.S. Department of Agriculture Contract No 53-3148-2009, Contract No NAS9-15345.

This paper describes how the synoptic, multispectral, and temporal characteristics of Landsat can be used to locate Soil Association boundaries. Then, using these techniques we describe how a low intensity soil survey was conducted and how some interpretive maps were developed from this. Finally, we describe how soil suitability and land use interpretations were made to aid in defining Agrophysical units used in crop inventories. (Author)

**A81-23565 #**      **Recognition of soils by their reflection spectra** K Ia Kondrat'ev and P P Fedchenko (Glavnaia Geofizicheskaiia Observatoriia, Moscow, USSR) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 409-413 5 refs

The identification of agricultural area soils by their reflection spectra is examined using the theory of statistical pattern recognition. Mass measurements of spectral brightness coefficients were made for soils in the Ukraine and Moldavia from an altitude of 100-150 meters using a fast field spectrometer with discrete spectral scanning in the wavelength region 400-900 nm. The coordinate system, the most informative indicators, and an appropriate decision rule were calculated using a learning data set. The results were used to prepare a soil map of the Ukraine and Moldavia which compared to the conventionally accepted map with a coincidence level of 94.3%. The use of the technique developed here is expected to accelerate and rationalize the process of soil mapping.

L S

**A81-23571 \* #**      **Soil moisture sensing with microwave techniques** T Schmutge (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, Md) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1.

Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 487-505 32 refs

Microwave approaches for the remote sensing of soil moisture are discussed, with the advantages described as follows: (1) the all-weather capability, (2) the greater penetration depth into the soil and through vegetation than with optical or infrared sensors, and (3) the large changes in the dielectric properties of soil produced by changes in water content. Both active and passive microwave approaches are discussed. The dependence of the relationship between microwave response and soil moisture on such things as soil texture, surface roughness, vegetative cover and nonuniform moisture and temperature profiles is analyzed from both the experimental and theoretical viewpoints. The dielectric properties of the soil are analyzed quantitatively, as these control the reflective and emissive properties of the soil surface, and a model for estimating a soil's dielectric properties from its texture and moisture content is also presented. Emissivity is calculated using the Fresnel equation of electromagnetic theory, and reflectivity is shown to be decreased by surface roughness, while the backscatter coefficient increases. It is demonstrated that microwave radiometers are sensitive to soil moisture for a wide range of surface conditions, and that the longer wavelengths are best for soil moisture sensing.

D K

**A81-23576 #**      **National agricultural statistics for Costa Rica** G Hanuschak, M Wallace, J Wallace, D Kleweno (U.S. Department of Agriculture, Economics, Statistics, and Cooperatives Service, Washington, D.C.), E Cordero, A Garreta (Direccion General de Estadistica y Censos, San Jose, Costa Rica), and O Hernandez (Ministerio de Agricultura y Ganaderia, San Jose, Costa Rica) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2.

Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 597-601 5 refs Research supported by the U S Agency for International Development

**A81-23578 #** Multispectral photographic remote sensing of vegetation amount and productivity P Curran (Reading, University, Reading, Berks, England) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 623-637 17 refs

Data are presented on the dynamic relationship between multispectral reflectance recorded photographically from ground and air altitudes and vegetation amount and productivity of seminatural vegetation and agricultural pasture It is shown that a low multi-spectral reflectance ratio value indicates a low vegetation amount and that a high multispectral reflectance ratio value can mean either a high vegetation amount or a low vegetation amount with high productivity It is noted that multispectral reflectance ratios can be used to measure, monitor, and even map the distribution of vegetation amount C R

**A81-23583 #** The use of remote sensing in detection of host plants of Mediterranean fruit flies in Mexico J A Diez, S Rivera (Secretaría de Agricultura y Recursos Hidráulicos, Mexico City, Mexico), W G Hart, S J Ingle, and M R Davis (Science and Education Administration, Weslaco, Tex) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 675-683 7 refs

It is noted that while the Mediterranean fruit fly cannot be detected with color infrared aerial photography, this is not the case with the fly's host plants Remote sensing can be used to determine the density and distribution of host plants It is pointed out that a knowledge of the density and distribution of host plants makes it possible to use suppressive biological or chemical measures quickly and efficiently Because it has been found that the fly can inhabit areas more than 1,000 m above sea level, it is recommended that remote sensing work be implemented to cover mountainous zones C R

**A81-23585 #** A land-resource inventory based upon vegetative index computed from digital Landsat data J M Miller and T H George (Alaska, University, Fairbanks, Alaska) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 695-700

Ratios of MSS 7 to MSS 5 have shown promise as indicators of green-leaf biomass and as a generalized vegetative index This paper describes the application of the 7/5 ratio as a tool in land selections in Alaska in lieu of the computer-aided classification techniques commonly used to map land use The results were qualitatively acceptable, but verification of accuracy of the resulting vegetative map remains to be done (Author)

**A81-23589 #** Planning and execution of a photographic mission over a wheat producing region in Rio Grande do Sul, Brazil P C Gurgel de Albuquerque and D A Cottrell (Instituto de Pesquisas Espaciais, São José dos Campos, São Paulo, Brazil) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 751-759

The initial phase of a wheat survey program was completed with the execution of a photographic mission during the booting and heading growth stage of wheat (*Triticum aestivum* L.) Three 20 km by 40 km target areas in Rio Grande do Sul were flown after cost/time saving changes in aircraft, oxygen requirements, geometric

parameters and base of operations A wild RC-10 metric camera with Wratten filter was used to expose color IR film to produce 1 20,000 scale transparencies and semicontrolled mosaics for hectareage estimations and data integration with hardware for CCT analyses A Bandeirante EMB-110B1 equipped with Daedalus scanner will be flown on future missions (Author)

**A81-23591 #** Remote sensing and agriculture - A national program in Italy Some technical aspects S Gizzi (Telespazio Sp A, Rome, Italy), A Giovacchini (Aquatec Sp A, San Lorenzo in Campo, Italy), and C Iannucci (Italeco Sp A, Rome, Italy) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 763-772

This paper concisely illustrates some technical aspects of the feasibility study on the utilization of satellite data for agricultural and hydrological purposes promoted by the Italian Ministry of Agriculture and Forestry and conducted by the I T A Consortium Of the seven tasks to be performed, the ones connected with crop production are in a more advanced state of realization and will be illustrated in this paper, which attempts to cover aspects such as methodological approach, adopted procedures, conventional survey operations and Landsat data processing techniques First results are briefly discussed and future developments are assessed (Author)

**A81-23596 \* #** Landsat features for agricultural applications W A Malila, P F Lambeck, E P Crist (Michigan, Environmental Research Institute, Ann Arbor, Mich), R D Jackson, and P J Pinter, Jr (US Department of Agriculture, Water Conservation Laboratory, Phoenix, Ariz) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 793-803 27 refs US Department of Agriculture Contract No 53-3187-8-19, Contract No NAS9-15476

This paper presents relationships among Landsat MSS bands and selected transformations of them, with emphasis on the Tasseled-Cap Transformation and its Brightness, Greenness variables It also discusses relationships between reflectance measurements made in the Landsat spectral bands and actual Landsat data Agronomically oriented analyses of reflectance measurements of wheat throughout a growing season are presented, with a comparison of various green measures, correlation with crop development stage, and examination of the effects of moisture stress The final example addresses the use of transformed variables in a newly developed approach to forestry change detection (Author)

**A81 23601 #** Optimum radar resolution studies for land use and forestry applications D R Inkster, R T Lowry (Intera Environmental Consultants, Ltd, Ottawa, Canada), and M D Thompson (Intera Environmental Consultants, Ltd, Calgary, Alberta, Canada) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 865-882 16 refs

**A81-23603 #** Remote sensing on land use inventory M Omakupt and V Vunpiyarat (Ministry of Agriculture and Cooperatives, Land Development Dept, Bangkok, Thailand) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 897-904 8 refs

**A81-23604 #** Delineation and mapping of agricultural soil limitations/hazards in arid and semi-arid tropics using Landsat MSS data - An Indian example L Venkataratnam (National Remote Sensing Agency, Hyderabad, India) In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April

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23 30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 905-914

**A81-23607 # Infrared applications for forest fire management** J R Warren (US Department of Agriculture, Boise Inter-agency Fire Center, Boise, Idaho) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 957-965 6 refs

Airborne infrared imaging systems used by the US Forest Service for detection of small starting fires and for thermally mapping large on-going fires are studied. The missions may cover hundreds of square miles in a short time and can detect and locate fires of 600 C, less than 0.0225 square miles in area, from 5 km altitude. A system description is provided and the special requirements for these applications are described. The potential for satellite usage is discussed as not being presently feasible due to operational, economic and technological considerations. Future plans for providing image transmission and processing, including a hand-held forward-looking infrared (FLIR) unit, are discussed. D K

**A81-23609 \* # The use of Landsat MSS data for detecting land use changes in forestland** A T Joyce, J H Ivey, and G S Burns (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St Louis, Miss.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 979-988 6 refs

**A81-23611 \* # Comparison of Landsat MSS and merged MSS/RBV data for analysis of natural vegetation** N E G Roller (Michigan, Environmental Research Institute, Ann Arbor, Mich.) and S Cox (NASA, Goddard Space Flight Center, Greenbelt, Md.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1001-1007

Improved resolution could make satellite remote sensing data more useful for surveys of natural vegetation. Although improved satellite/sensor systems appear to be several years away, one potential interim solution to the problem of achieving greater resolution without sacrificing spectral sensitivity is through the merging of Landsat RBV and MSS data. This paper describes the results of a study performed to obtain a preliminary evaluation of the usefulness of two types of products that can be made by merging Landsat RBV and MSS data. The products generated were a false color composite image and a computer recognition map. Of these two products, the false color composite image appears to be the most useful. (Author)

**A81-23613 \* # A temporal-spectral analysis technique for vegetation applications of Landsat** E P Crist and W A Malila (Michigan, Environmental Research Institute, Ann Arbor, Mich.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1031-1040 7 refs Contract No NAS9-15476

This paper presents a method for describing the overall continuous pattern of crop spectral development from a set of discrete Landsat observations, using mathematical representations termed profiles. The agronomic basis for the approach is described along with model forms and techniques for estimation of the model parameters. In addition, several current or potential applications of the technology are described. (Author)

**A81-23616 # Relations between biological and phenological characteristics of vegetation and its radiometric properties - Exam-**

ples in agriculture and forestry G Saint, A Killmayer (Centre National d'Etudes Spatiales, Toulouse, France), G Guyot, and J Riom (Institut National de la Recherche Agronomique, Avignon and Bordeaux, France) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1069-1080 13 refs

The interaction mechanisms between light and canopy in remote sensing were investigated to determine vegetation characteristics measurements by radiometers aboard satellites or aircraft. It was found that models for a crop are similar in various regions, provided that the scale of variations is adapted to each area. Canopy modeling involves global optical and structural properties related to global measurements using fish eye photographs, also, correlations were found between optical and structural characteristics and biological properties such as water content in leaves and grains. Remote sensing interpretation requires an airborne scanner which produces degradation effects in the geometry and variety of observation angles, these studies should provide correction techniques for future satellite sensing data. A T

**A81-23617 # Mapping geologic structural features in tropical forest areas using SLAR - An example from Central America** J V Gardner (MARS Aerial Remote Sensing, Inc., Phoenix, Ariz.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1083-1088

A radargeologic map emphasizing geologic structure was prepared using stereo side-looking airborne radar imagery for a remote test site in Central America. This area is covered with dense broadleaf tropical forest which masks the subtle geologic structure. Using a minimum of published data, geologic contacts, folds, faults and fractures were easily mapped. The radargeologic map added much structural and lithologic detail to existing survey maps. SLAR proved to be useful in solving a resource exploration problem in an area of low relief covered with dense vegetation. (Author)

**A81-23618 # Characterization of Cerrado vegetation using automatically classified Landsat MSS data** J R dos Santos, V Celso de Carvalho (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil), and H Aoki (São Paulo State Forestry Institute, São Paulo, Brazil) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1089-1099 11 refs

This is a study about the characterization of physiognomic unities of Cerrado vegetation through automatic IMAGE 100 analysis of Landsat MSS data. To verify the separability of the unities analyzed (cerrado, campo cerrado, campo sujo), respective spectral signatures were obtained using a MAXVER and a JM distances algorithm. A correlation analysis of correctly classified values was performed. The results obtained include the following: (1) the use of four channels together presented the best class separation, independent of season, (2) in considering the use of isolated channels, channel 5 provided the largest percent correct classification, and (3) the highest separability was observed between cerrado and campo sujo forms. It is concluded that the separability of physiognomic unities can contribute to studies for the rational use of Cerrado areas. (Author)

**A81-23620 # Classification of Landsat multitemporal training data based upon growth curve analysis** J D Tubbs (Arkansas, University, Fayetteville, Ark.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1123-1127 7 refs

**A81-23624 #** The nature of spaceborne /Seasat/ radar data of developing countries - A Costa Rica case study T W Wagner, J S Ott (Michigan, Environmental Research Institute, Ann Arbor, Mich ), F M Rudin, and C Elizondo (Instituto Geografico Nacional, San Jose, Costa Rica) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1165-1175 5 refs

Seasat synthetic-aperture radar (SAR) data of Guanacaste Province, Costa Rica were processed to determine their utility for agricultural and land use monitoring in developing countries The Seasat L-band (23.5 cm) data were obtained twice during the 1978 summer growing season which is characteristically cloud-covered The images were compared with ground observations and Landsat data to determine the nature of the image patterns The contrast and the tone of the remote sensing data were sufficient to categorize fields by general crop height, but not to differentiate crops Drainage patterns were indicated by the radar return of adjacent trees, and slope and aspect dominated the image patterns of hilly or mountainous terrain Digitized data from 38 selected fields were analyzed and the mean, standard deviation, and variance/mean for several examples of each major vegetation type are given L S

**A81-23625 \* #** Procedure M - An advanced procedure for stratified area estimation using Landsat Q A Holmes and R Horvath (Michigan, Environmental Research Institute, Ann Arbor, Mich ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1177-1185 15 refs Contract No NAS9-15476

Procedure M is a systematic approach to processing multispectral scanner data for classification and acreage estimation The procedure incorporates a statistically robust mechanism for estimation while utilizing component technologies that are based on the physically expected or measured responses of the canopy, atmosphere and sensor This paper describes Procedure M in the context of large-area agricultural applications, emphasizing three specific configurations for winter wheat, spring small grains, and corn and soybeans. (Author)

**A81-23628 \* #** Crop identification studies using Landsat data - Separation of barley from other spring small grains and corn and soybean decision logic C L Dailey, D T Register, K M Abotteen, W F Palmer, G D Spikes, E R Magness (Lockheed Engineering and Management Services Co, Inc , Johnson Space Center, Houston, Tex ), and L C Wade (NASA, Johnson Space Center, Houston, Tex ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1213-1219 9 refs Contract No NAS9 15800

Two labeling procedures were developed which identify various agricultural crops through the use of Landsat data One procedure separates barley from other spring small grains, and the other identifies corn and soybeans For both procedures, a minimum data set (critical acquisition time) has been designated Landsat data in both image format and various graphic displays were used along with ancillary data to obtain information which aided in labeling the spectral signatures The corn and soybean procedure also employed a structured decision logic Test results for the barley separation procedure emphasized the importance of obtaining a critical acquisition and showed some success especially in areas where spring crops followed the expected growth patterns Two tests of the corn and soybean procedure produced good labeling accuracies Problems with the procedure were easy to identify, and some solutions were implemented for the second test Automation of various parts of the procedure and extension to other crops and regions were recommended (Author)

**A81-23629 \* #** Deriving land use/land cover change statistics from Landsat - A study of prime agricultural land D A Stow, L R Tinney, and J E Estes (California, University, Santa Barbara, Calif ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1227-1237 21 refs NASA-supported research

**A81-23637 \* #** Spatial variability of surface temperature as related to cropping practice with implications for irrigation management J L Hatfield (California, University, Davis, Calif ), J P Millard (NASA, Ames Research Center, Moffett Field, Calif ), R J Reginato, R D Jackson, S B Idso, P J Pinter, Jr (US Department of Agriculture, Water Conservation Laboratory, Phoenix, Ariz ), and R C Goettelman (LFE Corp , Palo Alto, Calif ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1311-1320 11 refs

Crop stress measured using thermal infrared emission is evaluated with the stress degree-day (SDD) concept Throughout the season, the accumulation of SDD during the reproductive stage of growth is inversely related to yield This relationship is shown for durum wheat, hard red winter wheat, barley, grain sorghum and soybeans It is noted that SDD can be used to schedule irrigations for maximizing yields and for applying remotely sensed data to management of water resources An airborne flight with a thermal-IR scanner was used to examine the variability in temperature that may exist from one field to another and to determine realistic within-field temperature variations It was found that the airborne and the ground based data agreed very well and that there was less variability in the fields that were completely covered with crops than those of bare soil L S

**A81-23643 #** The use of Landsat data in mapping tropical vegetation L E Giddings, M Soto, M J Angulo, H Larios, and A M Ramirez (Instituto Nacional de Investigaciones sobre Recursos Bioticos, Jalapa, Universidad Nacional Autonoma de Mexico, Mexico City, Mexico) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1383-1387 10 refs

The Kauth Thomas and Principal Components Transformations techniques for compression of the four Landsat reflectance channels to two were employed in the mapping of tropical vegetation zones in the state of Veracruz, Mexico The Kauth Thomas method was found the more useful because of the relative simplicity of its calculations, which are well within the capabilities of small image analysis computer systems O C

**A81 23644 #** Integration of Landsat images into a geographical data bank - An attempt to classify soil types J A Nieto, J A Loyo (Fertilizantes Mexicanos, S A , Mexico City, Mexico), J F Corona, and M Hernandez (IBM de Mexico, S A , Centro Cientifico, Mexico City, Mexico) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1399-1407

In the interest of increasing agricultural productivity, Landsat satellite images from May 1976 and October 1972 were processed and categorized in order to arrive at a taxonomy of Mexican soil types Image bands were digitized and algorithmically processed to arrive at zonal characteristics of geology, altitude, slope, ground cover and weather for a pilot region The features thus derived were then applied to the automatic classification of other regions Additional uses of the data bank may cover fertilizer determination, irrigation information and soil erosion detection O C

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**A81-23649 #** Resource inventory procedures in the Dominican Republic using linear random sample data acquired by light aircraft survey techniques G Schultink and M A Karteris (Michigan State University, East Lansing, Mich ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1455-1467 8 refs Research supported by the U S Agency for International Development, Michigan State University, Secretaría del Estado de Agricultura, and Fuerza Aerea Dominicana, U S Department of Agriculture Contract No 12 17-07 8-1955

**A81-23654 #** Accuracy of Landsat forest cover type mapping in the Lake States region of the U S N E G Roller (Michigan, Environmental Research Institute, Ann Arbor, Mich ) and L Visser (Michigan, Dept of Natural Resources, Houghton Lake Heights, Mich ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1511 1520

A computer-generated forest-cover type map was made of Lake County, Michigan, using supervised pattern recognition techniques applied to Landsat digital data The accuracy of this map was then assessed using a single-stage cluster sampling procedure The basis for evaluation was a forest cover type map prepared by photo interpretation Construction of a contingency table revealed several things First, it does not appear that it is possible to map tree species or species-groups in the Lake States using automated methods with acceptable accuracy, second, it appears as though the spectral signatures of natural herbaceous vegetation, seedling tree stands and brush, and forest stands with low crown closure overlap, and third, when comparing Landsat-derived maps with traditional forest cover type maps, one needs to be aware of the distinction between classifying an area on the basis of land cover as opposed to land use Not taking this last point into consideration can result in a determination that Landsat is misidentifying things when in fact, it is recognizing their components (Author)

**A81-23664 \* #** An evaluation of 70mm color infrared photography for sugar cane rust assessment in the Dominican Republic M A Karteris, G Schultink, G R Safir, and R Hill Rowley (Michigan State University, East Lansing, Mich ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1631-1642 11 refs Research supported by the U S Agency for International Development, Michigan State University, Consejo Estatal de Azucar, Secretaría del Estado de Agricultura, Fuerza Aerea Dominicana, and NASA, U S Department of Agriculture Contract No 12 17 07 8 1955

**A81-23668 #** Integration of MSS and SAR data of forested regions in mountainous terrain B Guindon, P M Teillet, D G Goodenough (Canada Centre for Remote Sensing, Ottawa, Canada), J W E Harris (Pacific Forest Research Centre, Victoria, British Columbia, Canada), and J F Meunier (Intera Environmental Consultants, Ltd, Ottawa, Canada) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1673 1690 5 refs

As part of a project to evaluate the usefulness of synthetic aperture radar (SAR) for forest applications, satellite and airborne SAR and multispectral scanner (MSS) imagery was obtained over a test site in British Columbia Procedures for the geometric rectification of this imagery are proposed which involve the modeling of the aircraft flight parameters and utilize terrain information in the form of a digital elevation model Digital analysis of the combined data set and comparison with extensive ground cover information indicate that higher classification accuracies are obtained with MSS imagery as compared with SAR imagery V L

**A81-23669 \* #** Landsat analysis of tropical forest succession employing a terrain model T H Barringer (Pennsylvania, University, Philadelphia, Pa ), V B Robinson, J C Coiner (Hunter College, New York, N Y ), and R C Bruce (University of the Philippines, Quezon City, Philippines) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1691-1700 6 refs Research supported by the City University of New York, Grant No NsG 5325

Landsat multispectral scanner (MSS) data have yielded a dual classification of rain forest and shadow in an analysis of a semi-deciduous forest on Mindonoro Island, Philippines Both a spatial terrain model, using a fifth side polynomial trend surface analysis for quantitatively estimating the general spatial variation in the data set, and a spectral terrain model, based on the MSS data, have been set up A discriminant analysis, using both sets of data, has suggested that shadowing effects may be due primarily to local variations in the spectral regions and can therefore be compensated for through the decomposition of the spatial variation in both elevation and MSS data D K

**A81-23672 #** The use of Landsat data for evaluation and characterization of deforested pastureland and reforested areas in Brazil P H Filho, A Pacheco dos Santos, E M Leao de Morães Novo, Y E Shimabukuro, V Duarte (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil), J Simeão de Medeiros, E C Mignone Alves, and C Chefer de Santana (Instituto Brasileiro de Desenvolvimento Florestal, São Jose dos Campos, São Paulo, Brazil) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1723-1729 6 refs

**A81-23676 \* #** Stratification of forest vegetation for timber inventory using Landsat and collateral data C E Woodcock, A H Strahler (California, University, Santa Barbara, Calif ), and T L Logan (California Institute of Technology, Jet Propulsion Laboratory, Informatics, Inc , Pasadena, Calif ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1769-1787 9 refs Contracts No NAS9-15509, No NAS7-100

An automated forest stratification procedure based on Landsat and digital terrain data is reviewed The system uses Landsat multispectral brightness values, a spatial texture channel, and digital terrain data information to divide Klamath National Forest vegetation into timber volume homogeneous strata The stratification process involves analyst supervised class pooling editing, and the modeling of the regional type in a spatial manner using the digital terrain data It is noted that for a given size and density class, the timber volume will change when the regional type changes, reflecting differences in growth potential L S

**A81 23678 #** Some observations on the utility of remote sensors for humid tropical forests F G Sadowski (Michigan, Environmental Research Institute, Ann Arbor, Mich ) and W A Danjoy (Oficina Nacional de Evaluacion de Recursos Naturales, Lima, Peru) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1799 1802 Research sponsored by the U S Agency for International Development

A study has been carried out to evaluate the utility of synoptic sensors such as Landsat and other available remote sensor data for mapping forest associations in the Peruvian Amazon Region Results suggest that synoptic remote sensors provide useful information for first order stratification and classification Such first-order surveys

can demarcate forested area from most nonforest areas and further stratify forest classes according to landform, drainage conditions, and tree density V L

**A81-23984** On the use of hardwired algorithms to assess texture H Keller, A Favre, and J Fuhrer (Bern, Universitat, Berne, Switzerland) *Signal Processing*, vol 2, Oct 1980, p 391-396 10 refs Swiss National Science Foundation Grant No 3,209,77

Texture assessment by means of the hardwired functions of commercial image analysers is discussed The technique proposed relies on repeated measurements of such functions (e.g. area, boundary length, etc ), after thresholding the picture at increasing intensity levels The intensity distributions are then described by their statistical moments, which are fed into a discriminant analysis program The classification performance has been evaluated by means of a modified leave-one-out technique, and when applied to the recognition of single deciduous tree species (maple, plane, lime and horse chestnut) on infrared false-colour aerial pictures, the error is below 5% Further subdivision of the horse chestnuts tree class into a group of healthy and pollution-damaged respectively increases the error to 6.2% This technique should apply to a variety of objects showing colour and texture differences (Author)

**A81-24325 \*** Thermal IR exitance model of a plant canopy D S Kimes (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md ), J A Smith (Colorado State University, Fort Collins, Colo ), and L E Link (US Army, Environmental Laboratory, Vicksburg, Miss ) *Applied Optics*, vol 20, Feb 15, 1981, p 623-632 48 refs Grants No DAAG29-78-0045, No DACW39-77-C-0073

A thermal IR exitance model of a plant canopy based on a mathematical abstraction of three horizontal layers of vegetation was developed Canopy geometry within each layer is quantitatively described by the foliage and branch orientation distributions and number density Given this geometric information for each layer and the driving meteorological variables, a system of energy budget equations was determined and solved for average layer temperatures These estimated layer temperatures, together with the angular distributions of radiating elements, were used to calculate the emitted thermal IR radiation as a function of view angle above the canopy The model was applied to a lodgepole pine (*Pinus contorta*) canopy over a diurnal cycle Simulated vs measured radiometric average temperatures of the midcanopy layer corresponded with 2°C Simulation results suggested that canopy geometry can significantly influence the effective radiant temperature recorded at varying sensor view angles (Author)

**A81-24463** Peat resource mapping in Lewis using remote sensing techniques and automated cartography G C Stove and P D Hulme (Macaulay Institute for Soil Research, Aberdeen, Scotland) *International Journal of Remote Sensing*, vol 1 Oct-Dec 1980, p 319-344 7 refs

The application of methodology developed for peat resource survey has illustrated the usefulness of multi-level and multi band aerial photography in classifying Landsat multispectral imagery Ground truthing to characterize the thematic maps plotted from the aerial photography and Landsat imagery was based primarily on vegetation surveys The results of this work are illustrated with a series of maps and photographs and the usefulness of the approach is assessed (Author)

**A81-24464** Landsat crop identification for watershed water balance determinations J R Jensen (Georgia, University, Athens, Ga ) and D L Chery, Jr (US Science and Education Administration, Athens, Ga ) *International Journal of Remote Sensing*, vol 1, Oct Dec 1980, p 345-359 44 refs

**A81-24674** Densitometric analysis of colour aerial photographs - A new approach K Debrock and G Verduyn (Institute for

Hygiene and Epidemiology, Brussels, Belgium) *Photogrammetria*, vol 35, Mar 1980, p 163-177 9 refs

A modified operating method is proposed for performing diffuse optical density readings on individual trees, in this case poplar, photographed on low-altitude aerial transparencies, using a single-light beam transmission densitometer Instead of performing the measurements directly on the emulsion side of the transparencies, density readings are made on an unfocused projected image of the photographed object The new procedure has the advantages of eliminating uncontrolled interference of shadow present within and around the crowns, using one single density reading for a representative measurement of the spectral reflectance of the tree foliage, increasing precision and improving resolution A precision better than 5% at the 95% confidence level is obtained, as compared with 10 to 15% for the conventional method D K

**A81-24778 \* #** Discrimination of a chestnut-oak forest unit for geologic mapping by means of a principal component enhancement of Landsat multispectral scanner data M D Krohn, N M Milton, D Segal (US Geological Survey, Reston, Va ), and A England (NASA, Johnson Space Center, Houston, Tex ) *Geophysical Research Letters*, vol 8, Feb 1981, p 151-154 8 refs Contract No NAS7-100

**A81-25934** Radiometric measurements in studies of crop growth M D Steven (Nottingham University, Loughborough, Leics , England) In Symposium on New Developments and Applications in Optical Radiation Measurement, Teddington, Middx , England, May 7, 8, 1980, Proceedings Bellingham, Wash , Society of Photo-Optical Instrumentation Engineers, 1980, p 72-76 11 refs

The application of radiometric measurements of the effectiveness of crop canopies in intercepting solar radiation to studies of crop growth is discussed It is pointed out that, in the presence of adequate supplies of water and soil nutrients, crop efficiency in converting solar energy into food is limited by the amount of light intercepted, which can be measured by a combination of tube solarimeters or other spatially averaging instruments above and below the crop canopy Considerations of the sensitivity of photosynthesis to the solar spectrum are used to show that the incident photo synthetically active radiation may be accurately estimated from broadband solar energy measurements It is pointed out that plant development processes also respond to the spectral quality of light, for example in the case of the relative concentrations of two phytochromes depending on the ratio of red (660 nm) to far red (730 nm) light A L W

**A81-25935** Use of reflectivity ratios to measure light interception by crops M Kumar In Symposium on New Developments and Applications in Optical Radiation Measurement, Teddington, Middx , England, May 7, 8, 1980, Proceedings Bellingham, Wash , Society of Photo Optical Instrumentation Engineers, 1980, p 77-81 8 refs

A leaf typically has a small reflectance (about 0.1) in the visible spectral region and a larger reflectance (about 0.6) in the near infrared region Spectral differences are due to selective absorption by the chlorophyll in the red and internal leaf scattering in the near infrared The reflectance of a crop canopy is similar to leaf reflectance but other factors such as the orientation of leaves, shadows, background reflectivities solar zenith angles and the physiological status of the plants modify the process The ratio of light reflected in the near infrared and red spectral bands is well correlated with the amount of vegetation cover Normally, light intercepted by vegetation is determined from a knowledge of the leaf area index It is proposed that the ratio far red/red (or visible) can give a direct measure of the amount of light intercepted by a crop, thus bypassing destructive leaf area determinations (Author)

**A81-25950 \*** An airborne short wave infrared/SWIR/push broom imaging system using a 64-element PbS detector array A S Husain-Abidi, D Tom, L R Blaine, and G Ostrow (NASA, Goddard

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Space Flight Center, Greenbelt, Md.) In *Infrared systems, Proceedings of the Seminar*, Huntsville, Ala., September 30-October 1, 1980 Bellingham, Wash., Society of Photo-Optical Instrumentation Engineers, 1981, p. 8-15

Research evidence indicates that data in the short wave infrared (SWIR) spectral region will greatly improve the information content of remotely sensed data. Bands are required in the 1.55-1.75 micron and 2.08-2.35 micron spectral regions for a variety of agricultural and geological investigations. It is anticipated that future Landsat sensors will use pushbroom linear array technology to obtain high resolution, improved sensitivity and increased system reliability. To obtain early laboratory and field data, an airborne pushbroom image system has been designed for operation in the short wave infrared spectral region. The system uses a 64-element staggered PbS array and is operated at 195 K; the instrument has been designed to operate in an aircraft and will view a 19 degree swath width with a 5.8 mrad IFOV. The spectral bandwidth of each channel is 0.5 micron and the noise equivalent reflectivity in the order of 2% is provided. The requirements for more advanced detector arrays for use in future NASA spacecraft remote sensing instruments are also discussed. (Author)

**A81-26898 #** The compilation of a medium-scale vegetation map of the northern Baikal region on the basis of aerial and space imagery (Opyt sostavleniya srednemashtabnoi karty rastitel'nosti severnogo Pribaikal'ia na osnove aerokosmicheskoi informatsii) A. V. Belov (Akademiya Nauk SSSR, Institut Geografii Sibiri i Dal'nego Vostoka, Irkutsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p. 97-102. In Russian.

Experience with the use of aerial and space imagery for the vegetation-cover mapping of the northern Baikal region is described. The vegetation in this region is diverse and is characterized by mountain tundra, mountain taiga, steppe, meadow, swamp, and shrubby types. A fragment (along with its legend) of the map that resulted is presented. It is shown that aerial and space imagery, used in conjunction with other data on vegetation, appears to be promising for the purpose of mapping in this region. P. T. H.

**A81-27311** Experimental investigation of the dielectric permittivity of soils in the 100 MHz-1 GHz frequency range with application to the remote sensing of soil moisture content (Etude expérimentale de la permittivité diélectrique des sols dans la gamme de fréquence 100 MHz-1 GHz en vue d'une application à la télédétection de l'humidité des sols) P. Ruault (Telecommunications Radioélectriques et Téléphoniques, Le Plessis Robinson, Hauts-de-Seine, France) and A. Tabbagh (Paris VI, Université, Paris, CNRS, Centre de Recherches Géophysiques, Pouilly-sur-Loire, Nièvre, France) *Annales de Géophysique*, vol. 36, Oct-Dec 1980, p. 477-490. 10 refs. In French.

The complex dielectric permittivity of soils is investigated using coaxial line sampling and in situ measurements by reflection. Good agreement is obtained between the two data sets. The dielectric permittivity is found to be constant with frequency in the 100 MHz to 1 GHz range. Soil moisture content has a strong influence on permittivity and varies exponentially with it, with the growth rate depending on texture. The soil under the cultivated layer interferes significantly with measurements at 216 MHz and below for fine as well as for coarse soils, indicating that the depth of the investigation is satisfactory. Measurements at several frequencies are necessary for the determination of the permittivity profile. L. S.

**A81-27945 #** Spring wheat yield estimates from spectral reflectance measurements. J. K. Aase and F. H. Siddoway (U.S. Science and Education Administration, Sidney, Mont.) *IEEE Transactions on Geoscience and Remote Sensing*, vol. GE-19, Apr 1981, p. 78-84. 45 refs.

**A81-27946 \* #** Remote sensing of temperature profiles in vegetation canopies using multiple view angles and inversion techniques. D. S. Kimes (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md.) *IEEE Transactions on Geo-*

*science and Remote Sensing*, vol. GE-19, Apr 1981, p. 85-90. 19 refs.

A mathematical method is presented which allows the determination of vertical temperature profiles of vegetation canopies from multiple sensor view angles and some knowledge of the vegetation geometric structure. The technique was evaluated with data from several wheat canopies at different stages of development, and shown to be most useful in the separation of vegetation and substrate temperatures with greater accuracy in the case of intermediate and dense vegetation canopies than in sparse ones. The converse is true for substrate temperatures. Root-mean-square prediction accuracies of temperatures for intermediate-density wheat canopies were 1.8 C and 1.4 C for an exact and an overdeterminate system, respectively. The findings have implication for remote sensing research in agriculture, geology or other earth resources disciplines. O. C.

**A81-28075 #** Remote sensing of soils and vegetation /Survey of the Proceedings of the COSPAR Symposium held at Budapest, June 10-12, 1980/ (Distantionnoe izuchenie pochv i rastitel'nosti /Obzor po Materialam Simpoziuma KOSPAR, Budapesht, 10-12 VI 1980/) K. I. Kondrat'ev *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p. 108-118. In Russian.

**A81-28606** Use of Landsat imagery for forest management. G. Siccio Smit (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980*) *ITC Journal*, no. 3, 1980, p. 563-576.

Landsat imagery has been applied to a forest management study near Salzburg, Austria. Computer-compatible tapes of four MSS bands of Landsat 2 were obtained, and a sample set of radiance levels for the four bands was determined. It was found that the silvicultural system of group selection cutting and strip felling allows a natural regeneration of the beech and spruce. It was also concluded, however, that Landsat imagery does not accurately indicate recent fellings or age-class differentiation. In addition it only differentiates the forest into two types: pure spruce and mixed spruce-beech. S. C. S.

**A81-28653** Remote sensing of soil radionuclide fluxes in a tropical ecosystem. B. Clegg, J. Koranda, W. Robinson, and G. Holladay (California University, Livermore, Calif.) (*IEEE, DOE, NASA, and NBS, Nuclear Science Symposium, 27th, Orlando, Fla., Nov 5-7, 1980*) *IEEE Transactions on Nuclear Science*, vol. NS-28, Feb 1981, p. 249-254. 14 refs. Contract No. W 7405-eng-48.

A transponding geostationary satellite is being used to collect surface environmental data to describe the fate of soil-borne radionuclides. The remote, former atomic testing grounds at the Enewetak and Bikini Atolls present a difficult environment in which to collect continuous field data. The land-based, solar-powered microprocessor and environmental data systems remotely acquire measurements of net and total solar radiation, rain, humidity, temperature, and soil-water potentials. For the past year, a water flux model has been predicting wet season plant transpiration rates nearly equal to the 6-7 mm/d evaporation pan rate, which decreases to 2-3 mm/d for the dry season. Radioisotopic analysis confirms the microclimate-estimated 1.3 to 1.20 soil to plant Cs-137 dry matter concentration ratio. This ratio exacerbates the dose to man from intake of food plants. Nephelometer measurements of airborne particulates indicate a minimum respiratory radiological dose. (Author)

**A81-28710 #** The use of a coherent radar with Doppler filtering for the sounding of subsurface layers of the earth (O realizatsii podpoverkhnostnogo zondirovaniia sloistykh zemnykh pokrovov pri pomoshchi kogerentnogo radiolokatora s Dopplerovskoi fil'tratsiei) V. P. Glotov, V. A. Kutev, and M. I. Finkel'shtein *Radiotekhnika i Elektronika*, vol. 26, Mar 1981, p. 560-569. 6 refs. In Russian.

The feasibility of using coherent radar with Doppler filtering for subsurface sounding is investigated. Equations are presented that

make it possible to evaluate the technical characteristics of such a radar. Results are presented on the airborne sounding of subsurface layers of frozen soil, the experiment confirms the usefulness of coherent radar in subsurface sounding. B J

**A81-28727 \*** Azimuthal radiometric temperature measurements of wheat canopies. D S Kimes (NASA, Goddard Space Flight Center, Earth Survey Applications Div., Greenbelt, Md.) *Applied Optics*, vol 20, Apr 1, 1981, p 1119-1121. 14 refs

The effects of azimuthal view angle on the radiometric temperature of wheat canopies at various stages of development are investigated. Measurements of plant height, total leaf area index, green leaf area index and Feeks growth stage together with infrared radiometric temperature measurements at 12 azimuth intervals with respect to solar azimuth and at different solar zenith angles were obtained for four wheat canopies at various heights. Results reveal a difference on the order of 2 C between the temperatures measured at azimuths of 0 and 180 deg under calm wind conditions, which is attributed to the time-dependent transfer of heat between canopy component surfaces. The azimuthal dependence must thus be taken into account in the determination of radiometric temperatures.

A L W

**A81-28742 #** Improvement of the accuracy of aerial photography for agriculture and forestry through the application of multispectral techniques (Verbesserung der Aussagefähigkeit von Luftbildern für die Land- und Forstwirtschaft durch Anwendung der Multispektraltechnik). A Geschke (Gesellschaft für Internationalen Flugverkehr mbH, Berlin, East Germany) *Technisch-ökonomische Information der zivilen Luftfahrt*, vol 16, no 5, 1980, p 253-260. In German

The applicability of infrared and multispectral aerial photography techniques to agriculture and forestry is examined. Morphological changes in cell structure are found to produce a change in the spectral region between 0.7 and 1.3 micron, and changes in the water content of plants affect reflection in the region between 1.3 and 2.5 microns. Changes in sudation are noticeable in thermal infrared between 8 and 14 microns. Differences in reflection between healthy and sick leaves are detected on the basis of chlorophyll absorption, these differences can amount to 10 to 20% between 800 and 900 nm. Soil type and moisture are also observable with multispectral techniques, as moist soil has a reflection in the infrared which is less by a factor of 2 from that of dry soil. The calculation of quotients from neighboring channels in order to include the effect of the atmosphere in the observations is also discussed. D K

**A81-28750 #** Remote sensing methods for soil survey (Aero kosmicheskie metody izucheniya pochvy). V L Andronikov (Moscow, Izdatel'stvo Kolos, 1979. 288 p. 71 refs. In Russian)

The application of remote sensing to soil studies and soil mapping is discussed. Attention is given to the theoretical principles of photointerpretation in soil survey, the effect of variations of natural conditions on aerial and space images, the interpretation of soils and crops from multispectral aerial photographs, the use of multispectral space photography to study soil cover, and infrared and radar methods for the investigation of soils. B J

**A81-29832 \*** Using Landsat digital data to detect moisture stress in corn-soybean growing regions. D R Thompson (NASA, Johnson Space Center, Houston, Tex.) and O A Wehmanen (Lockheed Electronics Co., Inc., Houston, Tex.) *Photogrammetric Engineering and Remote Sensing*, vol 46, Aug 1980, p 1087-1093. 12 refs

As a part of a follow on study to the moisture stress detection effort conducted in the Large Area Crop Inventory Experiment (LACIE), a technique utilizing transformed Landsat digital data was evaluated for detecting moisture stress in humid growing regions using sample segments from Iowa, Illinois, and Indiana. At known growth stages of corn and soybeans, segments were classified as

undergoing moisture stress or not undergoing stress. The remote-sensing-based information was compared to a weekly ground-based index (Crop Moisture Index). This comparison demonstrated that the remote sensing technique could be used to monitor the growing conditions within a region where corn and soybeans are the major crop. (Author)

**A81-29835** The Lambertian assumption and Landsat data. J A Smith, T L Lin, and K J Ranson (Colorado State University, Fort Collins, Colo.) *Photogrammetric Engineering and Remote Sensing*, vol 46, Sept 1980, p 1183-1189. 22 refs. Research supported by the U.S. Forest Service.

The Lambertian assumption is evaluated for Landsat multispectral scanner data of a dense ponderosa pine forest on a Colorado mountain site. Effective view angles from 10 to 45 degrees and effective illumination angles from 30 to 80 degrees were included in the data. Seventy-six sample points were selected, topographic slope, aspect, and calculated incidence and exitance angles were merged with the multispectral Landsat data, and regression analysis was used to fit a generalized photometric function. The Lambertian assumption was rejected for this case at the 95% significance level. It was further shown that the Lambertian assumption may be more appropriate for an analysis restricted to slopes of less than 25 degrees and effective illumination angles of less than 45 degrees. In conclusion, attention is given to a generalized photometric function as applied to the topographic-induced Landsat radiance variations versus surface cover variations. K S

**N81-16359#** Georgetown Univ., Washington, D.C. Dept. of Electrical and Computer Science.

**DISCRETE SCATTERING APPROACH TO VEGETATION MODELING. Final Report**

Roger H Lang. Apr 1980. 59 p. refs.

(Contract DAAK70-77-C-0142, DA Proj 4A1-61102-B-52C) (AD-A092017, ETL-0215) Avail NTIS HC A04/MF A01 CSCL 20/3

This report studies microwave backscattering from a forest canopy which is modeled by a collection of dielectric discs with random orientation and position. The report begins by analyzing the mean field in a tenuous distribution of discrete scatterers. The correlation of the field is found by employing the distorted Born approximation. The above is then specialized to a half space of discrete scatterers with azimuthal symmetry. Horizontal, vertical and cross polarized backscattering coefficients for the half space are found. A comparison with experiment is made for the special case of lossy dielectric discs. GRA

**N81-17503#** Geological Survey, Reston, Va. **UNITED STATES GEOLOGICAL SURVEY OF SOURCES OF PHOTOGRAPHS AND IMAGES OF BIOSPHERE RESERVES TAKEN FROM SPACECRAFT AND AIRCRAFT: FRASER EXPERIMENTAL FOREST**

Marianne Moskowitz. 1980. 78 p. refs.

(PB80-224033) Avail NTIS HC A05/MF A01 CSCL 08B

A listing is given of remotely sensed data gathered from spacecraft and aircraft available for the Fraser Experimental Forest. The listed material is available in geographic form and, in the case of LANDSAT images, computer compatible magnetic tapes. GRA

**N81-18954#** ECON Inc., Princeton, N.J.

**THE ECONOMIC VALUE OF IMPROVED AGRICULTURAL INFORMATION. A CASE STUDY FOR THE ASSESSMENT OF A EUROPEAN REMOTE SENSING SATELLITE SYSTEM**

Francis M Sand and Franz Jaskolla (Zentralstelle fuer Geophotogrammetrie und Fernerkundung). In *ESA Econ Effects of Space and Other Adv Technol*. Sep 1980. p 185-190. refs. Sponsored by ESA.

