

NASA

Earth Resources  
A Continuing  
Bibliography  
with Indexes

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National Aeronautics and  
Space Administration

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## ACCESSION NUMBER RANGES

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

STAR (N-10000 Series)	N83-30354 - N83-37053
IAA (A-10000 Series)	A83-40666 - A83-50211

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# EARTH RESOURCES

## A CONTINUING BIBLIOGRAPHY WITH INDEXES

### Issue 40

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 October 1 and December 31, 1983 in

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

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



# INTRODUCTION

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

This literature survey lists 423 reports, articles, and other documents announced between October 1 and December 31, 1983 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.

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

- IAA* entries identified by accession number series A83-10,000 in ascending accession number order;

- STAR* entries identified by accession number series N83-10,000 in ascending accession number order.

After the abstract section, there are six indexes:

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

# AVAILABILITY OF CITED PUBLICATIONS

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All publications abstracted in this Section are available from the Technical Information Service, American Institute of Aeronautics and Astronautics, Inc (AIAA), as follows. Paper copies of accessions are available at \$8.50 per document. Microfiche<sup>(1)</sup> of documents announced in *IAA* are available at the rate of \$4.00 per microfiche on demand. Standing order microfiche are available at the rate of \$1.75 per microfiche for AIAA meeting papers, and \$1.45 per microfiche for *IAA* source documents.

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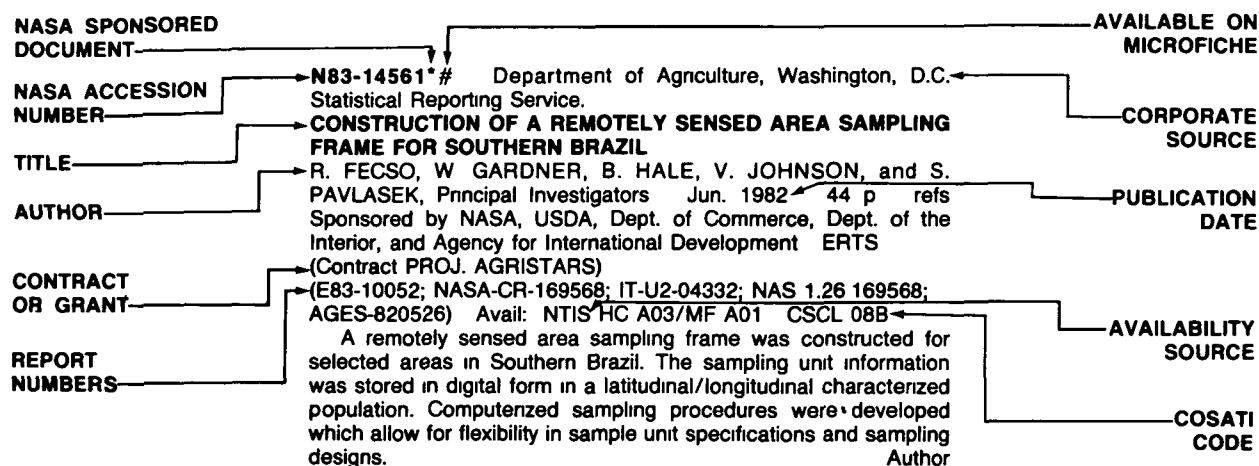
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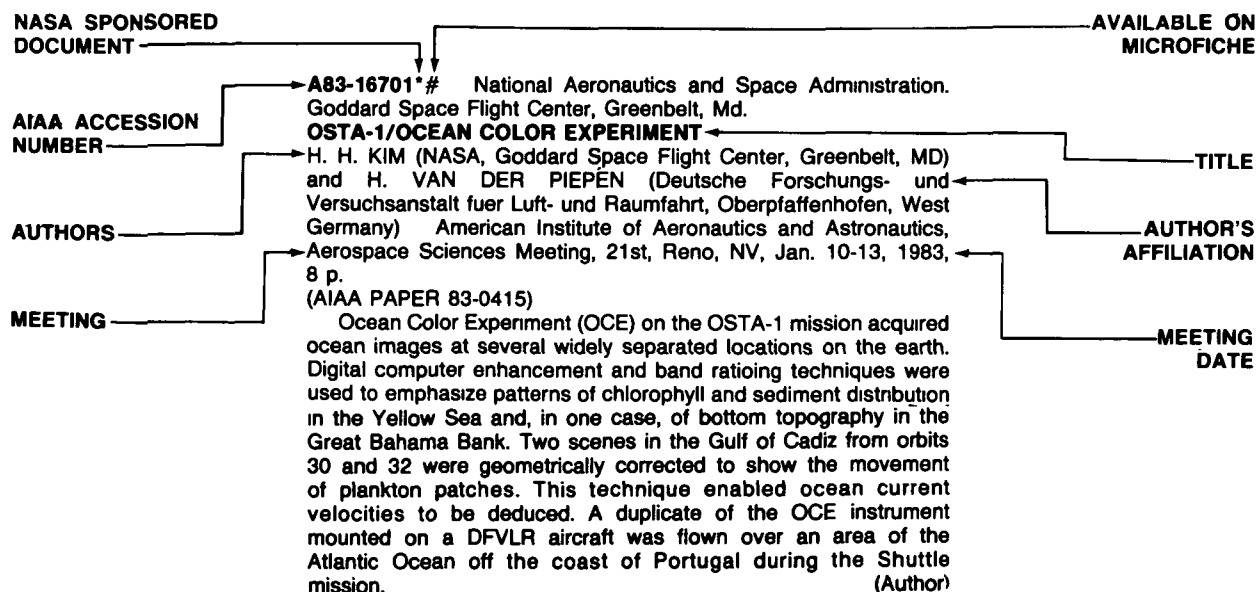
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## TYPICAL CITATION AND ABSTRACT FROM STAR