Avail NTIS HC A12/MF A01

The case study which provides a preliminary assessment of the performance and economic benefits of a European remote sensing satellite system for agricultural applications is discussed. An analytical approach to the economic theory of the value of



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improved information is presented. The measurement of economic benefits of the satellite is derived from the optimized decisions on production and distribution of cereals and feed commodities. Through the use of a dynamic program model, the improved decisions are compared with the decisions which would have been made under existing agricultural information. A performance assessment based on remote sensing data from LANDSAT and aircraft on European agricultural test sites is discussed. The classification accuracies obtained are integrated into an agricultural information system for subsequent economic assessment.  
Author (ESA)

**N81-19532\*#** Virginia Polytechnic Inst Blacksburg  
**GENERAL DESCRIPTION AND OPERATION OF THE AGRO-ENVIRONMENTAL SYSTEM CROP MANAGEMENT MODELING**

Ernest Gross and J H Scott Jr Mar 1981 35 p  
(Contract NAS6-2388)  
(NASA-CR-156874) Avail NTIS HC A03/MF A01 CSCL O2C

Input for a data management system to provide farmers with information to improve crop management practices in Virginia requires monitoring of control crops at field stations, crop surveys derived from remotely sensed aircraft data, meteorological data from synchronous satellites and details of local agricultural conditions. Presently models are under development for determining pest problems, water balance in the soil, stages of plant maturity and optimum planting date. The status of the Cerospora leafspot model for peanut crop management is considered. Other models under development planned relate to *Cylindrocladium* Balckrot and *Sclerotinia* blight of peanuts, cyst nematode (*Globerdena solanacearum*) of tobacco and red crown rot of soybeans. A software program for estimating precipitation and solar radiation on a statewide basis is also being developed.  
A R H

**N81-20487** Oregon State Univ, Corvallis  
**IDENTIFICATION OF IRRIGATION PRACTICES USING PHOTOGRAPHIC AND OPTICAL-MECHANICAL SCANNING REMOTE SENSING TECHNIQUES** Ph D Thesis

Shamim Naim 1981 280 p  
Avail Univ Microfilms Order No 8105186

A methodology to use remotely sensed data for irrigation method identification was developed. The main tasks were to (1) analyze multitemporal images for different emulsions and scales to identify irrigation methods, (2) develop mission parameters, (3) develop an image interpretation key, and (4) investigate the feasibility of using a quantitative approach to irrigation method identification. Conclusions drawn from this study include: image oriented analysis rather than quantitative analysis is best suited for irrigation method discrimination. CIR images provide better discrimination than black and white images while irrigated and nonirrigated crops can be discriminated using multitemporal 1:100,000 images, for satisfactory discrimination of all irrigation methods, 1:30,000 or larger imagery is needed, and the best time for differentiating irrigation methods is the early growing season. Optimum mission parameters for flying photographic missions and an image interpretation key useful for irrigation methods discrimination was developed.  
Dissert Abstr

**N81-20527#** National Aerospace Lab Amsterdam (Netherlands)  
Flight Div  
**FUNDAMENTALS OF REMOTE SENSING RELATIONS BETWEEN SPECTRAL SIGNATURES AND PHYSICAL PROPERTIES OF CROPS**

N J J Bunnik 20 Sep 1979 60 p refs Presented at Joint Res Centre of the Comm of European Communities, Ispra Italy 15-19 Oct 1979  
(NLR-MP-79035-U) Avail NTIS HC A04/MF A01

The detection of reflected radiation by a remote sensor and the influence of the atmosphere as radiative transfer medium are described. The reflectance behavior of green crops is analyzed after the introduction of the optical characteristics of plant leaves and the soil background. Two deterministic canopy reflectance models are compared. A possible approach is proposed to correlate changing plant canopy parameters with changing reflectance values in only three spectral bands. Model simulations are used

to demonstrate a systematic change of multispectral reflectance data during crop growth. Crop monitoring parameters derived from three spectral bands are defined. These parameters are sensitive to growth indicators. Ground based reflectance measurements are used to illustrate the dynamic behavior of several crop monitoring parameters, as predicted by model simulations.  
Author (ESA)

**N81-21411\*#** Colorado State Univ Fort Collins Dept of Earth Resources

**MONITORING DROUGHT IMPACT FROM LANDSAT**

Eugene L Maxwell R Martin Aherron Diana Fitz, Gary Gross, Jesse Grunblatt and Anthony Morse Principal Investigators Feb 1980 217 p refs Original contains imagery Original photography may be purchased from the EROS Data Center, Sioux Falls SD 57198 ERTS  
(Contract NAS5-25081)

(E81-00088 NASA-CR-166650 CSU-1951-F) Avail NTIS HC A10/MF A01 CSCL 08H

The application of LANDSAT data for monitoring drought impact is described. The use of optical and digital products was studied relative to operational requirements, reliability, image availability and analytical procedures. A statewide (Colorado) field measurements program produced crop calendars for major crops, crop height-biomass relationships and criteria for image date selection. Cloud studies using NOAA-VHRR images generated cloud cover maps for Colorado, specifying the probability of having less than 10% or less than 50% cloud cover on any LANDSAT overpass during the growing season. The use of any color product is not recommended because of quality control problems and satellite system variations. An optical vegetation index product is recommended for statewide surveys of vegetation condition. A simple level slicing or graymapping procedure was effective for mapping and tabulating of biomass values over a three decade range, in 3 dB (2 to 1) steps or increments.  
A R H

**N81-21417\*#** National Aeronautics and Space Administration Lyndon B Johnson Space Center Houston, Tex

**FOREIGN COMMODITY PRODUCTION FORECASTING PROGRAM REVIEW PRESENTATION TO LEVEL 1, INTER-AGENCY COORDINATION COMMITTEE Semiannual Project Management Report**

6 Nov 1980 137 p Sponsored by NASA, USDA, Dept of Commerce, Dept of Interior, and Agency for International Development Original contains imagery Original photography may be purchased from the EROS Data Center, Sioux Falls, SD 57198 ERTS  
(Proj AgRISTARS)

(E81-10100 NASA-TM-82322, FC-J-04010 JSC-16835) Avail NTIS HC A07/MF A01 CSCL 02C

Experiments planned to differentiate and inventory domestic and foreign wheat/barley and corn/soybean crops are described and methods for verifying the classifications and estimating the proportions are indicated. Tables and graphs show labeling accuracy, proportion estimation and planting data model results for the various crops.  
A R H

**N81-21419\*#** Lockheed Engineering and Management Services Co, Inc, Houston, Tex

**IDENTIFICATION OF USSR INDICATOR REGIONS**

J Disler and H Breigh, Principal Investigators Sep 1980 81 p refs Sponsored by NASA, USDA, Dept of Commerce, Dept of Interior and Agency for International Development ERTS  
(Contract NAS9-15800, Proj AgRISTARS)

(E81-10102 NASA-CR-160935, FC-LO-04027, LEMSCO-15118, JSC-16847) Avail NTIS HC A05/MF A01 CSCL 02C

Potential indicator regions were determined by comparing the statistics for barley and wheat at the lowest administrative levels for which published statistics were available. Fourteen were selected for review based on their relative abundances of wheat and barley. These potential indicator regions were grouped according to three conditions that could affect labeling and classification accuracies: (1) high-barley content, (2) presence of barley and spring wheat, and (3) presence of barley and

winter wheat Each region was further evaluated based on the availability of crop calendars LANDSAT acquisitions and ancillary data Based on the relative abundance of wheat and barley and the availability of data three indicator regions were recommended Within each region, individual oblasts and/or krays were selected according to segment availability and segment acquisition histories for potential barley separation A R H

**N81-21422\*#** Texas A&M Univ College Station Remote Sensing Center

**DRYLAND PASTURE AND CROP CONDITIONS AS SEEN BY HCMM Progress Report, Jul - Oct 1980**

W D Rosenthal J C Harlan and Bruce J Blanchard Principal Investigators Oct 1980 15 p Original contains imagery Original imagery may be purchased from NASA Goddard Space Flight Center (code 601) Greenbelt, Md 20771 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 NAS5-24383)

(E81-10118 NASA-CR-164112 PR-3712-11) Avail NTIS HC A02/MF A01 CSCL 02C

Ground truth aircraft and satellite data were examined in order to (1) assess the capability for determining wheat and pasture canopy temperatures in a dryland farming region from HCMM data (2) assess the capability for determining soil moisture from HCMM data in dryland crops (winter wheat) from adjacent range lands and (3) determine the relationship of HCMM-derived soil moisture and canopy temperature values with the condition of winter wheat and dryland farming areas during the principal growth stages The IR data were screened to include areas having greater than 60% pasture and surface temperatures were recalculated using the atmospheric correction factor calculated by the modified RADTRA model and the July 29 1978 IR data were analyzed Screening the IR data improved the relationship for July 24/July 13 and October 7/August 31 temperature/API relationship However the coefficient of determination was not improved in the July 29/July 13 relationship A R H

**N81-21424\*#** Environmental Research Inst of Michigan, Ann Arbor

**ANALYSIS OF SCANNER DATA FOR CROP INVENTORIES Progress Report, 16 May - 15 Aug 1980**

Robert Horvath Principal Investigator Richard Cicone, E Crist Richard J Kauth and W Pont Sep 1980 135 p Sponsored by NASA USDA Dept of Commerce Dept of Interior and Agency for International Development ERTS (Contract NAS9-15476 Proj AgRISTARS) (E81-10122 NASA-CR-160890 ERIM-132400-48-P) Avail NTIS HC A07/MF A01 CSCL 02C

Classification and technology development for area estimation of corn soybeans wheat barley and sunflowers are outlined Supporting research for corn and soybean foreign commodity production forecasting is highlighted Graphs profiling the greenness and brightness of the crops are presented T M

**N81-21425\*#** California Univ, Santa Barbara Geography Remote Sensing Unit

**MULTISPECTRAL DETERMINATION OF SOIL MOISTURE Annual Report**

John E Estes David S Simonett Principal Investigators Earl J Hajic, and Bruce J Blanchard Dec 1980 114 p refs Prepared in cooperation with Texas A & M Univ College Station ERTS

(Contract NCC5-5) (E81-10123 NASA-CR-164115) Avail NTIS HC A06/MF A01 CSCL 08M

The edited Guymon soil moisture data collected on August 2 5 14 17 1978 were grouped into four field cover types for statistical analysis These are the bare, milo with rows parallel to field of view milo with rows perpendicular to field of view and alfalfa cover groups There are 37, 22 24 and 14 observations respectively in each group for each sensor channel and each soil moisture layer A subset of these data called the five cover set (VEG5) limited the scatterometer data to the 15 deg look angle and was used to determine discriminant functions and combined group regressions T M

**N81-21427\*#** Instituto de Pesquisas Espaciais Sao Jose dos Campos (Brazil)

**USE OF LANDSAT DATA FOR AUTOMATIC CLASSIFICATION AND AREA ESTIMATION OF SUGARCANE PLANTATION IN SAO PAULO STATE BRAZIL**

Nelson deJesusParada Principal Investigator and Francisco Jose Mendonca Oct 1980 23 p refs Submitted for publication Sponsored by NASA ERTS

(E81-10125 NASA-CR-164117 INPE-1929-RPE/254) Avail NTIS HC A02/MF A01 CSCL 08B

Ten segments of the size 20 x 10 km were aerially photographed and used as training areas for automatic classifications The study areas was covered by four LANDSAT paths 235 236 237 and 238 The percentages of overall correct classification for these paths range from 79 56 percent for path 238 to 95 59 percent for path 237 T M

**N81-21437\*#** National Aeronautics and Space Administration John F Kennedy Space Center Cocoa Beach Fla

**AERIAL COLOR INFRARED PHOTOGRAPHY APPLICATIONS IN CITRICULTURE**

Carlos H Blazquez and Frank W Horn, Jr Nov 1980 89 p refs Prepared in cooperation with Florida Univ, Lake Alfred Original contains color illustrations

(NASA-RP-1067, TR-43-1) Avail NTIS HC A05/MF A01 CSCL 02C

The photographic specifications and operational parameters in this handbook were determined in a large aerial color infrared (ACIR) photographic experiment and in a follow-up demonstration with the cooperation of Florida citrus growers and aerial photographers The ACIR photography in the spring gave the best separation between healthy and diseased trees The best scale for photointerpretation with the use of inexpensive analysis equipment was 1 in = 333 ft Photographs taken with a 12 in focal length lens were far superior to those taken with a 6 in focal length lens A cell unit grid system, with window overlays for rapid photointerpretation and a black and white enlargement for ground verification, was developed for tree registration Use of the enlargement in ground surveys reduced the survey time from 25 hours to 2 5 hours The cell unit grid system is compatible with computer processing for rapid recording of photo interpreted data, storage retrieval, and analysis A mapping system with 99 percent accuracy was developed for fast surveillance of tree vigor and stress A R H

**N81-21438\*#** Remote Sensing Inst, Brookings, S Dak IRRIGATION MANAGEMENT WITH REMOTE SENSING Semiannual Status Report

Jim Heilman, Donald Moore, and Vic Myers 26 Nov 1980 8 p ref (Grant NAG5-37)

(NASA-CR-164143 SASR-1) Avail NTIS HC A02/MF A01 CSCL 08H

A ground study was conducted utilizing hand held radiometers to collect visible, near infrared and thermal infrared measurements The data were analyzed and evaluated in terms of the ground measurements, which included percent crop canopy cover The results used to recommend future action regarding use of satellite data in irrigation management R C T

**N81-21442\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**THERMAL MICROWAVE EMISSIONS FROM VEGETATED FIELDS A COMPARISON BETWEEN THEORY AND EXPERIMENT**

J R Wang, J C Shiu, S L Chuang (MIT Cambridge) and M Dombrowski Jul 1980 27 p refs Submitted for publication

(NASA-TM-80739) Avail NTIS HC A03/MF A01 CSCL 08F

The radiometric measurements over bare field and fields covered with grass soybean, corn, and alfalfa were made with 1 4 GHz and 5 GHz microwave radiometers during August - October 1978 The measured results are compared with radiative transfer theory treating the vegetated fields as a two layer random medium It is found that the presence of a vegetation cover

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generally gives a higher brightness temperature T(B) than that expected from a bare soil. The amount of this T(B) excess increases in the vegetation biomass and in the frequency of the observed radiation. The results of radiative transfer calculations generally match well with the experimental data, however a detailed analysis also strongly suggests the need of incorporating soil surface roughness effect into the radiative transfer theory in order to better interpret the experimental data. Author

**N81-21444\*#** Texas A&M Univ., College Station Remote Sensing Center  
**SOIL MOISTURE DETERMINATION STUDY Final Report, 28 Jul - 24 May 1979**  
Bruce J Blanchard 1 Apr 1979 76 p refs  
(Contract NAS5-25144)  
(NASA-CR-160046, FR-3829) Avail NTIS HC A05/MF A01 CSCL 08M

Soil moisture data collected in conjunction with aircraft sensor and SEASAT SAR data taken near Guymon, Oklahoma are summarized in order to minimize the effects of vegetation and roughness. Three bare and uniformly smooth fields were sampled 6 times at three day intervals on the flight days from August 2 through 17. Two fields remained unirrigated and dry. A similar pair of fields was irrigated at different times during the sample period. In addition, eighteen other fields were sampled on the nonflight days with no field being sampled more than 24 hours from a flight time. The aircraft sensors used included either black and white or color infrared photography, L and C band passive microwave radiometers, the 13.3, 4.75, 1.6 and 4 GHz scatterometers, the 11 channel modular microwave scanner, and the PRT5. A R H

**N81-21445\*#** Texas A&M Univ. College Station Remote Sensing Center  
**LANDSAT RANGE RESOURCE INFORMATION SYSTEM Final Report, Oct. 1979 - Jan 1981**  
W E Boyd and J Clifford Harlan 1981 25 p refs  
(Contract NAS9-15468)  
(NASA-CR-160920 RSC-3697-6) Avail NTIS HC A02/MF A01 CSCL 05B

A series of test products were developed from LANDSAT data sets for North Central Texas that paralleled the needs of ranchers, technical personnel, and the media. The products and evaluation questionnaires were mailed to approximately 150 ranchers who had reported an interest in evaluating the information systems. In addition to the rancher group, fourteen media people and a thirty-three member group in the agri business/technical community was also chosen to receive test products. The group responses are analyzed. Examples of the test products and associated questionnaires are included. M G

**N81-21446\*#** Texas A&M Univ., College Station Remote Sensing Center  
**CORRELATION OF SPACECRAFT PASSIVE MICROWAVE SYSTEM DATA WITH SOIL MOISTURE INDICES (API) Final Report**  
Bruce J Blanchard Marshall J McFarland Sidney Theis and John G Richter Feb 1981 99 p refs  
(Grant NsG-5193)  
(NASA-CR-164142 Rept-3622-4) Avail NTIS HC A05/MF A01 CSCL 08M

Electrical scanning microwave radiometer brightness temperature, meteorological data, climatological data, and winter wheat crop information were used to estimate that soil moisture content in the Great Plains region. Results over the predominant winter wheat areas indicate that the best potential to infer soil moisture occurs during fall and spring. These periods encompass the growth stages when soil moisture is most important to winter wheat yield. Other significant results are reported. R C T

**N81-21459#** Centre National d'Etudes Spatiales, Toulouse (France)  
**RELATIONS BETWEEN RADIATION AND THE STRUCTURE OF A SCENE [TRAVAUX PRATIQUES, NUMERO 3 RELATIONS ENTRE RAYONNEMENT ET STRUCTURE]**

G Saint *In its* Math and Phys Principles of Remote Sensing 1978 p 735-790 In FRENCH

Avail NTIS HC A99/MF A01

The structure of a scene is defined by its geometrical properties and by its radiometric properties. The influence of scene contour on luminance is determined analytically. Secondary reflection is taken into consideration. Calculation results are extended to a statistical surface description. Weighting functions are derived accounting for atmospheric emission and transmission at varying altitudes. Both aerial and ground measurements are used based on vertical temperature sounding. Expressions are formalized as a model of vegetative ground cover. A generalized equation for radiative transfer is developed and an approximation solution is presented. Extensive numerical analysis of model parameters under different radiation conditions is shown, characterizing ground cover. Author (ESA)

**N81-21480#** Centre National d'Etudes Spatiales, Toulouse (France)

**CROP INVENTORIES IN BEAUCE, BASED ON MULTI-SPECTRAL AND MULTITEMPORAL ANALYSIS OF LANDSAT DATA [TRAVAUX PRATIQUES, NUMERO 4. INVENTAIRE DE CULTURES EN BEAUCE PAR ANALYSE MULTISPECTRALE ET MULTITEMPORELLE DES DONNEES LANDSAT]**

Traizat *In its* Math and Phys Principles of Remote Sensing 1978 p 791-833 In FRENCH

Avail NTIS HC A99/MF A01

Several methods for establishing an inventory of ground cover were applied to LANDSAT data from 1978. The relative roles of the mathematics applied and of interpretation as well as the significance of the physical parameters of the objects under observation are brought out. The data compilation scheme is described. Three analysis techniques are reviewed: (1) direct analysis of histograms, (2) statistical analysis by Gaussian approximation, and (3) nonsupervised digital techniques. Results show that both the direct analysis and statistical analysis provide satisfactory image classification, with the Gaussian scheme presenting certain advantages for extending the observations. Nonsupervised techniques, while providing good feature separation for some special cases, e.g. wilderness, are as yet poorly adapted to crop inventory applications. Author (ESA)

**N81-21694\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md  
**THE 1977 TUNDRA FIRE AT KOKOLIK RIVER, ALASKA**  
D Hall, J Brown, and L Johnson *In its* Goddard Lab for Atmospheric Sci. Collected Reprints 1978 - 1979, Vol 2 Mar 1981 p 660-670 refs Repr from US Army Cold Regions Res and Engr SR-78-10, Aug 1978

Avail NTIS HC A22/MF A01 CSCL 04B

During the summer of 1977, fire totaled 44 sq km of tundra vegetation according to measurements using LANDSAT imagery. Based on the experience gained from analysis of this fire using ground observations, satellite imagery and topographic maps, it appears that natural drainages form effective fire breaks on the subdued relief of the Arctic coastal plain and northern foothills. It is confirmed that the intensity of the fire is related to vegetation type and to the moisture content of the organic rich soils. A R H

**N81-21695\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md  
**THE 1977 TUNDRA FIRE IN THE KOKOLIK RIVER AREA OF ALASKA**

*In its* Goddard Lab for Atmospheric Sci., Collected Reprints 1978 - 1979, Vol 2 Mar 1981 p 671-675 refs Repr from Arctic, J. of the Arctic Inst of North Am., v 31 no 1, Mar 1978

Avail NTIS HC A22/MF A01 CSCL 04B

Presumably caused by lightning, a large fire occurred due east of Point Lay several kilometers southwest of the Kokolik

River, the farthest north a fire was ever fought by Bureau of Land Management personnel in Alaska. The progress and area extent of the fire were determined by analysis of LANDSAT MSS band 5 and 7 imagery. Low altitude observations from helicopter showed the fire burned a range of vegetation and relief types which included low polygonized and upland tussock tundras. The burned area appeared wetter on the surface than the unburned area, due to a lack of moisture absorbing organic matter and the possible release of moisture from the deeper thawed zone. Suggestions for future investigations of the effects of fire on tundra and permafrost terrains are discussed. A R H

## 02

### ENVIRONMENTAL CHANGES AND CULTURAL RESOURCES

Includes land use analysis urban and metropolitan studies environmental impact air and water pollution geographic information systems and geographic analysis

**A81-20292** Aircraft observations of plumes emitted from elevated sources S Sandroni (Commission of the European Communities, Joint Research Centre, Ispra, Italy), P Bacci (Ente Nazionale per l'Energia Elettrica, Milan, Italy), and D Anfossi (CNR, Istituto di Cosmogeofisica, Turin, Italy) *Atmospheric Environment*, vol 15, no 1, 1981, p 95 100 9 refs

Aircraft measurements across the plumes emitted from the stacks of the Turbigo Power Plant are discussed By this technique, it was possible to characterize some aspects of structure of plumes from the chemical and physical point of view In particular, the mixing of three plumes emitted from three stacks close to each other is investigated (Author)

**A81-20792 #** Remote measurements of trace species in the troposphere R L Byer and M Endemann (Stanford University, Stanford, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St Louis, Mo, Jan 12 15, 1981, Paper 81 0377* 11 p 32 refs Grant No DAAG29 77-G-0181

A reliable single ended remote monitoring lidar operating in the infrared is described The system uses a 1.4 to 4.0 microns tunable OPO source as transmitter Continuous remote monitoring of atmospheric methane over a 17 hr period demonstrates the reliability of the system Simultaneous remote measurements of temperature and humidity using absorption lines of the 1.9 micron water band achieve relative accuracies of 1.0 C and 1%, respectively, over a 45 sec averaging period The expected sensitivity for the measurement of other pollutants with absorption lines within the tuning range of the transmitter is discussed (Author)

**A81-20793 #** A mobile differential absorption lidar /DIAL/ for range-resolved measurement of SO<sub>2</sub>, O<sub>3</sub>, and NO<sub>2</sub> J G Hawley, G F Wallace, and L D Fletcher (SRI International, Menlo Park, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St Louis, Mo, Jan 12 15, 1981, Paper 81-0378* 7 p 9 refs

A mobile DIAL system has been developed to map out the distribution of SO<sub>2</sub>, O<sub>3</sub>, and NO<sub>2</sub> associated with power plant plumes The laser radar (lidar) device uses the absorption properties of these gases in the atmosphere to assess their concentrations along the laser beam path By scanning the lidar, areas as large as 7 sq km may be mapped out Results of a power plant plume study are presented, demonstrating the capability of the system Some measurements made in correlation with an SO<sub>2</sub> monitor and earlier measurements on a previous system with an NO<sub>2</sub> monitor are also given By making simple wavelength adjustments, O<sub>3</sub> or NO<sub>2</sub> may be measured with the present system (Author)

**A81-22375 \* #** Ozone profiles from tethered balloon measurements in an urban plume experiment O Youngbluth, Jr., R W Storey, C G Clendenin, S Jones, and B Leighty (NASA, Langley Research Center, Hampton, Va) *Institute of Electrical and Electronics Engineers, SOUTHEASTCON'81, Huntsville, Ala, Apr 5-8, 1981, Paper 5* p 6 refs

NASA Langley Research Center used two tethered balloon systems to measure ozone in the general area of Norfolk, Va The large balloon system which has an altitude range of 1,500 meters was located at Wallops Island, Va, and the smaller balloon which has an altitude range of 900 meters was located at Chesapeake, Va Each

balloon system measured ozone, temperature, humidity, wind speed, and wind direction from ground to its maximum altitude From these measurements and from the location of the balloon sites, areas of ozone generation and ozone transport may be inferred The measurements which were taken during August 1979 are discussed as well as the measurement techniques (Author)

**A81-23039 \*** Landsat and digital terrain data for county-level resource management D A Stow and J E Estes (California, University, Santa Barbara, Calif) *Photogrammetric Engineering and Remote Sensing*, vol 47, Feb 1981, p 215-222 22 refs Grant No NGL-05-404-510

**A81-23532 \*** International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volumes 1, 2 & 3 Symposium sponsored by the Ministerio de Relaciones Exteriores of Costa Rica, Environmental Research Institute of Michigan, NASA, DOT, et al Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980 Vol 1, 678 p, vol 2, 695 p, vol 3, 674 p

Papers are presented on remote sensing applications in resource monitoring and management, data classification and modeling procedures, and the use of remote sensing techniques in developing nations The subjects of land use/land cover, soil mapping, crop identification, mapping of geological resources, renewable resource analysis, and oceanographic applications are discussed Papers from Argentina, Bolivia, Brazil, Costa Rica, the Syrian Arab Republic, the People's Republic of China, the Philippines, Italy, Upper Volta and the United States are included L S

**A81-23533 #** Current and future United States satellite remote sensing systems C A Spohn (NOAA, National Environmental Satellite Service, Washington, D C) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 15-18

The National Oceanic and Atmospheric Administration (NOAA) has been designated to be the operating agency for any operational satellite systems in the civil sector of the United States Government We are presently engaged in the initial planning for an operational land remote sensing program and for providing for a suitable transition from the present National Aeronautics and Space Administration (NASA) experimental Landsat to the future operational system In addition, NOAA, jointly with NASA and the United States Navy, is proposing an operational demonstration program for an oceanic satellite remote sensing system Along with these two new programs, NOAA proposes to continue its present TIROS-N-type polar-orbiting satellites and GOES geostationary satellite active for environmental remote sensing through the remainder of the decade Some changes will be made in instrumentation, but present services and capabilities will not be affected (Author)

**A81-23541 #** The Syrian Arab Republic Remote Sensing Center to meet national and regional needs A O Youssef (Ministry of Electricity, Damascus, Syria), A W Kabakibo (Ministry of Defense, Meteorological Dept, Damascus, Syria), and F Shahrokh (Tennessee, University, Tullahoma, Tenn) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 97-101 6 refs

The requirements for planning a remote sensing facility in developing countries are outlined The flexibility of design, location and operation of such facilities are cited as factors for consideration in planning such facilities It is noted that human and environmental resources as well as social, economic and political factors play a role

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in the selection of a high-technology enterprise The recent activities of the Syrian Remote Sensing Committee are discussed L S

**A81-23546 #** The influence of the atmosphere on remote sensing in South-West China Y Xun, L Zhan, Y Zhu, and S Yang (Academia Sinica, Anhui Institute of Optics and Fine Mechanics, Peking, Communist China) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 143-152 7 refs

The influence of the atmosphere on remote sensing is analyzed in a study in Southwest China through measurement of three parameters, the transmittance and path radiance of the total atmosphere and the total irradiance of the sun and sky, and through a measurement of the inherent reflectance and radiance of various ground targets Portable instruments in the spectral range of 400 to 1100 nm, whose range was divided into four bands, are used It is shown by calculations that atmospheric effects are more important in regard to targets with low reflectivity and it is proposed that measures of appropriate atmospheric correction should be taken to correct effects such as the reduction of contrast between targets by 10-20% when the zenith angle of the sun is 47 degrees D K

**A81-23556 \* #** Land-cover classification of California using mosaicking and high-speed processing D L Peterson, S Norman (NASA, Ames Research Center, Moffett Field, Calif.), N Tosta-Miller, D Wierman (NASA, Ames Research Center, Moffett Field, California, Dept of Forestry, Sacramento, Calif.), and W Newland (NASA, Ames Research Center, Technicolor Graphic Services, Inc., Moffett Field, Calif.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 279-305 10 refs

A land cover classification of Landsat MSS data has been made for the entire state of California Digital mosaicking of 32 Landsat scenes with registered digital elevation, slope, and aspect was prepared Stratified unsupervised clustering generated the spectral classes which were identified into 16 categories, mostly forest types, using U-2 CIR photos A verification using 81 primary sample units resulted in a forest/nonforest accuracy of 80.2% and a commercial conifer and hardwood accuracy of 75.1% The results are now being used in many projects throughout the state (Author)

**A81-23557 #** Application of satellite remote sensing to natural resources management in the Philippines R M Umali (Ministry of Natural Resources, Natural Resources Management Center, Quezon City, Philippines) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 307-313 21 refs

Since its creation in October, 1976 as the principal remote sensing agency of the Philippine government for natural resource applications, the Natural Resources Management Center (NRMC) has conducted several studies using Landsat multispectral scanner data to generate baseline resource information, monitor temporal depletion of resources, and provide site specific resource inventory and assessment needed for the rational management and conservation of these resources Using an interactive computer-assisted system for analysis of Landsat CCT, manual interpretation of images, and adequate ancillary data for 'ground truth' information, the Center has processed more than one hundred fifty (150) scenes of Landsat coverage encompassing the total terrestrial area and coastal waters of the country for purposes of evolving management plans and programs for the country's forest, mangrove, coral, coastal zone, and mineral resources (Author)

**A81-23559 #** Design of a nationwide natural resource inventory and information system for Costa Rica R W Campbell, Jr., S A Sader (Resources Development Associates, Los Altos, Calif.), and

H Rodriguez (U.S. Agency for International Development, San Jose, Costa Rica) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 325-340 8 refs

The Government of Costa Rica, in conjunction with the U.S. Agency for International Development and Resources Development Associates, has recently completed a Pilot Project to design an operational natural resource inventory and information system for Costa Rica This system employs aerial photographic and Landsat data to generate baseline land cover information which can be integrated with other resource data in a thematic mapping process to create a resource information system The technical capabilities of the Costa Rican Government have now been upgraded sufficiently that they may proceed with nationwide implementation (Author)

**A81-23564 #** Design considerations for resource inventory systems R J Kauth, W A Malila, R Horvath, and R C Cicone (Michigan, Environmental Research Institute, Ann Arbor, Mich.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 401-408 11 refs

General requirements on global or large-scale resource inventory systems based on remotely sensed satellite imagery and collateral data are discussed from a generic user's point of view From the scientist's point of view, technical efforts and an approach to the realization of the technologies needed are examined The overall development concept is that of systems based on physical understanding embedded in a statistical sampling framework with emphasis on self evaluation and objectivity V L

**A81-23566 #** Mapping land cover in Latin American countries by computer-aided analysis of satellite scanner data R M Hoffer and L A Bartolucci (Purdue University, West Lafayette, Ind.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 415-425

The results of Landsat remote sensing projects in Bolivia, Costa Rica, El Salvador, Guatemala, Honduras and Nicaragua involving the use of computer aided analysis techniques for mapping land cover are evaluated The effective application of such techniques requires a locally adapted land cover/land use classification scheme, a stratification of the region involved into areas of similar physiographic and cover type characteristics, and representative training sets The selection of a classification algorithm can significantly impact upon the results as well as the costs of a project The results of classification data from the six countries reveal spectral similarities between cover types such as recent lava flows and clear water In some cases, spectral separability could not be achieved between sugar cane and tall grass, or areas of coconuts and mangrove L S

**A81-23567 #** Land resource planning applications of land use mapping and inventory from remotely sensed data J R Anderson and R E Witmer (U.S. Geological Survey, Reston, Va.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 429-443

The U.S. Geological Survey's nationwide land use and land cover mapping and data compilation program is outlined A baseline set of information is systematically compiled from remotely sensed data according to a standardized classification system developed in the survey These maps and data fill the need for information on land use and land cover that is comparable from region to region, can be compiled cost effectively, is reasonably current, has an accuracy of 85 percent or better, and can be related to other spatial data sets such as census or water resource data These features of the maps and data have resulted in their application by many agencies at all levels

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of government They are also being used as prime data in several research projects L S

**A81-23568 #** Problems in ecodevelopment - Examples based upon joint research in Colombia's Ciénaga Grande de Santa Marta R D Mower (North Dakota, University, Grand Forks, N Dak ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 445-455 Research supported by the Instituto Nacional de Los Recursos Naturales Renovables y del Ambiente and University of North Dakota

Problems and prospects of ecodevelopment programs in Northern Colombia are surveyed in the context of the use of remote sensing The problems covered are cultural problems of perception, communication and technology transfer, and physical problems of hydrological processes, land use, and urbanization It is concluded that the use of remote sensing technology in Colombia is presently at the inception and conception stage, but that it bears promise for acquiring baseline data, monitoring change, and planning ecodevelopment programs D K

**A81-23577 #** Spatial land-use inventory - Denver Metropolitan area with inputs from existing maps, air photos, and Landsat imagery C H Tom (Science Applications, Inc , Golden, Colo ) and L D Miller (Texas A & M University, College Station, Tex ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 603-612

**A81-23580 #** Preliminary analysis of the potential of Landsat imagery to study desertification M A Lombardo and V C de Carvalho (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 645-652 19 refs

In this study, a preliminary analysis was carried out to verify if Landsat images could be used to define and delimit areas under process of desertification Imagery for two different years (1973 and 1976) and two different seasons (dry and rainy seasons in 1976), were used to identify terrain morphology and vegetation cover The integrated analysis of Landsat interpretation, combined with geological and soil information obtained from published literature, allowed the identification of eleven ecological units which were classified corresponding to the degree of desertification in the study area

(Author)

**A81-23584 #** Land use classification in Cajamarca Valley using Landsat 1 data L Velazco, G E Ramirez, and J Espinoza (Ministerio de Agricultura, Instituto Geofísico del Peru, Lima, Peru) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 685-693 12 refs

It is shown that remote sensing from the MSS Landsat-1 permits an inexpensive and efficient classification of land It is noted that because of synoptic coverage every 18 days, Landsat images provide an ideal method for evaluating changes in cropland Landsat systems make it possible to obtain rural land use maps having very good geometric accuracy in a short period of time It is pointed out that the pattern samples should not be extrapolated to other images C R

**A81-23590 #** Application of aerial remote sensing to the study of geothermal resources in the desertic north of Chile and environmental pollution in Santiago, Chile A F Mauricio (Universidad de Chile, Santiago, Chile) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April

23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 761, 762

The technology and field methodology employed in the remote sensing of geothermal resources in desert regions of Chile are found to provide good information and to be suitable for use in other parts of the country Over Santiago, it is found that the use of aerial multispectral photography (multiband camera) and images (thermal infrared line scanner) is very effective in detecting pollution sources Air ventilation tubes, machines (vehicles and other motors), factories, and industries are readily distinguished on thermal infrared images It is pointed out that these potential pollution sources can be identified in the multiband photography, where the near infrared band has a potential to penetrate the smog Water pollution is found to be dramatically illustrated, especially on thermal images C R

**A81-23593 #** An operational system to monitor desertification using Landsat data D Bannert (Bundesanstalt für Geowissenschaften und Rohstoffe, Hanover, West Germany) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2

Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980 p 783-785

**A81-23598 #** Coastal change assessment of the nuclear power plant site in Bataan, Philippines using Landsat temporal data J B R Lim, E S Elefan, and R S Jara (Ministry of Natural Resources, Natural Resources Management Center, Quezon City, Philippines) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 819-832

**A81-23606 #** Landsat/Skylab - Natural resources inventories in 1,000,000 sq km of the Argentine Republic A B Viola and C M V Binaghi (Aeroterra, S A, Buenos Aires, Argentina) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 947-955

The applications of remote sensing technology to evaluate and classify natural resources in Argentina and the watershed of the Pilcomayo River in 1976-1979 are discussed The Landsat images and Skylab photographs were used for quick cartographic description of the resources, thematic maps were drawn at 1 125,000 and 1 250,000 scales for land use, hydrology, transportation patterns, geomorphology, and hydrogeology Landsat-Skylab mosaics were prepared along with information derived from combinations of infrared, color, and panchromatic films A T

**A81-23615 #** Modeling soil loss and flood potential due to urbanization in humid subtropical southeastern environments Z Berger (Law Engineering Testing Co , Marietta, Ga ) and J R Jensen (Georgia, University, Athens, Ga ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1057-1067 8 refs

**A81-23631 #** Monitoring the areal growth of San Jose, Costa Rica R Ellefsen and R Davidson (Resources Development Associates, Los Altos, Calif ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1243-1249

Modern techniques in remote sensing, both the interpretation of aerial photography and computer analysis of Landsat satellite digital data, have been demonstrated in a test to monitor the areal growth of the metropolitan area of San Jose, Costa Rica First, conventional interpretation of aerial photography was employed to delimit the

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areal extent of the city's urbanized area in 1945, 1965, and 1977. In a parallel effort, digital information received from Landsat was processed by computer to measure areal extent of metropolitan growth. Subsequent manipulation of the data produced a systematic measurement of the contiguously built-up area, one which can serve as a base for use with satellite data acquired later. (Author)

**A81-23632 # Renewable resource analysis and monitoring in Costa Rica** S A Sader (Resources Development Associates, Los Altos, Calif.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1251-1259. 20 refs.

**A81-23634 # Remote sensing applications to land cover classification in Northern Thailand** P Prapinmongkolkarn (Chula longkorn University, Bangkok, Thailand), C Thisyakorn (Yip In Tsoi Co., Ltd., Bangkok, Thailand), N Kattiyakulwanich (Asian Institute of Technology, Bangkok, Thailand), S Murai, T Okuda, K Matsuoka (Tokyo, University, Tokyo, Japan), H Kittichanan, K Jirapayoungchai (National Research Council, Bangkok, Thailand), C Vanasathid, and J Sramudcha (Office of Narcotics, Bangkok, Thailand). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1273-1283. Research supported by the Japan Society for the Promotion of Science.

Remote sensing and computer technologies have been applied to Northern Thailand since 1969 in order to develop a land use classification system, including the identification of the opium poppy plantation area, and to monitor changes in the area. The Image Data Base System (IDBS), an interactive information retrieval system of image processing for change detection of land use pattern, incorporates data from Landsat satellite pictures, geometrically corrected to within the accuracy of one pixel by using ground control points in the 1:50,000 scale Universal Transverse Mercator map, Maximum Likelihood and Mahalanobis distance classifiers for the classification of six land cover types, a Digital Terrain Model to produce land contours, and various socio-economic data of the 300,000 hill-tribe peoples. The system uses a digital mesh-gridding system which encodes the mesh-grid of a one sq km area in accordance with local administrative zones. D K

**A81-23635 # Resource mapping by Landsats in developing countries** Z D Kalensky (Universite Laval, Quebec, Canada), K Darmoyuwono (National Coordination Agency for Surveys and Mapping, Jakarta, Indonesia), and J Kaser (Klimsch and Co., Frankfurt am Main, West Germany). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1285-1296. 54 refs.

Described are the main tasks in resource mapping based on Landsat multispectral images, including analog and computer-assisted methods of image processing, cartographic processing and accuracy evaluation. Integration of these tasks and available options are presented in system flowcharts. Discussion includes the expected impact of remote sensing from land resources satellites on resource mapping and the appropriateness of satellite based resource mapping technology for developing countries. (Author)

**A81-23638 # Land use evolution of the city of Rio de Janeiro, Brazil from 1972 to 1978** L H A de Azevedo (Sensoriamento e Interpretacao de Recursos Naturais, Ltda, Botafogo, Brazil) and J Fonseca Pitanga (Secretaria Municipal de Planejamento e Coordenacao Geral, Rio de Janeiro, Brazil). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1321-1334.

Remote sensor radio pictures were made in Rio de Janeiro from 1972 to 1978 by Landsat and Skylab spacecraft, with spacing of 15 minutes between each picture, permitting an overlapping between the radar bands of about 25 percent. The data obtained was used to plot the amount of deforestation occurring, and seven classes of land use were set up. This data proved that deforestation has been getting worse in the six-year period. D K

**A81-23639 # Using Landsat to monitor changes in vegetation cover induced by desertification processes** J C Corner (Hunter College, New York, N Y). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1341-1351. 7 refs. Research supported by the Ebon Research Systems.

To study the process of desertification in arid and semi-arid regions, Landsat data is used to set up variables for quantitatively determining vegetation change in four sites within an area of Mali, West Africa, encompassed by one Landsat frame (25,600 sq km/10,000 sq m). Filtered data blocks of 4 sq km, represented by 900 original Landsat pixels, are used to derive three vegetative status indicators, namely the covariance of MSS band 2 with MSS band 4, the correlation of MSS band 2 with MSS band 4 and the percent explained variance by the first eigenvalue. The construction of vegetative status maps for 1973 and 1975 is also discussed. It is cautioned that the new procedure may overstate change and cannot be independently validated, in comparison with maps with image analysis of the same areas. D K

**A81-23642 # Land cover change detection by principal component analysis of multitemporal MSS data - The presence of clouds** G F Byrne and P F Crapper (Commonwealth Scientific and Industrial Research Organization, Div of Land Use Research, Canberra, Australia). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1375-1382.

A previous application of principal component analysis in the detection of land cover change with cloud-free, multitemporal MSS imagery is briefly summarized. A subsequent application of a similar technique to the same study area, in which there is significant cloud cover in one of the images, is described. Results suggest that the technique effectively maps cloud-covered as well as cloud-free areas, highlighting changes that have occurred in cloud-free areas. Considering the 85-95% portion of variance in the data that is not concerned with change, this study also has implications for the bandwidth of data transmission systems for satellites designed to monitor change. O C

**A81-23647 # Remote sensing for route location and the mapping of highway construction materials in developing countries** T E Beaumont (Clyde Surveys, Ltd., Maidenhead, Berks., England). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1429-1441. 19 refs.

**A81-23655 # Air photo interpretation and the Latin American townscape** B L Thomas (Kent State University, Kent, Ohio). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1523-1528. 7 refs.

An experiment in the application of low-level aerial photography to the mapping of Ponce, Puerto Rico, is presented. Panchromatic black and white aerial photographs were obtained from the U.S. Geological Survey, and identification clues were derived for various townscape units. It is found that object identification is the primary source of image clues. L S

**A81-23658 # Land use/cover mapping from Seasat-A radar of the greater part of the Delmarva Peninsula, U.S.A.** B Drake and



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K H Patton (Old Dominion University, Norfolk, Va ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1565-1575 8 refs

**A81-23659 #** Socio-economic analysis - A survey of open space in metropolitan areas using colour infra-red aerial photography W G Collins (Aston, University, Birmingham, England) and S Sekliziotis (Ministry of Coordination and Planning, Athens, Greece) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 (A81 23532 09-43) Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1577-1586

**A81-23660 #** Environmental stratification - A method to improve Landsat digital analysis accuracy and land cover map utility L R Pettinger (Technicolor Graphic Services, Inc US Geological Survey, EROS Data Center, Sioux Falls, S Dak ) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1587 1599 9 refs US Geological Survey Contract No 14-08-0001-16439

Maps of vegetation and land cover in the Blackfoot River watershed were produced by computer assisted classification of Landsat data Training statistics were developed using a modified clustering technique, and classification was performed using a maximum likelihood algorithm Spectral overlap between many resource classes was markedly reduced by partitioning the watershed into upland, lowland, and agricultural strata Before stratification, 23 spectral clusters or classes (53% of the watershed area) represented more than one resource class After stratification, only six spectral classes (4.3% of the watershed area) consisted of more than one resource class V L

**A81-23661 #** Evaluation of Landsat imagery and digital data for monitoring desertification indicators in Tunisia U Hellden and M Stern (Lund, Universitet, Lund, Sweden) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1601-1610 9 refs

**A81-23674 #** Landsat digital data for population estimation - Testing the technique with grid-square census data in the Scottish highlands A Morrison (Glasgow, University, Glasgow, Scotland) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1745-1754

**A81-23683 #** Landsat related study for regional planning in onchocerciasis-free areas in West Africa G B Heinzenknecht (Tippett-Abbott-McCarthy-Stratton, New York, NY) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich , Environmental Research Institute of Michigan, 1980, p 1849-1857

A West African land-planning case study relying on remotely sensed technology is outlined The impetus for the study came from efforts to rid the Volta system basin of onchocerciasis (river blindness) The development of a data bank for land planning in Benin, Ghana and Upper Volta is outlined and an evaluation of land resource development potential is provided The ecological units were delineated according to land cover, existing land use, land form and soils L S

**A81-23971** Atmospheric transport of soil dust from Africa to South America J M Prospero, R A Glaccum, and R T Nees (Miami, University, Miami, Fla ) *Nature*, vol 289, Feb 12, 1981, p 570-572 28 refs NSF Grants No ATM-76-02198, No ATM-78-12246

The results of an examination of the principal African winter dust trajectories from an aerosol sampling station in Cayenne, French Guiana are given The mineralogical composition of 29 aerosol samples was analyzed by X-ray diffraction The second and third groups of 12 and four samples respectively indicated the presence of South American soil material, in the case of the former, probably derived from Brazil It is noted that concentrations of Saharan dust comparable with those measured in French Guiana can produce a marked increase in heating rates in the middle troposphere and a cooling at the surface which increases atmospheric stability to the extent that there may be a significant impact on the meteorological processes occurring over a large area of the tropical and equatorial North Atlantic L S

**A81 26897 #** Geographical studies in Siberia and problems in the use of aerial and space imagery (Geograficheskie issledovaniia v Sibiri i problemy ispol'zovaniia aerokosmicheskikh materialov) V V Vorob'ev, L A Plastinin, A V Belov, B A Bogoiavlenskii, O P Kosmakova, and V S Mikheev (Akademiia Nauk SSSR, Institut Geografii Sibiri i Dal'nego Vostoka, Irkutsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov Dec 1980, p 93 96 In Russian

A survey is presented of problems involving the application of aerial and space imagery to geographical research in Siberia Consideration is given to the geographical tasks that can be aided by aerial and space imagery, technical problems related to geographical interpretation, and future prospects of the utilization of aerial and space methods in geography P T H

**A81-28058 #** Space imagery - Models of regional landscape structure (Kosmicheskie snimki - Modeli regional'noi landsaftnoi struktury) V A Nikolaev (Gosudarstvennyi Universitet, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 16-21 12 refs In Russian

Space remote sensing images are considered as hierarchical spatial-temporal models of landscape structures of physico-geographical regions The basic objects of image interpretation are natural landscape complexes, studied from the structural-dynamic standpoint with a view to the estimation of natural development trends and anthropogenic changes B J

**A81-28605** The size of net residential areas on aerial photographs V F L Polle (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13 25, 1980*) *ITC Journal*, no 3, 1980, p 544 562 48 refs

Aerial photographs have been applied to measuring the size of net residential areas Sample aerial photographs of residential areas in the Middle East and Indonesia are presented It is found that the photographs make it possible to determine the size of net residential areas, thus yielding input data for housing and population estimates The accuracy of data determined by photo-interpretation can be 5 percent or better S C S

**A81-29132** Atmospheric turbulence and diffusion estimates derived from observations of a smoke plume C J Nappo, Jr (NOAA, Atmospheric Turbulence and Diffusion Laboratory, Oak Ridge, Tenn ) *Atmospheric Environment*, vol 15, no 4, 1981, p 541 547 9 refs

Plan view and elevation photographs of a smoke plume are used to estimate horizontal and vertical dispersion rates Dispersion rates measured from individual photographs agree with Batchelor's theoretical analysis of relative diffusion Dispersion rates measured from a composite of plume photographs agree with Taylor's theoretical analysis of single-particle diffusion These dispersion rates are then used to calculate Eulerian turbulence parameters which are compared with observations made on a 60 m tower near the smoke plume source In addition, the Lagrangian turbulence time scale and the horizontal eddy diffusivity are estimated The comparisons of estimated with observed parameters are good, suggesting that the smoke plume technique for estimating atmospheric dispersion is realistic (Author)

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**A81-29825** Image analysis as a check on census enumeration accuracy C Clayton and J E Estes (California, University, Santa Barbara, Calif ) *Photogrammetric Engineering and Remote Sensing*, vol 46, June 1980, p 757 764 16 refs

High altitude color infrared photography is used as a data source for checking on the accuracy of certain types of information presented by the Federal Census Bureau The study area chosen was in the Goleta Valley of the Santa Barbara Standard Metropolitan Statistical Area (SMSA), California The imagery was used to provide an estimate of a number of one family houses contained in census blocks It was found that (1) manual image analysis of high altitude aerial photography can provide a more accurate estimate of the number of one family homes than can alternate sources of information, (2) errors associated with imagery derived data can be less in both magnitude and variability, (3) independently derived estimates may provide similar degrees of accuracy at one spatial scale and highly dissimilar estimates at another scale It was concluded that with regard to the number of residential structures per given spatially defined unit (in this case the census tract and block), image interpretation procedures are superior in providing a count of higher absolute accuracy than the Federal Census K S

**A81-29827** Urban land mapping from remotely sensed data M J Jackson, T F Smith (Department of the Environment, Planning Intelligence Directorate, London, England), P Carter, and W G Gardner (Mines and Petroleum Department, Image Analysis Group, Harwell, Oxon, England) *Photogrammetric Engineering and Remote Sensing*, vol 46, Aug 1980, p 1041 1050 8 refs

Landsat imagery for monitoring land use in England and Wales was compared with the land use classification derived from aerial photography and site visits The research concentrated on six test areas ranging from a small town in rural East Anglia to a large area west of London Single date classification using only spectral information was found to yield initial accuracies of 80% for developed areas and 85 to 95% for rural areas A comparison of automated classification with conventional classification (ground truth) showed accuracy to be very high for physically developed areas in which the ground has been covered by some man made material and which are grouped so as to cover five hectares or more Misclassifications, however, occurred in low vegetation areas such as chalklands, in woodlands and heaths, and in areas of suburban housing as well as factories and public buildings in which the proportion of ground covered by buildings may be quite small Some possible refinements for these problems are suggested D K

**A81-29830** Statistical methods for determining land use change with aerial photographs B E Frazier and H F Shovic (Washington State University, Pullman, Wash ) *Photogrammetric Engineering and Remote Sensing*, vol 46, Aug 1980, p 1067 1077 16 refs

Three sampling methods are applied to the aerial detection of land use change occurring over a 337 sq km area of Whatcom County, Washington A 100% sample consisting of 130 squares (2.6 sq km each) was used as the conceptual population, and parameters within squares were determined with a random grid of 8 dots/sq km Simple random, stratified random, and systematic selection of samples from the population are examined, and land use change between two dates is assessed by paired and unpaired random techniques The most important parameters are found to be (1) sample square size sufficient to portray landscape complexity, (2) an adequate number of samples, and (3) the type of random method applied In all cases, paired random samples were more efficient than unpaired samples in showing differences between two dates Area-point sample distribution by random or stratified random procedures, however, showed no large differences in efficiency The most useful combinations of the sample square area and the dot density within each area are either 2.6 sq km with 8 dots/sq km or 1.25 sq km with 15 dots/sq km D K

**A81-29834** Effect of atmospheric conditions on remote sensing of a surface nonhomogeneity J V Dave (IBM Corp , Palo

Alto, Calif ) *Photogrammetric Engineering and Remote Sensing*, vol 46, Sept 1980, p 1173 1180 11 refs

Variations of the satellite-level radiance were studied numerically as a function of the nadir angle of a scan across a 5 km by 5 km surface nonhomogeneity The goal was to investigate the effect of atmospheric conditions on remote sensing of the surface nonhomogeneity The Lambert reflectivities of the nonhomogeneity and the background are taken to be 0.05 (e.g., water) and 0.30 (e.g., bright sand) An approximate solution for three one-dimensional atmospheric models, with varying numbers of aerosol particles, is obtained, and it is concluded that the atmospheric blurring effect is a function of the amount of atmospheric haziness, the solar zenith angle, the position of the nonhomogeneity with respect to the local nadir direction, and the wavelength of the radiation K S

**N81-16519#** Army Engineer Waterways Experiment Station Vicksburg, Miss Environmental Lab  
**ACQUISITION OF TERRAIN INFORMATION USING LANDSAT MULTISPECTRAL DATA REPORT 3 APPLICATION OF AN INTERACTIVE CLASSIFICATION PROCEDURE IN SOUTH LOUISIANA**  
Margaret H Smith and Horton Struve Sep 1980 125 p refs (DA Proj 4A1-61101-A-91D) (AD-A092807 WES-TR-M-77-2-3-Pt-3) Avail NTIS HC A06/MF A01 CSDL 08/6

This report documents the application of an interactive Landsat classification procedure in South Louisiana The procedure discussed in Report 2 of this series, is an interim solution to the problem of mapping very large areas in terms of relatively crude categories in very short periods of time The area selected for study was Baton Rouge and vicinity This area includes a portion of the Mississippi River, wooded areas farm land and various categories of urban land use The procedure successfully classified the water woods farm land and industrialized urban categories but failed to correctly classify residential urban areas due to the nonuniqueness of their spectral signatures GRA

**N81-16679\*#** Texas A&M Univ College Station Dept of Meteorology  
**COMPARISONS BETWEEN NIMBUS 6 SATELLITE AND RAWINSONDE SOUNDINGS FOR SEVERAL GEOGRAPHICAL AREAS**  
Nine-Min Cheng and James R Scoggins 1981 76 p refs Sponsored in part by NASA (Grant DAAG29-76-G-0078) (NASA-RP-1073, M-330) Avail NTIS HC A05/MF A01 CSDL 04B

Good agreement between satellite and weighted (linearly interpolated) rawinsonde temperature and temperature derived parameters was found in most instances with the poorest agreement either near the tropopause region or near the ground However, satellite moisture data are highly questionable The smallest discrepancy between satellite and weighted mean rawinsonde temperature and parameters derived from temperature was found over water and the largest discrepancy was found over mountains Cumulative frequency distributions show that discrepancies between satellite and rawinsonde data can be represented by a normal distribution except for dew point temperature T M

**N81-17506#** Environmental Monitoring and Support Lab, Las Vegas, Nev  
**REMOTE SENSING OF OZONE USING AN INFRARED DIFFERENTIAL ABSORPTION SYSTEM Technical Report, 1978**  
J L Guagliardo, R T Thompson Jr, D H Bundy and M H Wells (Nevada Power Co, Las Vegas) Nov 1980 14 p refs (PB81-111866, EPA-600/4-80-047) Avail NTIS HC A02/MF A01 CSDL 14B

A prototype airborne downlooking infrared differential absorption system using CO<sub>2</sub> TEA (transverse excited atmospheric) lasers is described The system uses two wavelengths and topographic reflection to measure the integrated column concentration of ozone between the laser source/receiver and a noncooperative target A comparison is made between ozone

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absorption coefficients measured with TEA lasers and values reported from other sources. Ground tests utilized two 30-cm long ozone-filled test cells, one in each laser path. A correlation was observed between measurements of TES laser pulses backscattered from a building and ultraviolet determination of ozone concentration in the cells. GRA

**N81-19649\*#** National Aeronautics and Space Administration Langley Research Center Hampton Va  
**THE 1979 SOUTHEASTERN VIRGINIA URBAN PLUME STUDY VOLUME 1 DESCRIPTION OF EXPERIMENTS AND SELECTED AIRCRAFT DATA**  
Gerald L Gregory, Robert B Lee, III and Joe J Mathis Jr  
Feb 1981 72 p refs  
(NASA-TM-81860-Vol-1) Avail NTIS HC A04/MF A01 CSCL 13B

The Southeastern Virginia Urban Plume Study (SEV-UPS) utilizes remote sensors and satellite platforms to monitor the Earth's environment and resources. SEV-UPS focuses on the application of specific remote sensors to the monitoring and study of specific air quality problems. The 1979 SEV-UPS field program was conducted with specific objectives: (1) to provide correlative data to evaluate the Laser Absorption spectrometer ozone remote sensors; (2) to demonstrate the utility of the sensor for the study of urban ozone problems; (3) to provide additional insights into air quality phenomena occurring in Southeastern Virginia; and (4) to compare measurement results of various in situ measurement platforms. The field program included monitoring from 12 surface stations, 4 aircraft, 2 tethered balloons, 2 radiosonde release sites, and numerous surface meteorological observation sites. The aircraft monitored O3, NO, NOx, Bscat, temperature, and dewpoint temperature. S F

**N81-19717#** Naval Oceanography Command Center/Joint Typhoon Warning Center Guam  
**ANNUAL TROPICAL CYCLONE REPORT 1980 Annual Report, Jan - Dec 1980**  
1980 190 p refs  
(AD-A094668) Avail NTIS HC A09/MF A01 CSCL 04/2  
Annual publication summarizing the tropical cyclone season in the western North Pacific, Bay of Bengal and Arabian Sea. A brief narrative is given on each significant tropical cyclone including the best track. All reconnaissance data used to construct the best tracks are provided. Forecast verification data and statistics for the JTWC are summarized. Research efforts at the JTWC and NEPRF are discussed briefly. GRA

**N81-20531#** Lockheed Engineering and Management Services Co., Inc Las Vegas Nev Remote Sensing Lab  
**SUMMARY OF THE WESTERN ENERGY OVERHEAD MONITORING PROJECT Final Report, 1 Jul 1975 - 31 Oct 1979**  
Paul Ishikawa Jr Nov 1980 38 p refs  
(Contract EPA-68-03-2636)  
(PB81-129009, EPA-600/4-80-051) Avail NTIS  
HC A03/MF A01 CSCL 13B

The Environmental Protection Agency and the National Aeronautics and Space Administration entered into a five year overhead monitoring project in June 1975. The purpose of the joint project was to transfer from NASA to EPA hardware and software technology for processing remotely sensed digital data and to assist EPA in developing and maintaining an operational remote sensing monitoring system. The overall objective was to define, develop and demonstrate operational remote sensing techniques to rapidly monitor, in a cost effective manner, the access with which an energy related extraction site has been or is being, rehabilitated. The technology transfer that took place is discussed and the remote sensing monitoring system EPA is described. GRA

**N81-20608\*#** National Aeronautics and Space Administration Langley Research Center Hampton Va  
**THE 1979 SOUTHEASTERN VIRGINIA URBAN PLUME STUDY VOLUME 2 DATA LISTINGS FOR NASA CESSNA AIRCRAFT**

Gerald L Gregory Robert B Lee, III and Joe J Mathis Jr  
Feb 1981 200 p  
(NASA-TM-81860-2) Avail NTIS HC A09/MF A01 CSCL 13B

The data reported are those measured onboard the NASA Langley chartered Cessna aircraft. Data include ozone, nitrogen oxides, light scattering coefficient, temperature, dewpoint, and aircraft altitude. T M

**N81-21429\*#** National Aeronautics and Space Administration Earth Resources Labs Bay St Louis Miss  
**EVALUATION OF THREE TECHNIQUES FOR CLASSIFYING URBAN LAND COVER PATTERNS USING LANDSAT MSS DATA**  
Paul R Baumann Principal Investigator (State Univ of New York at Oneonta) Jan 1979 37 p refs. Original contains imagery. Original photography may be purchased from the EROS Data Center Sioux Falls SD 57198 ERTS  
(E81-10127 NASA-TM-82323 Rept-178) Avail NTIS  
HC A03/MF A01 CSCL 08B

Three computer quantitative techniques for determining urban land cover patterns were evaluated. The techniques examined deal with the selection of training samples by an automated process, the overlaying of two scenes from different seasons of the year, and the use of individual pixels as training points. Evaluation was based on the number and type of land cover classes generated and the marks obtained from an accuracy test. New Orleans, Louisiana and its environs form the study area. The automated process produced results comparable, if not better than, sample classifications developed under normal manual approaches. Relative accuracy was at a level of 80 percent or higher, except for urban classes outside the urban area. The overlay technique created good classifications with respect to the type of urban land cover classes but had low relative accuracy in relation to the other techniques. Point clustering had very high accuracy for land cover classes and the residential class covering suburban areas separated well on the urban fringe. A R H

## GEODESY AND CARTOGRAPHY

Includes mapping and topography

**A81-23029** Algorithms for dense digital terrain models S H Collins (Guelph, University, Guelph, Ontario, Canada) and G C Moon (Collins and Moon, Ltd, Guelph, Ontario, Canada) *Photogrammetric Engineering and Remote Sensing*, vol 47, Jan 1981, p 71-76 6 refs Research supported by the Department of Energy, Mines and Resources and Department of National Defence

A family of computer algorithms has been developed at the University of Guelph to derive quantitative data and topographic and thematic maps from dense digital terrain models The sources of such models are discussed briefly, and the rules that have been adopted for generating new programs are described Some of the programs derive completely new quantitative and qualitative descriptors of the terrain, and all of them are intended for operations on 10 to the 5th to 10 to the 7th points or more Finally, a new geocoding algorithm is described for deriving thematic maps from arbitrary combinations of topographic and thematic data obtained from a wide variety of sources (Author)

**A81-23586 #** A system of advanced cartographic technology for developing nations F El-Baz (National Air and Space Museum, Washington, D C) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 701-712

**A81-23621 #** Cartographic methods for representing classified satellite images J Aste, J Gonzalez (IBM de Mexico, S A, Centro Científico, Mexico City, Mexico), and G Gonzalez (Estado de México, Universidad Autónoma, Toluca, Mexico) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1129-1132

The methods described in this work, provide an inexpensive and accurate means of representing classified satellite images These methods were developed as, in projects with various Latin American and Mexican government agencies, the need arose to print soil, erosion and land use classification results in the form of a cartographic map projection Before classification, the original image is geometrically corrected by means of an interpolation program in order to conform with cartographical map projections Once the corrected image is classified, three methods of cartographical representation were implemented Two of them use the output of a scanner/plotter to produce, either photographically or lithographically, a color print The third method uses a scaling process which, by means of a variable size, non integer, scanning window, produces accurate line printer character maps that are reproduced in color form through lithographic processes (Author)

**A81-25895** Using the Global Positioning System /GPS/ for geodetic positioning J D Bossler, C C Goad (NOAA, National Geodetic Survey, Rockville, Md.), and P L Bender (Joint Institute for Laboratory Astrophysics, Boulder, Colo) *Bulletin Geodésique*, vol 54, no 4, 1980, p 553-563 15 refs

Several concepts for the utilization of the NAVSTAR Global Positioning System (GPS) are briefly reviewed, and another concept, called the reconstructed carrier phase method, is described in detail Several government agencies are pursuing the development of this method in keeping with their requirements for accurate positioning Receivers whose testing is planned for mid 1982 should be highly portable, consume little power, and obtain base line accuracies of several centimeters in several hours of observation time, and full

accuracy may be achieved with the use of water vapor radiometers Initial simulation results using the reconstructed carrier phase method are included O C

**A81-25896 \*** A comparative analysis of GPS range, Doppler and interferometric observations for geodetic positioning P J Fell (U S Navy, Naval Surface Weapons Center, Dahlgren, Va) *Bulletin Geodésique*, vol 54, no 4, 1980, p 564-574 13 refs U S Defense Mapping Agency Contract No PE-63701B/3201/240, Grant No NsG 5265

Geodetic positioning accuracies obtained from range, integrated Doppler and double differenced interferometric phase observations from a constellation of twenty-four Global Positioning System satellites are presented It is demonstrated the GPS range and Doppler observations will provide sufficient accuracy for the estimation of geodetic coordinates However the instability of the receiver atomic oscillator will limit the usefulness of these observations in providing rapid first-order baseline determination Interferometric phase measurements twice differenced to eliminate clock error appear as an alternate procedure for providing such accuracies (Author)

**A81-26387** Satellite and field studies of man's impact on the surface in arid regions J Otterman (Tel Aviv University, Tel Aviv, Israel, U S Geological Survey, Reston, Va) *Tellus*, vol 33, Feb 1981, p 68-77 20 refs

The anthropogenic impact on the surface as well as on the surface albedo in the arid regions of the Sinai and Negev is examined using Landsat multispectral imagery and ground truth observations The anthropogenic pressures result in the crumbling of the soil and possibly prevent the natural crusting and cohesion of the surface Based on the spatial differences between the impact areas and the adjoining protected steppe, it is concluded that the anthropogenic pressures can result in an increase of albedo by a factor of two thirds The nadir reflectivity is characterized as a function of the fractional cover by plants or plant debris, and the models are used to evaluate the Negev/Sinai albedo differences The darkening of a surface in a Sinai enclosure not subject to anthropogenic effects since 1974 is also examined L S

**A81-27924** Surface albedos derived from satellite data and their impact on forecast models H J Preuss (Köln, Universität, Cologne, West Germany) and F Geleyn (European Centre for Medium Range Weather Forecasts, Reading, Berks, England) *Archiv für Meteorologie, Geophysik und Bioklimatologie, Serie A Meteorologie und Geophysik*, vol 29, no 4, 1980, p 345-356 12 refs

A method to derive surface albedos from satellite (Nimbus 3) data is described The resulting values are compared with the GFDL ones which were previously used in forecasting models of the European Center for Medium Range Weather Forecasts (ECMWF) Especially at high latitudes of the Northern Hemisphere, differences are to be seen The new surface albedos were implemented in ECMWF's operational system and the influences of this change are investigated It is shown that after 10 days the two different soil reflectances yield only small variations relative to the land surface temperatures The advantage of the more realistic, satellite derived surface albedos may become more important for larger forecasting periods (Author)

**A81-28071 #** Development and study of efficient methods for the carrying out of geophysical experiments (Razrabotka i issledovanie ekonomichnykh metodov provedeniia geofizicheskikh eksperimentov) M Iu Beliaev and T N Tian *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 90-95 In Russian

The development of efficient satellite control systems for the carrying out of geophysical studies from space is examined Attention is given to the determination of spacecraft attitude from telemetry data in the case when passive methods are used for the angular control of the spacecraft This method was used in carrying out geophysical experiments onboard the Salyut station in 1979

B J

### 03 GEODESY AND CARTOGRAPHY

**A81-28604** Spectral analysis of terrain relief for the accuracy estimation of digital terrain models K Tempfli (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980*) *ITC Journal*, no 3, 1980, p 478-510 6 refs

**A81-29836 \*** The topographic effect on spectral response from nadir-pointing sensors B N Holben and C O Justice (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md) *Photogrammetric Engineering and Remote Sensing*, vol 46, Sept 1980, p 1191-1200 19 refs

It is difficult to interpret multispectral Landsat earth resources data in areas of rugged and mountainous terrain because of the topographic effect on the sensor response. The objectives of this study were to examine and quantify the topographic effect on the sensor response from a uniform sand surface, to assess a simple theoretical incidence model for modeling the radiance from the surface, and to simulate Landsat sensor response due to the topographic effect. A field experiment was designed to collect data from a large range of slope angles and aspects at a range of solar elevations, using a hand-held radiometer. Analysis of these data showed that the magnitude of the topographic effect varied as a function of the solar elevation, the azimuthal orientation of the slope, and the slope inclination. The field measured variations in spectral response were found to have generally strong correlations with the theoretical model, and it was shown that the applicability of the Lambertian assumption varied within and between data sets. It is concluded that if slope angle, aspect, and solar zenith angle and azimuth are known, a technique incorporating a model to reduce the topographic effect prior to multispectral classification may be developed. K S

**N81-17499\*** National Aeronautics and Space Administration Hugh L Dryden Flight Research Center, Edwards, Calif  
**METHOD FOR OBSERVING THE FEATURES CHARACTERIZING THE SURFACE OF A LAND MASS** Patent  
Robert D Reed, inventor (to NASA) Issued 23 Dec 1980 7 p Filed 30 May 1979 Supersedes N79-24979 (17 - 16, p 2073)

(NASA-Case-FRC-11013-1, US-Patent-4,240,801, US-Patent-Appi-SN-043912, US-Patent-Class-244-160, US-Patent-Class-244-49) Avail US Patent and Trademark Office CSCL 08B

A method is described where a propeller driven, hydrazine powered aircraft is remotely piloted through rarefied atmosphere of a selected planet, including the planet Earth. It is employed as a communication platform for a telemetry system provided for relaying information relating to features characterizing the surface of the planet.

Official Gazette of the U S Patent and Trademark Office

**N81-19161#** Deutsche Forschungsgemeinschaft, Bad Godesberg (West Germany)

**SPACE RESEARCH IN THE FEDERAL REPUBLIC OF GERMANY, 1979** Annual Report  
1980 66 p refs

Avail NTIS HC A04/MF A01

Activities in aeronomy, ionospheric and magnetospheric physics are described. Studies of solar radiation and the solar wind, the atmosphere of Venus, micrometeorites and cosmic dust are outlined. Research was conducted in stellar astronomy, the life sciences, materials sciences, satellite geodesy and meteorology. Ground truth measurements were conducted.

Author (ESA)

**N81-19380#** Rome Air Development Center, Griffiss AFB, NY  
**THE SIGNIFICANCE OF DATA COLLECTION PARAMETERS WHEN UTILIZING RADAR AND DIGITAL TERRAIN MODELS TO LOCATE TERRAIN FEATURES**

Robert H Brock, Jr (State Univ of New York Coll of Environ Science and Forestry) and Donald I Zulch 1980 55 p refs (AF Proj 4519)

(AD-A094816, RADC-TR-80-312) Avail NTIS HC A04/MF A01 CSCL 08/6

The combination of cartographic and hypsographic data with radar data can generate the location of terrain features in the ground reference system. The significance of selected data collection parameters used in this task is investigated in three phases: (1) the development of deterministic radar models from given digital terrain models and varying radar parameters; (2) the perturbation of the terrain feature coordinates which result from errors in radar position, radar orientation, range and resolution; and (3) a factorial analysis of the terrain feature errors to establish the significance of the main fixed factors and their interactions. The main factors are azimuth from radar to terrain feature, range, resolution, terrain height and coordinate. The results indicate that the order of greatest to least importance for the factors is coordinate, range, resolution, terrain height and azimuth. GRA

**N81-19528\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**SEASAT ALTIMETER HEIGHT CALIBRATION**

Ronald Kolenkiewicz and Chreston F Martin (EG and G Washington Analytical Services Center, Inc., Riverdale, Md) Mar 1981 42 p refs Submitted for publication

(NASA-TM-82040) Avail NTIS HC A03/MF A01 CSCL 05B

The Seasat altimeter was calibrated for height bias using four overflight passes of Bermuda which were supported by the Bermuda laser. The altimeter data was corrected for tides, using recorded tide gauge data, propagation effects, using meteorological data taken around the time of each pass, acceleration lag, and sea state bias, including both surface effects and instrumental effects. Altimeter data for each of the four passes was smoothed and extrapolated across the island. Interpolation between passes then produced an equivalent altimeter measurement to the geoid at the laser site, so that the altimeter bias could be estimated without the use of a geoid model. The estimated height bias was  $0.0 \pm 0.07$  m. J M S

**N81-19544#** Committee on Space Research (COSPAR), Berne (Switzerland).

**SPACE RESEARCH IN SWITZERLAND, 1979** Annual Report

1979 23 p

Avail: NTIS HC A02/MF A01

Efforts in satellite geodesy, studies of the middle atmosphere and magnetosphere, solar wind research, and investigation of noble gases in lunar materials are reported. Work on solar flares, the solar constant, optical and radio astronomy observations, and Earth resource studies including digital classification of data and analog processing of imagery from LANDSAT are reviewed.

Activities involving BIORACK, and exobiology are listed. Author (ESA)

**N81-19552#** National Environmental Satellite Service, Washington, D C Environmental Sciences Group

**IMPROVED ALGORITHM FOR CALCULATION OF UTM AND GEODETIC COORDINATES**

Jeff Dozier Sep 1980 27 p refs

(PB81-132680, NOAA-TR-NESS-81 NOAA-80101501) Avail NTIS HC A03/MF A01 CSCL 08E

Expression of the equations for a Universal Transverse Mercator (UTM) (Gauss-Kruger) projection in terms of Jacobian elliptic functions rather than their series expansions allows the projection to be used over wider zones than the standard 6 deg strips, and thus makes it applicable to satellite data from the NOAA A-G series. An efficient iterative solution method for either UTM or geodetic coordinates is developed using a complex arithmetic version of Newton's method. The method can be used for longitudes up to 90 deg from the central meridian. GRA

**N81-19681\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**MAGNETIC SPACE-BASED FIELD MEASUREMENTS**

Robert A Langel Mar 1981 19 p refs

(NASA-TM-82104) Avail NTIS HC A02/MF A01 CSCL 08G

Because the near Earth magnetic field is a complex combination of fields from outside the Earth of fields from its core and of fields from its crust measurements from space prove to be the only practical way to obtain timely, global surveys. Due to difficulty in making accurate vector measurements early satellites such as Sputnik and Vanguard measured only the magnitude survey. The attitude accuracy was 20 arc sec. Both the Earth's core fields and the fields arising from its crust were mapped from satellite data. The standard model of the core consists of a scalar potential represented by a spherical harmonics series. Models of the crustal field are relatively new. Mathematical representation is achieved in localized areas by arrays of dipoles appropriately located in the Earth's crust. Measurements of the Earth's field are used in navigation, to map charged particles in the magnetosphere, to study fluid properties in the Earth's core, to infer conductivity of the upper mantels, and to delineate regional scale geological features. A R H

**N81-19701#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany)

**CONTINENTAL NETWORKS REPORT ON THE ACTIVITIES OF THE IAG-COMMISSION X FROM 1975 TO 1979**

Rudolf Sigl 1979 60 p refs Presented at Intern Assoc of Geodesy (IAG) Canberra Australia 2-15 Dec 1979 (Ser-B-243 ISBN-3-7696-8536-9 ISSN-0065-5317) Avail NTIS HC A04/MF A01

Activities for the establishment of uniform systems of geodetic control points are reported. Working methods are discussed. Subcommission activity reports include European triangulation, European leveling and other geodetic work. The definition and importance of continental networks are discussed. Problems with the establishment of geodetic networks using terrestrial observation as well as satellite geodesy are analyzed and proposals for possible solutions are presented. Author (ESA)

**N81-20496#** Centre National d'Etudes Spatiales, Toulouse (France)

**SPACEBORNE CARTOGRAPHY OF THE EARTH [CARTOGRAPHIE SPATIALE DE LA TERRE]**

1979 653 p refs In FRENCH Proc of CNES/Inst Geograph Natl Cours de Technol Spatiale 1979, Toulouse, 5-19 Jun 1979 Prepared in cooperation with Inst Geograph Natl, Paris Avail NTIS HC A99/MF A01

Several topics on the mapping of remote sensor data are discussed. The following are emphasized: cartography and geodesy, spacecraft motion and its influence on the geometric quality of imagery and classical photogrammetry. For individual titles, see N81-20497 through N81-20523.

**N81-20497#** Institut Geographique National, Paris (France) Ecole Nationale des Sciences Geographiques

**THE GEOMETRY OF GEODESY [GEODESIE GEOMETRIQUE]**

J LeMenestrel In CNES Spaceborne Cartography of the Earth 1979 p 3-30 In FRENCH

Avail NTIS HC A99/MF A01

The determination of a simple mathematical surface and the localization of points on the surface is treated using a two dimensional geometric approach. Examples offered are point location on (1) a solid, immobile sphere (2) a rotating fluid ellipsoid, (3) the geoid, and (4) on a geometrical polyhedron, for problems in three dimensional geodesy. Position data acquisition applications (triangulation horizontal line of sight and astronomic position measurement) are described. Extension of the method to spatial geodesy is discussed including optical satellite observations. Results are further used to outline a Doppler method from satellite geodesy. Author (ESA)

**N81-20499#** Centre National d'Etudes Spatiales, Toulouse (France)

**DYNAMIC SPATIAL GEODESY [GEODESIE DYNAMIQUE SPATIALE]**

M B Lago In its Spaceborne Cartography of the Earth 1979 p 51-59 In FRENCH

Avail NTIS HC A99/MF A01

Classical methods of spatial geodesy are discussed, then recent techniques in geodynamics and spatial oceanography are reviewed. The repartition of laser (or Doppler effect) ground tracking stations is examined. Orbital parameters that must be determined as well as conditions to be fulfilled as to the orbits, arcs, and measurements are outlined. Models for the global restitution of the gravitational potential of the Earth are compared. The role of complementary gravimetric measurements is shown. Results obtained using GEOS C and Seasat measurements to determine local geoids are cited. A strong correlation between the restituted geoid and marine topography is shown.

Author (ESA)

**N81-21413\*#** Colorado Univ Boulder Dept of Astro-Geophysics

**INVESTIGATION OF GEOMAGNETIC FIELD FORECASTING AND FLUID DYNAMICS OF THE CORE Quarterly Status Technical Progress Report, 1 Jan - 31 Mar, 1981**

Edward R Benton, Principal Investigator 1 Apr 1981 6 p ERTS

(Contract NAS5-25957)

(E81-10093, NASA-CR-164091, QSTPR-5) Avail NTIS HC A02/MF A01 CSCL 08G

The discovery of simple, theoretically sound upper limits for geomagnetic moments (dipole, quadrupole, etc) provides a significant use of MAGSAT data, establishes useful constraints for future magnetic models, and bears strongly on the probable time required before the next polarity reversal can occur. The field models of MAGSAT data are of prime use and are highly suitable as supplied to date. A R H

**N81-21428\*#** National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Md

**USING THE LANDSAT DATA COLLECTION SYSTEM FOR FIELD GEOPHYSICS OPERATIONS IN THE BRITISH VIRGIN ISLANDS**

William J Webster Jr Walter K Allen Eugene L Gilbert and J Earl Painter Principal Investigators Dec 1980 59 p refs ERTS

(E81-10126 NASA-TM-82018) Avail NTIS HC A04/MF A01 CSCL 08G

This particular application was to vertical geodesy by tide gauge and tiltmeter on a small desert island in the British Virgin Islands. The performance of the LANDSAT system under potentially marginal circumstances was found to be excellent.

T M

**04**  
**GEOLOGY AND MINERAL  
RESOURCES**

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

**A81-22939 \*** **Geologic remote sensing** A F H Goetz (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif) and L C Rowan (US Geological Survey, Reston, Va) *Science*, vol 211, Feb 20, 1981, p 781-791 65 refs Contract No NAS7-100

Remote-sensing techniques based on the analysis of spectral reflectance, spectral emittance, thermal inertia, and radar measurements are reviewed Specific applications of Landsat multispectral scanner are examined with emphasis on mineral exploration The potential of satellite systems for detailed lithologic mapping is pointed out V L

**A81-23031** **Textural enhancement of a circular geological feature** I L Thomas, A D W Fowler (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand), R Howorth, and A Eggers (Wellington, Victoria University, Wellington, New Zealand) *Photogrammetric Engineering and Remote Sensing*, vol 47, Jan 1981, p 89-91 7 refs

Subtractive box filtering is used to texturally enhance a circular structural feature recorded by a Landsat 2 image (2984-21002) over the northern part of South Island, New Zealand The geological structure is associated with porphyry molybdenum-copper sulphide mineralization (Author)

**A81-23545 #** **The application of remote sensing techniques to prospecting for metal deposits** B Kezheng (Ministry of Metallurgical Industry, Peking, Communist China) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 135-142

The uses of remote sensing for the study of fractural structures in Northern China are analyzed in the context of mineral prospecting Landsat imagery has indicated the control of faults over mineralization, specifically of Fe and Cu deposits, which are primarily distributed in a N-S zoning pattern Seven approximately evenly spaced zones of linear structures, according to direction, and two types of ring structures, the positive represented by rock bodies, volcanic structures and domes and the negative represented by basins, are presented, and the presence of Cu, Pb and Zn deposits primarily at the junctions of four concentrated linear structure zones and at the margins of various ring structures is discussed The efficiency of Landsat imagery for delineating new target areas and for compiling and revising geological maps, particularly for remote and mountainous areas, is stressed D K

**A81-23550 \* #** **Expanding the spectrum from space** L F Dellwig (Kansas, University, Lawrence, Kan) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 189-197 8 refs Contract No NAS7-100

Various space data gathering systems are described which aid in exploration for mineral and petroleum resources in Central America and elsewhere throughout the world The Side Looking Airborne Radar (SLAR), the Seasat, configured for ocean studies, and the SIR-A, the first spacecraft radar to be configured for geologic studies, are discussed The low cost and importance of spacecraft in data gathering are emphasized D K

**A81-23555 #** **Evaluating the environmental effects of past and present surface mining - A remote sensing applied research review** A T Anderson (US Department of the Interior, Office of Surface Mining, Washington, D C) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 275-278

The objectives of the Office of Surface Mining Reclamation and Enforcement (OSM) of the US Department of Interior are outlined, with a view to its applied research program on remote sensing projects The projects discussed include the development of a coal surface mine monitoring capability, the aerial photography of the Appalachian coal regions, contributions to the national high-altitude aerial photography data base and western surface mine aerial coverage Remote sensing is also being used as a supplementary tool in five project and program areas dealing with mine evaluation L S

**A81-23560 #** **Use of Landsat images in tin exploration, Brazil** J R Keighley, K R Nelson (Colorado School of Mines, Golden, Colo), and W W Lynn In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 341-343

Experimentation with Landsat imagery in Brazil over deposits where the geology is well known shows that tin-bearing intrusives can be identified and new targets discovered by using Band 7 images and false color composites This method differentiates the tin-bearing granites from barren granitic intrusives and anatectic granites Several extensive and economically important tin belts, both north and south of the Amazon Basin, are obvious on Landsat images covering the Amazonian Precambrian shield area of Brazil L S

**A81-23562 #** **Petroleum exploration with Landsat in Bay County, Michigan - An interim case study** R K Vincent and D H Coupland (Geospectra Corp, Ann Arbor, Mich) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 379-387

Results are presented from a Landsat study of an area in Bay County, Michigan performed for the purposes of petroleum exploration A lineation mapped from a contrast-stretched color composite was thought to be a fault trending NE SW from the Southeastern corner of Saginaw Bay Seismic data were used to confirm the existence of the fault and support an adjacent graben structure hypothesis The second of two holes drilled on the northwestern margin found a significant show of gas and a minor oil show Groundwater action along the fault trace may have been responsible for the appearance of the linear features in the computer-processed Landsat images L S

**A81-23587 #** **Remote sensing techniques for identification and evaluation of geothermal areas** L del Rio, P N Pascaud, S Camacho, and N Galvan (Universidad Nacional Autonoma de Mexico, Mexico City, Mexico) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23 30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 731-742 25 refs

**A81-23592 \* #** **Geologic mapping of the Ladakh Himalaya by computer processing of Landsat data** J R Francica, R W Birnie, and G D Johnson (Dartmouth College, Hanover, NH) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 773-782 14 refs NSF Grants No INT-77-18362, No EAR-78-03639, Grant No NSG 5014

## 04 GEOLOGY AND MINERAL RESOURCES

Computer processed Landsat digital data and field studies have been integrated to make a geologic map of the Indus Suture in the Ladakh Himalaya. This coordinated approach has been successful at locating and identifying the areal extent of the major rock bodies in a 2500 square kilometer area, much of which is inaccessible for conventional field geologic studies (Author)

**A81-23594 #** Multidisciplinary geoscientific investigations of Landsat imagery of Upper Volta, West Africa. D Bannert (Bundesanstalt für Geowissenschaften und Rohstoffe, Hanover, West Germany). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 787-789

A multidisciplinary geoscientific investigation of multitemporal Landsat imagery, conducted by a team of four scientists, is described. This work was carried out in the Republic of Upper Volta. The work resulted in an appraisal of the suitability of Landsat image interpretation for geology, mineral prospects, pedology and soil potential, land use, population distribution, rock lineations and land development potential. D K

**A81-23595 #** An evaluation of image processing methods applied to Landsat data for the detection of an arctic natural oil seep. M E Kirby (Intera Environmental Consultants, Ltd., Ottawa, Canada). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 791

**A81-23614 \* #** Remote sensing of surface mines - A comparative study of sensor systems. J R Irons (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md.), H La chowski, and C Peterson (General Electric Co., Space Div., Beltsville, Md.). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1041-1053. 13 refs

The application of remote sensing to the inventory of coal surface mines and to the monitoring of mine reclamation in the eastern United States was investigated. Data were acquired during spring and autumn by several sensor systems over study areas located within the bituminous coal fields of Pennsylvania. Data sources were the Landsat MSS, an airborne multispectral scanner (Daedalus DS 1260), the airborne Thematic Mapper Simulator, and high altitude color and color infrared aerial photography. A comparison of the data sets was conducted by a quantitative assessment of area measurement accuracy. Landsat data were found most suitable for a synoptic inventory of mines on a regional basis. High-altitude aerial photography was considered the best source of the detailed information required for reclamation monitoring. Nine channels of data from the airborne scanner were evaluated to select the most useful spectral bands for discriminating among the land cover types associated with surface mines. Four bands were selected in the following order by a stepwise linear discriminant procedure: 0.60-0.65 micron, 0.92-1.10 microns, 0.80-0.89 micron, and 8-14 microns. The data corresponding to these four bands were used for the thematic mapping of land cover. (Author)

**A81-23630 #** Remote sensing applied to the prospecting of geothermal anomaly in Caldas Novas County - State of Goiás - Brazil. P Veneziani and C Eustaquio dos Anjos (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1239-1242. 10 refs

The objective of this research was to study thermally anomalous areas associated with hot waters in the County of Caldas Novas, State of Goiás, Brazil. Data collection was conducted using a 50-cm soil

thermometer and a precision radiation thermometer. The temperature data, processed by a Trend Surface Analysis Program, indicated the presence of 4 principal anomaly areas, the town of Caldas Novas, Corrego Tucum, Pousada do Rio Quente, and Lagoa Pirapetinga. These areas were verified in the field. In the area of the town of Caldas Novas, of 14 deep wells drilled, 9 revealed water temperatures from 33 to 41 C, 2 contained hot mud, 1 contained sulfurous water measured at 29 C. Two dry wells were also encountered. (Author)

**A81-23641 #** Remote sensing techniques for geologic and mineral potential mapping in Brazil. P R Meneses, W R Faradella, and C C Liu (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1365-1373. 12 refs

**A81-23646 #** Drainage and lineament study of the Pampean plain with remote sensors. P Pasotti and C A Canoba (Rosario, Universidad Nacional, Rosario, Argentina). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1419-1427. 17 refs

The visual interpretation of Landsat images, which are found to be important in recognizing tectonic lineaments, is evaluated in a study of hydrographic nets and lineaments of a sector of the Pampean plains in Argentina. An account based on visual observation is given of the morphology and tectonics of the area, and the methods of visual interpretation of the MSS Landsat images are presented, including the use of an Additive Color Viewer for positive images in a scale of 70 mm. It is found that the lineal traits perceived on the Landsat images include the majority of those ascribed to known features and to topographic lineaments, but that the paleonetwork may be only partially perceived. D K

**A81-23656 #** Geology, morphotectonic analysis, and soils mapping of central Haiti, based on Landsat image and aerial photographs. N G Muñoz (Universidad Central de Venezuela, Caracas, Venezuela), A V Segovia, and J E Foss (Maryland, University, College Park, Md.). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1529-1535

**A81-23657 #** Structural mapping from MSS Landsat imagery - A proposed methodology for international geological correlation studies. E Crepani and P R Martini (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1557-1564. 19 refs. Translation

A methodology is proposed for international geological correlation studies based on Landsat MSS imagery. Bullard's et al. model of continental fit and compatible structural trends between Northeast Brazil and the West African counterpart. Six extensive lineaments in the Brazilian study area are mapped and discussed according to their regional behavior and relation to the adjacent continental margin. Among the first conclusions, correlations were found between the Sobral Pedro II Lineament and the megafaults that surround the West African craton, and the Pernambuco Lineament with the Ngaurandere Lineament in Cameroon. Ongoing research to complete the methodological stages will include the mapping of the West African structural framework, reconstruction of the pre-drift puzzle and an analysis of the counterpart correlations. (Author)

**A81-23670 #** Mapping of lithologies in North-East Mexico through satellite image processing. J Lira (IBM de Mexico, S A., Mexico City, Mexico), C Pacheco, and A Rodriguez (Instituto



Mexicano del Petroleo, Mexico City, Mexico) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1701-1710 10 refs

**A81-23673 # Thermal infrared continuous ground measurements in severe environment - A working data collection system** P A Brivio and R Tomasoni (National Research Council, Geophysics Institute, Milan, Italy) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1731-1740

The characteristics and operating procedure of a data collection station on Vulcano Island in Southern Italy are presented with a view to the use of remotely sensed data in the study of crater surface thermal behavior. The station system includes an infrared radiometer for the collection of crater surface radiation and an electrical sensor for the measurement of solar radiation. Aerial surveys in the thermal IR band are performed using a two-channel (4.5-5.5 and 9-11 micron) thermal scanner. The results of the IR surveys are being utilized in the context of a national program monitoring active volcanos. L S

**A81-23685 # HCMM and Landsat imagery for geological mapping in Northwest Queensland** M M Cole and D J Edmiston (Bedford College, London, England) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1865-1875 5 refs

Repetitive HCMM imagery of western Queensland and northern South Australia is being analysed to assess its role alongside Landsat imagery for geological mapping and terrain evaluation. The study area straddles the Precambrian Shield, within which lies the Mount Isa-Cloncurry mineral belt contained in highly folded and faulted Proterozoic sedimentary rocks, the level plains of the Great Artesian Basin, flooded by Mesozoic and later sediments, and the inland drainage basin focussing on Lake Eyre. (Author)

**A81-23687 # Geologic application of remote sensing in Tengchong, Yunnan, China** J Wei, Z Zhou, and Z Liu (Academia Sinica, Lanchow Institute of Geology, Lanchow, Communist China) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1891-1900

With the aid of a stereoscope and available ground truth, a visual geological interpretation of aerial remote sensing imagery in Tengchong, Yunnan, China is made in this paper. By means of 29 typical images selected to serve as Key-Forms, both the selection method and the exclusion method are used for interpreting lithology and structure. Based upon analysis of the imagery, the region is divided into four lithological zones and two structural zones. The resulting lithological and structural interpretation is mapped at a scale of 1:100,000. In addition, the distribution rule and the genesis mechanism of volcanos, earthquakes and geothermal fields are discussed. Finally, an evolutionary model of the geological structure of the Tengchong volcanic cluster region is tentatively proposed. (Author)

**A81-23688 # An infrared survey of Irazu volcano and vicinity, Costa Rica** S J Gawarecki, J O Morgan (U S Geological Survey, Reston, Va.), R M Moxham, and D C Parker In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3

Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1901-1912 5 refs

A thermal infrared survey of Irazu volcano and vicinity was prompted by the catastrophic ash eruption of Irazu from March 1963 until February 1965. San Jose, Costa Rica, is 27 km downwind

or west-southwest from Irazu. This eruption was detrimental to the population attracted to this area by the fertile soils that had developed on volcanic ash from previous eruptions. The infrared survey was to determine the distribution and relative intensities of the terrain temperatures associated with the volcanic activity. However, persistent cloud cover, rain, and/or dense ash plumes over the volcano prevented a sequential study, and only about 10 percent of the planned survey program was completed. All the surveys were flown in a Douglas R4D aircraft with scanning radiometers sensitive to the 4.5-5.5 and the 8-14 micron wavebands of the infrared spectrum. The radiation data were recorded on photographic film and on magnetic tape. Measurements of the ground surface temperature were made with infrared radiometers, contact pyrometers, and thermometers. Despite inclement weather conditions, surveys of the most important areas showed that Irazu has a butterfly-shaped lava pit, the axis of which is aligned roughly east-west. Fumaroles and hot springs were strongly developed on the northwest flank 1.3-2.1 km from the active crater and weakly developed 1.6-3.7 km to the northeast. (Author)

**A81-23860 Contribution of space technology to earthquake prediction research** A Vogel (Berlin, Freie Universität, Berlin, West Germany) *Advances in Earth Oriented Applications of Space Technology*, vol 1, no 1, 1981, p 117-48 refs

To begin with the predictability of earthquakes is discussed and earthquake prediction research is defined. It follows a discussion on global tectonics and the nature of earthquakes. A review is given on present activities in earthquake prediction research which follows three main lines: experimental field studies, laboratory experiments, and model computation of earthquake generating processes. The main chapter describes the capabilities and present applications of space technology in earthquake prediction research. Advantages of space geodetic techniques are shown in comparison with conventional geodetic ground surveys. Applications of satellite imagery and satellite mapping of the fine structure of the earth's gravity potential are pointed out. An important service in earthquake prediction research can be provided by satellite data transmission. Finally, the future role of space technology in earthquake prediction research is discussed. One important contribution to basic research will be to establish a world-wide geodynamics reference system for monitoring inter- and intraplate motion. The main task, however, will be the participation of space technology in dedicated control networks to be established in areas of potential earthquake risk. (Author)

**A81-26883 # Use of space photographs and geological and geophysical data for the metallogenic evaluation of ore regions (Ispol'zovanie kosmofotograficheskikh i geologo-geofizicheskikh materialov pri prognozno-metallogenicheskoi otsenke rudnykh raionov)** N V Skublova (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologiya, Leningrad, USSR) *Issledovanie Zemli iz Kosmosa*, Nov.-Dec 1980, p 9-15 9 refs. In Russian

Photographs of a region of Central Kazakhstan taken from the Salyut 1 space station are used to evaluate the information content of space photos interpreted on the basis of structural geology. Analyses are carried out to determine correlations between the interpreted photos and geological and geophysical ground truth data. The results obtained are used to compile a map indicating possible and probable deposits of semimetals, rare metals, molybdenum, and copper. F G M

**A81 26884 # The use of space and aerial imagery in metallogeny (with the Altai-Sayan fold belt considered as an example) (Ispol'zovanie materialov kosmo- i aeros'emok dlia metallogenicheskikh tselei (na primere Altae Saianskoi skladchatoi oblasti))** L V Alabin, Ia M Gritsiuk, A M Kuznetsov, and N I Reznik (Akademiya Nauk SSSR, Institut Geologii i Geofiziki, Novosibirsk, Zapadno-Sibirskoe Territorial'noe Geologicheskoe Upravlenie, Novokuznetsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov.-Dec 1980, p 16-21 21 refs. In Russian

## 04 GEOLOGY AND MINERAL RESOURCES

An interpretation of different-scale aerial and space imagery of the Altai-Sayan fold belt has made it possible to identify (1) regional structures and ore bearing zones as well as deep-seated faults along their boundaries, (2) ore-bearing ring structures, and (3) morphological features of small structures that control the distribution of ore fields and ore bodies. It is shown that regional and local metallogeny is promoted by the combination of aerial and space imagery with geological, geophysical, geochemical, and geomorphological data. P T H

**A81-26885 #** Results of the interpretation of space imagery and characteristics of the distribution of ore deposits in western and middle Siberia (Rezultaty deshifirovaniia kosmicheskikh snimkov i nekotorye zakonomernosti razmeshcheniia poleznykh iskopaemykh Zapadnoi i Srednei Sibiri) V G Senkevich and I M Rubinov *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 22-26. In Russian.

The interpretation of space imagery made it possible to map types of relief and to recognize lineament systems and deformation zones in western and middle Siberia. It is considered that such zones, generated by tectonic activity, are favorable for the localization of ore deposits. P T H

**A81-26886 #** Method of the complex interpretation of aerial and space imagery and some results of the tectonic analysis of the Ukrainian Shield (Metodika kompleksnogo deshifirovaniia aero kosmicheskikh materialov i nekotorye rezultaty tektonicheskogo analiza Ukrainskogo shchita) S S Bystrevskaia and N P Semeniuk (Akademiia Nauk Ukrainskoi SSR, Institut Geokhimi i Fiziki Mineralov, Kiev, Ukrainian SSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 27-31. 6 refs. In Russian.