## TYPICAL CITATION AND ABSTRACT FROM IAA



# EARTH RESOURCES

*A Continuing Bibliography (Issue 40)*

JANUARY 1984

01

## AGRICULTURE AND FORESTRY

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

**A83-42961**

### REMOTE SENSING OF TANK IRRIGATED AREAS IN TAMIL NADU STATE, INDIA

S. THIRUVENGADACHARI (National Remote Sensing Agency, Hyderabad, India) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 545-554. Research supported by the National Remote Sensing Agency. refs

**A83-42965\*** State Univ. of New York, Syracuse.

### THE EFFECT OF IRRADIATION AND REFLECTANCE VARIABILITY ON VEGETATION CONDITION ASSESSMENT

M. J. DUGGIN (New York, State University, Syracuse, NY) (Remote Sensing Society, Conference on Matching Remote Sensing Technologies and Their Applications, London, England, Dec 16-18, 1981, Paper) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 601-608. refs (Contract NAS9-16331)

Surface reflectance and global irradiance variations across an imaged area determine the minimum signal difference from groups of pixels in different targets needed to discriminate them. The factors affecting such variations and their magnitudes are considered. The sensor output also depends upon the interaction of the spectral response of the sensor and the spectral upwelling radiance from the target. From a consideration of the spectral instrument responses of detectors in the Landsat multispectral scanners (MS), together with measured reflectance factors of a vegetative canopy stressed to different levels of severity, the feasibility of mapping and quantifying disease stress with Landsat vegetative indices (VIs) is demonstrated. Author

**A83-43980#**

### THE GROUP AGROMET MONITORING PROJECT (GAMP) - APPLICATION OF METEOSAT DATA FOR RAINFALL, EVAPORATION, SOIL-MOISTURE AND PLANT-GROWTH MONITORING IN AFRICA

C. E. ENGLAND (Laboratory for Planetary Atmospheres, London, England), R. GOMBEER (Leuven, Katholieke Universiteit, Louvain, Belgium), E. HECHINGER (Strasbourg I, Universite, Strasbourg, France), R. W. HERSCHY (Department of the Environment, London, England), A. ROSEMA (Environmental Analysis and Remote Sensing, Ltd., Delft, Netherlands), and L. STROOSNIJDER (Landbouwhogeschool, Wageningen, Netherlands) ESA Journal (ISSN 0379-2285), vol. 7, no. 2, 1983, p. 169-188. Sponsorship: European Space Agency. (Contract ESA-4660/81-D-IM(SC))