A complex interpretation method developed for the tectonic analysis of the Ukrainian Shield is described. The method relies on space imagery of regional scale obtained from Salyut 4 and 6, Soyuz 22, and Landsat 1 and 2. The method makes it possible to identify a coherent pattern of the movement of structural elements of the shield, determine the shapes, dimensions, locations, and mutual interactions of large linear and ring structures, and to clarify the interaction of the shield with adjacent regions. P T H

**A81-26887 #** Interpretation of magma-controlling structures in the southern part of eastern Sayan (Deshifirovanie magmakontroliruiushchikh struktur luzhnoi chasti Vostochnogo Saiana) V E Kovalevskii (Novosibirskii Gosudarstvennyi Universitet, Novosibirsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 32-36. 6 refs. In Russian.

Multispectral remote sensing data acquired by Meteor satellites were used to investigate regional and local magma-controlling and magmatic structures in southeast Sayan. Tectonic and magma-controlling faults and ring structures were detected. Three main systems of subparallel lineaments were discovered and analyzed. P T H

**A81-26888 #** Utilization of space imagery for the structural analysis of the eastern Sikhote-Alin volcanic belt (Ispol'zovanie kosmicheskikh snimkov dlia izucheniia strukturnykh osobennosti Vostochno-Sikhote-Alin'skogo vulkanicheskogo poiasa) A A Prusevich (Novosibirskii Gosudarstvennyi Universitet, Novosibirsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 37-41. 5 refs. In Russian.

The regional structure of the eastern Sikhote-Alin volcanic belt was studied on the basis of multispectral scanner photographs taken from Meteor satellites. The interpretation of the images made it possible to study important systems of buried faults, and to recognize block boundaries and ring structures generated by magmatic processes. P T H

**A81-26889 #** The Kuzbas ring structures and their relationship to recent tectonic movements (Kol'tsevye obrazovaniia Kuzbassa i ikh svyaz' s sovremennymi tektonicheskimi dvizheniiami) V P Polkanov, I M Batugina, and A Z Luzvitskii (Sibirskii Nauchno-Issledovatel'skii Institut Geologii, Geofiziki i Mineral'nogo

Syr'ia, Novosibirsk, Kuzbasskii Politekhicheskii Institut, Kemerovo, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 42-46. 10 refs. In Russian.

Ring structures of several kilometers to 35 kilometers in diameter in the Kuzbas basin were identified on space TV imagery. The most prominent ellipsoidal ring structures were detected in the central part of the area under investigation. The character of these structures was examined in the light of data on recent movements of the earth's crust, and magnetic and gravimetry surveys. As a rule, higher rates of upward movement appear to be associated with the large ring structures of central Kuzbas. It is suggested that these structures have a tectonic character. P T H

**A81-26890 #** Lineaments of the Kuznetsk basin studied on the basis of space imagery interpretation (Lineamenty Kuznetskogo basseina po rezul'tatam deshifirovaniia kosmicheskikh snimkov) A Z Luzvitskii, V P Polkanov, and Ia M Gritsiuk (Sibirskii Nauchno-Issledovatel'skii Institut Geologii, Geofiziki i Mineral'nogo Syr'ia, Novosibirsk, Zapadno-Sibirskoe Territorial'noe Geologicheskoe Upravlenie, Novokuznetsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 47-53. 6 refs. In Russian.

Landscape lineaments 20 to 150 km in length in the Kuznetsk basin (Kuzbas) were recognized on space imagery. The orientation of the lineaments corresponds to distributions of fold structures, faults, and linear elements of magnetic and gravitational fields. Lineaments in the basement rocks correspond to fissure systems, folds, and linear folds. It is suggested that space imagery can be used to study the geological features and mining conditions of Kuzbas coal deposits. P T H

**A81-26891 #** Dimensional-statistical models of lineament patterns, interpreted on space imagery (Prostranstvenno-statisticheskie modeli poli lineamentov, deshifirruemykh na kosmicheskikh snimkakh) Ia M Gritsiuk and V I Le'chuk (Zapadno-Sibirskoe Territorial'noe Geologicheskoe Upravlenie, Novokuznetsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 54-60. 7 refs. In Russian.

Well known tectonic models of global, regional, and local fault patterns, interpreted in space imagery, were used to analyze two competing dimensional statistical models of parallel and subparallel lineament systems. The models are (1) a stationary model, which includes a random Poisson distribution and Poisson equal-density distributions, and (2) a nonstationary model, which includes distributions of different density. The models are compared in the light of tectonic data and applied to activity in the Kuznetsk Alatau region. P T H

**A81-26892 #** Investigation of strike-slip faults on space imagery (Izuchenie sdvigovykh deformatsii po kosmicheskim snimkam) V M Belousov (Irkutskii Gosudarstvennyi Universitet, Irkutsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 61-64. In Russian.

Meteor-satellite multispectral images of eastern Sayan and the Baikal rift were interpreted for the presence of strike-slip faults and recent tectonic movements. It is found that the rift zone is distinctly bounded by strike-slip faults on its southern and northern sides. Data on the extent of meridional and northeast lineaments and on directions of strike-slip movements in the present epoch are also examined. P T H

**A81-26893 #** Method of the complex interpretation of aerial and space imagery and geophysical fields in the investigation of the structure of unexposed regions /with the Turan plate considered as an example/ (Nekotorye voprosy metodiki kompleksnoi interpretatsii aerokosmicheskoi informatsii i geofizicheskikh poli pri izucheni struktury zakrytykh regionov /na primere Turanskoi plity/) M A Artamonov, S M Bogorodskii, and O G Sheremet (Vsesoiuznoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologia, Akademiia Nauk SSSR, Institut Litosfery, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 65-75. 8 refs. In Russian.

It is shown that the structural and tectonic patterns of unexposed regions can be studied successfully through the interpreta-

tion of aerial and space imagery and the analysis of geophysical anomalies. Theoretical and real models of geological bodies have been used to examine the character of the manifestation of deep structures in geophysical fields and surface features. This approach has been applied to the Shakhpakhty Baimen region in the eastern part of the Turan plate of the Buzachi peninsula P T H

**A81-26894 #** Possibilities of the interpretation of pre-Jurassic structures in the southern part of western Siberia by means of aerial and space imagery (Vozmozhnosti vyivleniia struktur v do-lurskikh obrazovaniakh po aero- i kosmicheskim snimkam na primere juzhnoi chasti zapadnoi Sibiri) N P Zapivalov and V A Beliaeva (Novosibirskoe Proizvodstvennoe Geologicheskoe Ob'edinenie, Novosibirsk, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 76-79 In Russian

Four fracture systems representing pre-Jurassic complex structures were determined in southwestern Siberia from the anomalous linear arrangement of the surface forms. In addition, structures of dome type and erosion tectonic nose type were determined from the circular arrangement of relief forms. The complex conditions of the interpretation of aerial and space imagery of the southwest Siberian plate are pointed out P T H

**A81-26895** Elements of the geological structure of the western Siberian plate on the basis of the interpretation of small-scale space images, with reference to the evaluation of petroleum and natural-gas content (Elementy geologicheskogo stroeniia zapadno Sibirskoi plity po dannym deshifirovaniia melkomasshtabnykh kosmicheskikh snimkov v sviazi s otsenкой neftegazonosti) V V Borovskii, A L Klopov, L L Podsozova, and I D Peskovskii (Zapadno Sibirskii Nauchno-Issledovatel'skii Institut Geologorazvedochnyi Neftianoi Institut, Tyumen, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 80-86 6 refs In Russian

Ring structures and fracture systems in the western Siberian plate were identified on small scale space imagery. The complex interpretation of geological and geophysical data indicates that the ring structures are related to the geological structure of deep parts of the crust and of the pre-Jurassic basement. Certain methodological problems associated with the use of magnetic and gravitational data in the present study are discussed P T H

**A81-26896 #** Possibilities of using aerial and space imagery for the mapping of unconsolidated cover in the BAM region (Vozmozhnosti ispol'zovaniia aerokosmicheskoi informatsii pri kartirovanii rykhlogo pokrova zony BAM) A I Muzis (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aero geologia, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 87-92 8 refs In Russian

Results on the identification of types of unconsolidated rocks on medium-scale and small-scale space images are presented. It is shown that the unconsolidated cover can be interpreted on medium scale images according to forms of relief and on small-scale images according to the structure of buried relief, which determines the spatial distribution and character of unconsolidated accumulations. The specific character of the space data is the three-dimensionality of the images or the 'transparence' of buried relief through the unconsolidated cover P T H

**A81-26917 #** On the interrelation between seismicity and fault structures identified by space image interpretation. Kh Spiridonov and E Grigorova. *Space Research in Bulgaria*, vol 3, 1980, p 42-46 11 refs

Consideration is given to the interrelation between seismicity and fault structures as identified by space image interpretation on a scale of 1,000,000 ERTS-1 photographs of the Upper Tracian lowland of Bulgaria were taken at 900 km, and images in the 0.6-0.7 micron and 0.8-1.1 micron range were used. The Upper Tracian depression is one of the most seismically active regions of Bulgaria. The photographs were used to identify three systems of faults and to plot the epicenters. The inner block-fault structuring established by the photographs was confirmed by geophysical data S C S

**A81-28060 #** Comparison of the geological information content of remote sensing data for the central portion of Southern Tien Shan (Svrnenie geologicheskoi informativnosti materialov distantsionnykh s'emok na primere tsentral'noi chasti juzhnogo Tian'-Shania) A K Glukh (Ministerstvo Geologii Uzbekskoi SSR, Tashkent, Uzbek SSR) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 27-30 In Russian

**A81-28061 #** Experience with the prediction of endogenous mineralization in Pamir from space imagery (Opyt prognozirovaniia endogenogo orudneniia na Pamire po materialam kosmicheskikh s'emok) R B Baratov, M M Bezuglyi, M Kh Ishanov, and B R Pashkov (Akademiia Nauk Tadzhikskoi SSR, Institut Geologii, Dushambe, Tadzhik SSR, Gosudarstvennyi Nauchno-Issledovatel'skii i Proizvodstvennyi Tsentr Priroda, USSR) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 31-36 In Russian

Space remote sensing data on endogenous mineralization in Pamir is examined and compared with ground prospecting results. It is found that endogenous mineralization in the Pamir region as well as in the middle and southern Tien Shan is concentrated in outer zones of positive (arch-type) ring structures. Several regions which are likely to contain endogenous mineralization were identified B J

**A81-28062 #** Ring structures at the confluence of the Tiunga and Tiukiana rivers and their relation to basement tectonic structures (Kol'tsevye obrazovaniia na nezhdurech'e rek Tiunga i Tiukiana i ikh sviaz' s tektonicheskimi strukturami drevnego zalozheniia) V P Polkanov (Sibirskii Nauchno-Issledovatel'skii Institut Geologii, Geofiziki i Mineral'nogo Syr'ia, Novosibirsk, USSR) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 37-42 11 refs In Russian

Several ring structures at the confluence of the Tiunga and Tiukiana rivers were identified from space remote sensing imagery. These structures are interpreted as arch-type forest areas or as a plane pattern of streams. An analysis of seismic, magnetic, and gravity data indicates that three of the ring structures may be tectonic formations B J

**A81-29838 \*** Optimum spectral bands for rock discrimination. A W Siegrist and C C Schnetzler (NASA, Goddard Space Flight Center, Greenbelt, Md.) *Photogrammetric Engineering and Remote Sensing*, vol 46, Sept 1980, p 1207-1215 24 refs

Using stepwise discriminant analysis on spectral reflectance and spectral emissivity data collected by a Multispectral Scanner and Data System, mounted in an NC-130B aircraft and flown at an altitude of approximately 3 km, spectral bands were ranked as to their usefulness in separating specific rock types and rock alteration products in seven geologically diverse Utah sites. The optimum band for rock discrimination included the 1.18 to 1.30 micron interval, and the optimum combination of bands comprised the 1.18 to 1.30, 4.50 to 4.75, 0.46 to 0.50, 1.52 to 1.73, and 2.10 to 2.36 micron intervals. It is concluded that the spectral interval combination was more successful in differentiating geologic materials than either simulated Multispectral Scanner bands or simulated Thematic Mapper bands K S

**N81-18460#** Hunting Surveys Ltd, Boreham Wood (England) **PRELIMINARY RESULTS OF AN EVALUATION OF THE LAND USE AND GEOLOGIC DATA CONTENT OF SEASAT IMAGERY**

M McDonough and G Deane. In *ESA SEASAT-SAR Processor 1980* p 9-18. Sponsored by RAE Farnborough, England

Avail NTIS HC A07/MF A01

Both optically and digitally correlated SEASAT SAR imagery were examined to test their applicability to geologic and land use mapping. In Northern Scotland, East Yorkshire and Southwest England, although surface cover inhibits direct expression of lithologies and many important units are not separable, important structures and other major rock units can be recognized and some information may be regarded as new. Lineaments are numerous. Overlapping imagery from converging orbits provides

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stereoscopic cover that assists geologic interpretations. In land use evaluations six tone/texture radar mapping units can be identified in East Anglia. After field checking these could be subdivided into land use units. Mature closed canopy woodland and certain crop groups can be recognized consistently, but some SAR signatures can have several possible interpretations. Hilly terrain modifies these SAR signatures. An IDP 3000 interactive image processor was used to evaluate digitally processed SEASAT SAR and make comparison with Landsat. Author (ESA)

**N81-18466#** Zentralstelle fuer Geo-Photogrammetrie und Fernerkundung, Munich (West Germany)

**COMPARISON OF SEASAT AND LANDSAT DATA OF ICELAND FOR QUALITATIVE GEOLOGICAL APPLICATION**  
J Bodechtel, K Hiller, and U Muenzer /in ESA SEASAT-SAR Processor 1980 p 61-67 refs

Avail NTIS HC A07/MF A01

The application of SEASAT synthetic aperture radar (SAR) data for geological application is demonstrated with the example of the young morphologically traced tectonics of Iceland. Advantages and limitation of SAR evaluation including geometric distortion, lay over and structure enhancement are discussed. A comparison of photolineament maps derived from both LANDSAT and SEASAT data is made. Author (ESA)

**N81-19680\*#** National Aeronautics and Space Administration  
Goddard Space Flight Center, Greenbelt, Md

**A GLOBAL TECTONIC ACTIVITY MAP WITH ORBITAL PHOTOGRAPHIC SUPPLEMENT**

Paul D Lowman, Jr Jan 1981 122 p refs Presented at 26th Intern Geol Congr, Jul 1980 (NASA-TM-82073) Avail NTIS HC A06/MF A01 CSCL 08B

A three part map showing equatorial and polar regions was compiled showing tectonic and volcanic activity of the past one million years, including the present. Features shown include actively spreading ridges, spreading rates, major active faults, subduction zones, well defined plates, and volcanic areas active within the past one million years. Activity within this period was inferred from seismicity (instrumental and historic), physiography, and published literature. The tectonic activity map was used for planning global geodetic programs of satellite laser ranging and very long base line interferometry and for geologic education. T M

**N81-21414\*#** Iowa Univ, Iowa City Dept of Geology  
**USE OF MAGSAT ANOMALY DATA FOR CRUSTAL STRUCTURE AND MINERAL RESOURCES IN THE US MIDCONTINENT** Quarterly Report, period ending 31 Mar 1981

Robert S Carmichael, Principal Investigator, Richard Hoppin, Ross Black, and Raymond Anderson 31 Mar 1981 10 p ERTS (Contract NAS5-26425) (E81-10094, NASA-CR-164092, QR-1) Avail NTIS HC A02/MF A01 CSCL 08G

Magnetic fields were measured from October 1979 until June 1980 using the satellite. The processed magnetic data yield long wavelength anomalies that arise from crustal and upper mantle sources. Analysis techniques are being developed to help interpret the structure and character of the lithosphere in central North America. The region includes the Midcontinent Gravity Anomaly paleorift zone and the New Madrid rift/seismic zone, both of which are of plateotectonic and neotectonic interest. Preliminary analysis of the initial MAGSAT data combined with correlative geological and geophysical data shows the utility of the satellite data for regional crustal and basement study. E D K

## OCEANOGRAPHY AND MARINE RESOURCES

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

**A81-20926** Ocean optics VI, Proceedings of the Sixth Seminar, Monterey, Calif., October 23-25, 1979 Seminar sponsored by the Society of Photo-Optical Instrumentation Engineers and U S Navy Edited by S Q Duntley (California, University, La Jolla, Calif) Bellingham, Wash, Society of Photo Optical Instrumentation Engineers (SPIE Proceedings Volume 208), 1980 274 p \$38

Developments in the fundamental and applied research in ocean optics are discussed with emphasis on optical remote sensing of living marine resources and remote measurements of ocean optical properties from satellites and aircraft Papers are presented on the spreading of light beams in ocean water, ultraviolet submersible spectroradiometer, laser hydrophone, remote detection of ocean waste, coastal zone color scanner radiometry, and degradation of optical transmission in the atmospheric marine boundary layer V L

**A81-20927 \*** Introduction to ocean optics H R Gordon (Miami, University, Coral Gables, Fla), R C Smith (California, University, La Jolla, Calif), and J R V Zaneveld (Oregon State University, Corvallis, Ore) In Ocean optics VI, Proceedings of the Sixth Seminar, Monterey, Calif, October 23-25, 1979

Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1980, p 14-55 108 refs Contracts No NAS5-22963, No N00014-76-0067, No EY-76-S-06-2227, Grant No NOAA-04-6-158-44033 NR Project 083-102, DOE Task 29

The fundamental inherent and apparent optical properties of natural waves are reviewed and relationships between these properties, as related through the radiative transfer equation, are examined Applications of ocean optics to geophysics, biological oceanography, and ocean remote sensing are discussed V L

**A81-20929 \*** Coastal zone color scanner radiometry R W Austin (California, University, La Jolla, Calif) In Ocean optics VI, Proceedings of the Sixth Seminar, Monterey, Calif, October 23-25, 1979

Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1980, p 170-177 7 refs Grant No NOAA-04-6-158-44033, Contracts No N00014 78-C-0566, No NAS5-25450

The characteristics of the Coastal Zone Color Scanner (CZCS) are described The factors affecting the apparent radiance signature at the satellite are presented along with some representative examples of measured spectral radiances, irradiances and transmittances in the ocean and in the atmosphere Finally an example is presented of the spectral radiance components measured and computed for an experiment conducted in southern California coastal waters for the purpose of obtaining surface validation data at the time of a satellite overpass (Author)

**A81-20931 \*** Remote detection of ocean waste W D Philpot and V Klemas (Delaware, University, Newark, Del) In Ocean optics VI, Proceedings of the Sixth Seminar, Monterey, Calif, October 23-25, 1979

Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1980, p 189-197 8 refs Grants No NSG-1149, No NSG 1398

An application of characteristic vector analysis to ocean color spectra for the detection of pollutants in water is described The technique can be useful for detecting and distinguishing among a variety of substances in the water The analysis also illustrates the variability of the water color spectra with both concentration and

depth distribution Both concentration and depth information may be extractable from passive multispectral data under certain circumstances (Author)

**A81-22424** Some aspects of Gulf Stream western boundary eddies from satellite and in situ data F M Vukovich and B W Crissman (Research Triangle Institute, Research Triangle Park, N C) *Journal of Physical Oceanography*, vol 10, Nov 1980, p 1792-1813 23 refs Contract No NOAA-7 35182

NOAA-5 infrared images were used to determine statistics of existing and developing perturbations on the western boundary of the Gulf Stream The satellite data were combined with oceanographic data to study both a new-born eddy and one that had been in existence for a considerable time On the average, the perturbations are much more intense, have larger dimensions, and move more slowly when located immediately downstream of the Charleston Bump, a region where the flow is influenced by the Blake Plateau, than when located farther downstream in a region where the slope is steeper (Author)

**A81-22558 \* #** Microwave observation of the Weddell polynya F D Carsey (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, Md) (*American Meteorological Society, Symposium on High Latitude Climate Systems, Boston, Mass, Nov 6-9, 1979*) *Monthly Weather Review*, vol 108, Dec 1980, p 2032 2044 36 refs

Satellite microwave image data from Nimbus 5 of the Weddell Sea are examined for the years 1973 77 During the winters of 1974, 1975 and 1976 a polynya or ice-enclosed open water area is observed It has an area 200,000-300,000 sq km and is observed drifting west at about 1 cm/s in the Weddell Sea ice pack The long-term and short-term behavior of the polynya margin and the regional ice concentration are interpreted in light of several oceanographic and meteorological theories explaining the circulation relevant to its origin, stability and role It is concluded that water column stability preconditioning alone is a necessary but not sufficient condition for the existence of the polynya (Author)

**A81-22559** Field observations of the Bering Sea ice edge properties during March 1979 J Bauer and S Martin (Washington, University, Seattle, Wash) (*American Meteorological Society, Symposium on High-Latitude Climate Systems, Boston, Mass, Nov 6-9, 1979*) *Monthly Weather Review*, vol 108, Dec 1980, p 2045-2056 15 refs Research supported by the U S Bureau of Land Management, U S Department of Commerce Contract No 78-4335, Contract No N00014-76-C-0234 NR Project 307-252

The March 1979 observations in the Bering Sea indicate the division of the ice edge due to the interaction of wind and ocean swell with the ice into three zones An 'edge' zone of 1-15 km width adjacent to the open ocean consists of heavily rafted and ridged floes 1.5 m thick and 10-20 m sides, a 'transition' zone 5 km wide, consists of rectangular ice floes 0.5 m thick, 20-40 m on the side, and the 'interior' zone, made up of flat floes 0.3 m thick, extends over hundreds of km The swells fracture the floes, gradually reducing in amplitude, so that the waves propagate without fracturing the ice, this ice distribution forms bands of ice floes at the ice edge which move south into warmer water until they melt A T

**A81-22563** Sea ice cover and related atmospheric conditions in Arctic Canada during the summer of 1978 B Dey (Howard University, Washington, D C) *Monthly Weather Review*, vol 108, Dec 1980, p 2092-2097 17 refs Research supported by the University of Saskatchewan

Maps are presented of sea ice cover and open water in the Canadian Arctic for the final day of each month, June-September, 1978 The maps are derived from NOAA satellite imagery and show an extent of open water which is considerably smaller than that in the summers of 1975-77 Areal and temporal variations in sea ice cover and open water in the Canadian Arctic are related to atmospheric conditions, particularly the locations of high- and low-pressure cells and the prevailing winds over the region and to

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melting degree days at four selected stations. The prevailing winds bring warm or cold air masses which increase or decrease air temperatures/melting degree days and consequently speed up or delay the time of ice melting. Moreover, strong prevailing winds depending on whether offshore or onshore take ice away from the coast or push ice toward the coast and thus cause areal variations of open water and ice cover (Author)

**A81-23484 \*** The damping of ocean surface waves by a monomolecular film measured by wave staffs and microwave radars. H. Huhnerfuss (Hamburg, Universität, Hamburg, West Germany), W. Alpers (Hamburg, Universität, Max-Planck-Institut für Meteorologie, Hamburg, West Germany), W. L. Jones (NASA, Langley Research Center, Hampton, Va.), P. A. Lange (Bundesanstalt für Wasserbau, Hamburg, West Germany), and K. Richter (Deutsches Hydrographisches Institut, Hamburg, West Germany). *Journal of Geophysical Research*, vol 86, Jan 20, 1981, p 429-438. 45 refs. Deutsche Forschungsgemeinschaft Contract No. SFB-94.

Open ocean and wave tank experiments were carried out with the aim of studying the damping of capillary and gravity waves by a monomolecular film. These films of biogenic origin influence air-sea interaction processes and thereby affect the use of remote sensing techniques in oceanography. Measurement was carried out by wave staffs, by a coherent X band microwave scatterometer mounted on a sea-based platform, and by an incoherent K band microwave scatterometer carried by an aircraft under moderate wind conditions. A wave attenuation of about 40-60% is observed in the frequency range between 3.2 and 16 Hz. Tank experiments show that a direct influence of oleyl alcohol surface films on wave damping is confined to frequencies equal to or greater than 2 Hz, a further indirect effect of films on the damping of ocean waves in the frequency range between 0.12 and 0.7 Hz (by modifying the wind input and wave-wave interaction mechanisms) is also indicated. D. K.

**A81-23485 #** Experimental sea slicks - Their practical applications and utilization for basic studies of air sea interactions. H. Huhnerfuss (Hamburg, Universität, Hamburg, West Germany) and W. D. Garrett (U.S. Navy, Naval Research Laboratory, Washington, D.C.). *Journal of Geophysical Research*, vol 86, Jan 20, 1981, p 439-447. 44 refs. Navy-supported research, Deutsche Forschungsgemeinschaft Contract No. SFB-94.

Initial experiments in the laboratory and in Chesapeake Bay are described whose aims were to determine (1) the feasibility of creating and sustaining an ocean film, (2) the resistance of the film to natural dispersive forces, and (3) the types and quantities of surface active materials required. Several techniques for generating films, generally oleyl alcohol, are detailed, including dispensation from a surface vessel and aerial dispensation of frozen oil cubes. Wave attenuation of films, using tower scatterometer and Doppler shift measurements, is shown to be 40 to 60% between 3.2 and 16 Hz. The practical applications of films are outlined, including rescue and recovery operations, enhancement of underwater visibility, and environmental protection. D. K.

**A81-23488 \* #** Seasat altimeter observations of dynamic topography in the Gulf Stream region. R. E. Cheney and J. G. Marsh (NASA, Goddard Space Flight Center, Geodynamics Branch, Greenbelt, Md.). *Journal of Geophysical Research*, vol 86, Jan 20, 1981, p 473-483. 34 refs.

A straightforward approach to altimeter data analysis in the Gulf Stream system is presented, using a detailed geoid model to remove the gravitational component. The resulting sea surface height profiles compare remarkably well with independent oceanographic observations. Specific features such as cold rings, warm rings, and no anomaly regions are analyzed and it is shown that known positions of cyclonic and anticyclonic rings correspond with depressions and elevations, respectively, with amplitudes as large as 95 cm. The apparent fluctuation of the Gulf Stream is indicated by the results, as in the finding that on time scales of a few days, surface transport indicated by the sea surface height difference across the stream varied by nearly 30%. D. K.

**A81-23552 #** Satellite oceanography research, development, and technology transfer. R. J. Holyer, P. E. La Violette, and J. R. Clark (U.S. Navy, Bay St. Louis, Miss.). In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 221-241. 13 refs.

Advances in the interactive digital image processing of data from new satellite systems such as GOES, Tiros-N, and Nimbus-7 are summarized. Problems related to the oceanographic use of these data are discussed with reference to specific techniques which may be employed for oceanographic analysis. V. L.

**A81-23553 #** Current status of remote sensing for oil pollution control in U.S. coastal waters. A. P. Manning, Jr., J. R. White, and R. R. Vollmers (U.S. Coast Guard, Washington, D.C.). In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 249-268. 10 refs.

**A81-23554 #** Current status of remote sensing for oil pollution control in French coastal waters. R. Burkhalter, C. Meyer (Laboratoire National d'Essais, Paris, France), and J.-M. Massin (Ministère de l'Environnement et du Cadre de Vie, Paris, France). In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 269-274.

**A81-23573 #** Satellite-tracked buoys in the Eastern Indian Ocean. G. R. Cresswell (Commonwealth Scientific and Industrial Research Organization, Div. of Fisheries and Oceanography, Cronulla, New South Wales, Australia). In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 531-541. 18 refs.

Satellite-tracked buoys were used to study a warm, low salinity seasonal intrusion of tropical water that flows southward along the continental slope of Western Australia and then turns at Cape Leeuwin to flow eastward toward the Great Australian Bight. (Author)

**A81-23574 #** Optical remote sensing of the sea - A Caribbean example. W. G. Egan (Grumman Aerospace Corp., Research Dept., Bethpage, N.Y.). In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 563-586. 51 refs.

Corrections for three factors affecting the accuracy of remotely sensed signals from the sea are analyzed: (1) bulk absorption and scattering properties of the sea, (2) the wave structure and reflecting characteristics of the sea surface, and (3) the absorption and scattering properties of the atmosphere. Two optical models, namely, the LOWSUN and Dave radiative transfer models, are presented in the application of corrections to determinations of chlorophyll, turbidity, water quality, depth, sea-floor biota, oil slicks, land water boundaries and effects of wave action and atmosphere scattering and absorption on remotely sensed signals. Finally, an example of detailed ground calibration with sea surface and atmospheric modeling is presented, using St. Thomas, U.S. Virgin Islands, as a case study, with multispectral imagery from both an aircraft and Landsat I. D. K.

**A81-23575 #** Remote sensing for coastal fisheries applications. H. J. Holley and K. J. Savastano (NOAA, National Marine Fisheries Service, Bay St. Louis, Miss.). In *International Symposium on Remote Sensing of Environment*, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 587-595. 20 refs.

The paper surveys selected investigations which demonstrate potentials of remotely sensed observations for enhancing the management and utilization of coastal fishery resources. Several new sensor applications are discussed, including the study of submerged seagrass, the Seasat-A surface layer transport experiment, and the Coastal Zone Color Scanner experiment. Marine animal tracking is also examined, with attention given to satellite dolphin tracking and satellite sea turtle tracking. B J

**A81-23581 #** Analysis of Coastal Zone Colour Scanner imagery over Mediterranean coastal waters. W Mehl, B Sturm (Commission of the European Communities, Joint Research Centre, Ispra, Italy), and W Melchior (Berlin, Technische Universität, Berlin, West Germany). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 653-662. 12 refs.

An example of the Coastal Zone Color Scanner (CZCS) data taken over the Mediterranean is presented, and the preprocessing steps that can be used to improve data quality are shown. Two approaches to the problem of atmospheric correction of CZCS data are applied: the Gordon method (each pixel darkest pixel) and the darkest-pixel-in-the-scene method. The spectral subsurface radiance in chlorophyll-a concentration algorithms published by various authors is used to produce chlorophyll maps. The results are seen to be less dependent on the type of atmospheric correction algorithm than on the type of chlorophyll algorithm used. The surface chlorophyll-a maps presented for the area considered demonstrate a concentration variation in the range 0.1 to 0.8 mg/cu m and a rather complex eddy-like spatial structure. It is thought that both the qualitative and quantitative information derived in such a way from the CZCS data will be of great value for oceanography and related disciplines. C R

**A81-23597 #** Application of a global sensitivity analysis model to the retrieval of chlorophyll concentrations in water from remotely measured radiances. S Tassan (Commission of the European Communities, Joint Research Centre, Ispra, Italy). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 807-818. 15 refs.

**A81-23600 \* #** SAR observations of coastal zone conditions. G A Meadows (Michigan, University, Ann Arbor, Mich.), E S Kasischke, and R A Shuchman (Michigan, Environmental Research Institute, Ann Arbor, Mich.). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 845-863. 21 refs. Research supported by the University of Michigan and NASA, Contracts No N00014-76-C-1048, No NOAA-MO-A01-78-00-4339.

Applications of Synthetic Aperture Radar (SAR) technology to the observation of coastal zone phenomena are detailed. The conditions observed include gravity wave detection, surf zone location, surface currents, and long-period 'surf beats'. Algorithms have been developed and successfully tested that determine significant wave and current parameters from the sea surface backscatter of microwave energy. Doppler information from the SAR optical correlator allows a rough estimation of near shore surface flow velocities that has been found in agreement with both theory and in situ observations as well. Seasat SAR data of the Scotland and North Carolina coasts are considered, as well as the results of bathymetric updating of coastal area charts. O C

**A81-23610 #** Monitoring annual variations in the ice coverage of Baffin Bay from satellite imagery. B Dey (Saskatchewan, University, Saskatoon, Canada). In International Symposium on

Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 989-998. 12 refs. Research supported by the University of Saskatchewan.

**A81-23626 #** Operational use of remote sensing during the Campeche Bay oil well blowout. R M Hayes (US Coast Guard, Washington, D C). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1187-1196. 7 refs.

A blowout of the Ixtoc 1 oil well in the southeastern Bay of Campeche caused oil to spill into the Gulf of Mexico from June 3, 1979 through the 1979-1980 winter. The US federal on scene coordinator in Corpus Christi, Texas was provided with several satellite and aircraft remote sensing products to aid in marine environmental response planning for the oil entering US coastal waters and onto shores. The various products are described, correlated and examples are provided. An intercomparison of the remotely sensed data outputs as well as their operational use is made. A brief discussion of the systems' limitations and a statement of the requirements for operational remotely sensed information are included. (Author)

**A81-23627 #** Landsat tracking of oil slicks from the 1979 Gulf of Mexico oil well blowout. M Deutsch (US Geological Survey, Reston, Va.), R R Vollmers (US Coast Guard, Washington, D C), and J P Deutsch (Ohio State University, Columbus, Ohio). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1197-1211.

**A81-23633 #** Measurement of spectral upward radiance at several altitudes over the sea and atmospheric correction of the radiance by water vapor quantity. K Muneyama, Y Sasaki (Japan Marine Science and Technology Center, Yokosuka, Japan), M Fuchimoto, and Y Takahashi (Asia Air Survey Co., Ltd, Tokyo, Japan). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1267-1272. Research sponsored by the Science and Technology Agency.

The remote sensing of the spectral radiance of the sea's surface at altitudes ranging from 100 to 2000 meters is examined in two experiments. The remote sensor data were acquired by spectroradiometer between wavelengths of 400 and 1100 nm. The spectral reflectance factor and the quantity of path radiance are estimated without the use of spectral sea truth data. The 15 measurements made over a three year period show that the optical atmospheric character is delicate and changeable, even over short periods of time. It is noted that the experimental method of atmospheric correction using atmospheric vapor data presented provides a means of evaluating the atmospheric optical condition as well as of estimating the sea's spectral radiance. (Author)

**A81-23653 \* #** The application of Seasat-1 radar altimetry to continental shelf circulation modeling. P Cornillon, M Reed, M Spaulding, and C Swanson (Rhode Island, University, Kingston, RI). In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3. Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1499-1509. 18 refs. Grant No NsG-1495.

Seasat-1 radar altimetry data have been used to verify a continental shelf circulation model subjected to tidal forcing on the open boundary. The model makes use of the semi-implicit mode of time integration, removing the surface gravity wave time step restriction. Both the altimetry and the model predictions are compared with empirically determined tidal fluctuations and generally good agreement is obtained. V L

## 05 OCEANOGRAPHY AND MARINE RESOURCES

**A81-23665 #** Remote sensing of the North Sea using Landsat-2 MSS and Nimbus-7 CZCS data A P Cracknell, S M Singh, and N MacFarlane (Dundee, University, Dundee, Scotland) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1643-1651 5 refs Research supported by the Science Research Council

Landsat 2 band 7 MSS data for a low tide scene are used to map quantitatively the sandbanks in the upper and lower Tay Estuary. The outlines obtained are compared with those given in the Ordnance Survey maps and in the Admiralty charts of various years. The 'sea-truth' data measured on June 27, 1977 during 'The North Sea Ocean Color Scanner Experiment, 1977' are correlated to the Landsat-2 MSS data for the same scene which was imaged at the same time. Quantitative maps for chlorophyll-a and suspended sediment are obtained near the coast of the low countries. These derived maps are compared with the maps obtained by correlating the same 'sea-truth' data with the simultaneous data from the Ocean Color Scanner (OCS) flown on an aircraft during the above experiment. Work on data from Nimbus-7 CZCS and on Tiros N and NOAA 6 AVHRR is outlined briefly. (Author)

**A81-23677 #** Remote sensing and its role in coastal resource studies J B Johnston (U S Department of the Interior, Fish and Wildlife Service, Slidell, La) and W L Longley (Texas, General Land Office, Austin, Tex) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1789-1797

The use of remote sensing techniques by the U S Fish and Wildlife Service in coastal ecological characterization studies is discussed. The various techniques used include the interpretation of color infrared imagery and black and white photography, and the digital analysis of Landsat II imagery. The topics which have been portrayed in the ecological characterization atlases using remote sensing are habitats (past and present distribution), bird rookeries, dunes, waste disposal sites, pipeline corridors, water control structures and land-use patterns. L S

**A81-24466 \*** Seasat detection of waves, currents and inlet discharge M G Mattie, D E Lichy (U S Army, Coastal Engineering Research Center, Fort Belvoir, Va), and R C Beal (Johns Hopkins University, Applied Physics Laboratory, Laurel, Md) *International Journal of Remote Sensing*, vol 1, Oct-Dec 1980, p 377-398 13 refs NASA supported research, Contract No NOAA-MO-A01 78-00-4330

A new era of remote sensing for coastal and oceanographic monitoring was born on June 26, 1978 with the launch of Seasat Duck-X was a 2 month experiment conducted during August to October 1978, off the east coast of the U S A for the validation of the Seasat synthetic aperture radar (SAR). During this field experiment, various oceanographic phenomena were monitored. Ground truth observations of these phenomena have been correlated with Seasat SAR imagery. The ground truth sensors included airborne photographic and radar imagery, meteorological satellite imagery, land based radars, and conventional wave gauges. The direction and length of the principal ocean wave trains are compared for the periods of Seasat overflight of the Duck-X area. During these overflights significant wave heights were 1.5 m and less and the maximum wave period was 15 sec. The current correlations concentrate on the western boundary of the Gulf Stream and its associated eddy structure. Inlet outflow is shown for inlets on the east coast of the U S A. This ground truth study has indicated that the SAR imagery contains an unanticipated abundance of information on a variety of oceanographic and coastal phenomena. (Author)

**A81-26900 #** Experience with oceanographic satellite observations in the United States II - GEOS 3 (Opyt sputnikovykh okeanograficheskikh issledovanii v SShA II - 'GEOS-3') K Ia Kondrat'ev *Issledovanie Zemli iz Kosmosa*, Nov Dec 1980, p 107-112 12 refs In Russian

Oceanographic research carried out with GEOS 3 is reviewed. Methods and results are described connected with the retrieval of various geodetic, oceanographic, and geophysical parameters from measurements of altitude as well as the shape and structure of backscattering signals. Attention is given to such problems as the recognition of ocean currents, the determination of current velocity, the retrieval of significant wave heights, and the study of the wind field at the ocean surface. The role of subsatellite measurements in reliable data interpretation is shown. Various theoretical models of microwave backscattering by the ocean surface are discussed, and the possibility of the mapping of sea states in the world ocean is assessed. P T H

**A81-28066 #** Radio-physical methods for the sounding of the atmosphere and ocean surface from space (Radiofizicheskie metody zondirovaniia atmosfery i poverkhnosti okeana iz kosmosa) A S Gurvich, S T Egorov, and B G Kutuzov (Akademiia Nauk SSSR, Institut Fiziki Atmosfery and Institut Radiotekhniki i Elektroniki, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 63-70 14 refs In Russian

The use of scattering and thermal emission of millimeter and centimeter waves for the sounding of the atmosphere and ocean surface from space is considered. Microwave studies from the Meteor and Cosmos satellite are examined as an example. Prospects for the further improvement of the remote sensing methods are discussed. B J

**A81 28479 #** Detecting the movement of oceanic fronts using registered Tiros-N imagery J R Clark and P E LaViolette (U S Navy, Bay St Louis, Miss) *Geophysical Research Letters*, vol 8, Mar 1981, p 229-232

The capability of the Tyros-N satellite to monitor ocean surface features with previously unavailable accuracy is demonstrated. Although precautions must be taken to test for erroneous satellite coordinates and missing scan lines, data without these problems can be used for accurate positioning. Together with the use of interactive image processing systems, the accurate registration possible with these data provides oceanographers with a new capability for making quantitative spatial measurements from polar-orbiting satellite imagery. O C

**A81 28732 \*** Absolute tracer dye concentration using airborne 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*, vol 20, Apr 1, 1981, p 1191-1202 22 refs

The use of simultaneous airborne laser induced dye fluorescence and water Raman backscatter to measure the absolute concentration of an ocean-dispersed tracer dye is discussed. Theoretical considerations of the calculation of dye concentration by the numerical comparison of airborne laser induced fluorescence spectra with laboratory spectra for known dye concentrations using the 3400/cm OH-stretch water Raman scatter as a calibration signal are presented which show that minimum errors are obtained and no data concerning water mass transmission properties are required when the laser wavelength is chosen to yield a Raman signal near the dye emission band. Results of field experiments conducted with an airborne conical scan lidar over a site in New York Bight into which rhodamine dye had been injected in a study of oil spill dispersion are then indicated which resulted in a contour map of dye concentrations, with a minimum detectable dye concentration of approximately 2 ppb by weight. A L W

**A81-29244** Satellite and hydrographic observations of low-frequency wave motions associated with a cold core Gulf Stream ring T W Spence (Texas A & M University, College Station, Tex) and R Legeckis (NOAA, National Environmental Satellite Service, Washington, D C) *Journal of Geophysical Research*, vol 86, Mar 20, 1981, p 1945-1953 20 refs Contract No N00014 75-C-0537

Thermal infrared data from the NOAA polar orbiting satellite and hydrographic observations from surface ships are used to estimate the eccentricity and the rotation rate of wavelike perturbation



tions around the circumference of a Gulf Stream cyclonic eddy in April 1977. From the satellite data, the rotation rate is estimated at  $(4.4 \pm 0.1) \times 10^{-6}$  th/sec for the period April 8-16. Estimates of the rotation rate are obtained from the trajectory of satellite-tracked drifters and from changes in the sea surface temperature fields determined from expendable bathythermograph trace surveys. A simple Eady model suggests the perturbations are stable modes of azimuthal wave number 2. (Author)

**A81-29824** Remote sensing techniques for kelp surveys. J. R. Jensen (Georgia, University, Athens, Ga.), J. E. Estes, and L. Tinney (California, University, Santa Barbara, Calif.) *Photogrammetric Engineering and Remote Sensing*, vol. 46, June 1980, p. 743-755. 27 refs.