**A83-44267\*** Maryland Univ., College Park.

### AN EXPERIMENT IN MULTISPECTRAL, MULTITEMPORAL CROP CLASSIFICATION USING RELAXATION TECHNIQUES

L. S. DAVIS (Maryland, University, College Park, MD), C.-Y. WANG (Maryland, University, College Park, MD; Chinese Academy of Sciences, Automation Institute, Beijing, People's Republic of China), and H.-C. XIE (Maryland, University, College Park, MD; China University of Science and Technology, Hefei, People's Republic of China) Computer Vision, Graphics, and Image Processing (ISSN 0734-189X), vol. 23, Aug. 1983, p. 227-235. refs

(Contract NAS9-16434)

The paper describes the result of an experimental study concerning the use of probabilistic relaxation for improving pixel classification rates. Two LACIE sites were used in the study and in both cases, relaxation resulted in a marked improvement in classification rates. Author

**A83-45419#**

### MICROWAVE RADIOMETRIC FEATURES OF VEGETATED SURFACES

F. BENINCASA, G. FASANO, S. PALOSCIA, P. PAMPALONI, and G. ZIPOLI (CNR, Istituto di Analisi Ambientale e Telerilevamento Applicati all'Agricoltura, Florence, Italy) Alta Frequenza (ISSN 0002-6557), vol. 52, May-June 1983, p. 230-232. refs

Microwave emission of soil and vegetation depends on the physical conditions of the medium. Due to the high value of the water dielectric constant with respect to that of dry soil and vegetation, detected microwave radiation may be used to evaluate soil moisture and plant water content. Radiometer data at 9.8 and 36.6 GHz of corn have been correlated with 'in situ' measured physical parameters of soil and vegetation. A strong correlation between the brightness and physical temperature of crop has been found, moreover daily emissivity variations are small, but clearly correlated with the humidity of air at the top of vegetation. Author

**A83-46102**

### STATUS OF MODELLING OF MICROWAVE EMISSION FROM MOIST SOILS

J. W. ROUSE, JR. (Texas, University, Arlington, TX) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest, Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

The use of analytical models has proven to be a powerful tool in the effort to develop an effective passive microwave technique for remote monitoring of soil moisture. Excellent models exist to describe emission from smooth, bare soils, even in cases involving inhomogeneous subsurface moisture and temperature profiles. Several approaches have been tried to extend these models to rough surface situations; both randomly rough and tilled surfaces, with moderate success. The present area of concern in both theoretical and empirical studies is adequately accounting for surface vegetation. This aspect of the soil moisture monitoring problem remains unresolved, but some insight into the relevant processes has been gained. This paper provides a concise summary of the characteristics of the most useful techniques. Author



## 01 AGRICULTURE AND FORESTRY

**A83-46103\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **A MULTI-FREQUENCY MEASUREMENT OF THERMAL MICROWAVE EMISSION FROM SOILS - THE EFFECT OF SOIL TEXTURE AND SURFACE ROUGHNESS**

J. R. WANG, P. E. ONEILL (NASA, Goddard Space Flight Center, Greenbelt, MD), T. J. JACKSON, and E. T. ENGMAN (U.S. Department of Agriculture, Agricultural Research Center, Beltsville, MD) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

An experiment on remote sensing of soil moisture content was conducted over bare fields with microwave radiometers at the frequencies of 1.4 GHz, 5 GHz, and 10.7 GHz during July-September of 1981. Three bare fields with different surface roughnesses and soil textures were prepared for the experiment. Ground truth acquisition of soil temperatures and moisture contents for 5 layers down to the depth of 15 cm was made concurrently with radiometric measurements. The experimental results show that the effect of surface roughness is to increase the soils' brightness temperature and to reduce the slope of regression between brightness temperature and moisture content. The slopes of regression for soils with different textures are found to be comparable, and the effect of soil texture is reflected in the difference of regression line intercepts at brightness temperature axis. The result is consistent with laboratory measurement of soils' dielectric permittivity. Measurements on wet smooth bare fields give lower brightness temperatures at 5 GHz than at 1.4 GHz. Previously announced in STAR as N82-24550

Author

### **A83-46104**

#### **ACTIVE MICROWAVE SIGNATURES OF SOIL AND CROPS -**

#### **SIGNIFICANT RESULTS OF THREE YEARS OF EXPERIMENTS**

T. LE TOAN (Centre d'Etude Spatiale des Rayonnements, Toulouse, France) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

Radar reflectivity of soil and crop (wheat) has been investigated by using the ground-based scatterometer RAMSES (4 frequencies: 1.5, 3, 4.5 and 9 GHz). Results of data analysis confirm the conclusions by the Kansas group on optimum sensor parameters for detecting soil moisture with a minimum effect of the surface roughness and for identifying crop parameters with a minimum effect of the underlying soil. The relations between the radar backscattering coefficient and the soil moisture content are evaluated through penetration depth and power reflection coefficient. The sensitivity of the radar backscattering coefficient to some crop parameters (LAI, water per unit volume of the canopy) is presented.

Author

### **A83-46137**

#### **GROUND TRUTH MEASUREMENTS AND RESULTS FROM THE INTERPRETATION OF MULTISPECTRAL DATA DURING THE CONVAIR PROJECT AT THE STRAUBING TEST SITE (D9)**

H. ERNST, G. FISCHBECK (Muenchen, Technische Universitaet, Freising, West Germany), K. DIETZ, F. JASKOLLA (Muenchen, Universitaet, Munich, West Germany), and B. PFEIFFER (Karlsruhe, Universitaet, Karlsruhe, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

Crop-cover, plant-water-content, plant-height, plant-density, and soil-water-content measurements made on the ground at the Makofen farm (400 ha) in the D9 test site, Bavaria, during July, 1981, are reported. Preliminary interpretations of multispectral aerial images of the site obtained with SAR-580 during the same period are presented. The site-selection criteria (flat, uniform terrain; varying field size; typical crops and rainfall), preparations, and sampling techniques are discussed, and the results are given in a table. Crop classifications based on direction-dependent statistical analysis of a simulated chromatic-infrared image produced by

combining bands 3, 6, and 9 (519, 640, and 818 nm) are illustrated, and identification statistics reveal both the potential value of the methods used and problems associated with the time of data collection.

T.K.

### **A83-46138**

#### **DIFFERENCES IN TWO LINEAR LIKE-POLARIZED SAR IMAGES AT SAME FREQUENCY**

A. J. SIEBER, W. NOACK, and H. SCHROETER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhöfen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

The interpretation of soil condition and crop cover from SAR images is investigated theoretically and experimentally. Backscattering models for soil and vegetative canopy are discussed in terms of the difference between VV and HH-polarized cross sections in different bands and at different incidence angles. X-band images at incidence angle 50 deg of the Straubing test site in Bavaria were obtained during the SAR-580 experiment in July, 1981, processed optically, and digitized for analysis. Ground-truth data (Fischbeck et al., 1982) and ground scatterometer measurements (Kleintz et al., 1982) of the site are compared. It is shown that the differences in the VV and HH images cannot be explained by current models except in the bare-soil areas. In the case of a potato field, it is found helpful to take different degrees of penetration by the VV and HH waves into account. Improved backscattering models which include the effects of scatterers of a size similar to the wavelength are considered necessary.

T.K.

### **A83-46160**

#### **THE UTILITY OF REMOTE SENSING IN AGRICULTURAL STATISTICS**

R. ALLEN (U.S. Department of Agriculture, Statistical Reporting Service, Washington, DC) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p. refs

Attention is given to those applications in which remote sensing was appropriate and in which a technique was available for converting the remote sensing data into useful and reliable information. It is believed that most of the breakthroughs in yield statistics will come from computerized yield models that may or may not involve remotely sensed data. Aerial photography can be used directly in situations in which knowledge of planted area in particular land covers is necessary and the total planted area is either not known by farmers or, if known, must for certain legal reasons be certified. Examples are presented of the use of remotely sensed interpretations for crop identification and statistical expansion. Attention is called to the usefulness of image products in the development of sampling frames. The advantages of area frame sampling are that all the units can be identified, the true probability samples can be selected, and the frame units do not move or leave the total population. Also considered is the expansion of ground truth through remote sensing.

C.R.

### **A83-46161**

#### **MULTISPECTRAL OBSERVATIONS OF AGRICULTURAL FIELDS IN THE KISKOERE TEST-AREA**

G. BUETTNER, E. CSATO, F. CSILLAG, and A. SZILAGYI (Institute of Geodesy and Cartography, Budapest, Hungary) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. Research supported by the Ministry of Agriculture, National Committee for Technical Development and Magyar Tudományos Akademia. refs

A multilevel remote sensing and image processing project was carried out on a typical Hungarian lowland territory using aerial and satellite multispectral images. With detailed ground truth agricultural land-use has been investigated with special respect to quality estimation of wheat, rapeseed and soils. Analog processing

of aerial photos and computer-aided interpretation of Landsat MSS images has led to the identification of categories with an accuracy of over 80 percent. Author