The demand for algin derivatives, food supplements, and methane gas will increase the demand for harvested kelp during the 1980's. Color infrared aerial photography, Landsat digital imagery, aircraft X-band radar, and Seasat L band radar are used to monitor giant kelp to estimate acreage of kelp beds along the Southern California Bight. The practicality of monitoring kelp by using remote sensing system is discussed and it is concluded that high altitude color infrared photography and X band radar imagery can provide aerial extent data on kelp at approximately the same level of accuracy as conventional large scale inventories. Additional L-band research must document if kelp can be discriminated from the ocean under calm sea-states. K S

**N81-16515\*** Ocean Weather, Inc., White Plains, N.Y. **SIMULATION STUDIES OF THE APPLICATION OF SEASAT DATA IN WEATHER AND STATE OF SEA FORECASTING MODELS. Final Report.** Vincent J. Cardone and J. Arthur Greenwood. Oct. 1979. 94 p. refs. (Contract NAS5-24498) (NASA-CR-160085) Avail. NTIS HC A05/MF A01 CSCL 05B

The design and analysis of SEASAT simulation studies in which the error structure of conventional analyses and forecasts is modeled realistically are presented. The development and computer implementation of a global spectral ocean wave model is described. The design of algorithms for the assimilation of theoretical wind data into computers and for the utilization of real wind data and wave height data in a coupled computer system are presented. T M

**N81-16516#** Army Cold Regions Research and Engineering Lab., Hanover, N.H. **INVESTIGATIONS OF SEA ICE ANISOTROPY, ELECTROMAGNETIC PROPERTIES, STRENGTH, AND UNDER-ICE CURRENT ORIENTATION.** Austin Kovacs and Rexford M. Morey. Sep. 1980. 27 p. refs. (NR Proj. 307-393) (AD-A092089, CRREL-80-20) Avail. NTIS HC A03/MF A01 CSCL 08/12

Results of impulse radar studies of sea ice give support to the concept of a sea ice model in which the ice bottom is composed of an array of lossy parallel plate waveguides. The fundamental relation between the average bulk brine volume of sea ice and its electrical and strength properties is discussed as is the remote detection of under-ice current alignment. It was found that (1) the average effective bulk dielectric constant is dependent upon the average bulk brine volume of the sea ice, (2) sea ice anisotropy, arising from a bottom structure of crystal platelets with a preferred c-axis horizontal alignment, can be detected by radio echo sounding measurements made not only on the ice surface but also from an airborne platform, (3) the effective coefficient of reflection from the sea ice bottom decreases with increasing average effective bulk dielectric constant of the ice, decreases with increasing bulk brine volume, and is typically one to two orders of magnitude lower than the coefficient of reflection from the ice surface and (4) the losses in sea ice increase with increasing average bulk brine volume. GRA

**N81-16518#** Naval Postgraduate School, Monterey, Calif. Dept. of Oceanography

**SUBSURFACE DYNAMICAL PROPERTIES OF VARIABLE FEATURES SEEN IN SATELLITE IR IMAGERY OFF POINT SUR AND THEIR ACOUSTIC SIGNIFICANCE.** M.S. Thesis. John Edward Johnson, Jr. Jun. 1980. 240 p. refs. (AD-A092632) Avail. NTIS HC A11/MF A01 CSCL 08/10

This study is a continuation of chemical mesoscale research of cold water anomalies detected by satellite IR imagery off the Point Sur area with emphasis upon description of the thermal structure. Analysis of dynamic forcing is restricted to the relationship between equatorward alongshore wind stress and coastal upwelling. The preferred location of the features was on the south side of Point Sur near the axis of a mesoscale canyon (consistent with background theory). In all cases a surface (upper 100 m) 'lens' type feature with horizontal dimensions of 20 km at 50 m was observed below the surface cold spot expression. Typical temperature changes across the feature were of the order of 3 C/10 km with temperature changes across frontal zones of the order of 1 C/km. The surface density field pattern of November 1979 was similar to the surface temperature pattern. As determined by Parabolic Equation (PE) Acoustic Model runs, the presence of the wedge decreased propagation loss particularly in the cross shelf directions. GRA

**N81-16521#** Washington Univ., Seattle. Dept. of Oceanography

**THE USE OF SEASAT (SMMR) IMAGERY TO STUDY THE BERING SEA ICE.** Interim Report. Seelye Martin. 1 Jul. 1980. 22 p. refs. (Contract MO-A01-78-00-4335) (PBB1-106643, REF-A80-21, NOAA-80090806) Avail. NTIS HC A02/MF A01 CSCL 08L

The movement of thick ice by winds and currents represents a potential hazard to any future drilling operations in lease areas such as the Navarin Basin and Bristol Bay. The knowledge of the ice edge properties and ability to forecast the edge position is essential to the safety of fishing boats operating near the edge. It was observed that the ice divided into three general types moving in from the pack edge. The cause of these three different zones appears to be the ocean swell. This means that when the wind blows from the north the increased surface roughness causes greater atmospheric drag and the roughened ice is blown away from the pack where it forms the observed ice bands. GRA

**N81-16714#** Massachusetts Inst. of Tech., Cambridge. Dept. of Earth and Planetary Sciences

**DETERMINATION OF THE GENERAL CIRCULATION OF THE OCEAN AND THE MARINE GEOID USING SATELLITE ALTIMETRY.** Final Report, 1 Jan. - 31 Dec. 1980. Carl Wunsch. 1 Dec. 1980. 9 p. refs. (Contract N00014-80-C-0273, NR Proj. 083-157) (AD-A092755) Avail. NTIS HC A02/MF A01 CSCL 08/3

This contract was the continuation of a previous one for the general purpose of understanding the use of satellite altimetry in physical oceanography. There have been several activities some of which are continuing. We have published a paper demonstrating a general formalism for using altimetry for the joint purpose of determining the general circulation of the oceans and improving the geoid. Using conventional hydrography in the North Atlantic Ocean, a sea surface relative to the geoid has been constructed and will soon be published. The general problem of constructing marine geoids independent of altimetric measurements has been solved in the context of inverse theory. Such geoids are required for subtraction from an altimetric surface to find the ocean current signal. Finally, the principal investigator has been involved in the active planning for a proposed new altimetric mission called TOPEX. GRA

**N81-18462#** Hamburg Univ. (West Germany). Inst. fuer Geophysik

**IMAGE CONTRAST ENHANCEMENT BY APPLYING FOCUS ADJUSTMENT IN SYNTHETIC APERTURE RADAR IMAGERY OF MOVING OCEAN WAVES.** Werner R. Alpers and Clifford L. Rufenach (NOAA, Boulder, Colo.) In: ESA SEASAT-SAR Processor 1980, p. 25-31. refs. Avail. NTIS HC A07/MF A01

## 05 OCEANOGRAPHY AND MARINE RESOURCES

Image contrast enhancement in synthetic aperture radar (SAR) imagery of ocean waves is shown to be dependent on orbital acceleration effects and not phase velocity of long waves. In order to obtain maximum image contrast, it is necessary to apply a correction to the azimuthal focus setting which is of the order of  $R/2V \times A \text{ sub } R$  where  $A \text{ sub } R$  is the (orbital) acceleration of the water particles in the range direction,  $R$  the distance between the platform and the target and  $V$  the platform velocity. The correlation is often of the same order as the phase velocity of long waves. The modulation depth of a SAR image of a monochromatic ocean wave is numerically calculated as a function of the azimuthal focus setting. The calculations clearly show the relevance of focusing for ocean wave imagery of certain SAR and ocean wave parameters. Author (ESA)

**N81-18463#** Southampton Univ (England)  
**SYNTHETIC APERTURE RADAR WAVE IMAGING**  
D G Appelby /in ESA SEASAT-SAR Processor 1980 p 33-35 refs  
Avail NTIS HC A07/MF A01

Mechanisms for synthetic aperture radar imaging of ocean waves are reviewed. Theories based on the two scale wave concept are outlined for tilt roughness and orbital velocity modulation effects. Rayleigh scattering and radar layover are mentioned as being of possible importance in rough sea conditions. Some comments are made on the stationary surface model. Author (ESA)

**N81-18464#** Canada Centre for Remote Sensing, Ottawa (Ontario)  
**SYNTHETIC APERTURE RADAR PROCESSING OF PARTIALLY COHERENT PHENOMENA**  
R K Raney /in ESA SEASAT-SAR Processor 1980 p 37-52 refs  
Avail NTIS HC A07/MF A01

Partially coherent synthetic aperture radar (SAR) imaging of a scene that is subjected to random fade is considered. The impulse response, frequency response and response to extended random fields are formally derived and the problem is addressed of estimating SAR impulse response from measures of spectra corresponding to random distributed scenes. Explicit results are obtained using Gaussian functions to describe the SAR, its coherence, and the scene coherence. Results are presented which converge appropriately on known results for cases treated previously. The results are applied to the problem of SAR imagery of oceanic waves with comments on certain aspects of SAR from the SEASAT-A satellite. Author (ESA)

**N81-18465#** Institut Franco-Allemand de Recherches St Louis (France)  
**DIRECTIONAL SPECTRA OF WAVES IN THE NORTH SEA INTERPRETATION OF SEASAT-SAR IMAGES**  
A Fontanel and D deStaerke /in ESA SEASAT-SAR Processor 1980 p 53-60 refs

Avail NTIS HC A07/MF A01  
Images and two dimensional spectra from orbit 1149 over the North Sea were analyzed covering an area 800 km by 100 km including the southern part of the Shetland Islands. Approximately 100 optical Fourier Transforms were used to estimate the wavelengths of the waves and their directions of propagation + or - 180 deg. Each spectrum corresponds to a zone measuring about 20 x 20 km. There is considerable variation in the wavelengths present on the sea. Northwest and west of the Shetland Islands waves of more than 300 m wavelength were propagating eastward. The wavelengths decrease progressively toward the southeast approaching a front running from east to west. To the west of this front the longest wavelengths were no more than 90 m. Author (ESA)

**N81-18467#** Technical Univ of Denmark Lyngby Inst of Electromagnetics  
**SYNTHETIC APERTURE RADAR IMAGERY OF SEA ICE**  
Finn Soendergaard /in ESA SEASAT-SAR Processor 1980 p 69-75 ref  
Avail NTIS HC A07/MF A01

Weather maps NOAA 5 satellite photographs and ice maps were compared visually with two SEASAT images taken during revolutions 719 and 762 16 and 19 Aug 1978. With moderate to high winds little difference was found in the level of the backscattered signal from the sea ice and little contrast on the imagery, making discrimination difficult or impossible. The depression angle and frequency of the SEASAT Synthetic Aperture Radar are not well suited for sea ice detection. Author (ESA)

**N81-18468#** University Coll Cork (Ireland) Dept of Civil Engineering  
**REQUIREMENTS FOR REMOTE SENSING WAVE DATA NEAR IRELAND**  
A W Lewis /in ESA SEASAT-SAR Processor 1980 p 77-78 ref  
Avail NTIS HC A07/MF A01

Offshore drilling operations feasibility studies for wave power sites and coastal erosion problems are cited as justifying satellite measurement of wave parameters with Altimeter or synthetic aperture radar. Sea truth sites are identified for calibrating flights i.e. four buoys and one gas production platform. Author (ESA)

**N81-19529\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt Md  
**COMPARISON DATA FOR SEASAT ALTIMETRY IN THE WESTERN NORTH ATLANTIC**  
R E Cheney Jan 1981 23 p refs Submitted for publication (NASA-TM-82069) Avail NTIS HC A02/MF A01 CSCL 05B

The radar altimeter flown on Seasat in 1978 collected approximately 1 000 orbits of high quality data (5-8 precision). In the western North Atlantic these data were combined with a detailed gravimetric geoid in an attempt to produce profiles of dynamic topography. In order to provide a basis for evaluation of these profiles, available oceanographic observations in the Gulf Stream/Sargasso Sea region have been compiled into a series of biweekly maps. The data include XBT's satellite infrared imagery and selected trajectories of surface drifters and sub-surface SOFAR floats. The maps document the known locations of the Gulf Stream cyclonic and anticyclonic rings, and mid-ocean eddies during the period July to October 1978. T M

**N81-19534#** Applied Science Technology, Inc Arlington, Va  
**FEASIBILITY STUDY OF AIRBORNE BATHYMETRIC SENSING USING THE CO2 LASER/ ACOUSTIC TECHNIQUE (BRIGHTON DAM TEST RESULTS) Interim Report, Sep 1978 - Nov 1979**  
G Daniel Hickman B S Maccabee (Naval Surface Weapons Center) and C E Bell (Naval Surface Weapons Center) May 1980 39 p refs  
(AD-A094694 AST-R-070580) Avail NTIS HC A03/MF A01 CSCL 08/10

A feasibility experiment was performed on a concept for a remote system for bathymetric mapping in turbid shallow waters. The concept consists of a CO2 laser transmitter and a microphone receiver. The CO2 laser is used from a platform in the air to generate an acoustic field in the water, while the microphone (in air) detects the sound pulses after being reflected off the bottom sediment. The results of these experiments definitively proved that the CO2 laser/acoustic technique could be used to derive bathymetric data using a microphone located in the air. The possibility therefore exists that this technique could be used as the basis for a remote sensing system for shallow water bathymetry. Similar type measurements were also made of acoustic reflections from an aluminum plate located at various water depths. Calculations of the Sound Pressure Levels (SPL) are in good agreement with SPL's measured with a hydrophone in the water. However, large discrepancies exist between measured and calculated SPL's with the Air-located microphone. The resolution of these discrepancies, which are thought to be due to a malfunction of the microphone will be one of the objectives of future experiments. GRA

**N81-19543#** Technical Research Centre of Finland, Espoo Lab of Land Use

**THE USE OF SATELLITE IMAGERY IN SEA-ICE MONITORING**

Sipi Jaakkola Jun 1979 49 p refs In FINNISH, ENGLISH summary  
(VTT-LU-27, ISBN-951-38-0903-X, ISSN-0355-3477) Avail  
NTIS HC A03/MF A01

The possibilities of sea-ice monitoring using available satellite imagery were examined for the Gulf of Bothnia area. The state of the art of remote sensing techniques for sea-ice monitoring is reviewed. The installation of a Tiros-N satellite data receiving station is suggested as an immediate solution to the monitoring problem, and the required facilities are described. Certain principles for a long term solution are presented.

Author (ESA)

**N81-19734\*# National Aeronautics and Space Administration  
Goddard Space Flight Center Greenbelt Md  
OCEANOGRAPHIC INFLUENCES ON THE SEA ICE COVER  
IN THE SEA OF OKHOTSK**

Andrew J Gratz (Princeton Univ N J) and Claire L Parkinson  
Feb 1981 22 p refs  
(NASA-TM-82085) Avail NTIS HC A02/MF A01 CSCL  
08L

Sea ice conditions in the Sea of Okhotsk, as determined by satellite images from the electrically scanning microwave radiometer on board Nimbus 5, were analyzed in conjunction with the known oceanography. In particular, the sea ice coverage was compared with the bottom bathymetry and the surface currents, water temperatures, and salinity. It is found that ice forms first in cold shallow, low salinity waters. Once formed, the ice seems to drift in a direction approximating the Okhotsk-Kuril current system. Two basic patterns of ice edge positioning which persist for significant periods were identified as a rectangular structure and a wedge structure. Each of these is strongly correlated with the bathymetry of the region and with the known current system, suggesting that convective depth and ocean currents play an important role in determining ice patterns.

Author

**N81-20526# Lille Univ (France) Lab d'Optique Atmospherique**

**CRITICAL EVALUATION OF THE RADIOMETRIC REQUIREMENTS OF SATELLITE ONBOARD EQUIPMENT FOR THE MEASUREMENT OF OCEAN COLOR [EVALUATION CRITIQUE DES EXIGENCES RADIOMETRIQUES POUR UN EQUIPEMENT MESURANT A BORD D'UN SATELLITE LA COULEUR DES OCEANS]**

P Y Deschamps, D Tanre, and M Viollier Paris ESA Jul 1980 158 p refs In FRENCH  
(Contract ESA-3986/79/F-CG)  
(ESA-CR(P)-1390) Avail NTIS HC A08/MF A01

The required radiometric performance of a sensor (ocean color monitor) onboard a CMOSS satellite (coastal ocean monitoring satellite system) is defined. The sensor measures ocean color in the visible spectrum and ocean temperature in the infrared. Desired accuracy is set at + or - 20% for the measurement of chlorophyll pigment concentration, and + or - 0.5 K for the determination of ocean surface temperature. Analysis shows the necessity of high reflectance sensitivity across several bands situated between 0.4 and 0.7 microns in order to discriminate between the influence of marine turbidity and chlorophyll pigment absorption. Interference effects due to atmospheric diffusion and ocean surface reflectance are revealed large in comparison with necessary precision. Correction algorithms are proposed. For ocean surface temperature measurement two bands between 10.5 and 12.5 microns are suggested, which make it possible to correct for the influence of water vapor absorption.

Author (ESA)

**N81-20631 Wisconsin Univ - Madison  
RADAR INVESTIGATIONS OF THE ROSS ICE SHELF  
Ph D. Thesis**

Kenneth Charles Jezek 1980 221 p  
Avail Univ Microfilms Order No 8025828

Airborne and surface radar soundings were carried out over the Ross Ice Shelf as part of the Ross Ice Geophysical and

Glaciological Survey. These data were analyzed to obtain detailed maps of ice thickness, flow lines, surface and bottom crevasse fields and locally detailed studies of bottom crevasses from which inferences were made about the recent history of the ice shelf, the present mass balance of the ice shelf, and the implication for future changes in the West Antarctic Ice Sheet. Airborne radar sounding data tied to surface data, were used for broadbased analysis of the ice shelf. Ice thickness contours show the ice shelf to be a complex, dynamic system. The correlation of some of the ice thickness anomalies with ocean floor topography and bottom and surface crevasse fields suggests that the grid western Ross Ice Shelf is characterized by a number of previously unidentified ice rises-areas where the ice shelf becomes grounded on highs in the ocean floor.

Dissert Abstr

**N81-20686\*# Jet Propulsion Lab, California Inst of Tech, Pasadena**

**SATELLITE ALTIMETRIC MEASUREMENTS OF THE OCEAN. REPORT OF THE TOPEX SCIENCE WORKING GROUP**  
Robert Stewart 1 Mar 1981 88 p refs  
(Contract NAS7-100)  
(NASA-CR-164087, JPL-PUB-81-4) Avail NTIS  
HC A05/MF A01 CSCL 08C

The scientific usefulness of satellite measurements of ocean topography for the study of ocean circulation was investigated. The following topics were studied: (1) scientific problems which use altimetric measurements of ocean topography, (2) the extent in which in situ measurements are complementary or required, (3) accuracy, precision, and spatial and temporal resolutions which are required of the topographic measurements, (4) errors associated with measurement techniques, and (5) influences of these errors on scientific problems. An operational system for measuring ocean topography, was defined and the cost of conducting such a topographic experiment, was estimated.

E A K

**N81-21412\*# Lancaster Univ (England) Lunar and Planetary Unit**

**SATELLITE MONITORING OF SEA SURFACE POLLUTION**  
Final Report, Jan 1977 - Oct 1980

Gilbert Fielder, Timothy Stuart Hall, Principal Investigators. Duncan John Telfer, Lionel Wilson, and Richard John Fryer. Oct 1980 134 p. Sponsored by NASA. Original contains imagery. Original imagery may be purchased from NASA Goddard Space Flight Center, (code 601) Greenbelt Md 20771. Domestic users send orders to 'Attn National Space Science Data Center', non-domestic users send order to Attn World Data Center A for Rockets and Satellites' HCMM  
(E81-10089 NASA-CR-164085 FR-2-16/F1) Avail NTIS  
HC A07/MF A01 CSCL 08J

Thermal IR data from NASA's Heat Capacity Mapping Mission were used in a study of the feasibility of detecting oil spills in the seas around the UK. The period of observation covered the years 1978/9, in which there were no major spills in the area. A video processor capable of generating false color renderings of any satellite image from eight density levels was used in the synoptic search for spills. Other laboratory equipment, and associated analyses were used to study the thermal behavior of oil spills on water. Oil spills may appear to be warmer or cooler than the surrounding sea, depending on numerous factors. TM

**N81-21426\*# Instituto de Pesquisas Espaciais - Sao Jose dos Campos (Brazil)**

**SPATIAL AND TEMPORAL VARIATIONS IN LAGOON AND COASTAL PROCESSES OF THE SOUTHERN BRAZILIAN COAST**

Nelson de Jesus Parada, Principal Investigator and Renato Herz Aug 1980 24 p refs. Presented at the 13th Symp on Remote Sensing of Environ, Ann Arbor Mich Apr 1979. Sponsored by NASA. Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, SD 57198. ERTS

(E81-10124 NASA-CR-164116, INPE-1848-RPE/205) Avail  
NTIS HC A02/MF A01 CSCL 08C

## 05 OCEANOGRAPHY AND MARINE RESOURCES

From a collection of information gathered during a long period, through the orbital platforms SKYLAB and LANDSAT, it was possible to establish a method for the systematic study of the dynamical regime of lagoon and marine surface waters, on coastal plain of Rio Grande do Sul. The series of multispectral images analyzed by visual and automatic techniques put in evidence spatial and temporal variations reflected in the optical properties of waters, which carry different loads of materials in suspension. The identified patterns offer a synoptic picture of phenomena of great amplitude, from which trends of circulation can be inferred, correlating the atmospheric and hydrologic variables simultaneously to the overflight of orbital vehicles. T M

**N81-21436\*#** National Aeronautics and Space Administration  
Goddard Space Flight Center, Greenbelt, Md  
**INFERENCE OF THE BOUNDARY LAYER STRUCTURE  
OVER THE OCEANS FROM SATELLITE INFRARED MEASUREMENTS**

C Prabhakara, G Dalu, R Lo (Computer Sciences Corp., Silver Spring, Md), and N R Nath (Computer Sciences Corp., Silver Spring, Md) Sep 1978 60 p refs  
(NASA-TM-79653) Avail NTIS HC A04/MF A01 CSCL  
O4A

The characteristics of the boundary layer of the atmosphere over the global oceans between about 50 deg N to 40 deg S were remotely sensed for three different periods, about 3 months each, during the year 1970. The spectral measurements made by Nimbus 4 Infrared Interferometer Spectrometer were used for this purpose. T M

**N81-21457#** Centre National d'Etudes Spatiales, Toulouse  
(France)

**OBSERVATION OF THE OCEAN: POSSIBILITIES FOR  
SENSING IN THE VISIBLE AND THE INFRARED [TRAVAUX  
PRATIQUES, NUMERO 1: OBSERVATION DE LA MER,  
POSSIBILITES OUVERTES EN VISIBLE ET INFRA-ROUGE]**  
M Viellefosse *In its* Math and Phys Principles of Remote  
Sensing 1978 p 671-714 refs In FRENCH

Avail: NTIS HC A99/MF A01

Remote sensing data taken from LANDSAT and aerial reconnaissance is examined in order to determine the orders of magnitude of the measured values, the significance of the observations, and the confidence limits of calculations. Using LANDSAT data, reflectance, atmospheric transmissivity, and the significance of physical measurements are determined. As an application, the organization of a flight for radiometric reconnaissance of the ocean surface is discussed. As a specific application, results from radiometric thermal infrared observation of an oil slick are reported. Calculation problems in data interpretation are brought out. Author (ESA)

## 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

**A81-20930** # Combined coastal zone color scanner /CZCS/, aircraft, and in-situ water quality remote sensing experiment in Lake Ontario S C Jain (Moniteg, Ltd, Toronto, Canada), H H Zwick, W D McColi (Canada Centre for Remote Sensing, Ottawa, Canada), R P Bukata, and J H Jerome (Canada Centre for Inland Waters, Burlington, Ontario, Canada) In Ocean optics VI, Proceedings of the Sixth Seminar, Monterey, Calif, October 23-25, 1979 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1980, p 178-188 13 refs

A multi-stage experiment has been conducted over Lake Ontario during the summer season of 1979 in conjunction with CZCS overpasses Airborne data were acquired with a multispectral 11 channel imager, a two channel experimental pushbroom imager, a profiling 4 channel photometer and a 500 spectral element profiling spectrometer Ground based radiance measurements of the atmospheric attenuation coefficient and sky radiance were made at six wavelengths The airborne and atmospheric measurements were made to coincide with CZCS overpasses and in situ measurements were made from a ship which traversed the lake along the same line from the Niagara River to Toronto during the same day The remote experimental data will be corrected for atmospheric effects and inverted to predict water quality parameters The experiment and some preliminary results will be discussed (Author)

**A81-21810 \* #** Measurement of dielectric properties and determination of microwave emissivity of polluted waters H J C Blume (NASA, Langley Research Center, Hampton, Va) (IEEE, Volkswagenwerk AG, Siemens AG, and Helmholtz Fonds, Conference on Precision Electromagnetic Measurements, Braunschweig, West Germany, June 23-27, 1980) IEEE Transactions on Instrumentation and Measurement, vol IM-29, Dec 1980, p 289-291

The dielectric properties of polluted waters are measured with a reflection-type resonant cavity at 1.43 GHz Very small water samples in quartz tubes of known volume are placed in the center of the maximum electric field Measurement of the resonance-frequency variation and a change of the cavity's quality factor are used to determine the dielectric properties The microwave emissivity of the polluted water is then calculated via the Fresnel equation and applied to data reductions of microwave radiometer measurements (Author)

**A81-23569 #** An overview of remote sensing based regional information systems for hydrologic modeling R M Ragan and J D Fellows (Maryland, University, College Park, Md) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 457-466 10 refs

The use of hydrologic models to simulate various components of the runoff cycle is an important element in water resource planning and management Models having parameters based on measurable drainage-basin characteristics such as landcover, soil type, slope, etc, are especially attractive to engineers and planners because they allow experimentation with various forms of watershed development to assess the impact of changes that might occur Proper definition of the model parameters is pivotal to the development of a successful planning or management strategy When a governmental organization routinely analyzes a large number of watersheds within its area of jurisdiction, the formidable task of defining hydrologic model parameters can be significantly enhanced through the use of

geographical information systems stored on computers Such a system stores the land cover and physiographic data required for parameter definition as an array of cells or polygons covering the entire area of jurisdiction Supporting software allows personnel to enter the coordinates of watershed boundaries The geographical information system accesses the data within the boundary and defines the necessary hydrologic parameters in real time of batch mode (Author)

**A81-23570 #** Snowpack estimation in the St John River basin J M Power (Environment Canada, Ottawa, Canada), C J Merry (U S Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), N B A Trivett, and S E Waterman (Environment Canada, Downsview, Ontario, Canada) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 467-486 11 refs Army-sponsored research

The paper outlines a method currently used for estimating the snowpack water equivalent in the sub-basins simulated in the Streamflow Synthesis and Reservoir Regulation model Two new techniques are evaluated in terms of possible improvements in the accuracy of spring runoff simulations A sensitivity analysis is performed to determine the effect of errors in snowpack inputs on the output hydrographs V L

**A81-23579 #** Cost effectiveness of conventional and remote sensing techniques for watershed planning T S George, R S Taylor, and R P Shubinski (Camp, Dresser and McKee, Inc, Springfield, Va) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 639-644

The cost and effectiveness of developing land cover information derived from the Landsat imagery are compared with that obtained from conventional sources A set of six demonstration watersheds that represent a range of basin characteristics and different drainage area sizes throughout the US forms the basis for the study It is shown that the conventional and Landsat methods are nearly equally effective in producing adequate land cover data needed for hydrologic studies The total cost effectiveness analysis shows that the conventional method is cost effective for a study area containing less than 26 sq km and that the Landsat method is cost effective for areas containing more than 26 sq km C R

**A81-23599 #** Groundwater discharge detection along the coasts of the Arabian Gulf and the Gulf of Oman using airborne thermal infrared imagery K P B Thomson and G Nielsen (Hydrogeo Canada, Montreal, Canada) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 835-843 7 refs

An airborne thermographic survey was carried out along two coasts of the United Arab Emirates in March 1979 The objective of the study was to detect possible sources of groundwater discharge into the sea Infrared linescanning was successful in detecting thermal anomalies at a number of locations along both the Arabian Gulf and Gulf of Oman coasts Several of the warmer anomalies have been identified as groundwater discharge The volume of groundwater loss was estimated at four main locations and was found to range from 2,240 to 14,950 cu m/day depending on the location (Author)

**A81-23622 #** Remote sensing of chlorophyll found in bodies of water S Uno (Nansei Regional Fisheries Research Laboratory, Hiroshima, Japan), Y Sugahara, and S Hayakawa (Asia Air Survey Co, Ltd, Tokyo, Japan) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich,

## 06 HYDROLOGY AND WATER MANAGEMENT

Environmental Research Institute of Michigan, 1980, p 1147-1157  
Research supported by the Science and Technology Agency

**A81-23623 #** **Regional surface water and dam inventories via Landsat multispectral scanner** J G Cook (US Army, Corps of Engineers, Nashville, Tenn) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1159-1164

**A81-23636 #** **The application of remote sensing techniques towards the management of the Aswan High Dam Reservoir** S E Smith, K H Mancy (Michigan, University, Ann Arbor, Mich), and A F A Latif (Egyptian Academy of Scientific Research and Technology, Cairo, Egypt) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1297-1307  
10 refs Research sponsored by the US Environmental Protection Agency and Ford Foundation

**A81-23640 #** **Remote sensing of water quality using an airborne spectroradiometer** H L McKim, C J Merry (US Army, Cold Regions Research and Engineering Laboratory, Hanover, NH), and R W Layman (Dartmouth College, Hanover, NH) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1353-1362  
6 refs Army-sponsored research

An airborne spectroradiometer with 500 parallel channels has been used to monitor water quality in various water environments. Field experiments were run to test and evaluate the instrument's response to various amounts of suspended materials in water. Procedures were evaluated in the laboratory to separate the various components from the total reflected radiance and to correlate the spectral distribution of the subsurface reflectance to the organic/inorganic materials in the water. It was concluded that qualitative and quantitative measurement of turbidity within a water body is possible using the airborne spectroradiometer. The accuracy of the quantitative measurement is still under investigation, but suspended sediment concentrations of less than 5 ppm can be detected. Organic and inorganic constituents can be qualitatively differentiated.  
(Author)

**A81-23645 #** **Study of Karnafuli reservoir and its watershed** M U Chaudhury, M H Q Huda, and M A Gafur In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1409-1418  
Research supported by the International Development Research Centre

An attempt is made, by means of computerized analysis of Landsat imagery from March 1975, to quantify the gradual but serious siltation of the Karnafuli hydroelectric reservoir in Bangladesh. The entire watershed area of the reservoir has been deforested for shifting cultivation by burning its vegetation cover, with extensive soil erosion resulting during the Monsoon rains. It is concluded that the hills surrounding the reservoir will have to be put under permanent vegetation cover at an accelerated pace, since both dry season navigation of the reservoir and its pisci-cultural potential are threatened.  
O C

**A81-23648 #** **Evaluation of Landsat data for disaster assessment and planning - Sudan flood 1978** A S Andrawis, D G Moore (South Dakota State University, Brookings, S Dak), and A Doka (Soil Survey Administration, Wad Medani, Sudan) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3

Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1443-1454  
7 refs US Agency for International Development Contract No OFDA-147 79-03

The use of Landsat data in reconnaissance disaster assessment was evaluated for the 1978 Gezira Flood of Sudan. The authors concluded that Landsat data are beneficial to a rapid assessment of large-area flood damage if high quality, cloud free data are available in a timely manner. They are best used in stratifying zones of varying levels of apparent damage. After quantification of various themes of damage by ground or low flight aircraft observation, the Landsat interpretation provides a data base to extend the point observations into a map. The mapping units are measured to quantify the assessment.  
(Author)

**A81-23662 #** **The infrared photography and the limnological study of the Brockman Dam** L Lemus Hildalgo, J Rodríguez Monroy, and P Ruiz Azuara (Universidad Nacional Autónoma de México, México City, México) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1611-1618  
12 refs

The dynamics of the Brockman Dam, Edo de Mex was studied (summer 1978-spring 1979) by a ground truth program, infrared photography, radiance measurements, and laboratory analysis. The main point was to obtain a relationship between infrared film transmissibility and primary productivity. The results show that the dam has oligo eutropic dystrophic characteristics and that suspended solids, secchi transparency, radiance, primary productivity, and infrared film transmissibility are highly correlated. The dynamics of the primary productivity during the annual cycle studied indicates that an increase in the productivity implies a decrease in the secchi transparency, and this is correlated with an increase of the infrared film transmissibility.  
(Author)

**A81-23667 \* #** **Identification of lateral spectral contrasts in the lower Hudson River Estuary using Landsat digital data** R W Birnie (Dartmouth College, Hanover, NH) and E W Posementier (Dartmouth College, Hanover, NH, Long Island University, Southampton, NY) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1663-1672  
12 refs Grant No NsG 5014

**A81-23680 #** **Determination of land use from satellite imagery for input to hydrologic models** R P Webb, R Cermak, and A Feldman (US Army, Hydrologic Engineering Center, Davis, Calif) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich, Environmental Research Institute of Michigan, 1980, p 1815-1829  
10 refs

The calibration of hydrologic parameters for watershed models based on a Landsat land use classification procedure is discussed. The procedure consists of an integrated set of computer programs centered around an unsupervised classification routine. The grid cell data banks provide information on the watershed's environmental, economic and social characteristics as well as a basis for the quantification of the relationship between storm runoff and land use. The procedure was successful in eliminating the need for expensive image processing equipment and its accuracy was as good as or better than those of commercial firms which supplied land-use data for the same area.  
L S

**A81-23686 #** **Três Marias reservoir, Minas Gerais State - Study of the dispersion of suspended sediments in surface waters using orbital imagery** T M Sausen (Instituto de Pesquisas Espaciais, São Jose dos Campos, São Paulo, Brazil) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann

Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1877-1890 7 refs

Landsat MSS gray tone data and Secchi depth measurements have been used to produce semiquantitative maps of sediment dispersion in an artificial reservoir for the dry and the wet season. In a correlation analysis, MSS channels strongly correlate with and are inversely proportional to Secchi depth measurements. The rainy season is found to be an optimum season for the discrimination of gray tones. It is also shown that in the rainy season MSS channel 4 has the least error in the estimation of means. V L

**A81-24675** Drainage on multiband radar imagery in the Laurentian area, Quebec, Canada. J T Parry, R K Wright (McGill University, Montreal, Canada), and K P B Thomson (Canada Centre for Remote Sensing, Ottawa, Canada). *Photogrammetria*, vol 35, Mar 1980, p 179-198 17 refs

High-resolution, synthetic-aperture airborne radar (SAR 580) is used in an analysis of drainage networks in the forested, southeastern margin of the Canadian Shield. Of the two frequencies (X- and L-band) and two polarizations (HH and HV), X band HH polarized imagery is found to be the most useful because of the more marked differences in radar backscattering from different terrain materials at shorter wavelengths, and the higher signal level and lower speckle in the like polarized return compared with the cross polarized XHH imagery provided 64% of the actual drainage network as opposed to 37% mean for the four radar channels, and detected 95% of the lakes of all sizes. XHH imagery was also effective in recording channel detail. A 19% increase in the amount of drainage detail resulted from the use of two look directions. D K

**A81-26899** # Prospects for the use of space imagery in limnological investigations (Perspektivy ispol'zovaniia kosmicheskoi informatsii v limnologicheskikh issledovaniakh). G I Galazii, N P Ladeishchikov, P P Sherstiankin, and M N Shimaraev (Akademiia Nauk SSSR, Limnologicheskii Institut, Irkutsk, USSR). *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 103-106 5 refs. In Russian

It is shown that space remote sensing data makes it possible to obtain information on the temporal and spatial variability of water basin characteristics. Information on other limnological characteristics, such as surface state (turbulence, ice cover, snow cover, etc.), and on the state of the atmosphere and neighboring lands, can also be obtained in short time periods. It is suggested that limnological investigations using space imagery lend themselves to the protection and utilization of natural resources. The application of such techniques to the Baikal region is discussed. P T H

**A81-28057** # Development and prospects of space remote sensing studies of glaciology (Stanovlenie i perspektivy kosmicheskoi gliatsiologii). V M Kotliakov (Akademiia Nauk SSSR, Institut Geografii, Moscow, USSR). *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 7-15 13 refs. In Russian

Several objectives of remote sensing studies of glaciology are discussed: (1) the investigation of global snow cover and sea ice, and their temporal variability, (2) the study of the formation and variability of mountain snow and ice, and (3) the observation of snow and ice conditions in specific areas of the globe. The application of space remote sensing imagery to the study of snowline dynamics and the determination of thaw runoff in rivers is discussed. The use of remote sensing for the mapping of mountain glacier areas (particularly for the World Atlas of Snow and Ice Resources) is considered. B J

**A81-28065** # Investigation of thermal microwave emission from snow cover (Issledovanie radioteplovogo izlucheniia snezhnykh pokrovov). V E Gershenzon, Iu B Khapin, and V S Etkin (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovaniia, Moscow, USSR). *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 58-62 11 refs. In Russian

The paper presents an analysis of snow cover brightness temperatures obtained by airborne microwave radiometers at fre-

quencies of 89, 37, 20, 9, 7.5, 3.6, and 1.7 GHz. A comparison with a model experiment makes it possible to evaluate the thickness and internal structure of the snow cover. It is shown that the millimeter-wave channel is very significant for the identification of land snow. B J

**A81-28714** # Evaluation of the physico-chemical parameters of the surface layers of bodies of water according to their microwave emission (Ob otsenke fiziko-khimicheskikh parametrov poverkhnostnykh vod akvatorii po sobstvennomu SVCh-izlucheniui). A G Grankov, B M Liberman, and A M Shutko. *Radiotekhnika i Elektronika*, vol 26, Mar 1981, p 624-626 7 refs. In Russian

The application of microwave radiometry to the evaluation of the physical and chemical properties of surface waters is investigated. Determinations of brightness temperatures between 0.8 and 30 cm were obtained by an airborne radiometer for areas of the Black Sea and the Dniester estuary and interpreted on the basis of a model of the radiation characteristics of water surfaces. The radio brightness levels obtained are shown to allow the determination of pollutant concentrations, salinity, and water temperature in the polluted and clean, fresh and salt water areas surveyed. A L W

**A81-29826** \* Development of an information data base for watershed monitoring. A Y Smith and R J Blackwell (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.). *Photogrammetric Engineering and Remote Sensing*, vol 46, Aug 1980, p 1027-1038 10 refs. Contract No. NAS7-100

Landsat multispectral scanner data, Defense Mapping Agency digital terrain data, conventional maps, and ground data were integrated to create a comprehensive information data base (the Image Based Information System), to monitor the water quality of the Lake Tahoe Basin. Landsat imagery was used as the planimetric base to which all other data were registered. A georeference image plane, which provided an interface between all data planes for the Lake Tahoe Basin data base, was created from the drainage basin map. The data base was used to extract each drainage basin for separate display. The Defense Mapping Agency-created elevation image was processed with VICAR software to produce a component representing slope magnitude, which was cross tabulated with the drainage basin georeference table. Future applications of the data base include the development of precipitation modeling, surface runoff models, and classification of drainage basin cover types. D K

**A81-29829** Land-cover classification using digital processing of aerial imagery. F L Scarpace and B K Quirk (Wisconsin University, Madison, Wis.). *Photogrammetric Engineering and Remote Sensing*, vol 46, Aug 1980, p 1059-1065 13 refs

Land cover information for a hydrological model was provided by digital analysis of aerial photography. A fast method for obtaining land-cover information in two watersheds was tested and found to be cost effective. Thematic representations as well as tabular information was produced. Accuracy of approximately 88 percent was determined for the digitally classified imagery. (Author)

**A81-29900** # The use of space information for swamp conservation and reclamation (Isopol'zovanie kosmicheskoi informatsii dlia okhrany bolot i ikh melioratsii). E A Vostokova, V I Somova, V A Sushchenia, and L A Shevchenko. In *The significance of swamps in the biosphere (Znachenie bolot v biosfere)*. Moscow, Izdatel'stvo Nauka, 1980, p 159-167 8 refs. In Russian

The applicability of space borne photography in the study and mapping of swamp areas in order to determine their proper utilization is discussed. The usefulness of the wide geographical coverage of space photographs for the determination of swamp boundaries, structural properties, surface characteristics, vegetation cover and thus swamp type and hydrology is pointed out, and the relevant indicators of swamp characteristics on space photographs are considered. The use of the information thus obtained in determining appropriate areas for land reclamation is then discussed, and

## 06 HYDROLOGY AND WATER MANAGEMENT

examples of maps of swamplands and of land reclamation areas obtained from space photographs are presented A L W

**N81-16685\*#** Morgan State Univ Baltimore, Md Dept of Mathematics

**ASSESSMENT OF THE QUALITY OF GATE AREA RAINFALL DATA FROM A NIMBUS-5 RADIOMETER Final Report** Nathaniel Knox and Rosalind R Cottrell Feb 1981 18 p refs (Grant NAG5-14)

Avail NTIS HC A02/MF A01 CSCL 04B

The quality of rainfall intensity estimates derived from passive microwave measurements by the electrically scanned microwave radiometer (ESMR-5) aboard the Nimbus 5 satellite are evaluated. The microwave measurements used are those coincident with the global atmospheric research program Atlantic tropical experiment (GATE). The ESMR 5 derived rainfall intensity estimates are compared with hourly averaged GATE radar rainfall measurements. It is determined from the transfer curves derived using the radar measurements as ground truth, that the ESMR 5 derived data consistently over estimates rainfall by a factor of approximately 1.4 E D K

**N81-17504#** Colorado State Univ, Fort Collins Dept of Earth Resources

**A WATERSHED INFORMATION SYSTEM Ph.D. Thesis**

Anton G Thomsen 1980 177 p refs

(OWRT Proj B-160-COLO(3))

(PB81-115701, W81-00081, OWRT-B-160-COLO(3)) Avail NTIS HC A09/MF A01 CSCL 08H

An information system for the analysis and simulation of mountain watersheds is described. Data on topography, vegetation and soils in digital terrain models (overlays) serve as the data base for watershed analysis, classification of snow in LANDSAT imagery and automatic generation of parameter decks for operating distributed simulation models of snowcover dynamics and streamflow generation. The computer programs that generate the parameter decks have built in calibration options for all major processes. Snow processes are simulated within square grid cell elements. The hydrograph resulting from spring snowmelt is simulated by a lateral flow model of streamflow generation driven by the simulated spatially distributed input (snowmelt and rain). Options are available for simulating the effects of forest management alternatives (thinning, clearcutting) on selected forest stands. GRA

**N81-18081#** Naval Postgraduate School Monterey Calif  
**HYDROGRAPHIC APPLICATIONS OF THE GLOBAL POSITIONING SYSTEM M.S. Thesis**

Penny D Dunn and John W Rees II Sep 1980 229 p refs (AD-A094556) Avail NTIS HC A11/MF A01 CSCL 08/10

Global positioning satellites receivers have been tested under a variety of conditions and have demonstrated exceptional accuracy. The most portable of the Phase 1 development equipment is the manpack/vehicle user equipment (MVUE or Manpack). The purpose of this study was to determine if a manpack is suitably accurate for coastal hydrographic surveying at scales on the order of 1:20,000. The MVUE was placed aboard the Naval Postgraduate School Research Vessel (R/V) ACANIA and operated under survey conditions in Monterey Bay, California. This objective required the testing of the manpack developed by Texas Instruments, Inc under varying survey conditions to determine the degradation of positional accuracy. The limit of the survey to which the unprocessed manpack data could be employed in a real-time operation was found to be 1:80,000 and smaller by the positioning error criteria of 0.5 mm to the scale of the survey (Umbach 1976). Application of differential techniques during the post-processing of the MVUE position data increased the limit of the survey scale to 1:40,000 using the same positioning criteria. GRA

**N81-18481** Maryland Univ, College Park

**ANALYSIS OF THE ORIGIN OF WATER WHICH FORMS LARGE AUFEIS FIELDS ON THE ARCTIC SLOPE OF ALASKA USING GROUND AND LANDSAT DATA Ph.D. Thesis**

Dorothy Kay Hall 1980 137 p

Avail Univ Microfilms Order No 8103882

Field and laboratory studies indicate that the water derived from aufeis meltwater has a chemical composition different from the adjacent upstream river water. The association of aufeis with springs and faults in the eastern Arctic Slope is indicative of a subterranean origin of the source water. In addition, large aufeis fields were not found to be strongly associated with breaks in channel gradient nor did aufeis extent follow meteorological patterns both of which would be indicative of a local origin of aufeis feed water. It is concluded that aufeis extent in a given river channel on the Arctic Slope is controlled by discharge from reservoirs of groundwater. It seems probable that precipitation passes into limestone aquifers in the Brooks Range through an interconnecting system of subterranean fractures in calcareous rocks and ultimately discharges into alluvial sediments on the coastal plain to form aufeis. It is speculated that only small (perhaps beaded) aufeis patches are affected by local meteorological conditions of the months just prior to aufeis formation. Dissert Abstr

**N81-19511\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**MICROWAVE REMOTE SENSING OF SNOWPACK PROPERTIES**

Albert Rango, ed 1980 272 p refs Conf held at Fort Collins, Colo., 20-22 May 1980

(NASA-CP-2153) Avail NTIS HC A12/MF A01 CSCL 08L

Topic concerning remote sensing capabilities for providing reliable snow cover data and measurement of snow water equivalents are discussed. Specific remote sensing techniques discussed include those in the microwave region of the electromagnetic spectrum.

**N81-19513\*#** California State Dept of Water Resources, Sacramento

**CALIFORNIA'S TRANSITION FROM CONVENTIONAL SNOWPACK MEASUREMENTS TO A DEVELOPING REMOTE SENSING CAPABILITY FOR WATER SUPPLY FORECASTING**

A J Brown and Ned Peterson /in NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 11-17 refs

Avail NTIS HC A12/MF A01 CSCL 08H

California's Snow Survey Program and water supply forecasting procedures are described. A review is made of current activities and program direction on such matters as the growing statewide network of automatic snow sensors, restrictions on the gathering of hydrometeorological data in areas designated as wilderness, the use of satellite communications which both provides a flexible network without mountaintop repeaters and satisfies the need for unobtrusiveness in wilderness areas and the increasing operational use of snow covered area (SCA) obtained from satellite imagery which combined with water equivalent from snow sensors, provides a high correlation to the volumes and rates of snowmelt runoff. Also examined are the advantages of remote sensing, the anticipated effects of a new input of basin wide index of water equivalent, such as the obtained through microwave techniques, on future forecasting opportunities, and the future direction and goals of the California Snow Surveys Program. E D K

**N81-19517\*#** National Aeronautics and Space Administration Ames Research Center, Moffett Field, Calif

**SNOW ELECTROMAGNETIC MEASUREMENTS**

William I Linlor, James L Smith (U.S. Forest Service Berkeley, Calif), Fred D Clapp (California Univ Berkeley), and Diogenes J Angelakos (California Univ Berkeley) /in NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 93-117 refs

(Contract NCA2-OR050-704)

Avail NTIS HC A12/MF A01 CSCL 08L

An electromagnetic system is described for measuring the dielectric constant and attenuation of snow samples in the



frequency range of 4 to 12 GHz System components consists of a swept-frequency source, microwave horns, network analyzer and XY plotter The procedure for calibrating the effect of wetness on the snow properties is described Equations are given that express the experimentally determined relation between attenuation per unit length and volume percent wetness at any frequency between 4 and 12 GHz permittivity can be calculated from the snow density attenuation per unit length and frequency Some applications of the techniques are described such as runoff forecasting from mountain snowpacks E D K

**N81-19518\*# Colorado State Univ Fort Collins  
ACTIVE MICROWAVE WATER EQUIVALENCE**

H S Boyne and D A Ellerbruch (NBS, Boulder, Colo) *In* NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 119-129 refs Sponsored in part by USDA Soil Conservation Service

Avail NTIS HC A12/MF A01 CSCL 08H

Measurements of water equivalence using an active FM-CW microwave system were conducted over the past three years at various sites in Colorado Wyoming and California The measurement method is described Measurements of water equivalence and stratigraphy are compared with ground truth A comparison of microwave, federal sampler, and snow pillow measurements at three sites in Colorado is described E D K

**N81-19519\*# Kansas Univ Center for Research Inc., Lawrence  
Remote Sensing Lab**

**RADAR OBSERVATION OF SNOWPACKS**

W Herschel Stiles and Fawwaz T Ulaby *In* NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 131-146 refs

(Contract NAS5-23777)

Avail NTIS HC A12/MF A01 CSCL 08L

Radar observations of snowpacks were made at test sites in Kansas, South Dakota and Colorado using truck mounted scatterometers covering the 1 to 18 GHz frequency range and the atmospheric window frequency of 35 GHz Experiments were conducted as a function of snow depth, wetness, and surface roughness The acquired data were used to model the backscattering coefficient in terms of snow and underlying soil parameters The results indicate that the radar return (1) increase with increasing water equivalent (2) decrease with increasing wetness (3) is sensitive to the snow surface roughness only when the snow is wet (4) is sensitive to the state (frozen or thawed) of the underlying soil if the snow is dry and (5) is repetitive from one site to another and from one season to the next Additionally, the measurements indicate the multifrequency observation or day-night observations may potentially provide the means for monitoring snow water equivalent, snow wetness, and the soil state E D K

**N81-19520\*# Massachusetts Inst of Tech., Cambridge Dept  
of Electrical Engineering and Computer Science  
THEORETICAL MODELS FOR MICROWAVE SNOW RE-  
SPONSE AND APPLICATIONS TO REMOTE SENSING**

J A Kong, R Shin, S L Chuang and L Tsang *In* NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 147-167 refs

(Contracts NAG5-16, F19628-80-C-0052, Grant NSF  
ENG-78-23145)

Avail NTIS HC A12/MF A01 CSCL 08L

Two theoretical models were developed to characterize snowpacks (1) a random medium with a variance a horizontal correlation length, and a vertical correlation length, and (2) a homogeneous dielectric containing discrete scatters Theoretical results were matched with experimental data collected from snow ice fields For snow ice fields the horizontal correlation length is no less than the vertical correlation length signifying a more laminar structure The correspondence between the continuum random medium and the discrete spherical scatter model can be verified when the vertical correlation length is equal to the horizontal correlation length The vertically polarized backscattering

cross section sigma (sub vv) is always greater than the horizontally polarized backscattering cross section sigma (sub hh) for half space scattering media and may become smaller for a two layer model In order to account for diurnal change exhibited by snow fields in both the active and passive remote sensing cases, a three layer model with a thin top layer caused by solar illumination must be used E D K

**N81-19521\*# National Aeronautics and Space Administration  
Goddard Space Flight Center, Greenbelt, Md Earth Survey  
Applications Div**

**REMOTE SENSING OF SNOW PROPERTIES BY PASSIVE  
MICROWAVE RADIOMETRY GSFC TRUCK EXPERI-  
MENT**

A T C Chang, Albert Rango, and J C Shiue *In* *its* Microwave Remote Sensing of Snowpack Properties 1980 p 169-185 refs

Avail NTIS HC A12/MF A01 CSCL 08L

Recent results indicate that microwave radiometry has the potential for inferring the snow depth and water equivalent information from snowpacks In order to assess this potential for determining the water equivalent of a snowpack it is necessary to understand the microwave emission and scattering behavior of the snow at various wavelengths under carefully controlled conditions Truck-mounted microwave instrumentation was used to study the microwave characteristics of the snowpack in the Colorado Rocky Mountain region during the winters of 1977 to 78 and 7978 to 79 The spectral signatures of C, X, K sub u, and K sub a band radiometers with dual polarization were used, together with measurements of snowpack density, temperature an ram profiles, liquid water content, and rough characterization of the crystal sizes These data compared favorably with calculated results based on recent microscopic scattering models Author

**N81-19522\*# Kansas Univ Center for Research, Inc., Lawrence  
Remote Sensing Lab**

**MICROWAVE RADIOMETRIC OBSERVATIONS OF SNOW-  
PACKS**

Fawwaz T Ulaby and W Herschel Stiles *In* NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 187-201 refs

(Contract NAS5-23777)

Avail NTIS HC A12/MF A01 CSCL 08L

Models for the microwave emission from snowpacks were generated on the basis of radiometric observations made at 10.7 GHz, 37 GHz, and 94 GHz at a test site near Steamboat Springs, Colorado In addition to conducting measurements on an approximately daily basis over a six week observation period, measurements were made over several diurnal cycles during which the change in snow wetness was tracked by the microwave radiometers Also, the variation in emissivity with snow water equivalent was examined as was the sensitivity to changes in snow surface geometry The microwave emissivity was observed to (1) decrease exponentially with snow water equivalent and (2) increase with snow wetness Thus, the emission behavior is the reverse of the backscattering behavior observed by the radar By fitting the models to the measured data, the variation of the optical depth with snow wetness was estimated Author

**N81-19523\*# Jet Propulsion Lab., California Inst of Tech.,  
Pasadena**

**MICROWAVE SIGNATURES OF THE NATURAL SNOW  
COVER AT WEISSFLUHJOCH**

R Hofer, C Maetzler (Inst of Applied Physics, Bern), E Schanda (Inst of Applied Physics, Bern), and W Good (Swiss Federal Inst for Snow and Avalanche Res., Weissfluhjoch) *In* NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 203-223 refs

Avail NTIS HC A12/MF A01 CSCL 08L

The natural snow cover on a high altitude alpine test site was monitored with a multi-frequency radiometer for more than three years Some measurements were also made with a 105 GHz scatterometer The microwave observations are supported by a large set of ground truth data From year to

## 06 HYDROLOGY AND WATER MANAGEMENT

year a wide variation in the development of the snowpack above and below average was observed Typical microwave data are presented for the different snow conditions in view of the applicability as signatures for remote sensing E D K

**N81-19524\*#** Helsinki Univ of Technology, Espoo (Finland) Radio Lab

**THEORETICAL AND EXPERIMENTAL STUDIES OF MICROWAVE RADIATION FROM A NATURAL SNOW FIELD** Martti Tiuri and Henrik Schultz IN NASA Goddard Space Flight Center Microwave Remote Sensing of Snowpack Properties 1980 p 225-234 refs

Avail NTIS HC A12/MF A01 CSCL 08L

The brightness temperature of a natural snow field in northern Europe was studied theoretically and experimentally at 5, 12, and 37 GHz for satellite remote sensing applications A snow model consisting of ice spheres covered by a water shell was used in calculation taking into account scattering and absorption The brightness temperature of a natural snow field as a function of view angle was measured from a tower in 1978 and 1979 The measured brightness temperature curves can be fitted with calculated ones by assuming reasonable values for the wetness and the particle size of snow Experimental results also show that relatively small changes in the snow conditions cause large changes in the brightness temperature In order to obtain a more controlled situation, experiments were continued in 1980 using a measuring site covered with aluminum sheets and determining the wetness and the particle size in addition to the density and physical temperature E D K

**N81-19525\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md Earth Survey Applications Div

**MONITORING SNOWPACK PROPERTIES BY PASSIVE MICROWAVE SENSORS ON BOARD OF AIRCRAFT AND SATELLITES**

A T C Chang, J L Foster, D K Hall, and Albert Rango /in its Microwave Remote Sensing of Snowpack Properties 1980 p 235-248 refs

Avail NTIS HC A12/MF A01 CSCL 08L

Snowpack properties such as water equivalent and snow wetness may be inferred from variations in measured microwave brightness temperatures This is because the emerged microwave radiation interacts directly with snow crystals within the snowpack Using vertically and horizontally polarized brightness temperatures obtained from the multifrequency microwave radiometer (MFMR) on board a NASA research aircraft and the electrical scanning microwave radiometer (ESMR) and scanning multichannel microwave radiometer (SMRM) on board the Nimbus 5, 6, and 7 satellites linear relationships between snow depth or water equivalent and microwave brightness temperature were developed The presence of melt water in the snowpack generally increases the brightness temperatures which can be used to predict snowpack priming and timing of runoff Author

**N81-19528\*#** National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Md

**UTILIZATION OF REMOTE SENSING IN ALASKA PERMAFROST STUDIES**

Dorothy K Hall Feb 1981 14 p refs Proposed for presentation at IEEE Geosci and Sensing Soc Washington D C 8-10 Jun 1981

(NASA-TM-82084) Avail NTIS HC A02/MF A01 CSCL 08G

Permafrost related features such as auefs tundra thaw lakes and subsurface ice features were studied LANDSAT imagery was used to measure the extent and distribution of auefs in Arctic Slope rivers over a period of 7 years Interannual extent of large auefs fields was found to vary significantly Digital LANDSAT data were used to study the short term effects of a tundra fire which burned a 48 sq km area in northwestern Alaska Vegetation regrowth was inferred from Landsat spectral reflectance increases and compared to in-situ measurements Aircraft SAR (Synthetic Aperture Radar) imagery was used in conjunction with LANDSAT imagery used in conjunction with LANDSAT imagery

to qualitatively determine depth categories for thaw lakes in northern Alaska T M

**N81-19556#** Colorado State Univ Fort Collins  
**APPLICATIONS OF REMOTE SENSING IN HYDROLOGY** William D Striffler and Diana C Fitz Sep 1980 89 p refs (Contract DI-14-34-0001-7145) (PB81-127425 W81-00505 COMPLETION-99 OWRT-B-160-COL(7)) Avail NTIS HC AC5/MF A01 CSCL 08H

Potential applications of remote sensing in the field of hydrology are considered The physical principles of electromagnetic energy and many of the available sensors are described Operational uses and research applications of remote sensing in areas related to watershed management are summarized GRA

**N81-20490\*#** National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Md  
**SNOW WATER EQUIVALENT DETERMINATION BY MICROWAVE RADIOMETRY**

A T C Chang, J L Foster, D K Hall, A Rango, and B K Hartline Jan 1981 22 p refs Submitted for publication (NASA-TM-82074) Avail NTIS HC A02/MF A01 CSCL 08L

One of the most important parameters for accurate snowmelt runoff prediction is snow water equivalent (SWE) which is contentiously monitored using observations made at widely scattered points in or around specific watersheds Remote sensors which provide data with better spatial and temporal coverage can be used to improve the SWE estimates Microwave radiation which can penetrate through a snowpack may be used to infer the SWE Calculations made from a microscopic scattering model were used to simulate the effect of varying SWE on the microwave brightness temperature Data obtained from truck mounted, airborne and spaceborne systems from various test sites were studied The simulated SWE compares favorably with the measured SWE In addition whether the underlying soil is frozen or thawed can be discriminated successfully on the basis of the polarization of the microwave radiation A R H

**N81-20528#** Colorado State Univ, Fort Collins Dept of Earth Resources

**A WATERSHED INFORMATION SYSTEM**

Anton G Thomsen and William D Striffler Sep 1980 117 p refs

(Contract DI-14-34-0001-7145)

(PB81-127433, COMPLETION-100, W81-00506,

OWRT-B-160-COLO(8)) Avail NTIS HC A06/MF A01 CSCL 08H

An information system for the analysis and simulation of mountain watersheds is described Watershed information on topography, vegetation and soils in digital terrain models (overlays) serve as the data base for watershed analysis Classification of snow in LANDSAT imagery and automatic generation of parameter decks for operating distributed simulation models of snowcover dynamics and streamflow generation is considered The computer programs that generate the parameter decks have built-in calibration options for all major processes, that permit fast model calibration from an interactive computer terminal, on watersheds with varying characteristics Options are available for simulating the effects of forest management alternatives (thinning, clearcutting) on selected forest stands Snow course measurements and LANDSAT imagery are used for simulation updates GRA

**N81-21410\*#** Calspan Advanced Technology Center Buffalo NY

**APPLICATIONS OF HCMM SATELLITE DATA Quarterly Report, 23 Aug - 23 Nov 1980**

23 Nov 1980 7 p HCMM

(Contract NAS5-24263)

(E81-10079 NASA-CR-163777, QR-13) Avail NTIS HC A02/MF A01 CSCL 05B

The thermal properties of Lake Ontario as they relate to water equality, lake hydrology and energy exchange were investigated as well as the urban heat island problem in selected areas adjacent to the lake The HCMM thermal sensor was fully

calibrated for several underflight data Actual surface water temperature maps were generated for all of Lake Ontario using the calibration procedure developed Major water quality changes associated with the thermal bar as located by HCMM thermal data were observed from satellite and aerial data and verified by ground truth A R H

**N81-21423\*#** Instituto Geografico Nacional Madrid (Spain) **THERMAL MAPPING, GEOTHERMAL SOURCE LOCATION, NATURAL EFFLUENTS AND PLANT STRESS IN THE MEDITERRANEAN COAST OF SPAIN Progress Report** Rodolfo Nunez delasCuevas D Fernando Lopez deSagredo (Univ Politecnica de Madrid) D Joaquin Melia Miralles (Valencia Univ) D Pedro Herranz Araujo (Univ Complutense) D Jesus Paredes Perlado (Centro de Estudios Hidrograficos Madrid) D Gregorio Parrilla (Inst Espanol de Oceanografia Madrid) D J Luis Picon (Centro de Investigacion Madrid), and D J Luis Labradero Principal Investigators (Consejo Superior de Investigaciones Cientificas Madrid) 30 Jun 1980 3 p Sponsored by NASA HCMM

(E81-10119 NASA-CR-164113 PR-3) Avail NTIS HC A02/MF A01 CSCL 13B

Although no significant results were achieved during the report period research continues A sample of imagery showing thermal inertia and temperature differences over the northeastern United States and Europe was received The project coordinator attended a TELLUS Project meeting in Ispra Italy at which general guidelines for the future were established and the quality of the data received was discussed A R H

**N81-21431\*#** National Conference of State Legislatures Denver Colo

**SOIL EROSION AND SEDIMENT CONTROL LAWS A REVIEW OF STATE LAWS AND THEIR NATURAL RESOURCE DATA REQUIREMENTS**

Susan B Klein Nov 1980 110 p refs Sponsored by NASA (NASA-CR-164132) Avail NTIS HC A06/MF A01 CSCL 05A

Twenty states the District of Columbia and the Virgin Islands enacted erosion and sediment control legislation during the past decade to provide for the implementation or the strengthening of statewide erosion and sediment control plans for rural and/or urban lands That legislation and the state programs developed to implement these laws are quoted and reviewed The natural resource data requirements of each program are also extracted The legislation includes amendments to conservation district laws water quality laws and erosion and sediment control laws Laws which provide for legislative review of administrative regulations and LANDSAT applications and/or information systems that were involved in implementing or gathering data for a specific soil erosion and sediment control program are summarized as well as principal concerns affecting erosion and sediment control laws A R H

**N81-21466#** California Univ, Livermore Lawrence Livermore Lab

**EQUATORIAL HYDROLOGY STUDIES BY SATELLITE TELEMETRY**

Bruce Clegg John Koranda William Robison, and Gale Holladay 30 Dec 1980 22 p refs (Contract W-7405-eng-48) (UCID-18869) Avail NTIS HC A02/MF A01

The use of a geostationary satellite as a transponder to collect surface environmental data to describe the fate of soil-borne radionuclides is discussed The remote, former atomic testing grounds at the Enewetak and Bikini Atolls present a difficult environment in which to collect continuous field data Land-based solar powered microprocessor and environmental data systems remotely measure net and total solar radiation rain, humidity temperature and soil-water potentials A water-flux model predicted wet season plant-transpiration rates nearly equal to the 6 to 7 mm/d evaporation-pan rate, which decreases to 2 to 3 mm/d for the dry season From the microclimate data a 1.3 and 1.20 (137) Cs dry-matter concentration ratio was estimated which was later confirmed by radioisotopic analysis This ratio exacerbates the dose to man from intake of food

plants Nephelometer measurements of airborne particulates indicate a minimum respiratory radiological dose M G

**N81-21698\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md **SEASONAL AND DAILY SNOWMELT RUNOFF ESTIMATES UTILIZING SATELLITE DATA**

In its Goddard Lab for Atmospheric Sci Collected Reprints 1978 - 1979 Vol 2 Mar 1980 p 742 refs Repr from the Specialty Conf on Irrigation and Drainage in the Nineteen-Eighties, Albuquerque, N Mex, 17-20 Jul 1979

Avail NTIS HC A22/MF A01 CSCL 04B

Methods using snowcovered area to update seasonal forecasts as snowmelt progresses are also being used in quasi-operational situations The input of snowcovered area to snowmelt models for short term predictions was attempted in two ways, namely, the modification of existing hydrologic models and/or the use of models that were specifically designed to use snowcovered area A daily snowmelt runoff model was used with LANDSAT data to simulate discharge on remote basins in the Wind River Mountains of Wyoming Daily predicted and actual flows compare closely, and, summarized over the entire snowmelt season (April 1 - September 30), the average difference is only three percent The model and snowcovered area data are currently being tested on additional watersheds to determine the method's transferability A R H

**N81-21699\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**THE UTILIZATION OF SPACEBORNE MICROWAVE RADIOMETERS FOR MONITORING SNOWPACK PROPERTIES**

A Rango, A T C Chang, and J L Foster In its Goddard Lab for Atmospheric Sci Collected Reprints 1978 - 1979, Vol 2 Mar 1980 p 745-760 refs Repr from Nordic Hydrol, v 10, 1979 p 25-40

Avail NTIS HC A22/MF A01 CSCL 04B

Snow accumulation and depletion at specific locations can be monitored from space by observing related variations in microwave brightness temperatures Using vertically and horizontally polarized brightness temperatures from the Nimbus 6 electrically scanning microwave radiometer, a discriminant function can be used to separate snow from no snow areas and map snowcovered area on a continental basis For dry snow conditions on the Canadian high plains significant relationships between snow depth or water equivalent and microwave brightness temperature were developed which could permit remote determination of these snow properties after acquisition of a wider range of data The presence of melt water in the snowpack causes a marked increase in brightness temperature which can be used to predict snowpack priming and timing of runoff As the resolutions of satellite microwave sensors improve the application of these results to snow hydrology problems should increase Author

**N81-21700\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**APPLICATION OF A SNOWMELT-RUNOFF MODEL USING LANDSAT DATA**

In its Goddard Lab for Atmospheric Sci Collected Reprints 1978 - 1979, Vol 2 Mar 1980 p 745-760 refs Repr from Nordic Hydrol, vol 10, 1979 p 225-238

Avail NTIS HC A22/MF A01 CSCL 04B

The snowmelt-runoff model developed for two small central European watersheds simulate daily streamflow on the 228 sq km Dinwoody Creek basin in Wyoming using snowcover extent for LANDSAT and conventionally measured temperature and precipitation For the six-month snowmelt seasons of 1976 and 1974, the simulated seasonal runoff volumes were within 5 and 1%, respectively, of the measured runoff Also the daily fluctuations of discharge were simulated to a high degree by the model Thus far the limiting basin size for applying the model has not been reached and improvements can be expected if the

hydrometeorological data can be obtained from a station inside the basin. LANDSAT provides an efficient way to obtain the critical snowcover input parameter required by the model A R H.

## DATA PROCESSING AND DISTRIBUTION SYSTEMS

Includes film processing computer technology satellite and aircraft hardware and imagery

**A81-20421 #** Looking down on the aurora from space C P Pike (USAF, Geophysics Laboratory, Bedford, Mass) and E H Gardner (USAF, Air Weather Service, Los Angeles, Air Force Station, Calif) *Astronautics and Aeronautics*, vol 19, Jan 1981, p 64 70 11 refs

Observations of the aurora, obtained by the two Defense Meteorological Satellites (DMS) in their sun-synchronous, nearly polar orbits along the day night terminator and the noon-midnight meridian, are discussed Photographs from DMS taken since 1971 have shown the auroral belt or oval in great detail, allowing the state of auroral activity to be determined The photographs are integrated over several auroral spectral features, including the oxygen red lines at 6300 and 6343 Å, the oxygen green line at 5577 Å and part of the N2 first positive and N2(+) Meinel system, and are for primary use in preparing weather and space and ionospheric environmental forecasts The Block 5B/C satellites, which ceased operation in 1977, carried as a primary sensor a scanning radiometer designed to collect simultaneously information in the 0.4 to 1.1 and 8 to 13 micron bands The present Block 5D satellites carry a visible night detector of spectral range 0.4 to 0.9 microns for meteorological observations, also capable of auroral observations, as well as special sensors that measure ionospheric and auroral parameters SCS

**A81-20746 \* #** A flexible approach to an Operational Land Observing System J M Driver (California Institute of Technology, Jet Propulsion Laboratory, Mission Design Section, Pasadena, Calif) *American Institute of Aeronautics and Astronautics, Aerospace Sciences Meeting, 19th, St Louis, Mo, Jan 12-15, 1981, Paper 81 0315* 11 p 11 refs Contract No NAS7 100

This paper presents a concept for an Operational Land Observing System (OLOS) formulated to satisfy a broad spectrum of perceived user needs for a diverse discipline community The concept formulated will allow continuous orthographic imaging across multiple spectral bands, near global stereoscopic imaging, and next day oblique imaging of any desired spot on earth Imaging parameters will be adaptable to known phenomena characteristics to facilitate information extraction including optional onboard theme selection The conceptual system will provide 6- to 12-hour quick look capability, 48-hour turnaround on all standard imaging products, and a guaranteed data flow schedule reliability for 10 to 20 years A fleet of successive operational satellites will be used (Author)

**A81-20933** Reconstruction of surface slopes from photographs of the ocean K S Krishnan, M A Nokes, R S Poulsen, and U B Shah (Systems Control, Inc, Palo Alto, Calif) In *Ocean optics VI*, Proceedings of the Sixth Seminar, Monterey, Calif, October 23-25, 1979 Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1980, p 206-212 5 refs

An optical method is presented for determining the actual slope distribution at a given time over an area of the ocean surface From slope data analysis, statistical descriptors of the ocean surface, such as the slope probability density function and the two dimensional power spectral density of slopes, can be derived unambiguously The method and data obtained provide a way to correlate the ocean surface geometry with ocean surface measurements based on electromagnetic radiation V L

**A81-20934** Beam spread and point spread functions and their measurement in the ocean R C Honey (SRI International,

Menlo Park, Calif) In *Ocean optics VI*, Proceedings of the Sixth Seminar, Monterey, Calif, October 23-25, 1979

Bellingham, Wash, Society of Photo-Optical Instrumentation Engineers, 1980, p 242-248 14 refs Navy-DARPA-supported research

It is demonstrated experimentally that the principle of reciprocity, when applied to the problem of spreading of a collimated beam incident on the sea from above, can significantly simplify the measurement of beam spread at large depths in real, inhomogeneous oceans The reciprocal experiment replaces the cosine irradiance detector with a cosine light source, and the resultant angular radiance distribution is measured at the surface with a camera system The experiment can be easily extrapolated to a camera in an aircraft V L

**A81-21676** Hill shading and the reflectance map B K P Horn (MIT, Cambridge, Mass) *IEEE, Proceedings*, vol 69, Jan 1981, p 14-47 155 refs Contract No N00014-75-C-0643

Manual hill-shading methods used in the past are briefly reviewed and methods that have been proposed for the automatic generation of shaded overlays are examined These techniques are evaluated in terms of the corresponding reflectance maps as a common representation for the dependence of tone or gray level on the orientation of surface elements V L

**A81-22072** Color image maps from black-and-white photographs S E Martin (US Geological Survey, Reston, Va) *Photogrammetric Engineering and Remote Sensing*, vol 46, Feb 1980, p 193-200 5 refs

The US Geological Survey is experimenting with the lithographic reproduction of color image maps from black-and-white film Two high-altitude photographs are simultaneously exposed in two vertically oriented mapping cameras, one containing black-and-white panchromatic film filtered to record the visible spectrum and the other containing black-and-white infrared film filtered to record the near-infrared spectrum Negatives of the two images are rectified, scaled, and processed to an optimum density range Halftones are made by screening the negatives for various combinations of yellow, magenta, cyan, and black, depending on the color rendition desired The 1:24,000 scale color image map produced has pleasing colors and the good resolution of an image map made from black-and-white panchromatic film (Author)

**A81-23033** Optimal distribution of control points to minimize Landsat image registration errors F Orti (IBM Scientific Center, Madrid, Spain) *Photogrammetric Engineering and Remote Sensing*, vol 47, Jan 1981, p 101-110

To precisely correct an MSS-Landsat image, ground control points are necessary because of the inaccuracy of the satellite's attitude and altitude measurements If the attitude and altitude are assumed to be described by certain polynomials of time, the corresponding coefficients can be estimated from the set of ground control points (GCP), and their estimated error propagated to obtain an average registration error over the whole image as a function of the GCP's coordinates Minimization of this error leads to the result that GCP's should be chosen around certain locations on the left and right edges of the image Some experiments are run to assess the practical value of this result (Author)

**A81-23037** Photogrammetric mapping - A chain of events R R Chamard (Systemhouse, Inc, Alexandria, Va) *Photogrammetric Engineering and Remote Sensing*, vol 47, Feb 1981, p 199-202

Events involved in a mapping project accomplished by photogrammetric techniques are discussed in general terms These events include definition of map specifications, planning, control, aerial photography, compilation, manuscript verification, and drafting V L

**A81-23538 #** Collection, processing, and distribution of remote sensing data from the Brazilian receiving station N J Parada (Instituto de Pesquisas Espaciais, São Jose dos Campos, Brazil) In

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 55-64

Basic information about the Brazilian Landsat Tracking, Receiving, Processing and Distribution System operated by INPE is presented. The localization of the receiving facilities at Curitiba allows the coverage, with a periodicity of 18 days, of the entire Brazilian territory, as well as most of South America. Also, the plans of the Brazilian Remote Sensing Satellite Program are briefly described.

(Author)

**A81-23602 \* # Radar image enhancement and simulation as an aid to interpretation and training** V S Frost, J A Stiles, J C Holtzman, L F Dellwig (University of Kansas Center for Research, Inc., Lawrence, Kan.), and D N Held (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 883-895 12 refs. Research supported by the California Institute of Technology, Contract No NAS7-100, Grant No DAAG29-77-G-0075

Greatly increased activity in the field of radar image applications in the coming years demands that techniques of radar image analysis, enhancement, and simulation be developed now. Since the statistical nature of radar imagery differs from that of photographic imagery, one finds that the required digital image processing algorithms (e.g., for improved viewing and feature extraction) differ from those currently existing. This paper addresses these problems and discusses work at the Remote Sensing Laboratory in image simulation and processing, especially for systems comparable to the formerly operational SEASAT synthetic aperture radar.

(Author)

**A81-23605 # SPOT program - Specifications and simulations of standard SPOT data products** B Cabrieres (Institut Geographique National, Saint-Mande, Val-de-Marne, France), J C Cazaux (Centre National d'Etudes Spatiales, Toulouse, France), and G Weill (Centre National d'Etudes Spatiales, Paris, France) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 931-940 6 refs

The SPOT satellite due to be launched in 1984 will have the capability of providing high-resolution images and stereoscopic coverage of large areas. This paper describes the geometric and radiometric quality of standard SPOT data products for each level of preprocessing and the program of the simulation of images.

(Author)

**A81-23608 # Comparative experimental study on the use of original and compressed multispectral Landsat data for applied research** K A Ulbricht (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Institut für Nachrichtentechnik, Oberpfaffenhofen, West Germany) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 967-977 9 refs

Parts of two multispectral Landsat scenes, compressed by a ratio of 6.4/1, were investigated on the effect of the compression on the image contents. Landsat images of the Bayuda desert in Sudan and the Baltic Sea have been submitted to supervised maximum likelihood classification. Partitioning of classified images is given on a percentage basis as a function of the rejection class parameter sigma. Three-dimensional clusters of spectral channels and histograms show the influence of compression. Discussion of results shows effect of compression on partitioning of classified scenes, being displayed in several tables and figures.

(Author)

**A81-23612 # Incorporating collateral data in Landsat classification and modeling procedures** A H Strahler, J E Estes, P F

Maynard, F C Mertz, and D A Stow (California, University, Santa Barbara, Calif.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1009-1026 31 refs

**A81-23650 # Feature selection and its impact upon Bayes' procedure** J D Tubbs (Arkansas, University, Fayetteville, Ark.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1469-1475 11 refs

A procedure is presented for comparing feature selection algorithms whereby the criterion is to maintain the classification accuracy obtainable in the original space. The procedure is based on the theoretical work of Decell et al (1979) who obtained an explicit expression for data compression to the smallest dimension without increasing the probability of misclassification using Bayes' procedure.

V L

**A81-23652 # Land cover data base with use of digitized high altitude aerial photograph** S Murai, T Okuda, R Matsuoka (Tokyo, University, Tokyo, Japan), and H Maeda (Gumma Technical College, Gumma, Japan) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1487-1497

Radiometric and geometric corrections for digitized high altitude color infrared aerial photographs are presented, as part of a Japanese Government project to produce digital land cover maps of 1:25,000 scale with pixel size of 10 meters grid. The following algorithms have been developed: shading correction for high altitude color infrared by using polynomials, and geometric correction for local relief of the terrain to produce a land cover map which geographically coincides with the digital national data bank of land use. Summarized information of vegetative and non-organic cover of 250 meters mesh is extracted from the functions of greenness and grayness defined here.

D K

**A81-23682 # Registration of Seasat/Landsat composite images to UTM coordinates** F H Wong and R Orth (Macdonald, Dettwiler and Associates, Ltd., Richmond, British Columbia, Canada) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1841-1847 8 refs. Research supported by the National Research Council of Canada.

The paper deals with a digital technique for producing a color composite Seasat/Landsat image. A brief presentation of the geometrical issues leading to registration equations is followed by an example of a composite scene produced on the UTM projection with a standard map scale.

V L

**A81-23689 # An approach to the problems of producing a complete, high resolution, remotely-sensed image of earth** J B Friedman (Kentucky, University, Lexington, Ky.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3  
Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1913-1923 9 refs

High resolution remotely sensed data can be processed and digitally mosaiced to present a comprehensive and complete Landsat quality image of earth. Program goals are established for such an image. Problems concerning handling and processing very large data bases, digital mosaicing and sampling, high speed high resolution printing, special film needs and format are noted. Alternate modes for presenting a full earth image are considered, and a preferred method is offered, with design parameters for a prototype.

(Author)

**A81-23721 \*** The development of a spectral-spatial classifier for earth observational data D A Landgrebe (Purdue University, West Lafayette, Ind) *Pattern Recognition*, vol 12, 1980, p 165-175 27 refs Grant No NGL-15-005-112, Contracts No NAS9-14016, No NAS9 14970

Over the last several years a classifier for earth observational image data has been under development intended to achieve improved performance by utilizing spatial characteristics of the data as an adjunct to multispectral properties The paper provides an overview of the conception, development, evaluation and documentation of this spectral-spatial classifier The research program leading to this classifier is described, the algorithms of the current implementation called ECHO are outlined, and results on its performance are summarized These results show improved accuracy, with greater computation efficiency, and only slightly increased operator complexity (Author)

**A81-23817** Optimum windows for image registration H Mostafavi, T L Steding, F W Smith, and R S Poulsen (Systems Control, Inc, Palo Alto, Calif) *IEEE Transactions on Aerospace and Electronic Systems*, vol AES-17, Jan 1981, p 101-110 6 refs Grant No DAAK40-77-C-0113

Two-dimensional cross-correlation techniques are applied to the problem of image registration under the assumption of small geometric distortion Optimum window functions are derived for two performance measures of interest peak-to-sidelobe ratio and mean-square registration error The latter is examined in terms of the contribution caused by noise and the contribution caused by geometric distortion A generalized Lagrange multiplier approach is used to derive approximate solutions assuming random images The case of Gaussian autocorrelation functions is examined in detail Results of applying the theoretically derived window functions to real data are presented, showing significant improvement in correlation performance (Author)

**A81-24288** Polarization imagery R Walraven (California, University, Davis, Calif) *Optical Engineering*, vol 20, Jan-Feb 1981, p 14-18 7 refs

A method for producing high-resolution images of the polarization information in a scene is presented, and several examples of polarization images are shown A 35 mm camera with a polarizing filter is used to obtain a set of four slides for each image of interest The slides are scanned with a digitizing video camera, and the resulting 512 x 512 digital images are manipulated with an image processing computer to produce separate images of the intensity, magnitude of linear polarization, and direction of polarization Several polarization images of typical natural scenes have been processed by this method These images show that both the magnitude and direction of polarization contain new and useful information that is not obtainable from the intensity The Multi-spectral Resource Sampler (MRS) experimental remote sensing satellite, to be launched in the mid 1980's, will be able to measure both intensity and polarization at several wavelengths The results of this paper indicate that the additional information obtained from the MRS polarization data should allow previously indistinguishable ground features to be separated (Author)

**A81-24326 \*** Surface reflectance measurements in the ultraviolet from an airborne platform II D D Doda and A E S Green (Florida, University, Gainesville, Fla) *Applied Optics*, vol 20, Feb 15, 1981, p 636-642 5 refs Contract No NAS5-22980

The spectral and broadband reflectance of naturally occurring desert sand, black lava, gypsum sand, and snow cover is measured from a twin engine Cessna 402 series aircraft The measurement system is computer controlled and electrically isolated from the aircraft It consists of upward and downward looking hemispheric diffusers, filters, a rotating 90 degree mirror, a focusing lens, and a double monochromator/PMT or a UV enhanced photodiode Measurements are made at several altitudes enabling the empirical determination of the backscatter and attenuation effects on the reflectance These reflectance results along with those reported

earlier for a pine forest, green farmland, the open ocean, and brown farmland are represented analytically (Author)

**A81-24465** Spectral and spatial image processing for remote sensing R Harris (Durham, University, Durham, England) *International Journal of Remote Sensing*, vol 1, Oct-Dec 1980, p 361 375 66 refs

This paper presents an argument that remote sensing image processing should attempt to copy human abilities The techniques of spectral analysis and texture analysis are reviewed and compared in their abilities to emulate human interpretation A preference for texture analysis is expressed (Author)

**A81-25309** Influence of different classification parameters in land-use mapping with Landsat data (Einfluss verschiedener Klassifizierungsparameter auf die Landnutzungskartierung mit Landsat-Daten) J Baumgart and F Quiel (Karlsruhe, Universität, Karlsruhe, West Germany) *Bildmessung und Luftbildwesen*, vol 49, Mar 1, 1981, p 29-41 6 refs In German

This study assesses the influence of different algorithms and procedures on land-use classification by means of Landsat data, with the area of Mannheim-Heidelberg taken as an example Most significant is the estimation of spectral properties of classes with training areas Different algorithms and combinations of channels have a relatively small influence Statistical data from one region do not yield good results in other areas, but the combination of training areas from different regions should yield good results for complete Landsat scenes Using table-look-up procedures, it was possible to classify one Landsat scene in three channels with a minicomputer in about half-an-hour of CPU time B J

**A81-25310** Radiometric correction of Landsat data (Radiometrische Korrektur von Landsat-Daten) B-S Schulz (Institut für angewandte Geodäsie, Frankfurt am Main, West Germany) *Bildmessung und Luftbildwesen*, vol 49, Mar 1, 1981, p 43-50 In German

A method for the relative and absolute calibration of six sensors in each band of Landsat is presented The method differs from previous ones in that it employs a nonlinear model enabling a fit to an arbitrary number of discrete radiometric levels Images are presented which demonstrate the improvement of the data with this method B J

**A81 26425** The concept of 'photo-variant' self-calibration and its application in block adjustment with bundles H Moniwa (Council of Maritime Premiers, Surveys and Mapping Div, Summer side, Prince Edward Island, Canada) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980*) *Photogrammetria*, vol 36, Feb 1981, p 11 29 29 refs

The concept of 'photo-variant' self-calibration, which overcomes many shortcomings of 'block invariant' self calibration, is described The novel approach is assigning an individual set of compensation parameters to each photograph or group of photographs rather than postulating a common set of parameters for all photographs in a block It is believed that the generalized character of this approach, applicable to any type of camera (metric or not) and photography (aerial or close range), compensates for the more laborious computational effort entailed Mathematical and computational considerations are considered in detail O C

**A81-28059 #** Aerospace methods and data in the study of exogenic processes in mountainous regions of the Baikal-Amur Mainline (Aerokosmicheskie metody i materialy v izucheni ekzogenykh protsessov v gornyykh raionakh BAMa). L A Pastinin, V M Plusnin, and V P Stupin (Akademii Nauk SSSR, Institut Geografii Sibiri i Dal'nego Vostoka, Irkutsk, USSR) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 22-26 5 refs In Russian

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

**A81-28063 #** Comparative analysis of satellite microwave and infrared images (Sравnitel'nyi analiz radioteplovykh i infrakrasnykh izobrazhenii, poluchennykh s ISZ) A A Vlasov, S T Egorov, and V A Pliushchev *Issledovanie Zemli iz Kosmosa*, Jan -Feb 1981, p 43-47 In Russian

Microwave images (at a wavelength of 8 mm) and infrared images (at wavelengths of 8-12 microns) obtained synchronously by the Meteor satellite are compared with regard to the determination of characteristics of cloud cover and the earth's surface. In many cases, the characteristics of land areas are defined better on microwave images than on infrared images. An analysis of microwave images makes it possible to determine the location of precipitation fields and to evaluate the water content of the cloud cover, while an analysis of infrared images can be used to determine the location of the upper boundary of the cloud cover B J

**A81-28064 #** Formation of an optical image with side illumination (O formirovani opticheskogo izobrazheniia s uchedom bokovogo podsveta) I V Mishin and A P Tishchenko (Gosudarstvennyi Nauchno-Issledovatel'skii Tsentr Izuchenii Prirodnykh Resursov, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Jan -Feb 1981, p 48-57 13 refs In Russian

An approximate method is presented for determining the brightness of the radiation field over the earth's surface with an inhomogeneous albedo. The method is used to examine the influence of side illumination on the structure of images obtained in satellite remote sensing. An algorithm is presented for the compensation of amplitude distortions of remote-sensing images caused by side illumination B J

**A81-28069 #** Allowance for cloud cover in the planning of space remote sensing of the earth with reference to Soyuz-22 mission results (Oblachnost' v planirovani kosmicheskoi s'emki zemli po rezul'tatam poleta KK 'Soyuz-22') E A Gorbushina and V A Kottsov (Akademiia Nauk SSSR, Institut Kosmicheskikh Issledovani, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Jan -Feb 1981, p 78-82 In Russian

Earth imagery from Soyuz 22 is analyzed with reference to the effect of cloud cover on the image quality. It is shown that the image quality is significantly improved by scheduling remote sensing on the basis of cloud cover forecasts. Results obtained have implications for the development of automatic remote sensing control systems for unmanned spacecraft V L

**A81-28070 #** Mathematical modeling of cloud cover for the planning of remote sensing missions (Matematicheskie modeli oblachnosti dlia apriornogo planirovani nabludeni zemli iz kosmosa) V T Bobronnikov *Issledovanie Zemli iz Kosmosa*, Jan -Feb 1981, p 83-89 11 refs In Russian

An approach based on discrete Markovian stochastic processes is used to model temporal and spatial variations of the earth's cloud cover. This approach yields compact models which allow for the essentially non-Gaussian nature of the process with arbitrary times between observations and arbitrary distances between the observed areas. The model parameters have to be determined from satellite or ground-based observations of the cloud cover V L

**A81-28072 #** Optimum projection of scanner imagery (K voprosu o vybore optimal'noi proektsii skanernykh snimkov) V I Khizhnicenko *Issledovanie Zemli iz Kosmosa*, Jan Feb 1981, p 96-99 In Russian

An isogonal projection is proposed for satellite scanner imagery which has all the properties of the transverse Mercator projection but uses a more convenient orbital coordinate system. It is shown that the proposed projection has minimum inherent distortions V L

**A81-28073 #** Application of the optimum linear prediction method to the geometric correction of satellite imagery of the earth and other planets (Ispol'zovanie metoda optimal'nogo lineinogo prognoza dlia geometricheskoi korrektsii kosmicheskikh snimkov zemli i drugikh planet) L I Permitina (Moskovskii Gosudarstvennyi

Universitet, Moscow, USSR) and S V Lebedev (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR) *Issledovanie Zemli iz Kosmosa*, Jan Feb 1981, p 100-104 13 refs In Russian

An algorithm has been developed for computerized rectification of satellite imagery. The algorithm is based on the method of optimum linear prediction which provides a way to estimate the relative contributions of various factors to image distortion. Application of the proposed method to the correction of 'Zond 8' lunar imagery is discussed V L

**A81-28602** Automatic off-line generation of digital terrain models B Makarovic (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980*) *ITC Journal*, no 3, 1980, p 408-420 5 refs

Consideration is given to the acquisition of digital terrain model (DTM) data for photogrammetry. Analog-to-digital conversion is linked with the analog sampling of image data and data compression and structuring. Image matching involves the partitioning of beta-matrices into submatrices (patches) for processing and into target segments and conjugated search segments. Using a matching operation the target segment is fitted into the conjugated search segment. On the basis of a predictive selection of conjugated segments, the computational load is reduced and a compressed set of DTM data is generated S C S

**A81-28603** A view on digital image processing N J Mulder (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980*) *ITC Journal*, no 3, 1980, p 452-477 7 refs

Digital image processing (DIP) is discussed in terms of the decision making procedure, noting image segmentation and enhancement, feature extraction and enhancement, and radiometric and geometric corrections. DIP is applied to mapping in the intensity, multispectral, spatial and temporal domains. It is noted that a conception of visual perception is important in mapping color and pattern features in human decision making. The DIP procedure is applicable to converting raw data into color coded class and state probabilities. It improves local consistency of class probability and helps spatial image segmentation for preclassification S C S

**A81-29324 #** The effect of an outer optical wedge on the geometry of a photograph (O vlianii vneshnego opticheskogo klina na geometriiu fotosnimka) U N Kamenev and S V Knorozov *Geodeziia i Kartografiia*, Jan 1981, p 18-22 In Russian

A theoretical study is presented of the effect of an outer optical wedge, i.e., the optical filter and protective glass of a camera, on the geometry of the photographs. Analytic geometry is used to investigate changes of the direction of a light ray passing through the wedge, and analytic expressions are obtained for calculating the corresponding corrections to the measured point coordinates of the photograph. The expressions can be used in high precision photogrammetry B J

**A81-29831 \*** Resolving the percentage of component terrains within single resolution elements S E Marsh, P Switzer, W S Kowalik, and R J P Lyon (Stanford University, Stanford, Calif) *Photogrammetric Engineering and Remote Sensing*, vol 46, Aug 1980, p 1079-1086 11 refs Research supported by the U S Geological Survey, Grant No N5G-5050

An approximate maximum likelihood technique employing a widely available discriminant analysis program is discussed that has been developed for resolving the percentage of component terrains within single resolution elements. The method uses all four channels of Landsat data simultaneously and does not require prior knowledge of the percentage of components in mixed pixels. It was tested in five cases that were chosen to represent mixtures of outcrop, soil and vegetation which would typically be encountered in geologic studies with Landsat data. For all five cases, the method proved to be



superior to single band weighted average and linear regression techniques and permitted an estimate of the total area occupied by component terrains to within plus or minus 6% of the true area covered. Its major drawback is a consistent overestimation of the pixel component percent of the darker materials (vegetation) and an underestimation of the pixel component percent of the brighter materials (sand) D K

**A81-29837** Spatial postprocessing of spectrally classified Landsat data I L Thomas (Department of Scientific and Industrial Research, Physics and Engineering Laboratory, Lower Hutt, New Zealand) *Photogrammetric Engineering and Remote Sensing*, vol 46, Sept 1980, p 1201-1206 10 refs

Usual spectrally based classification techniques make little allowance for the spatial relationship between surrounding picture elements. A process based on the evaluation of a proximity function is advanced that makes this allowance possible. This process reduces the classification 'noise' brought about by a variable range of spectral signatures for a target over an extended area. The proximity function was derived by analogy with the scalar gravitational attractive force (Author)

**N81-16511** State Univ of New York at Binghamton  
**AUTOMATED CLASSIFICATION OF AERIAL PHOTOGRAPHIES Ph D Thesis**

Timothy David Masters 1980 170 p  
Avail Univ Microfilms Order No 8100295

Three aspects of the automated interpretation of aerial photographs are considered. First is the selection and computation of variables suitable for the identification of unique training areas. Both black and white and four band multispectral frames are considered. Measures of tone, texture and special purpose variables are studied. Particular attention is paid to speed of computation and generalizability. Second, algorithms which greatly speed the selection of training sets are presented. These include automatic splitting of multimodal sets, rejection of outliers and selection of training sets without the need for supervision. Third, discrimination algorithm is presented. The algorithm is not distribution-free but is far more rugged than the normal maximum likelihood method against the high skewed distributions frequently encountered in the analysis of aerial photographs. A fourth section demonstrates these algorithms using two black and white and two color frames. Dissert Abstr

**N81-16512\*** Research Triangle Inst., Research Triangle Park, N C  
**CONCEPTS FOR ON-BOARD SATELLITE IMAGE REGISTRATION, VOLUME 1**

W H Ruedger, D R Daluge, and J V Aanstoos Jun 1980 155 p refs

(Contract NAS1-15768)  
(NASA-CR-159287, RTI/1796/00-01F-Vol-1) Avail NTIS HC A08/MF A01 CSCL 05B

The NASA-NEEDS program goals present a requirement for on-board signal processing to achieve user-compatible information-adaptive data acquisition. One very specific area of interest is the preprocessing required to register imaging sensor data which have been distorted by anomalies in subsatellite-point position and/or attitude control. The concepts and considerations involved in using state-of-the-art positioning systems such as the Global Positioning System (GPS) in concert with state-of-the-art attitude stabilization and/or determination systems to provide the required registration accuracy are discussed with emphasis on assessing the accuracy to which a given image picture element can be located and identified, determining those algorithms required to augment the registration procedure and evaluating the technology impact on performing these procedures on-board the satellite. A R H

**N81-18434** Purdue Univ Lafayette Ind  
**DIGITAL IMAGE SIMULATION FOR PHOTOGRAMMETRIC APPLICATIONS Ph D Thesis**

John-Edward Unruh 1980 276 p  
Avail Univ Microfilms Order No 8102716

The feasibility of using computer generated image displays which simulate aerial photographs in lieu of actual photography for photogrammetric experimentation is described. Factors affecting photograph simulation, the compilation of ground descriptions for photograph simulation and a computer program developed for this purpose are discussed. Sample simulated photographs are presented. Monoscopic and stereoscopic pointing experiments using both simulated photographs and digitized photographs are also described. The capability to program a wide range of image characteristics into the displays was demonstrated. Pointing experiments showed that in terms of measurement accuracy and precision observers respond similarly to both real and simulated photography. Photograph-like displays were demonstrated as a tool for viewing and editing digital cartographic data. Dissert. Abstr

**N81-18439#** Amsterdam Univ (Netherlands)  
**DIGITAL IMAGE PROCESSING OF SATELLITE PHOTOGRAPHS [DIGITALE BEELDVERWERKING VAN SATELLIET OPNAMEN]**

Nico H W Donker *In its The Computer as an Instr in Phys Geography* 1979 p 35-61 refs In DUTCH

Avail NTIS HC A07/MF A01

The use of satellites in obtaining information about the Earth and the recording of digital images is discussed. Employment of satellites especially for information to underdeveloped countries in their exploration of soil and weather patterns and predictions is examined. Too far advanced techniques for third world countries are considered disadvantageous. The following criteria are considered in the application of satellite information: (1) greater reliability (no continuous adjustment of equipment to process data); (2) high recording frequency (no cloud interference); (3) speed (soil control recordings have to be available immediately). It is concluded that there is still a shortage of soil scientists who are able to combine their discipline with computer technology. Transl by E A K

**N81-18446\*** Jet Propulsion Lab California Inst of Tech, Pasadena

**A SOFTWARE-BASED SYSTEM WHICH PRODUCES SEASAT SAR IMAGERY**

Chialn Wu *In ESA Instrumentation for Preprocessing of SAR Data to Image Form* Jul 1980 p 7-13 refs

(Contract NAS7-100)

Avail NTIS HC A06/MF A01 CSCL 09B

A digital processing algorithm and its associated system design for producing images from SEASAT synthetic aperture radar (SAR) data is described. The proposed system uses the fast Fourier transform approach to perform the two dimensional correlation process. The range migration problem can be alleviated by approximating the locus of echoes from a point target by several linear segments. Data corresponding to each segment are correlated separately and the results are coherently summed to produce full resolution images. This processing approach exhibits high computation efficiency and simple processing control functions. It is particularly attractive for software implementation based on general purpose computers. Results of this implementation and examples of digitally correlated SEASAT SAR imagery are discussed. Author (ESA)

**N81-18449#** Dornier-Werke G m b H Friedrichshafen (West Germany)

**BREADBOARD ACTIVITIES ON SYNTHETIC APERTURE CORRELATORS AND SYNTHETIC APERTURE RADAR SIMULATOR**

R Schotter *In ESA Instrumentation for Preprocessing of SAR Data to Image Form* Jul 1980 p 31-33

Avail NTIS HC A06/MF A01

A breadboard model of an analog charge coupled device 64 word correlator was tested for synthetic aperture radar (SAR) azimuth processing. The 32 word analog correlator R 5403 is used, two being cascaded indirectly to form one 64 word

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correlator For analysis and tests two SAR simulators were built to provide the azimuth correlator with specific radar signals Measurements are discussed and a method shown for performing a real time subaperture correlation at a swath width of 100 km A comparison between the results of cross correlation realized by the 64 word complex analog correlation and the corresponding digital correlation is given Author (ESA)

**N81-18454#** Christian Roving Ltd Copenhagen (Denmark)  
**ARCHIVING AND HANDLING OF IMAGE DATA**  
Erik H Nielsen *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 77-82

Avail NTIS HC A06/MF A01

The image data archiving subsystem which was developed for the METEOSAT ground support system is described The archive is based on high density digital tape recording technique and the experience from two years of operational use of such a technique is presented An image file processor was implemented by a special configuration of processing and interface modules interconnected by high speed data buses which allow the use of several large buffers during input/output operations By using shared random access memory areas together with special MOVE instructions data are transferred at high speed between devices Performance data are given for a number of image handling operations for a 42 M byte multispectral LANDSAT scene Author (ESA)

**N81-18456#** Compagnie d'Informatique Militaire, Spatiale et Aeronautique, Velizy-Villacoublay (France)  
**SYSTEMS INCLUDING PROPAL II PROCESSOR**  
J T Hollette *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 91-96 refs

Avail NTIS HC A06/MF A01

A minicomputer based associative parallel processor was designed for image processing The parallel processors use serial bit operators performing logical and arithmetic operations on variable length data The host computer is connected to the processor module by a data channel and a control channel Each processor contains a 16 bit register which is included also in the stack which serves both as a work register for each elementary processor and as an interchange box for interprocessor communication Configurations based on a MITRA 125 computer and a SOLAR 16/65 computer are shown A 100 km x 100 km SAR image can be processed in 8 hours Author (ESA)