#### A83-46162

##### QUALITATIVE AND QUANTITATIVE EVALUATION OF AIRBORNE SCANNER IMAGERY FOR PEDOLOGICAL AND AGRICULTURAL PURPOSES IN NORTH GERMANY

J. JAKOB, W. KIRCHHOF (Kiel, Neue Universitaet, Kiel, West Germany), and J. LAMP (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wessling, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

#### A83-46163

##### REMOTE SENSING OF ARID AND SEMIARID RANGELAND

C. F. HUTCHINSON (Arizona, University, Tucson, AZ) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Aerial photography and Landsat data are used for inventorying and monitoring rangeland vegetation. Aerial photography is the most widely used tool for rangeland inventory. Digital Landsat data are effective in monitoring vegetation amount, but may be unreliable where vegetation cover is less than 30 percent. Recent uses of multispectral classification of Landsat data for rangeland inventory have been most effective when combined with ground sampling, large-scale aerial photography and digital elevation data. Author

A83-46166\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

##### MAPPING OF DECIDUOUS FOREST COVER USING SIMULATED LANDSAT-D TM DATA

B. N. ROCK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. Research supported by the Columbia Gas Corp., NSF, and NASA refs

An evaluation is presented of the supervised vegetation classification images of heavily forested terrain in the eastern US produced from simulated Landsat-D Thematic Mapper data as part of the Joint NASA/Geosat Test Case study of the Lost River, West Virginia, gas field. This investigation utilized data supplied by the NS-001 aircraft multispectral scanner (15 m IFOV) of NASA. The instruments recognized a total of 9 vegetation classes and one soil class. A hybrid parallelepiped-Bayesian maximum likelihood classifier was employed to produce the supervised vegetation classifications. The data were obtained at the height of the fall foliage display for this portion of West Virginia. Results show that both classifications are highly accurate, based on a comparison of assignment of vegetation classes on each of the images with actual ground conditions. It is noted that the anomalous distribution of certain woody species found in the resulting supervised classifications may be related to the microseepage of methane from the gas reservoir. N.B

#### A83-46181

##### ON THE DESIGN AND OPERATION OF A SLAR SYSTEM WITH DIGITAL RECORDING

P. HOOGEBOOM (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Fysisch Laboratorium TNO, The Hague, Netherlands) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest, Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

The design and implementation of an accurate side-looking airborne radar (SLAR) system with digital recording are discussed, and the correction of the digital data and images is treated. The system is based on an inexpensive ship radar unit and emphasizes

speckle reduction and system accuracy. The digital data are processed by computer using algorithms for geometric and radiometric corrections. Although the basic system is inexpensive, the total costs, including mounting in an aircraft and digital data recording and data processing, are considerable. An example of a fully corrected image taken over an agricultural area in the Netherlands is shown. C.D

#### A83-46182\* Kansas Univ. Center for Research, Inc., Lawrence. REVIEW OF APPROACHES TO THE INVESTIGATION OF THE SCATTERING PROPERTIES OF MATERIAL MEDIA

F. T. ULABY (University of Kansas Center for Research, Inc., Lawrence, KS) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. (Contract NAS9-15421)

An attempt is made to identify gaps in the current understanding of the backscattering properties of natural media, with attention both to fundamental questions which relate to the physics of scattering from such media, and applications-related considerations of the extraction of data of interest to the user from a given sensor image output. It is suggested that experiments be conducted, and models developed, for the areas of canopy constituents' dielectric and attenuation properties, volume geometry, and emission characteristics, as well as backscattering properties. O.C.

#### A83-46183\* Kansas Univ. Center for Research, Inc., Lawrence. THE EFFECTS OF VEGETATION COVER ON THE RADAR AND RADIOMETRIC SENSITIVITY TO SOIL MOISTURE

F. T. ULABY, M. C. DOBSON, D. R. BRUNFELDT, and M. RAZANI (University of Kansas Center for Research, Inc., Lawrence, KS) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p. refs (Contract NAG5-30)