**N81-18458#** European Space Agency Paris (France) EARTH-NET Programme Office  
**SEASAT-SAR PROCESSOR**  
1981 139 p refs Proceedings of ESRIN Workshop Frascati, Italy 10 - 14 Dec 1979  
(ESA-SP-154 ISSN-0379-6566) Avail NTIS HC A07/MF A01

Topics discussed at the workshop include SEASAT imagery of land sea and ice surfaces, processing of partially coherent phenomena, and image processing software and hardware for synthetic aperture radar data comparison of SEASAT and LANDSAT images The status of various microwave remote sensing projects is assessed

**N81-18459#** Bern Univ (Switzerland) Inst of Applied Physics  
**EXPERIENCE WITH SEASAT**  
E Schanda *In* ESA SEASAT-SAR Processor 1980 p 3-8 refs  
Avail NTIS HC A07/MF A01

Resolution problems experienced in using optically processed synthetic aperture radar (SAR) images from SEASAT for soil moisture studies are briefly listed Recommendations are made for improvements in SAR for land applications Calibration is needed in terms of backscattered signal in steps of less than 2 db for relative and less than 10 db for absolute calibration Storage of the full dynamic range of intensities is needed Processing requirements call for digital processing and maps of

numerical values of calibrated intensity An alert system (6 to 24 hr Telex warning) is needed to warn of unscheduled use of the satellite sensors Coordination of underflights by comparable sensors is recommended Author (ESA)

**N81-18461#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany) Inst fuer Nachrichtentechnik  
**TENTATIVE IMAGE PROCESSING WITH SEASAT-SAR IMAGE CORRELATED ONTO LANDSAT SCENE**  
K A Ulbricht *In* ESA SEASAT-SAR Processor 1980 p 19-23

Avail NTIS HC A07/MF A01

A SEASAT synthetic aperture radar (SAR) image of August 21, 1978, was geometrically rectified onto a LANDSAT scene of August 28, 1978 Image processing was applied to explain SAR imagery with the help of LANDSAT scenes or vice versa No ground check was possible Available cartographic maps proved to be useless for explanation of phenomena or images Passpoints for geometrical correlation were taken from border lines of lakes, from mountain tops, or from specific field points Correlations of LANDSAT and SAR images were used to attempt an explanation of higher resolved SAR imagery grey values and phenomena False color presentations of several image processing modules show results of unsupervised minimum distance classification as well as supervised maximum likelihood classification Results can only be tentative because of the lack of adequate ground truth Author (ESA)

**N81-18469#** GEC-Marconi Electronics Ltd Chelmsford (England)  
**THE INFLUENCE OF RADIOMETRIC RESOLUTION ON SYNTHETIC APERTURE RADAR DESIGN PARAMETERS**  
S R Brooks and P F Miller *In* ESA SEASAT-SAR Processor 1980 p 79-85  
Avail NTIS HC A07/MF A01

The dependence of the signal-to-noise ratio on range resolution and the normalized radar scattering cross section is outlined One interpretation of a proposed measurement of radiometric resolution is discussed The effect of incoherent integration on radiometric resolution is described for independent observations of the reflectivity of a distributed target The analysis is extended to include the effect of correlated observations of varying signal-to-noise ratios Author (ESA)

**N81-18470\*#** Jet Propulsion Lab California Inst of Tech Pasadena  
**SEASAT-SAR DATA ANALYSIS IN THE US AN UPDATE**  
James A Dunne *In* ESA SEASAT-SAR Processor 1980 p 87-89 ref  
(Contract NAS7-100)  
Avail NTIS HC A07/MF A01 CSCL 05B

A graph is shown which compares SEASAT synthetic aperture radar (SAR) wave length measurements and Krasman's shallow water dispersion relationship for a swell system of deep water length 210 m and period 11.7 sec The data were taken during the Duck experiment The status of the production of optically correlated SAR data is given along with a tabulation of both digitally and optically processed SAR image data available to the user community as of Aug 1979 Results from several SAR workshops are mentioned Author (ESA)

**N81-18471#** European Space Research and Technology Center, Noordwijk (Netherlands)  
**FINAL ACCEPTANCE OF THE MACDONALD DETTWILER AND ASSOCIATION SOFTWARE SYNTHETIC APERTURE RADAR PROCESSOR**  
J P Guignard *In* ESA SEASAT-SAR Processor 1980 p 91-100 refs  
Avail NTIS HC A07/MF A01

The image characteristics resulting from using a SAR and acceptance test procedures are described Measured were spatial and radiometric resolution, and integrated sidelobe ratio Processor performance was measured with simulated input and real SEASAT imagery These tests included performance at increased equivalent

yaw, focus across a processor segment, dynamic range, spatial distribution of image points, absolute location of specified targets and processor throughput. The effect of beam offset from zero Doppler (equivalent yaw) was shown to be of importance in assessing the quality of SAR images. Author (ESA)

**N81-18472#** Communications Research Centre, Ottawa (Ontario)

**THE COMMUNICATIONS RESEARCH CENTRE SYNTHETIC APERTURE RADAR PROCESSOR**

M R Vant G E Haslam and W E Thorp (W E Thorp Assoc Ltd) In ESA SEASAT-SAR Processor 1980 p 101-112 refs

Avail NTIS HC A07/MF A01

A two dimensional, software based, digital synthetic aperture radar (SAR) processor capable of generating images from airborne or satellite-borne SAR's operating in either 'squinted or sidelooking' modes is presented. This processor implements true two dimensional matched filtering, via two dimensional fast convolution. The process by which the range variation of the parameters of the SAR signal causes a mismatch between the filter and the data at the edges of the processing block is described. Provided the mismatch is not severe, the resultant image is in focus but contains geometric distortions that are removed later. The signal processor implementation is outlined and typical processing speeds are given. Images produced from the SEASAT-A SAR are presented. Author (ESA)

**N81-18473#** Royal Aircraft Establishment Farnborough (England) Space Dept

**PRELIMINARY RESULTS FROM THE RAE DIGITAL PROCESSOR**

G E Keyte In ESA SEASAT-SAR Processor 1980 p 113-125 refs

Avail NTIS HC A07/MF A01

An experimental facility for digitally processing data from the synthetic aperture radar (SAR) on SEASAT-A is described. The procedures for defining image parameters and high density digital tape start and finish times, for transferring raw data from high density tapes to computer compatible tape and for processing raw data and output to an image tape are described. Data selection, range compression and azimuth compression techniques are given with processing times. Production methods of multilook and single look hard copy images are treated. Simulated raw data were generated from point targets and processed with the system for assessment of processor performance. Author (ESA)

**N81-18474#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen (West Germany)

**MIDTERM REPORT ON THE TRANSFER OF MDA'S SEASAT SAR SOFTWARE PROCESSOR TO AN IBM COMPUTER FACILITY**

G Waller In ESA SEASAT-SAR Processor 1980 p 127-128 refs

Avail NTIS HC A07/MF A01

Problems which occurred in transferring synthetic aperture radar (SAR) processing programs written for an INTERDATA 8/32 to an Amdahl 470V6/IMB3032 are listed. Minor problems resulting from the differences between INTERDATA extended FORTRAN and FORTRAN IV required some substitutions by PL/1 routines. Major discrepancies which may severely influence the SAR processing performance include the substitution or suppression of the program runtime-decision-loops for timesharing operation in multi-user computer systems and the realization of the INTERDATA specific Contiguous File structure for fast direct access disc input/output. Author (ESA)

**N81-19527\*#** National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Md

**THERMAL INFRARED REMOTE SENSING OF SURFACE FEATURES FOR RENEWABLE RESOURCE APPLICATIONS**

Jean E Welker Jan 1981 29 p refs (NASA-TM-82106) Avail NTIS HC A03/MF A01 CSCL 08B

The subjects of infrared remote sensing of surface features for renewable resource applications is reviewed with respect to

the basic physical concepts involved at the Earth's surface and up through the atmosphere as well as the historical development of satellite systems which produce such data at increasingly greater spatial resolution. With this general background in hand the growth of a variety of specific renewable resource applications using the developing thermal infrared technology are discussed including data from HCMM investigators. Recommendations are made for continued growth in this field of applications. Author

**N81-19530\*#** National Aeronautics and Space Administration Goddard Space Flight Center Greenbelt Md

**PRELIMINARY EVIDENCE FOR THE INFLUENCE OF PHYSIOGRAPHY AND SCALE UPON THE AUTOCORRELATION FUNCTION OF REMOTELY SENSED DATA**

M L Labovitz D L Toll, and R E Kennard Dec 1980 36 p refs Submitted for publication (NASA-TM-82064) Avail NTIS HC A03/MF A01 CSCL 05B

Previously established results demonstrate that LANDSAT data are autocorrelated and can be described by a univariate linear stochastic process known as auto-regressive-integrated-moving-average model of degree 1, 0 1 or ARIMA (1 0 1). This model has two coefficients of interest for interpretation  $\phi(1)$  and  $\theta(1)$ . In a comparison of LANDSAT thematic mapper simulator (TMS) data and LANDSAT MSS data several results were established: (1) The form of the relatedness as described by this model is not dependent upon system look angle or pixel size. (2) The  $\phi(1)$  coefficient increases with decreasing pixel size and increasing topographic complexity. (3) Changes in topography have a greater influence upon  $\phi(1)$  than changes in land cover class. (4) The  $\theta(1)$  seems to vary with the amount of atmospheric haze. These patterns of variation in  $\phi(1)$  and  $\theta(1)$  are potentially exploitable by the remote sensing community to yield stochastically independent sets of observations characterize topography and reduce the number of bytes needed to store remotely sensed data. Author

**N81-19533#** Susquehanna Resources and Environment, Inc Johnson City NY

**COMPARATIVE EVALUATIONS OF THE RADC/HSU TEXTURE MEASUREMENT SYSTEM WITH PERCEPTUAL ANALYSIS Final Report**

Shin-yi Hsu and Richard G Burreight Oct 1980 50 p refs (Contract F49620-79-C-0009 AF Proj 2313) (AD-A094416 AFOSR-81-0079TR) Avail NTIS HC A03/MF A01 CSCL 06/16

Aspects of the enormously important pattern recognition problem were examined. Real world digitized image information from high and low resolution aerial photographs of different and similar terrain types was used. We compared human judgments of overall visual differences among chloropleth representations with computer solutions based on the RADC/Hsu system. The work has resulted in new methodological and theoretical perspectives (including Master's scaling technique) which provide means for better defining and understanding both human and computer information handling systems when highly complex remotely sensed, real world data are involved. GRA

**N81-19906#** Earth Science Consulting and Technology Corp Costa Mesa, Calif

**RADAR, THERMAL INFRARED, AND PANCHROMATIC IMAGE COLLECTION AND ANALYSIS MULTI-SOURCE IMAGE ANALYSIS, ADDENDUM**

David D Steller Jeffrey W Adams and William Muir Dec 1980 110 p refs (Contract DAAK70-78-C-0180) (AD-A095169 ETL-0249-Add) Avail NTIS HC A06/MF A01 CSCL 20/6

The addendum to the Multi-Source Image Analysis contract consists of a reference set of simultaneously collected remote sensor data designed to evaluate terrain features. Airborne radar thermal infrared, and panchromatic imagery was collected by the Oregon Army National Guard at the Corvallis Oregon test site on 13 and 19 August 1980. Ground teams collected radiant and air temperatures, ground site photographs and soil samples from three traverses through the test area. GRA

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

**N81-20494\***# National Aeronautics and Space Administration  
Goddard Space Flight Center, Greenbelt, Md  
**ICAP AN INTERACTIVE CLUSTER ANALYSIS PROCEDURE  
FOR ANALYZING REMOTELY SENSED DATA**  
Stephen W Wharton Jul 1980 27 p refs  
(NASA-TM-80732) Avail NTIS HC A03/MF A01 CSCL  
05B

An Interactive Cluster Analysis Procedure (ICAP) was developed to derive classifier training statistics from remotely sensed data. The algorithm interfaces the rapid numerical processing capacity of a computer with the human ability to integrate qualitative information. Control of the clustering process alternates between the algorithm, which creates new centroids and forms clusters and the analyst, who evaluate and elect to modify the cluster structure. Clusters can be deleted or lumped pairwise, or new centroids can be added. A summary of the cluster statistics can be requested to facilitate cluster manipulation. The ICAP was implemented in APL (A Programming Language), an interactive computer language. The flexibility of the algorithm was evaluated using data from different LANDSAT scenes to simulate two situations: one in which the analyst is assumed to have no prior knowledge about the data and wishes to have the clusters formed more or less automatically, and the other in which the analyst is assumed to have some knowledge about the data structure and wishes to use that information to closely supervise the clustering process. For comparison, an existing clustering method was also applied to the two data sets. Author

**N81-20500#** Centre National d'Etudes Spatiales, Toulouse (France)  
**GENERAL REFLECTIONS [PRESENTATION GENERALE]**  
J P Carrou *In its* Spaceborne Cartography of the Earth 1979  
p 65-80 In FRENCH

Avail NTIS HC A99/MF A01

Problems of geometrical deformation affecting the quality analysis of remote imagery from artificial Earth satellites are presented. Different orbit and attitude perturbations are analyzed and their effects correlated with imaging techniques. Several types of orbit and stabilization control techniques are covered emphasizing those appropriate to the SPOT satellite program. Image quality specifically for scanning on the pushbroom principle, is discussed in terms of establishing a precise correspondence between an image element (pixel) and the source (ground). Numerical simulation for evaluating each parameter is mentioned. Author (ESA)

**N81-20501#** Centre National d'Etudes Spatiales, Toulouse (France)  
**GEOMETRICAL QUALITY OF SCANNING SENSOR IMAGERY [QUALITE GEOMETRIQUE DES IMAGES DES CAPTEURS A BALAYAGE]**  
R Rosso *In its* Spaceborne Cartography of the Earth 1979  
p 81-107 In FRENCH

Avail NTIS HC A99/MF A01

An analysis of user needs is given in terms of imagery applications. A relationship between quality requirements and preprocessing complexity is shown. An analytic accounting of the different sources of geometric error is described. Results are used in a computer simulation of SPOT satellite imagery in order to balance error tolerances over the entire sensor system. The simulation program is briefly described. Author (ESA)

**N81-20504#** Institut Geographique National, Paris (France)  
**PRINCIPLES OF PHOTOGRAMMETRY [PRINCIPES DE LA PHOTOGRAMMETRIE]**  
M P Denis *In* CNES Spaceborne Cartography of the Earth 1979  
p 186-188 In FRENCH

Avail NTIS HC A99/MF A01

A generalized methodology of photogrammetry is presented. The concept of view angle perspective is introduced and the case of two solid view angles intersecting is illustrated. The internal elements of a solid view angle are identified. The problem

of locating a field of view relative to elements external to the view angle is considered. The problem of locating a field of view relative to elements external to the view angle is considered. Homologous rays are identified for two fields of view (stereoscopic observation). The reconstruction of photogrammetric data, e.g., coordinate determination, is recorded. Author (ESA)

**N81-20505#** Institut Geographique National, Paris (France)  
**APPARATUS FOR RECONSTRUCTION [APPAREILS DE RESTITUTION]**  
M P Denis *In* CNES Spaceborne Cartography of the Earth 1979  
p 189-194 In FRENCH

Avail NTIS HC A99/MF A01

Two reconstruction methods for the interpretation of stereoscopic imagery are described: (1) analytic reconstruction, based on measurements taken from photographic plates, thus reconstituting the corresponding field of view and orienting it in space by calculation, and (2) analog reconstruction, using an apparatus which instantaneously materializes the elements of the geometrical solution to an intersection problem. The necessary types of equipment to perform either of these functions are specified and the methodology of photogrammetric reconstruction is explained analytically. Author (ESA)

**N81-20506#** Institut Geographique National, Paris (France).  
**ORTHO PHOTOGRAPHY AND NUMERICAL TERRAIN MODELS [ORTHOPHOTOGRAPHIE-MODELES NUMERIQUES DE TERRAIN]**  
M P Denis *In* CNES Spaceborne Cartography of the Earth 1979  
p 195-201 In FRENCH

Avail NTIS HC A99/MF A01

Orthophotography in application for the differential enhancement of aerial photographs is discussed analytically. Geometrical illustrations of corrections for distortion due to terrain relief are presented. Terrain locally assimilable to an inclined plane is studied. Systematic deformations arising from the alteration of the image are derived. The correction of focusing distortion is also considered. The use of stereo orthophotography to compensate for vertical unevenness is discussed. Author (ESA)

**N81-20509#** Institut Geographique National, Paris (France)  
**THE GEOMETRY OF SCANNING IMAGERY [LA GEOMETRIE D'UN ENREGISTREMENT A BALAYAGE]**  
A Baudoin *In* CNES Spaceborne Cartography of the Earth 1979  
p 315-356 refs In FRENCH

Avail NTIS HC A99/MF A01

The parameters on which the geometry of an image depends are identified and analyzed. These include the nature of the object observed (shape and dimensions in trirectangular coordinates), the properties of the medium, (atmospheric refraction), the position or movement of the point of view, the orientation and the qualities of the imaging system (particularly for optics), and the operational characteristics of the detector. A generalized form of the geometry is developed, then applied to the nominal geometry of satellite imagery from a circular orbit. The effect of observation platform motion is emphasized. The influence of terrain relief is shown, emphasizing stereoscopy applications. Results from the analysis are reduced to a mathematical model and the calculation of image distortion is outlined. Author (ESA)

**N81-20510#** Institut Geographique National, Paris (France)  
**POSITIONING SPOT IMAGES: RECONSTITUTION FROM A STEREOSCOPIC PAIR [LA MISE EN PLACE DE L'IMAGE SPOT. LA RESTITUTION D'UN COUPLE STEREOSCOPIQUE PAR]**  
D Kiraner *In* CNES Spaceborne Cartography of the Earth 1979  
p 357-365 refs In FRENCH

Avail NTIS HC A99/MF A01

Modifications applied to classical photogrammetry needed for the processing of generalized images are presented. Analytical definitions of an image, a stereoscopic pair, and of a theoretical apparatus for stereoscopic image reconstruction are given. As

an example, the equation system for reconstituting SPOT satellite scanner imagery is formalized. Specifically, modeling and calculation of small random distortion is shown, emphasizing the effect on instrument calibration. A flow chart of the image processing scheme is illustrated. Author (ESA)

**N81-20512#** Centre National d'Études Spatiales, Toulouse (France)

**SATELLITE LIMITATIONS COMPARED TO MISSION REQUIREMENTS FOR EARTH OBSERVATION [LES CONTRAINTES DUES AUX SATELLITES COMPAREES AUX EXIGENCES DES MISSIONS D'OBSERVATION DE LA TERRE]**

M Cazenave *In its* Spaceborne Cartography of the Earth 1979 p 381-392 In FRENCH

Avail NTIS HC A99/MF A01

The constraints inherent to a spaceborne remote sensing system are reviewed qualitatively. The choices of orbit, attitude control system, and of sensing instrumentation of satellites are covered. Criteria, such as availability of onboard power supplies as well as data processing and transmission capabilities, are considered. The impact of the quality and variety of satellite imagery on the organization of ground support systems is determined. Author (ESA)

**N81-20513#** Centre National d'Études Spatiales, Toulouse (France)

**RADIOMETRIC DEGRADATION OF IMAGES AND GROUND PREPROCESSING [DEGRADATIONS RADIOMETRIQUES DES IMAGES ET PRE-TRAITEMENT SOL]**

G Begni *In its* Spaceborne Cartography of the Earth 1979 p 395-436 refs In FRENCH

Avail NTIS HC A99/MF A01

Different types of degradation which can affect a signal between its emission at the surface and its transmission to a ground station are studied. Degradation sources identified are atmospheric effects, transfer functions and spatial discretization (effects induced by the geometry), effects related to detector gain, and instrument noise along with quantification. Two methods for the partial compensation for these effects are given. The methods involve calibration procedures as well as deconvolution and interpolation analysis as a first step in image processing. Author (ESA)

**N81-20514#** Institut Geographique National, Paris (France)  
**THE LOCALIZATION OF REFERENCE POINTS [LA LOCALISATION DES POINTS D'APPUI]**

A Baudoin *In CNES* Spaceborne Cartography of the Earth 1979 p 437-456 refs In FRENCH

Avail NTIS HC A99/MF A01

The relationship between image coordinates (X, Y) and terrain coordinates (X, Y, Z) is defined as collinear. Specifically, reference points on an image are identified and used to determine the parameters of a geometrical model of the image. The application of digital techniques for the precise measurement of image coordinates is discussed. An interactive CRT display system is described and the constitution of a numerical file of reference points is formulated. Stereoscopic automatic correlation of points on two images is also discussed. The identification of pseudoreference points and reference lines is also considered. Author (ESA)

**N81-20515#** Institut Geographique National, Paris (France)  
**MODELS OF DEFORMATION [MODELES DE DEFORMATION]**

B Cabrieres *In CNES* Spaceborne Cartography of the Earth 1979 p 451-471 refs In FRENCH

Avail NTIS HC A99/MF A01

Analytical models which account for image distortion due to variations in the physical parameters of a remote sensor system are derived. The vector geometry of idealized imagery is established. A direct model is constructed taking account of satellite position given precise ephemerides, satellite attitude given

pitch angle, roll, and yaw relative to the local orbit (from sensors and gyroscopes), internal structure of the imaging apparatus, the precise instant of recording each observed point, and the surface geometry under observation. Determination of the inverse model, either by interpolation or by iteration, is also illustrated. The models are evaluated using reference points and a polynomial interpolation method. The modeling of unknown parameters is also described. The SPOT satellite imagery is analyzed with respect to and deformation lattices are obtained. Author (ESA)

**N81-20517#** Centre National d'Études Spatiales, Toulouse (France)

**GEOMETRICAL CORRECTION OF IMAGES: METHODS AND PERFORMANCE [CORRECTIONS GEOMETRIQUES D'IMAGES: METHODES ET PERFORMANCE]**

B Fleutiaux *In its* Spaceborne Cartography of the Earth 1979 p 489-515 In FRENCH

Avail NTIS HC A99/MF A01

Diverse techniques developed for the rectification of geometric distortion in radiometric images are presented. The principle of geometric correction is explained and the nature and origin of geometric deformations are described. The architectures of different numerical correction systems are also described. Methods for extracting reference points are illustrated. Hardware includes a mono/stereo comparator, a coordinatograph, and a user interactive console. Modeling of distortion is used to determine expressions for matching a point on an image with a homologous reference point. A global approach, a selective approach, and a hybrid approach to this problem are outlined. Rectification by interpolation by planimetry, and by segmentation is also demonstrated. Various geometrical processing schemes are also outlined and obtainable precision is discussed. Author (ESA)

**N81-20518#** Centre National d'Études Spatiales, Toulouse (France)

**PROCESSING RADIOMETRIC DATA FOR CARTOGRAPHY [TRAITEMENTS RADIOMETRIQUES POUR LA CARTOGRAPHIE]**

G Saint *In its* Spaceborne Cartography of the Earth 1979 p 519-531 In FRENCH

Avail NTIS HC A99/MF A01

The thematic extraction of radiometric data by teledetection and the subsequent classification, either quantitative or qualitative, of the data along with determining data quality are summarized. The importance of establishing user requirements in formulating an extraction and classification scheme is emphasized. As an example, image contrast adaptation of LANDSAT imagery is considered. Other processing techniques considered are analysis of principal and derived components, enhancement of particular features, and special filtering. The relevance of interpretive processing to numeric thematic cartography is discussed. Author (ESA)

**N81-20520#** Centre National d'Études Spatiales, Toulouse (France)

**THE SPOT SATELLITE IMAGE PROCESSING FACILITY IN TOULOUSE AND ITS CAPABILITIES [LE SEGMENT SOL IMAGE SPOT DE TOULOUSE ET LES PRODUITS ASSOCIES]**

J C Cazaux *In its* Spaceborne Cartography of the Earth 1979 p 545-562 refs In FRENCH

Avail NTIS HC A99/MF A01

The SPOT satellite image processing center is presented, emphasizing its data handling capabilities as well as how user requirements can be met. The center is composed of a space image reception station and a facility for the rectification of space images. The image rectification facility includes the subsystems archiving preprocessing, and data display for dissemination. The functional organization of each of these subsystems is described in detail. Author (ESA)

**N81-20523#** Centre National d'Études Spatiales, Toulouse (France)

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

### **TECHNICAL DEMONSTRATION APPARATUS FOR LOCATING LANDMARKS [DEMONSTRATIONS TECHNIQUES DISPOSITIF DE REPERAGE D'AMERS]**

D Borel *In its* Spaceborne Cartography of the Earth 1979 p 583-587 In FRENCH

Avail NTIS HC A99/MF A01

A point location apparatus (or coordinatograph), used for correcting geometrical distortion observed on aerial or satellite images is described. The device aids in determining the coordinates of characteristic points, both on a reference map and on an unprocessed image, restituted on photographic film. The equipment specifications are given and the output data format is listed. Author (ESA)

### **N81-20688# Environmental Research Inst of Michigan, Ann Arbor Applications Div COASTAL REMOTE SENSING INVESTIGATIONS. VOLUME 2: BEACH SENSING INVESTIGATIONS. Final Technical Report**

Eric S Kaaschke Dec 1980 96 p refs (Contract N00014-78-C-0458) (AD-A095692, ERIM-134400-11-F-Vol-2) Avail NTIS HC A05/MF A01 CSCL 17/5

An algorithm was developed which first classifies beach sands into one of five mineralogical classifications, then estimates grain size and soil moisture using equations based on actual and AQUASAND data. This algorithm was evaluated using 'unknown' beach sand samples. The algorithm correctly identified the beach mineralogy in three out of the six cases, and the soil moisture estimates were in good agreement with the correctly predicted grain size. The algorithm was modified to classify airborne multispectral scanner data from two test sites (Lake Michigan and Panama City, Florida). This report also contains sections on the use of satellite data as inputs into the MOGS algorithm and the development of similar algorithms for soils other than sand. GRA

### **N81-20766# Engins Matra Velizy (France) Lab de Traitement des Images**

#### **RANKING VARIOUS CLASSIFICATIONS OF THE SAME DATA FROM GROUND TRUTHS AND CONTINGENCY TABLES**

Gabriel E Lowitz and Jean M Vivier Paris ESA Jul 1980 18 p (Contract ESTEC-3749/78) (ESA-CR(P)-1388) Avail NTIS HC A02/MF A01

An objective strategy to assess the comparative performances of various classifications of the same multispectral data using ground truth and contingency tables is described. Contingency tables are used as objective tools to assess the merit of a given classification strategy in terms of probabilities of correct classification, incorrect classification, and no classification. A factor of merit implies the knowledge of the cost of every type of error. This cost depends on applications. The heaviest cost is applied to misclassification errors and a smaller cost to the decision to refuse to classify when in doubt. When the cost is not available a mini-max technique can be used setting  $n$  to that value which renders  $F$  extremum. Results of classification of NRL data are given in their raw forms, in their clustered compressed form, in their cascaded clustered form, and after interactive manipulation to improve the classification performances. Compressing the data is shown to improve rather than degrade the supervised classification results. Author (ESA)

### **N81-20814# Forschungsinstitut fuer Informationsverarbeitung Karlsruhe (West Germany)**

#### **SEMI-AUTOMATIC AND AUTOMATIC EXTRACTION OF OBJECTS FROM AERIAL IMAGES**

W Kestner and M Sties *In* AGARD Image and Sensor Data Process for Target Acquisition and Recognition Nov 1980 13 p refs Avail NTIS HC A12/MF A01

Different methods for the extraction of objects from aerial images are presented. Unlike other methods which process the complete image systematically, object guided methods were

developed which are applied only to those parts of the image where objects or parts of objects have already been detected i.e. where a continuation of an object is probable. Basic principles as well as details of the extraction methods are explained. The methods differ with respect to the local precision of the results, the applicability to different object types and the required image quality. Local operators are described which evaluate grey level diagrams in order to detect object continuations. The methods were implemented on a computer DEC PDP 11/70. Results are presented. A R H

### **N81-21415\*# Miami Univ, Fla School of Marine and Atmospheric Science**

#### **INVESTIGATIONS OF MEDIUM WAVELENGTH MAGNETIC ANOMALIES IN THE EASTERN PACIFIC USING MAGSAT DATA Interim Report, Jan. - Mar 1981**

Christopher G A Harrison, Principal Investigator 31 Mar 1981 15 p refs Sponsored by NASA ERTS (E81-10095, NASA-CR-164093) Avail NTIS HC A02/MF A01 CSCL 08C

The suitability of using magnetic field measurements obtained by MAGSAT is discussed with regard to resolving the medium wavelength anomaly problem. A procedure for removing the external field component from the measured field is outlined. Various methods of determining crustal magnetizations are examined in light of satellite orbital parameters resulting in the selection of the equivalent source technique for evaluating scalar measurements. A matrix inversion of the vector components is suggested as a method for arriving at a scalar potential representation of the field. Author

### **N81-21416\*# Houston Univ Tex Dept of Mathematics ON THE EXISTENCE, UNIQUENESS, AND ASYMPTOTIC NORMALITY OF A CONSISTENT SOLUTION OF THE LIKELIHOOD EQUATIONS FOR NONIDENTICALLY DISTRIBUTED OBSERVATIONS APPLICATIONS TO MISSING DATA PROBLEMS**

Charles Peters, Principal Investigator 10 Sep 1980 21 p refs Sponsored by NASA, USDA, Dept of Commerce, Dept of Interior and Agency for International Development ERTS (Contract NAS9-14689, Proj AgRISTARS) (E81-10099, NASA-CR-160931, SR-HO-00492, Rept-76) Avail NTIS HC A02/MF A01 CSCL 02C

A general theorem is given which establishes the existence and uniqueness of a consistent solution of the likelihood equations given a sequence of independent random vectors whose distributions are not identical but have the same parameter set. In addition, it is shown that the consistent solution is a MLE and that it is asymptotically normal and efficient. Two applications are discussed: one in which independent observations of a normal random vector have missing components, and the other in which the parameters in a mixture from an exponential family are estimated using independent homogeneous sample blocks of different sizes. Author

### **N81-21418\*# Lockheed Engineering and Management Services Co, Inc, Houston, Tex**

#### **PATCH IMAGE PROCESSOR USER'S MANUAL**

M J Nieves, Principal Investigator Sep 1980 12 p Sponsored by NASA, USDA, Dept of Commerce, Dept of Interior, and Agency for International Development ERTS (Contract NAS9-15800, Proj AgRISTARS) (E81-10101, NASA-CR-160930, EW-LO-00707, LEMSCO-15692, JSC-16833) Avail NTIS HC A02/MF A01 CSCL 02C

The patch image processor extracts patches in various sizes (32 x 32, 64 x 64, 128 x 128, and 256 x 256 pixels) from full frame LANDSAT imagery data. With the patches that are extracted, a patch image mosaic is created in the image processing system, IMDACS, format. Author

### **N81-21420\*# Miami Univ, Fla School of Marine and Atmospheric Science**

#### **INVESTIGATIONS OF MEDIUM WAVELENGTH MAGNETIC ANOMALIES IN THE EASTERN PACIFIC USING MAGSAT DATA Interim Report, Oct - Dec 1980**

Christopher G A Harrison, Principal Investigator 31 Dec 1980  
2 p Sponsored by NASA ERTS  
(E81-10104 NASA-CR-164098) Avail NTIS  
HC A02/MF A01 CSCL 08J

The computer program package for dealing with MAGSAT data was refined and a program listing and deck of cards was forwarded for use by interested investigators. Instead of doing equivalent source calculations it is proposed to use spherical harmonics to model the observed data since spherical harmonic functions are orthogonal and addition of higher degree and order harmonics can be done without recalculation of the harmonics of lower degree and order already calculated. These functions are much more easy to manipulate in that the height of the term of the observation can be taken care of with great facility. Downward calculation (after suitable filtering) can also be performed very simply. A R H

**N81-21421\*** Texas Univ at Dallas Richardson Center for Space Sciences

**INVESTIGATION OF THE EFFECTS OF EXTERNAL CURRENT SYSTEMS ON THE MAGSAT DATA UTILIZING GRID CELL MODELING TECHNIQUES** Quarterly Status Technical Progress Report, 15 Sep - 31 Dec 1980

David M Klumpar Principal Investigator 5 Jan 1980 7 p ERTS

(Contract NAS5-26309)

(E81-10105 NASA-CR-164099 QSTPR-1) Avail NTIS  
HC A02/MF A01 CSCL 08G

The feasibility of modeling magnetic fields due to certain electrical currents flowing in the Earth's ionosphere and magnetosphere was studied. Initial efforts were devoted to reading MAGSAT data tapes in preparation for further analysis of the MAGSAT data. Further efforts concern a modeling procedure developed to compute the magnetic field at satellite orbit due to hypothesized current distributions in the ionosphere and magnetosphere. This technique utilizes a linear current element representation of the large scale space current system. E D K

**N81-21430\*** Business and Technological Systems Inc  
Seabrook Md

**EQUIVALENT SOURCE MODELING OF THE MAIN FIELD USING MAGSAT DATA** Quarterly Report, 1 Oct - 31 Dec 1980

31 Dec 1980 2 p ERTS

(Contract NAS5-26047)

(E81-10128 NASA-CR-164118 QR-4) Avail NTIS  
HC A02/MF A01 CSCL 08G

The software was considerably enhanced to accommodate a more comprehensive examination of data available for field modeling using the equivalent sources method by (1) implementing a dynamic core allocation capability into the software system for the automatic dimensioning of the normal matrix (2) implementing a time dependent model for the dipoles (3) incorporating the capability to input specialized data formats in a fashion similar to models in spherical harmonics and (4) implementing the optional ability to simultaneously estimate observatory anomaly biases where annual means data is utilized. The time dependence capability was demonstrated by estimating a component model of 21 deg resolution using the 14 day MAGSAT data set of Goddard's MGST (12/80). The equivalent source model reproduced both the constant and the secular variation found in MGST (12/80). A R H

**N81-21441\*** National Aeronautics and Space Administration  
Goddard Space Flight Center, Greenbelt, Md

**THE SPATIAL RESOLVING POWER OF EARTH RESOURCES SATELLITES A REVIEW**

John R G Townshend Sep 1980 39 p refs Submitted for publication

(NASA-TM-82020) Avail NTIS HC A03/MF A01 CSCL 05B

The significance of spatial resolving power on the utility of current and future Earth resources satellites is critically discussed and the relative merits of different approaches in defining and estimating spatial resolution are outlined. It is shown that choice of a particular measure of spatial resolution depends strongly

on the particular needs of the user. Several experiments have simulated the capabilities of future satellite systems by degradation of aircraft images. Surprisingly, many of these indicated that improvements in resolution may lead to a reduction in the classification accuracy of land cover types using computer assisted methods. However, where the frequency of boundary pixels is high, the converse relationship is found. Use of imagery dependent upon visual interpretation is likely to benefit more consistently from higher resolutions. Extraction of information from images will depend upon several other factors apart from spatial resolving power: these include characteristics of the terrain being sensed, the image processing methods that are applied as well as certain sensor characteristics. Author

**N81-21449#** Strasbourg Univ (France)  
**FUNDAMENTAL PHYSICS OF TELEDETECTION [PHYSIQUE FONDAMENTALE DE LA TELEDETECTION]**

F Becker In CNES Math and Phys Principles of Remote Sensing 1978 p 1-107 refs In FRENCH

Avail NTIS HC A99/MF A01

The physics needed to design and interpret remote sensor experiments are reviewed. Electromagnetic radiation is depicted as energy propagating in the form of transverse wave vectors. The waves interact with their media, particularly through energy transformations. The interactions can be oscillatory or corpuscular, depending on the wavelength and the type of interaction. Electromagnetic propagation in a vacuum and in a homogeneous medium are described. The parametric characteristics of the medium in relation to the type of radiation are shown. Radiation sources and measurement principles are defined. Characteristic photometric quantities for the ground-air interface are also given. The physics are applied in a brief overview of analysis methods for satellite remote sensor data. Author (ESA)

**N81-21450#** Geological Survey, Denver, Colo  
**THERMAL PHENOMENA AND ENERGY EXCHANGE IN THE ENVIRONMENT**

K Watson In CNES Math and Phys Principles of Remote Sensing 1978 p 109-174 refs

Avail NTIS HC A99/MF A01

An iterative model, initially chosen with only a few variables, is developed. The model comprehends heat transfer mechanisms, radiation laws and a differential heat conduction, or diffusion, equation. Also involved are the physics of the atmosphere, material properties, and the energy balance. The heat conduction equation and boundary condition necessary to thermal models, including linear and nonlinear transfer, are shown, then discussed for numerical solutions, error analysis, and model predictions. Field measurement problems are brought out, e.g., parameters and instruments, detectors and data collection local versus regional effects, transients, etc. Image analysis techniques are also covered. Case histories of specific geologic applications are presented. General applications and the satellite systems approach are commented on, emphasizing model limitations and extensions. Author (ESA)

**N81-21451#** Laboratoire de Meteorologie Dynamique, Paris (France)

**TELEDETECTION OF EARTH RESOURCES PROBLEMS ASSOCIATED WITH THE PRESENCE OF THE ATMOSPHERE [TELEDETECTION DES RESSOURCES TERRESTRES PROBLEMES LIES A LA PRESENCE DE L'ATMOSPHERE]**

N A Scott In CNES Math and Phys Principles of Remote Sensing 1978 p 175-213 refs In FRENCH

Avail NTIS HC A99/MF A01

Radiation propagating through an inhomogeneous medium (Earth atmosphere) is described theoretically. A radiative transfer equation and functions for transmission through a gas medium are developed. Specific infrared intensity is expressed in terms of the spectral intensity of the absorption bands, the shape of the bands, Planck's function, the variation with altitude in the absorbing gas concentration and in terms of necessary data for

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

the parametric evaluation of the transfer equation i.e. spectroscopic data. As an application to spectroscopic remote sensing, atmospheric parameters are determined by inversion of the transfer equation. Several calculation methods are suggested.

Author (ESA)

**N81-21452#** Kansas Univ Lawrence  
**THEORETICAL BASES AND METHODS OF IMAGE PROCESSING**

R Haralick /in CNES Math and Phys Principles of Remote Sensing 1978 p 215-291 refs

Avail NTIS HC A99/MF A01

Pattern discrimination and identification processes are summarized. The pattern discrimination process constructs a good decision rule  $f$ . The pattern identification process implements the decision rule on data sequence  $S$  sub  $d$  thereby constructing a category identification sequence  $S$  sub  $c$ . Under the independence of units assumption, the decision rule  $f$  is a function from measurement space  $D$  to the category  $C$  and  $f$  determines a partition of  $D$  which induces a partition of  $S$  sub  $v$ . How decision rules are constructed is explained. Eight decision rules are examined for Bayes gain and maximum gain under specified prior probability functions. The effects of conditional independence assumptions, Markov dependence assumptions, and of the Markov tree dependence assumption are shown. Calculation of the goodness of approximations is demonstrated. Author (ESA)

**N81-21453\*#** National Aeronautics and Space Administration, Washington, D C  
**THEORY ON DATA PROCESSING AND INSTRUMENTATION**

Frederic C Billingsley /in CNES Math and Phys Principles of Remote Sensing 1978 p 293-447 refs

Avail NTIS HC A99/MF A01 CSCL 05B

A selection of NASA Earth observations programs are reviewed, emphasizing hardware capabilities. Sampling theory, noise and detection considerations, and image evaluation are discussed for remote sensor imagery. Vision and perception are considered, leading to numerical image processing. The use of multispectral scanners and of multispectral data processing systems, including digital image processing, is depicted. Multispectral sensing and analysis in application with land use and geographical data systems are also covered. Author (ESA)

**N81-21454#** Bern Univ (Switzerland)  
**INTERACTION OF ELECTROMAGNETIC WAVES WITH THE ENVIRONMENT**

E Schanda /in CNES Math and Phys Principles of Remote Sensing 1978 p 449-508 refs

Avail NTIS HC A99/MF A01

A theoretical remote sensing system is outlined in block diagram. Measurement interference due to the presence of the atmosphere is discussed. Moreover, a relation between surface roughness and wavelength is shown, where roughness effects depend on the values of surface roughness and of heterogeneity compared to the wavelength used. Radiative transfer is modeled mathematically, including expressions for scattering and absorption. The use of line radiation data to calculate transition between energy levels is demonstrated. The cases of radiation in liquids and solids are covered. An application example of soil moisture mapping is shown. Theoretical results are placed in context for passive (microwave) radiometry and for various types of radar sensing. Author (ESA)

**N81-21455#** Ottawa Univ (Ontario) Dept of Electrical Engineering  
**PROCESSING OF REMOTE SENSING DATA AND OPTIMIZATION**

Morris Goldberg /in CNES Math and Phys Principles of Remote Sensing 1978 p 509-642 refs

Avail NTIS HC A99/MF A01

Computer processing of remotely sensed data is introduced

Multispectral scanner imagery from LANDSAT of an agricultural area in western Canada is used for illustrative purposes. Three types of information are distinguished: spectral, spatial, and syntactic. Spectral information is what the sensor actually measures. Spatial information comes from the regularity property of the observed terrain. Syntactic information is information external to the image and provided by the user. Techniques based upon the spectral information are the simplest to implement and naturally the most widespread. Use of spatial information in general requires more computer time. Different ways of making use of the spatial information are discussed. The use of the syntactic information is the most complex due to the fact that it is difficult to quantify. The different steps involved in computer analysis of remotely sensed data are defined. These include input, preprocessing, segmentation, classification, and application (user interactive mode) of a world model. Hardware considerations are also briefly mentioned. Author (ESA)

**N81-21456#** Centre National d'Etudes Spatiales, Toulouse (France).

**INFLUENCE OF THE ATMOSPHERE ON RADIATION REFLECTED OR EMITTED BY THE EARTH: DIFFUSION-ABSORPTION IN THE VISIBLE AND NEAR INFRARED [INFLUENCE DE L'ATMOSPHERE SUR LE RAYONNEMENT REFLECHI DU EMIS PAR LA TERRE: DIFFUSION-ABSORPTION DANS LE VISIBLE ET PROCHE INFRAROUGE]**

M. Vieillefosse /in Its Math. and Phys Principles of Remote Sensing 1978 p 843-870 refs In FRENCH

Avail: NTIS HC A99/MF A01

The atmosphere as a perturbation factor in remote sensing of the Earth surface is considered. Interference phenomena are discussed theoretically, emphasizing atmospheric diffusion. Expressions for the coefficient of extinction, the angular distribution of diffuse light, and Bouguer's law are given. Rayleigh diffusion and Mie diffusion are handled separately. A mathematical model combining these different phenomena is constructed. The model is then used to examine the atmospheric effect on image contrast, spectral distribution, and spatial distribution. A comparison with measured data from aerial photography is made. Results show the importance of minimizing the atmospheric effect by correctly choosing remote sensing parameters, i.e., view angle, time, etc. Author (ESA)

**N81-21462#** Lincoln Lab, Mass Inst of Tech, Lexington  
**RADC MULTI-DIMENSIONAL SIGNAL-PROCESSING RESEARCH PROGRAM Semiannual Technical Summary Report, 1 Apr - 30 Sep 1980**

Dan E Dudgeon 30 Sep 1980 19 p refs  
(Contract F19628-80-C-0002, AF Proj 4594)  
(AD-A096391 ESD-TR-80-218) Avail NTIS  
HC A02/MF A01 CSCL 05/8

This Semiannual Technical Summary Report covers the significant results of the Multi-Dimensional Signal-Processing Program in the areas of image modeling, image segmentation and classification, advanced digital filter implementations for image processing, and iterative algorithms for image restoration and enhancement. GRA

**N81-21469#** Marconi Co Ltd Chelmsford (England)  
**ADDITIONAL STUDIES OF EARTH RESOURCES SYNTHETIC APERTURE RADAR PAYLOAD VOLUME 1 EXECUTIVE SUMMARY Final Report**

S R Brooks and W Rupp Paris ESA Jun 1980 37 p  
Prepared in cooperation with Messerschmitt-Boelkow-Blohm GmbH, Munich  
(MTR-80/24-Vol-1 ESA-CR(P)-1389-Vol-1) Avail NTIS  
HC A03/MF A01

The synthetic aperture radar (SAR) payload for a European remote sensing satellite is discussed. Improvements in gray level resolution, onboard calibration, image quality definitions and antenna design features are examined. Author (ESA)



**N81-21470#** European Space Agency, Paris (France)  
**CONTRIBUTION TOWARDS AUTOMATIC INVESTIGATION  
AND PERCEPTION OF TEXTURE IN DIGITIZED REMOTELY  
SENSED IMAGES Ph D Thesis - Tech. Univ , Berlin**  
Rudolf Fiedler Nov 1980 242 p refs Transl into ENGLISH  
of 'Beitrag zur Automatischen Untersuchung u Erkennung von  
Texturen in Digitalisierten Bildern aus der Fernerkundung' DFVLR  
Oberpfaffenhofen West Germany Report DFVLR-FB-79-08 Feb  
1979 Original report in GERMAN previously announced as  
N80-22670  
(ESA-TT-621, DFVLR-FB-79-08) Avail NTIS  
HC A11/MF A01

The problems that arise from the automated analysis of texture  
in images are reviewed. Mathematical algorithms are presented  
for the determination of texture and borders as well as texture  
classification. The description makes use of the frequency  
dependence of the image structure that characterizes texture.  
The interactive digital image processing system, DIBIAS, which  
provided the images for the analysis is described. Author (ESA)

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## INSTRUMENTATION AND SENSORS

*Includes data acquisition and camera systems and remote sensors*

**A81-20414 #** Radio-brightness contrasts of various regions of the earth's surface in millimeter and centimeter wave ranges (Radioarkostnye kontrasty zemnykh pokrovov na millimetrovykh i santimetrovykh volnakh) G A Andreev, L F Borodin, and S N Rubtsov (Akademiia Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR) *Radiofizika*, vol 23, no 10, 1980, p 1266-1268 5 refs In Russian

Airborne superheterodyne radiometer measurements were performed at frequencies of 1, 1.5, 3, 8.8, 13.3, 22.2, and 37.5 GHz to investigate the radio-brightness contrasts of different regions of the earth's surface. It is shown that, in the 1-37.5 GHz range, there exist stable radio-brightness contrasts of the earth's surface, which change only insignificantly during the precipitation of weak rain (intensities not greater than 5 mm/h). In the long-wavelength region of the mm-range, the contrasts relative to forest land are 220-260 K for metallic bodies, 60 K for concrete, 15 K for sand, 10-15 K for grass, and 30-40 K for planted fields. P T H

**A81-23034** A solid-state airborne sensing system for remote sensing R M Hodgson, F M Cady, and D Pairman (Canterbury University, Christchurch, New Zealand) *Photogrammetric Engineering and Remote Sensing*, vol 47, Feb 1981, p 177-182 12 refs Research supported by the University of Canterbury and University Grants Committee