The measured effects of vegetation canopies on radar and radiometric sensitivity to soil moisture are compared to emission and scattering models. The models are found to predict accurately the measured emission and backscattering for various crop canopies at frequencies between 1.4 and 5.0 GHz, especially at theta equal to or less than 30 deg. Vegetation loss factors,  $L(\theta)$ , increase with frequency and are found to be dependent upon canopy type and water content. In addition, the radiometric power absorption coefficient of a mature corn canopy is 1.75 times that calculated for the radar. Comparison of an L-band radiometer with a C-band radar shows the two systems to be complementary in terms of accurate soil moisture sensing over the extreme range of naturally occurring soil moisture conditions. Author

#### A83-46184\* George Washington Univ., Washington, D.C. SCATTERING FROM A RANDOM LAYER OF LEAVES IN THE PHYSICAL OPTICS LIMIT

R. H. LANG (George Washington University, Washington, DC), S. S. SEKER (NASA, Goddard Space Flight Center, Greenbelt, MD), and D. M. LE VINE IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs (Contract NAG5-83)

Backscatter of electromagnetic radiation from a layer of vegetation over flat lossy ground has been studied in collaborative research at the George Washington University and the Goddard Space Flight Center. In this work the vegetation is composed of leaves which are modeled by a random collection of lossy dielectric disks. Backscattering coefficients for the vegetation layer have been calculated in the case of disks whose diameter is large compared to wavelength. These backscattering coefficients are obtained in terms of the scattering amplitude of an individual disk by employing the distorted Born procedure. The scattering amplitude for a disk which is large compared to wavelength is

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then found by physical optic techniques. Computed results are interpreted in terms of dominant reflected and transmitted contributions from the disks and ground. Author

**A83-46185**

### **A MULTILAYER MODEL FOR RADAR BACKSCATTERING FROM VEGETATION CANOPIES**

D. H. HOEKMAN, L. KRUL, and E. P. W. ATTEMA (Delft, Technische Hogeschool, Delft, Netherlands) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p. refs

The effective use of active microwave remote sensing for agricultural crop monitoring calls for insight into microwave scattering physical mechanisms. Attention is presently given to a multilayer model in which directional scattering by stems and leaves, as well as the nonuniformity of the vegetation layer, are taken into account. The model, which is based on radar signature data acquired through X-band scatterometer measurements throughout the growing season, is used to predict the radar cross section for eight different crop types as a function of incidence angle with 90-97 percent correlation between observed and predicted responses. Soil moisture and biomass are found to be the dominant object variables, with soil roughness and the spatial distribution of stems and leaves being the most important parameters. O.C.

**A83-46186**

### **WIND INFLUENCE ON THE BACKSCATTERING COEFFICIENT FROM CROPS**

A. J. SIEBER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 3 p. refs

A phenomenological attempt is made to arrive at a modeling approach applicable to the analysis of backscattering cross section wind dependency, in such frequently encountered cases as the swaying of wheat field top surfaces, known as the 'snake pattern'. Since such a wheat field cannot be described by a single eigenfrequency, it is presently assumed that the eigenfrequencies may be randomly distributed about an artificial mean value. O.C.

**A83-46187**

### **COHERENT MEASUREMENTS OF RADAR BACKSCATTER FROM RARE AND VEGETATION COVERED SOIL IN THE 8-12.5 GHZ BAND**

M. KLEINTZ, G. GRAF, B. ROEDE, and A. SIEBER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

A coherent pulse radar has been used in radar backscatter measurements of both bare and vegetation-covered soil, with attention to the dependence of the radar cross section on frequency in the 8-12.5 GHz range, as well as on polarization and aspect angles and wind velocity. An analysis of the echo statistics is compared with earlier measurements and with theoretical results. The overall variation of the coherent radar cross section is found in all cases to be in agreement with an exponential distribution. While the radar cross section of bare soil showed a clear polarization dependence which increased with decreasing depression angle, the polarization dependence for the case of wheat fields was nearly negligible. O.C.