Currently most non-satellite multispectral remote sensing in the visible and near infrared is carried out using clusters of conventional photographic cameras. A project is in progress which exploits microcomputer and solid-state technology in the development of a multispectral scanner to be flown in light aircraft. Such systems offer the potential advantages of improved linearity and dynamic range, extended spectral response, the direct generation of digital data, and the real time display of captured images. The problems of sensor selection, stored array size, and pixel quantization are discussed. A prototype single camera system based on the use of a 100 by 100 element charge coupled device area sensor has recently been flight tested. A four-camera system that will allow the simultaneous capture and storage of 128 by 128 element images in four spectral bands in the 400-1100 nm range is under development. (Author)

**A81-23547 #** Emissivity measurement of objects at usual temperature R-H Zhang (Academia Sinica, Geography Institute, Peking, Communist China) and G-L Tian (Academia Sinica, Institute of Remote Sensing Application, Peking, Communist China) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 153-158

A method is presented for the calculation of emissivity using the voltage output values of an infrared radiometer with two blackbody cylinders of large heat capacity. Measurements were made on numerous objects and homogeneous materials from 1977-79 which indicated stable measured values with small standard deviations. The results for materials of known emissivity such as aluminum and water corresponded well with the reference values. L S

**A81-23619 #** Investigations on future remote sensing missions, satellite systems and instruments E H Velten and G Rausch (Dornier System GmbH, Friedrichshafen, West Germany) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 2 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1111-1121 9 refs Research

supported by the European Space Agency and Bundesministerium für Forschung und Technologie

The development of instruments for Spacelab 1 as well as for future Shuttle and Spacelab missions within the European and German Remote Sensing Programs is surveyed. The Microwave Remote Sensing Experiment uses three different measurement modes: two-frequency scatterometry of ocean surfaces, high resolution imaging using the synthetic-aperture principle (SAR mode), and a passive radiometer mode. The Synthetic-Aperture Radar Facility under development within the German program for an earth oriented measurement mode will provide high resolution SAR imagery in two frequencies and, if possible, two polarizations to serve a broad range of measurement requirements. The preliminary results of the SAR-Antenna, SAR-processing and electronic subsystems development are outlined. The future European remote sensing satellite systems are discussed with an emphasis on their payload instruments, which will include both active and passive microwave sensors and optical multispectral imagers. L S

**A81-23675 \* #** Sources of variation in Landsat autocorrelation R G Craig (Kent State University, Kent, Ohio) and M L Labovitz (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1755-1767 14 refs

Analysis of sixty-four scan lines representing diverse conditions across satellites, channels, scanners, locations and cloud cover confirms that Landsat data are autocorrelated and consistently follow an Arima (1,0,1) pattern. The AR parameter varies significantly with location and the MA coefficient with cloud cover. Maximum likelihood classification functions are considerably in error unless this autocorrelation is compensated for in sampling. (Author)

**A81-24312 \*** Laser absorption spectrometer - Remote measurement of tropospheric ozone M S Shumate, R T Menzies, W B Grant (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, Calif.), and D S McDougal (NASA, Langley Research Center, Hampton, Va) *Applied Optics*, vol 20, Feb 1981, p 545-552, 590 25 refs Contract No NAS7 100

The laser absorption spectrometer (LAS) is an airborne instrument able to perform remote measurement of trace atmospheric gases. The instrument uses a pair of carbon dioxide laser heterodyne receiver systems that are directed downward from an airplane and determines gas concentration by the differential absorption method. Configured to measure tropospheric ozone, the LAS has been used in conjunction with another instrumented aircraft to test the accuracy of this method of measurement. A complete description of the instrument is presented, and the results of extensive flight testing are summarized. (Author)

**A81-24800** On the use of satellite altimeter data for radial ephemeris improvement C C Goad, B C Douglas, and R W Agree (NOAA, National Geodetic Survey, Rockville, Md) *Journal of the Astronautical Sciences*, vol 28, Oct-Dec 1980, p 419-428 5 refs

**A81-27947 \*** A seismic signal processor suitable for use with the NOAA/GOES satellite data collection system W J Webster, Jr., W H Miller, R Whitley, R J Allenby (NASA, Goddard Space Flight Center, Greenbelt, Md), and R T Dennison (Computer Sciences-Technicolor Associates, Seabrook, Md) *IEEE Transactions on Geoscience and Remote Sensing*, vol GE-19, Apr 1981, p 91-94

Because of the high data-rate requirements, a practical system capable of collecting seismic information in the field and relaying it, via satellite, to a central collection point is not yet available. A seismic signal processor has been developed and tested for use with the NOAA/GOES satellite data collection system. Performance tests on recorded, as well as real time, short period signals indicate that the event recognition technique used is nearly perfect in its rejection

## 08 INSTRUMENTATION AND SENSORS

of environmental noise and other non-seismic signals and that, with the use of solid state buffer memories, data can be acquired in many swarm situations. The design of a complete field data collection platform is discussed based on the prototype evaluation (Author)

**A81-27948** Ultrasonic attenuation measurement by spectral ratios utilizing signal processing techniques F M Sears (Bell Telephone Laboratories, Inc., Murray Hill, N J) and B P Bonner (California, University, Livermore, Calif) *IEEE Transactions on Geoscience and Remote Sensing*, vol GE-19, Apr 1981, p 95-99 21 refs Contract No W-7405-eng-48

Broadband ultrasonic pulses are transmitted through a specimen to be characterized for comparison to a reference with low dissipation, according to a new signal averaging and processing approach for measuring ultrasonic attenuation of compressional and shear waves in highly attenuative (low-Q) materials. An experimental example of the calculation of attenuation from the ratio of spectral amplitudes which are corrected for diffraction effects is given for the halite of Avery Island, La. The technique is shown to be useful for materials so lossy that multiple echoes cannot be detected by conventional procedures O C

**A81-27949 \* #** Modeling the effects of various radiant transfers in mountainous terrain on sensor response D S Kimes and J A Kirchner (NASA, Goddard Space Flight Center, Earth Resources Branch, Greenbelt, Md) *IEEE Transactions on Geoscience and Remote Sensing*, vol GE-19, Apr 1981, p 100-108 28 refs

A model is developed for the study of remote sensing spectral data problems encountered in mountainous terrain, where slope orientation with respect to sources of incident radiation must be considered for accurate classification of multispectral data. The model simulates the effects of solar, sky and adjacent slope irradiance fluxes and the bidirectional reflectance properties of the target surface on sensor response for various slope orientations. The errors associated with two practical techniques used to account for topographic effects on sensor response were evaluated in light of the model, and it was found that the simple cosine correction of the direct solar source showed reflectance errors greater than 11% while the technique considering both direct solar and diffuse sky sources was 50% more accurate O C

**A81-27950 \*** Conceptual performance of a satellite borne, wide swath synthetic aperture radar K Tomiyasu (GE Valley Forge Space Center, Philadelphia, Pa) *IEEE Transactions on Geoscience and Remote Sensing*, vol GE-19, Apr 1981, p 108-116 32 refs Contract No NAS1-15657

A satellite borne synthetic aperture radar can image a wide swath in the order of 700 km with one-look 100 m resolution. If the design meets the ambiguity constraints at the far edge of the swath, the maximum swath width is independent of both radar wavelength and shape of the physical antenna aperture. The antenna pattern can be a pencil beam scanned in the elevation plane, or a fan beam formed by a long antenna. The scanning pencil beam antenna may be a phased array or multiple-feed reflector which may be more practical than a long antenna to image a wide swath. Design performance trade computations are presented involving resolution, swath width, antenna area, average transmitter power and digital data rate (Author)

**A81-28056 #** New experiment on the observation of earth from space (Novyi eksperiment po issledovaniyu zemli iz kosmosa) *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 5, 6 In Russian

A brief description is given of a Soviet remote sensing experiment involving multispectral scanning from the Meteor satellite. The objectives of the experiment are discussed, and the basic technical characteristics of the sensors are presented B J

**A81-28601** Sensor orientation and navigation F L J H Corten (International Institute for Aerial Survey and Earth Sciences, Enschede, Netherlands) (*International Society for Photogrammetry, Congress, 14th, Hamburg, West Germany, July 13-25, 1980*) ITC

*Journal*, no 3, 1980, p 381-396 25 refs

The state of the art in sensor orientation is reviewed, noting the accuracy and performance of Doppler and inertial navigation systems. Attention is given to the global positioning system, NavStar. Sensor orientation is discussed with reference to immediate semicontrolled photo mosaic sheets, mapping operations, aerial triangulation and absolute orientation at the air station. Navigation is considered in terms of visual survey navigation, VLF-Omega, Doppler and inertial navigation S C S

**A81-29325 #** A study of the decoding properties of aerial photographs taken with modern camera systems (Issledovanie deshi fvrochnykh svoystv aerofotosnimkov sovremennykh s'emochnykh sistem) V P Olokhtonov *Geodeziya i Kartografiya*, Jan 1981, p 32-34 In Russian

**A81-29822** Image properties with environmental factors C L Norton (USAF, Hill AFB, Utah) *Photogrammetric Engineering and Remote Sensing*, vol 46, June 1980, p 725-737 10 refs

Cartographic cameras are calibrated under rigidly controlled laboratory environments, but acquire imagery under a wide range of vastly different conditions. The environments of the aerial survey and the effects they have on the image properties of geometry and resolution are discussed. A few 'rule of thumb' suggestions for improving the image properties are offered and plans for empirical studies are considered (Author)

**N81-16345#** Kansas Univ Center for Research, Inc., Lawrence Remote Sensing Lab  
**CIRCULARLY POLARIZED MEASUREMENTS OF RADAR BACKSCATTER FROM TERRAIN AND SNOW-COVERED TERRAIN Final Report**  
W H Stiles, Fawwaz T Ulaby, E A Wilson, and J C Holtzman  
Jul 1980 148 p refs  
(Contract DAAK70-78-C-0121)  
(AD-A092077, CRINC/RSI-TR-393-2 ETL-0234) Avail NTIS HC A07/MF A01 CSCL 17/9

This report covers a measurement program to obtain circularly polarized radar backscatter coefficient data along with associated ground-truth information on snow-covered terrain. Snow-covered grass, asphalt and ice were observed at selected frequencies from 8 to 18 GHz for angles of incidence 0 deg (nadir) and 80 deg. Also included are some analyses of the effects of snowcover on the backscatter from terrain GRA

**N81-16676#** Committee on Science and Technology (U S House)  
**CENTRALIZED STORM INFORMATION SYSTEM**  
Washington GPO 1980 22 p Hearing before the Subcomm on Space Sci and Appl of the Comm on Sci and Technol, 96th Congr, 2nd Sess, no 161, 14 Oct 1980  
(GPO-69-030) Avail Subcommittee on Space Science and Application

A promising development for improving severe storms forecasting is the centralized storm information system, a joint NOAA-NASA project. The system consists of three minicomputers and four interactive terminals. One of the computers, the data base manager, codes and maintains a current file of meteorological data, receives satellite imagery, and is linked to radar. The second processor, the applications processor, performs operations on the data as directed by the forecaster. The third computer and one terminal are devoted to developmental work so that new techniques can be implemented and tested without impacting the operational systems. The system will provide immediate improvement in the timeliness of the data available to forecasters A R H

**N81-16698#** Air Force Inst of Tech., Wright-Patterson AFB, Ohio  
**THE INFLUENCE OF CLOUD AND ATMOSPHERIC MOISTURE ON THE STATISTICAL ANALYSIS OF NIMBUS 8 MULTISPECTRAL RADIATION MEASUREMENTS M S. Thesis - Utah Univ.**  
Peter Werner Speck Aug 1980 129 p refs

(AD-A092217, AFIT-CI-80-43T) Copyright Avail Air Force Inst of Technology Wright-Patterson AFB, Ohio CSCL 04/2

A study of the Earth-atmosphere system with multispectral remote sensing measurements from Nimbus VI satellite was carried out over the North American continent when a mid-latitude cyclone was present. Correlative information between such conventional meteorological parameters as clouds, precipitation, atmospheric temperature, snow cover, and soil moisture was made with measurements from the SCAMS, ESMR, and HIRS experiments on Nimbus VI. The results showed SCAMS microwave measurements were most sensitive to atmospheric parameters such as temperature and precipitating clouds while ESMR microwave measurements were dependent on surface conditions especially snow cover and soil moisture. Infrared and reflected solar radiance measurements from HIRS were useful in identifying cloud areas with conventional meteorological data. GRA

**N81-18444#** European Space Agency Paris (France)  
**INSTRUMENTATION FOR PREPROCESSING OF SAR DATA TO IMAGE FORM**

Norman Longdon, ed Jul 1980 106 p refs Proceedings of 2nd SEASAT-SAR Working Group Meeting Frascati Italy, 13-14 Dec 1979 Prepared in cooperation with Intern Soc of Photogrammetry

(ESA-SP-1031) Avail NTIS HC A06/MF A01

The working group reviewed existing digital and optical SEASAT synthetic aperture radar processors and the instrumentation which is needed for future systems was discussed. Analog and digital devices, image storage and archiving hardware and bit organized parallel processors were considered.

**N81-18445#** European Space Agency, Paris (France)  
**STATE-OF-THE-ART OF THE SEASAT DIGITAL SAR PROCESSORS**

J P Guignard *In its* Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 3-5 refs

Avail NTIS HC A06/MF A01

The hardware configurations used in six laboratories for processing data from SEASAT synthetic aperture radar (SAR) are listed. Included is all equipment needed to interface the high density digital recorder and to generate computer compatible tapes and printed data. Although the processing algorithms used differed, there is much commonality of hardware. All systems are based on 16 or 32 bit minicomputers array processors and disk storage. Author (ESA)

**N81-18447#** MacDonald, Dettwiler and Associates Ltd, Richmond (British Columbia)

**A REAL-TIME AIRBORNE SYNTHETIC APERTURE RADAR PROCESSOR**

John R Bennett, Pietro Widmer, and Ian G Cumming *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 15-23 refs

Avail NTIS HC A06/MF A01

A one-look digital processor for a dual polarization X-L band synthetic aperture radar was built and installed on a Convair aircraft. The airborne processor performs both pulse compression in range and synthetic aperture formation in azimuth. The time domain convolution algorithm used is described and a block diagram of the hardware given with some performance data. A laser beam recorder using heat developed dry silver paper is used to provide real time image output. Author (ESA)

**N81-18448#** European Space Research and Technology Center, Noordwijk (Netherlands)

**INSTRUMENTATION FOR HIGH THROUGHPUT SYNTHETIC APERTURE RADAR SIGNAL PROCESSORS**

J C Degavre *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 25-29 refs

Avail NTIS HC A06/MF A01

The characteristics of the satellite synthetic aperture radars envisaged by ESA for a European Remote Sensing Program and

possible radar signal processing system are given. Memory requirement and arithmetic load are estimated assessing the throughput capacity of special purpose hardware and computer based ground processors. Results show that real time processing of data from proposed remote sensing satellites is feasible, but must be implemented on special purpose hardware. An image from a typical satellite (100 km x 100 km) can be obtained in 30 min. Author (ESA)

**N81-18450#** Dornier-Werke G m b H Friedrichshafen (West Germany)

**THE MICROWAVE REMOTE SENSING EXPERIMENT**

B Fritsch and G Bommas *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jan 1980 p 35-37

Avail NTIS HC A06/MF A01

An experimental instrument which measures the directional wave height spectrum of the sea surface by the two frequency scatterometer method and generates high resolution radar images of land surfaces by application of the synthetic aperture principle is described. The experiment is in the integration phase and is a demonstration of European sensor technology and offers to the experimenters a possibility of gaining experience with this sensor. Parameters for the synthetic aperture mode and for azimuth processing are listed. Facilities for data transmission and ground processing are mentioned. Author (ESA)

**N81-18451#** Canada Centre for Remote Sensing Ottawa (Ontario)

**A QUICK-LOOK SEASAT SAR DIGITAL PROCESSOR**

E Shaw *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 39-41 refs

Avail NTIS HC A06/MF A01

The problems of range cell migration and the large amount of computation time required for SEASAT data processing are discussed. A skew time domain approach is described which reduces the offset Doppler range migration to zero Doppler migration. The resolution is reduced to 100 m but with a factor 16 reduction in data processing workload. The processor is implemented on a DEC 10/90 computer. A 17 km by 20 km seven look image requires two hours and 20 minutes. Author (ESA)

**N81-18452#** Environmental Research Inst of Michigan Ann Arbor Radar and Optics Div

**OPTICAL PROCESSING OF SEASAT-SAR DATA**

I Cindrich, C Dwyer, A Klooster and J Marks *In* ESA Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 43-74 refs

Avail NTIS HC A06/MF A01

A coherent optical processor system used for processing SEASAT-A synthetic aperture radar data is described and examples of resultant radar imagery are presented. The processor provides simultaneous two dimensional radar data processing to generate high resolution radar imagery at a high throughput capacity. The principles of radar data characteristics are reviewed. The tilted plane optical processor uses a spherical and a cylindrical telescopic lens set operating on the focused light field generated by the zone plate radar data at its input. Phase perturbation caused by azimuth wander, range walk, and range curvature are corrected. Author (ESA)

**N81-18453#** European Space Agency, Paris (France) Earthnet Programme Office

**SYNTHETIC APERTURE RADAR PROCESSING AND MULTIPLE MISSION REQUIREMENTS**

L Marelli *In its* Instrumentation for Preprocessing of SAR Data to Image Form Jul 1980 p 75-76

Avail NTIS HC A06/MF A01

The processing requirements for the next generation of satellite-borne synthetic aperture radars and optical multispectral sensors are compared briefly with throughput data from SEASAT. Improvements in hardware are mentioned which enable

## 08 INSTRUMENTATION AND SENSORS

EARTHNET to fulfill its processing requirements based upon minicomputers with large memories large disk stores and fast array processors Data processing workloads associated with input/output checking, and labelling which were underestimated in the past are indicated  
Author (ESA)

**N81-18475#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt Oberpfaffenhofen (West Germany)  
**STATUS OF THE MICROWAVE REMOTE SENSING EXPERIMENT (MRSE) PROJECT**  
F Schlude, A P Wolfram and M Werner /n ESA SEASAT-SAR Processor 1980 p 131-133

Avail NTIS HC A07/MF A01

The microwave remote sensing experiment (MRSE) to be used in Shuttle/Spacelab flights incorporates a synthetic aperture radar (SAR) a 2 frequency scatterometer and a radiometer mode The status of the hardware production and the preparatory work for the use of the hardware during the first Spacelab mission are summarized Mission objectives include delivery of high resolution radar imagery and demonstration of the two frequency technique for measuring ocean wave spectra from space Instrument parameters are listed  
Author (ESA)

**N81-19362\*#** Research and Data Systems Inc Lanham MD  
**A STUDY OF RADIO FREQUENCY INTERFERENCE WITH THE NIMBUS-7 SCANNING MULTICHANNEL MICROWAVE RADIOMETER (SMMR)**  
John A Kogut 5 Nov 1980 58 p refs  
(Contract NAS5-25997)  
(NASA-CR-166638) Avail NTIS HC A04/MF A01 CSCL 20N

One of the important objectives of the NIMBUS-7 Scanning Multichannel Microwave Radiometer (SMMR) is to demonstrate the feasibility of all weather measurements of various ocean parameters such as sea surface temperature (SST) and near surface wind speed (WS) These ocean parameters can be determined from multispectral measurements of ocean brightness temperatures in the microwave region of the electromagnetic spectrum These microwave measurements however are distorted if the field of view of the SMMR antenna encounters radio transmissions from terrestrial sources Sources of terrestrial Radio Frequency Interference (RFI) in the SMMR ocean data were identified Its extent and characteristics over different ocean areas on the Earth were determined  
T M

**N81-19697#** California Univ Livermore Lawrence Livermore Lab  
**USE OF COMPUTER-SIMULATED RADIANCES TO RETRIEVE TOTAL ATMOSPHERIC OZONE DATA FROM SATELLITE-MOUNTED INFRARED MULTIFILTER RADIOMETERS**  
P P Weidhaas Oct 1980 18 p refs Presented at the 14th Ann Simulation Symp Tampa, Fla 16-20 Mar 1981 Submitted for publication  
(Contract W-7405-eng-48)  
(UCRL-84352 CONF-810305-1) Avail NTIS HC A02/MF A01

Four satellites equipped with multichannel filter radiometer (MFR) sensors supplied infrared radiance data at various spectral channels An ozone retrieval model was developed in order to derive total ozone values from the radiance data Statistical comparison against a network of ground observatories which measure total ozone with a Dobson spectrophotometer showed good agreement between MFR derived ozone data and Dobson measurements Thus the scientific feasibility of the ozone retrieval model was established Currently, SOAC has begun to automate the processing and archiving of the MFR data  
R C T

**N81-20491\*#** Ball Aerospace Systems Div., Boulder, Colo  
**DEVELOPMENT OF THE COASTAL ZONE COLOR SCANNER FOR NIMBUS 7 VOLUME 2 TEST AND PERFORMANCE DATA, REVISION A Final Report, Jan. 1975 - 7 Oct. 1978**  
May 1979 99 p refs 2 Vol  
(Contract NAS5-20900)

(NASA-CR-166649, F78-11-Vol-2-Rev-A) Avail NTIS HC A05/MF A01 CSCL 20F

The results of the Coastal Zone Color Scanner protoflight tests are examined in detail while some of the test results are evaluated with respect to expected performance Performance characteristics examined include spectral response, signal to noise ratio as a function of radiance input, radiance response, the modulation transfer function, and the field of view and coregistration The results of orbital sequence tests are also included The in orbit performance or return of radiometric data in the six spectral bands is evaluated along with the data processing sequence necessary to derive the final data products Examples of the raw data are given and the housekeeping or diagnostic data which provides information on the day to day health or status of the instrument are discussed  
J M S

**N81-20493\*#** National Aeronautics and Space Administration, Washington, D C  
**LAPR AN EXPERIMENTAL AIRCRAFT PUSHBROOM SCANNER**  
Stephen W Wharton, J I Irons, and F Heugel Jul 1980 31 p refs Submitted for publication  
(NASA-TM-80729) Avail NTIS HC A03/MF A01 CSCL 14B

A three band Linear Array Pushbroom Radiometer (LAPR) was built and flown on an experimental basis by NASA at the Goddard Space Flight Center The functional characteristics of the instrument and the methods used to preprocess the data, including radiometric correction, are described The radiometric sensitivity of the instrument was tested and compared to that of the Thematic Mapper and the Multispectral Scanner The radiometric correction procedure was evaluated quantitatively, using laboratory testing, and qualitatively, via visual examination of the LAPR test flight imagery Although effective radiometric correction could not yet be demonstrated via laboratory testing, radiometric distortion did not preclude the visual interpretation or parallel piped classification of the test imagery  
Author

**N81-20507#** Institut Geographique National, Paris (France)  
**PHOTOGRAPHIC CAMERAS AND RETURN BEAM VIDICONS [CAMERAS PHOTOGRAPHIQUES ET RBV]**  
A Baudoin /n CNES Spaceborne Cartography of the Earth 1979 p 203-230 refs In FRENCH

Avail NTIS HC A99/MF A01

Purely photographic remote sensors, i.e., apparatus that necessitates the use of photographic film for the storage of data, as well as return beam vidicons (RBV) are studied For each of these sensors, the instantaneous acquisition of images and their geometric quality are discussed Generalized requirements for photographic systems operating in space are listed Cameras flown during the Skylab program, onboard Soyuz 22, and the photo-optical systems to be flown with spacelab and the space shuttle (Large Format Camera) are described in detail The RBVs operated onboard various LANDSAT satellites are illustrated The operating principle as well as performance characteristics, such as resolution, geometric fidelity, and radiometric properties, are given  
Author (ESA)

**N81-20508#** Centre National d'Etudes Spatiales, Toulouse (France)  
**SPACEBORNE SCANNERS FOR PHOTOELECTRIC DETECTION [LES INSTRUMENTS SPATIAUX A DETECTION PHOTOELECTRIQUE ET A BALAYAGE]**  
A deLefte /n its Spaceborne Cartography of the Earth 1979 p 233-314 refs In FRENCH

Avail NTIS HC A99/MF A01

Instruments for spaceborne observation, other than photo-optical cameras, are studied The advantages, e.g., ease of image processing and data transmission, intrinsic to scanning multispectral radiometers over photo-optical systems are discussed Functional elements making up a photoelectrical detector system are described According to the type of observation to be made, three scanning modes are identified (1) multispectral mechanical scanning, (2) pushbroom imagery, and (3) television camera

imagery Examples of instrumentation typical of each scanning mode are drawn from various space programs and illustrated in detail  
Author (ESA)

**N81-20511#** Centre National d'Etudes Spatiales, Toulouse (France)  
**PRINCIPLE AND PERFORMANCE OF RADAR SENSORS [PRINCIPE ET PERFORMANCES DES CAPTEURS RADAR]**  
M Dorrier *In its* CNES Spaceborne Cartography of the Earth 1979 p 367-378 refs In FRENCH

Avail NTIS HC A99/MF A01

Fundamentals of side-looking radar and of synthetic aperture radar (SAR) are described, emphasizing their geometrical characteristics and the quality of the images obtained Resolution, deformation in distance radiometric factors, scintillation, the effects of ground relief, and radar coverage are discussed The possibility of radar stereography is brought up and analyzed, including a scheme for a combined radar and optical system For an aircraft mounted SAR system, highly detailed imagery is obtainable Impulse compression, multiview, and nonfocused antenna modes are also considered  
Author (ESA)

**N81-20516#** Institut Geographique National, Paris (France)  
**ANALOG RECTIFICATION [LA RECTIFICATION ANALOGIQUE]**  
Bernard Cabrieres *In* CNES Spaceborne Cartography of the Earth 1979 p 473-487 refs In FRENCH

Avail NTIS HC A99/MF A01

Techniques and associated apparatus for rendering an aerial photograph usable in relief map applications are reviewed General functional principles of orthoprojectors are outlined Three types of apparatus are described (1) a device for manual profiling and optical transfer of an image by horizontal linear elements, (2) an automatic correlator with image transfer by CRT, and (3) an image converter with optical transfer of linear elements and correction for slope Possible application of the orthoprojector with slope correction to SPOT satellite imagery is demonstrated Both a vertical and oblique line of sight are studied using simulated SPOT imagery Application of analog rectification to LANDSAT imagery is also discussed  
Author (ESA)

**N81-20519#** Centre National d'Etudes Spatiales, Toulouse (France)  
**OVERVIEW OF THE SPOT MISSION AND DESCRIPTION OF THE GROUND SEGMENT [RAPPEL DE LA MISSION SPOT ET DESCRIPTION DU SEGMENT SOL]**  
J C Cazaux *In its* Spaceborne Cartography of the Earth 1979 p 535-543 In FRENCH

Avail NTIS HC A99/MF A01

The objectives of the first SPOT satellite mission are reviewed and the organization of its ground based systems is described Details of the satellite orbit are given along with specifications on its high resolution scanner for the visible spectrum its optical system, and on its telemetry instrumentation The ground segment handles command and control of the spacecraft as well as processing of received imagery A filing system for processed data is implemented and user relations service is available  
Author (ESA)

**N81-21701\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt Md  
**INFERENCE OF THE BOUNDARY LAYER STRUCTURE OVER THE OCEANS FROM SATELLITE INFRARED MEASUREMENTS**  
C Prabhakara, G Dalu R Lo (Computer Sciences Corp Silver Spring Md), and N R Nath (Computer Sciences Corp, Silver Spring, Md) *In its* Goddard Lab for Atmospheric Sci, Collected Reprints 1978 - 1979 Vol 2 Mar 1980 p 1042 refs Repr from NASA-TM-79653, Sep 1978

(NASA-TM-79653) Avail NTIS HC A22/MF A01 CSCL 04B

Remote infrared spectral measurements in the 8-13 micron m window region, at a resolution about 3 cm/1 contain useful information about the water vapor and temperature stratification of the atmosphere within the first few kilometers above the water surface Two pieces of information are retrieved from the spectral measurements precipitable water vapor in the atmosphere, from the depth of the line structure between 8 and 9 micron m due to water vapor lines, and sea surface temperature from the variation of brightness temperature between 11 and 13 micron m Together, these two pieces of information can signify either the presence of a deep moist convective layer or the prevalence of stable conditions such as caused by temperature inversions, which inhibit moist convection A simple infrared radiative transfer model of the 9 micron m water vapor lines was developed to validate the method With the help of this model and the Nimbus 4 infrared interferometer spectrometer data a gross picture of the planetary boundary layer for different seasons over the global oceans is deduced The important regions of the trade wind inversion and the intertropical convergence zones over all the oceans are clearly identified with this method The derived information is in reasonable agreement with some observed climatological patterns over the oceans  
Author

**N81-21703\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md  
**TOPICAL CYCLONE RAINFALL CHARACTERISTICS AS DETERMINED FROM A SATELLITE PASSIVE MICROWAVE RADIOMETER**

E B Rodgers and R F Adler Dec 1979 48 p refs (NASA-TM-80596) Avail NTIS HC A03/MF A01 CSCL 04B

Data from the Nimbus-5 Electrically Scanning Microwave Radiometer (ESMR-5) were used to calculate latent heat release and other rainfall parameters for over 70 satellite observations of 21 tropical cyclones in the tropical North Pacific Ocean The results indicate that the ESMR-5 measurements can be useful in determining the rainfall characteristics of these storms and appear to be potentially useful in monitoring as well as predicting their intensity The ESMR-5 derived total tropical cyclone rainfall estimates agree favorably with previous estimates for both the disturbance and typhoon stages The mean typhoon rainfall rate (1.9 mm h(-1)) is approximately twice that of disturbances (1.1 mm h(-1))  
M G

**N81-21906\*#** Daedalus Enterprises, Inc Ann Arbor Mich  
**DESIGN STUDY FOR THERMAL INFRARED MULTISPECTRAL SCANNER (TIMS) Final Report**  
C G Stanich F G Osterwisch D M Szeles and W H Houtman 27 Mar 1981 82 p refs Prepared for JPL (Contracts NAS7-100 JPL-955829) (NASA-CR-164165 Rept-78004-01 JPL-9950-524) Avail NTIS HC A05/MF A01 CSCL 20F

The feasibility of dividing the 8-12 micron thermal infrared wavelength region into six spectral bands by an airborne line scanner system was investigated By combining an existing scanner design with a 6 band spectrometer a system for the remote sensing of Earth resources was developed The elements in the spectrometer include an off axis reflective collimator a reflective diffraction grating a triplet germanium imaging lens a photoconductive mercury cadmium telluride sensor array and the mechanical assembly to hold these parts and maintain their optical alignment across a broad temperature range The existing scanner design was modified to accept the new spectrometer and two field filling thermal reference sources  
A R H

## GENERAL

Includes economic analysis

**A81-23534 # Integrated information systems for resource management.** W M Strome, L W Morley, D G Goodenough, J Cihlar, A K McGillan (Canada Centre for Remote Sensing, Ottawa, Canada), and F M Rudin (Instituto Geografico Nacional, San Jose, Costa Rica) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 19-26 15 refs

The design of integrated information systems for resource management using remotely sensed data is studied. A system utilizing a computerized geographic data base capable of being accessed positionally in any user selected manner is proposed. The data bases of the contributing agencies would be rendered compatible with one another via a switchboard element for direction to each type of data. It is noted that the principal advantage of the system is the avoidance of duplication in information updating and handling. L S

**A81-23535 # Remote sensing applications in Latin America and the Caribbean.** T W Wagner (Michigan, Environmental Research Institute, Ann Arbor, Mich.) and L A Bartolucci (Purdue University, West Lafayette, Ind.) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 27-33

The informational needs of Latin American and Caribbean nations are discussed with a view to remote sensing applications in resource management and environmental monitoring. Landsat data and imagery were used in obtaining forest cover maps of Peru, in agricultural crop inventory surveys in western Costa Rica, and in the mapping of ocean depth in the Bahama Islands. The development of national remote sensing programs in Bolivia, Brazil, Chile, Ecuador, and Venezuela is discussed. It is noted that Landsat image maps will increasingly replace traditional maps in regional decision-making processes. L S

**A81-23536 # Argentina remote sensing programme establishment of a Landsat receiving station.** M S Peña and S F Pagel (Comisión Nacional de Investigaciones Espaciales, Buenos Aires, Argentina) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 35-46

**A81-23537 # Remote sensing applications - Bolivian experience.** C E Brockmann (Servicio Geológico de Bolivia, La Paz, Bolivia) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 47-54

Landsat remote sensing activities in Bolivia are surveyed with a view to their applications in cartography, geology, geomorphology, soil surveys and forestry. The investigations of multispectral numerical analysis as applied to soil surveys, land cover and land use and geology are reviewed. As a result of the investigations, it was possible to identify grasses, woods, soya crops, bodies of water, barren lands and agricultural patterns. L S

**A81-23539 # ASEAN remote sensing program.** C R Roque (Ministry of Natural Resources, Natural Resources Management Center, Quezon City, Philippines) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor,

Mich., Environmental Research Institute of Michigan, 1980, p 65-70

The remote sensing programs of Indonesia, Malaysia, the Philippines, Thailand and Singapore are surveyed with a view to future cooperative efforts between the national programs. Although no formal mechanism has been designed at the present time to launch an ASEAN remote sensing program whereby member countries can complement each other's technical capabilities in this area, recent ASEAN space technology proposals point out the essential nature of a unified remote sensing program. L S

**A81-23542 # The African Remote Sensing Programme.** H Quedraogo (United Nations, Economic Commission for Africa, Addis Ababa, Ethiopia) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 103-112

An account of the African Remote Sensing Programme, made up of 14 African nations, is presented, giving its development from its inception in February 1975 to the approval of the Constitution and the inaugural meeting in October 1979. The activities of the Program, such as the establishment of three regional receiving and processing centers and five trainer and user assistance centers, the carrying out of national and regional projects by various African nations and the financing of the program by African and Western nations, are detailed. The importance of the program for economic development policy-making, planning and resource management is emphasized. D K

**A81-23543 # Remote sensing education and research in the institutions of higher education of the People's Republic of China.** C-C Cheng (Peking University, Peking, Communist China) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 1 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 115-118

**A81-23666 # A working concept of remote sensing technology transfer.** S Pala (Ontario Ministry of Natural Resources, Ontario Centre for Remote Sensing, Toronto, Canada) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1653-1660

The technology transfer program implemented by the Ontario Centre for Remote Sensing is reviewed. The program is directed to government, the private sector and the universities. The three-point program designed for the transfer of remote sensing technology to the universities includes assistance in training students, cooperative research, and cooperative application projects. L S

**A81-23679 # An experimental technology-transfer project in Remote Sensing between Canada and West Africa.** G Rochon (Université Laval, Quebec, Canada), F Bonn (Sherbrooke, Université, Sherbrooke, Quebec, Canada), and B D Bruce (Canada Centre for Remote Sensing, Ottawa, Canada) In International Symposium on Remote Sensing of Environment, 14th, San Jose, Costa Rica, April 23-30, 1980, Proceedings Volume 3 Ann Arbor, Mich., Environmental Research Institute of Michigan, 1980, p 1803-1813 9 refs. Research supported by the Canadian International Development Agency.

A technology transfer program between the Canadian Center for Remote Sensing and the Upper Volta Regional Remote Sensing Center is reviewed. The objectives of the program were the training of West African resource managers, and the development and implementation of pilot projects applied to natural resource management problems in the West African context. The deforestation and ground water potential assessment projects are reviewed. Edge enhancement techniques in the Bobo Dioulasso areas showed most of the previously mapped lineaments and several new ones. These



## 09 GENERAL

results may be applicable to the extensive drilling program scheduled for the region in the 1980's  
L S

**A81-26416 #** Space, nature, and man (Kosmos-priroda-chelovek) lu P Kienko and A D Koval' In Scientific lectures in aviation and astronautics 1978 Moscow, Izda tel'stvo Nauka, 1980, p 130-144 In Russian

Experience in the USSR space program with the remote sensing of earth resources is reviewed Particular attention is given to photography systems used aboard Soyuz 12, Soyuz 22, Salyut 4, and Salyut 6 Visual and sensor observations of the earth's surface from Salyut 4, 5, and 6 are described, and the preflight training of cosmonauts in remote sensing is briefly discussed  
B J

**A81-26882 #** Aerospace studies of the natural resources of Siberia and the Far East (Aerokosmicheskie issledovaniia prirodnykh resursov Sibiri i Dal'nego Vostoka) L K Ziat'kova and A L Ianshin *Issledovanie Zemli iz Kosmosa*, Nov-Dec 1980, p 5-8 In Russian

A summary is given of the proceedings of the second scientific session of the Council for Aerospace Studies of the Natural Resources of Siberia and the Far East The papers read at the session dealt with (1) the use of space photographs in studies of soil erosion, permafrost, and landscape geomorphology, as well as in the compilation of geological maps and special thematic maps showing the evolutionary dynamics of various natural processes, (2) the use of space photos in oil and gas exploration, mineral prospecting, tectonic surveying, environmental protection, and the planning of major industrial complexes in Siberia, and (3) facilities in Siberia for the computerized processing and interpretation of space photos Three tasks were outlined at the session the use of remote sensing techniques in the study of various landscape components, the use of information collected in space to improve methods of compiling geological and other specialized maps, and the improvement of facilities and methods for the computerized processing and interpretation of aerial and space photos  
F G M

**A81-28076 #** Experimental multispectral aerial and space remote sensing of earth resources of Cuba (Eksperimental'nye mnogozonal'nye aerokosmicheskie s'emki dlia izucheniia prirodnykh resursov na Kube) L Fernandes *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 118-120 In Russian

**A81-28077 #** Remote sensing in Poland - The Earth Experiment (Aerokosmicheskie issledovaniia v PNR - Eksperiment 'Zemlia') M Germashevskii and R Kachin'ski *Issledovanie Zemli iz Kosmosa*, Jan-Feb 1981, p 121-123 In Russian

**N81-18932\*#** National Aeronautics and Space Administration John F Kennedy Space Center, Cocoa Beach Fla  
**RESEARCH AND TECHNOLOGY 1980 Annual Report**  
Oct 1980 8 p  
(NASA-TM-82260) Avail NTIS HC A02/MF A01 CSCL 05B

Topics are divided into three major areas Earth resources, advanced development and technology transfer Topics include aerial color infrared photography, fiber optics lightning research soil mechanics corrosion prevention, image processing and communication systems development  
T M

**N81-19158\*#** National Aeronautics and Space Administration Washington D C  
**NEWS OF BRAZILIAN SPACE ACTIVITIES**  
Aug 1980 36 p Transl into ENGLISH from Espacial (Brazil) v 7 no 35 Aug 1979 p 1-8 Transl by Kanner (Leo) Associates Redwood City Calif Original doc prep by Inst de Pesquisas Espaciais, Sao Jose dos Campos, Brazil  
(Contract NASw-3199)  
(NASA-TM-76303) Avail NTIS HC A03/MF A01 CSCL 22A

Remote sensing and meteorological observations of satellites are covered Development of an oceanographic atlas prediction

of droughts, and results of geological surveys using satellite data are discussed  
J M S

**N81-19557#** National Oceanic and Atmospheric Administration, Rockville, Md  
**PLANNING FOR A CIVIL OPERATIONAL LAND REMOTE SENSING SATELLITE SYSTEM A DISCUSSION OF ISSUES AND OPTIONS**

20 Jun 1980 130 p  
(PB81-130336 NOAA 80101702) Avail NTIS  
HC A07/MF A01 CSCL 08C

The issues involved in implementing an operational land remote sensing system from space initially based on LANDSAT technology are presented The goal of eventual private sector ownership and operation of the system is emphasized  
GRA

**N81-20957#** Council on Environmental Quality, Washington, D C Council on Environmental Quality  
**GLOBAL FUTURE: TIME TO ACT. REPORT TO THE PRESIDENT ON GLOBAL RESOURCES, ENVIRONMENT AND POPULATION**

Jan 1981 264 p  
Avail NTIS HC A12/MF A01

Considered assessments and ideas for action that the United States, in concert with other nations, could take to respond vigorously to urgent global problems are presented The effectiveness of current government programs related to long term global issues is discussed for the following areas population, food and agriculture, renewable energy resources and conservation, tropical forests, biological diversity, coastal and marine resources, water resources, global pollution, sustainable development, and institutional changes The creation of public awareness is considered for all aspects  
A R H

**N81-20973\*#** National Aeronautics and Space Administration Washington, D C  
**DEEPENING PERSPECTIVE A NEW LOOK AT THE OLD WORLD**

In its Beyond the Atmosphere Early Years of Space Sci 1980 p 172-200

Avail NTIS MF A01 SOD HC \$11 00 CSCL 08F

The development space satellites is examined with particular reference to their contributions to scientific research The accomplishments in the fields of geodesy and the magnetosphere are reviewed in some detail  
M G

**N81-20981\*#** National Aeronautics and Space Administration Washington, D C

**SPACE SCIENCE AND PRACTICAL APPLICATIONS**

In its Beyond the Atmosphere Early Years of Space Sci 1980 p 319-326

Avail NTIS MF A01 SOD HC \$11 00 CSCL 05B

The interrelationships between space science research, practical applications, and funding are investigated in a historical context  
M G

**N81-21409\*#** National Aeronautics and Space Administration Washington, D C

**EARTH STUDY FROM SPACE**

A V Sidorenko Apr 1981 20 p Transl into ENGLISH from Prii, (USSR), no 11, Nov 1980 p 3-9 Transl by Scientific Translation Service Santa Barbara, Calif Original doc prep by USSR Academy of Sciences (USSR)

(Contract NASw-3198)  
(NASA-TM-76486) Avail NTIS HC A02/MF A01 CSCL 08F

The significance that space studies are making to all Earth sciences in the areas of geography geodesy cartography, geology, meteorology oceanology, agronomy and ecology is discussed It is predicted that cosmonautics will result in a revolution in science and technology  
A R H

**N81-21439\*#** Stanford Univ, Calif Dept of Engineering-Economic Systems

**UNDERSTANDING THE LANDSAT MARKET IN DEVELOPING COUNTRIES Final Report**

Matthew R Willard Nov 1980 86 p refs  
(Contract NASw-3204)  
(NASA-CR-164171, Rept-30) Avail NTIS HC A05/MF A01  
CSCL 08F

The constraints on the growth of the market which stem from the development process itself and from a country's technical, political, and institutional attributes were examined. Four competing factors guide the development of policy regarding an operational land remote sensing system and are summarized. The factors are: there is a need to boost U.S. experts in areas where the U.S. holds a technological lead, the need to develop user applications in developing countries on their terms coincides with foreign policy, developing countries desire to take control of their own development and the U.S. government wants to enlist the participation of major companies in the management, operation, and ownership of the operational system. T M

**N81-21440# National Aeronautics and Space Administration  
Ames Research Center Moffett Field, Calif  
WESTERN REGIONAL REMOTE SENSING CONFERENCE  
PROCEEDINGS, 1979**

1980 192 p Conf held at Naval Postgraduate School, Monterey  
Calif., 17 - 19 Oct 1979  
(NASA-CP-2148, Rept-A-8320) Avail NTIS  
HC A09/MF A01 CSCL 05A

Remote sensing users from the 14 western states explained their diverse applications of LANDSAT data, discussed operational goals and exchanged problems and solutions. In addition, conference participants stressed the need for increased cooperation among state and local governments, private industry, and universities to aid NASA's objective of transferring to user agencies the ability to operationally use remote sensing technology for resource and environmental quality management. A R H

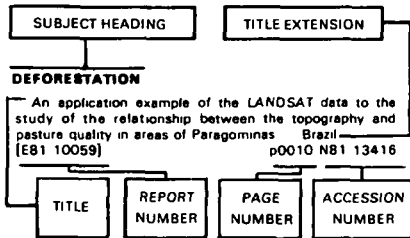
**N81-21448# Centre National d'Etudes Spatiales Toulouse  
(France)**

**MATHEMATICAL AND PHYSICAL PRINCIPLES OF REMOTE SENSING**

1978 851 p refs Partly in ENGLISH and FRENCH Proceedings  
of CNES Summer School of Space Phys Lectures Strasbourg,  
18 Aug - 15 Sep 1978  
Avail NTIS HC A99/MF A01

The physical and mathematical foundations of remote sensing are discussed. Subjects treated include the theoretical physics of remote sensing, thermal phenomena and energy exchange in the environment, and remote sensing problems stemming from the presence of the atmosphere. Also covered were image processing theory, data processing and instrumentation and electromagnetic wave interaction with the environment. Special study results concerning diffusion in the visible and the IR, ocean surface observation and crop inventory algorithms are reported as examples of application.

## 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

### ACOUSTIC SOUNDING

Feasibility study of airborne bathymetric sensing using the CO<sub>2</sub> laser/ acoustic technique (Brighton Dam test results)  
[AD-A094694] p0088 N81 19534

### ACOUSTIC VELOCITY

Subsurface dynamical properties of variable features seen in satellite IR imagery off Point Sur and their acoustic significance  
[AD-A092632] p0087 N81 16518

### AERIAL PHOTOGRAPHY

Design of a nationwide natural resource inventory and information system for Costa Rica p0066 A81 23559  
Planning and execution of a photographic mission over a wheat producing region in Rio Grande do Sul, Brazil p0053 A81 23589  
Experimental multispectral aerial and space remote sensing of earth resources of Cuba p0120 A81-28076  
Improvement of the accuracy of aerial photography for agriculture and forestry through the application of multispectral techniques p0059 A81 28742  
Semi Automatic and automatic extraction of objects from aerial images p0108 N81 20814

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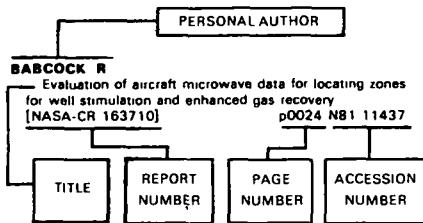
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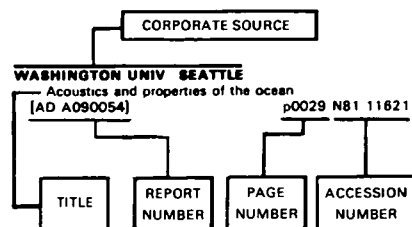
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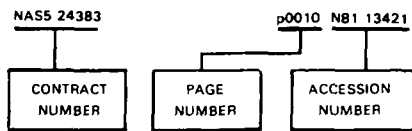
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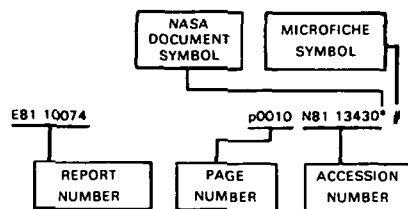
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Earth Resources/A Continuing Bibliography (Issue 30)

JULY 1981

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