**A83-46188**

### **REMOTE SENSING OF VEGETATION WITH MICROWAVE RADIOMETERS**

F. BENINCASA, G. MARACCHI, S. PALOSCIA, P. PAMPALONI, and G. ZIPOLI (CNR; Institute of Environmental Analysis and Remote Sensing for Agriculture, Florence, Italy) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

An equipment for the experimental investigation of microwave radiometric signatures of soil and vegetation has been realized and used in June-July 1981 over corn. Data from two microwave radiometers at 9.8 GHz and 36.6 GHz (H and V polarization, observation angle between 10 and 70 degrees from nadir) placed on a 10 m tower have been continuously recorded for about two months together with a variety of air and soil physical parameters. Radiometric data have been correlated with several physical parameters of soil and vegetation and the results are presented in this paper. Author

**A83-46191\*** Kansas Univ. Center for Research, Inc., Lawrence.

### **A STATISTICAL MODEL FOR RADAR IMAGES OF AGRICULTURAL SCENES**

V. S. FROST, K. S. SHANMUGAN, J. C. HOLTZMAN, and J. A. STILES (University of Kansas Center for Research, Inc., Lawrence, KS) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs (Contract NAG9-3)

The presently derived and validated statistical model for radar images containing many different homogeneous fields predicts the probability density functions of radar images of entire agricultural scenes, thereby allowing histograms of large scenes composed of a variety of crops to be described. Seasat-A SAR images of agricultural scenes are accurately predicted by the model on the basis of three assumptions: each field has the same SNR, all target classes cover approximately the same area, and the true reflectivity characterizing each individual target class is a uniformly distributed random variable. The model is expected to be useful in the design of data processing algorithms and for scene analysis using radar images. O.C.

**A83-46211**

### **IMAGE ENHANCEMENT FOR DETERMINATION OF AGRICULTURAL FIELDS USING DIGITAL-SLAR DATA**

S. MOHAN (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India) and J. NITHACK (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p.

Image-enhancement techniques applied to digital SLAR data obtained at 1 km altitude over an agricultural area in India are evaluated. The techniques used were moving-average smoothing, linear-contrast stretching, and spatial-contrast stretching based on local statistics. The original and enhanced images are shown and discussed, and a table of contrast ratios for different features is presented. It is found that the moving-average technique is always helpful, that the linear stretching method is helpful only when used in combination with moving-average, and that spatial stretching can help sharpen a specific target but leads to a loss of information over larger areas. T.K.

A83-46217

**THE ASPECT ANGLE DEPENDENCE OF SAR IMAGES**

A. J. SIEBER, B. FREITAG, and K. LAWLER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Oberpfaffenhofen, West Germany) IN. 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2 New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Preliminary, qualitative results from an experimental investigation of aspect-angle effects on the quality of SAR images of agricultural areas are presented. Images in the X, C, and L bands at angles of 0, 30, 60, and 90 deg to the furrows of specially prepared bare and vegetated fields were obtained in 3 and 5.4-km-altitude flights over the Straubing, Bavaria, test site during the SAR-580 experiment in July, 1981. Optically processed data were digitized and corrected for antenna-pattern and gain-change effects. Grey-level-comparison and power-spectrum analysis methods are applied, and the results are summarized in tables. No significant row-direction effects on mean grey levels were detected, except for potato fields in the X band. L and X-band power spectra revealed periodicity in fields of sugar beets and potatoes or winter wheat and potatoes, respectively. It is suggested that the dielectric and geometric properties of the vegetative canopy are the primary factors influencing backscatter, especially in the X band. T K.

A83-46234

**COMPARISON OF MULTIFREQUENCY BAND RADARS FOR CROP CLASSIFICATION**

A. J. SIEBER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) and J. W. TREVETT (Hunting Technical Services, Ltd., Borehamwood, Herts., England) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 285-294. refs

Systematic X-, C-, and L-band airborne SAR experiments were undertaken during the SAR 580 experiment in 1981. Attention is given to results from the analysis of images taken over two German test sites. These data show that differences of crop backscattering behavior are primarily related to the dielectric geometry of the plants. A distinct potential is seen in the use of multifrequency and multipolarization radars for crop discrimination, as well as in the combination of different radar images into color composites in order to increase the interpretive or discriminative value of radar.

O.C.

A83-46239

**CLASSIFICATION OF AGRICULTURAL CROPS IN RADAR IMAGES**

P. HOOGEBOOM (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Fysisch Laboratorium TNO, The Hague, Netherlands) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 329-336. refs

The images of an X-band Side-Looking Airborne Radar (SLAR) system employing digital recording are corrected to indicate radar backscatter coefficients rather than arbitrary grey tones. Ground-based measurements undertaken in 1980 together with flights whose timings had been derived from a simulation study are presently analyzed. It is found that the one-dimensional case consisting of one SLAR flight over the test area at a previously derived optimum flight time yields only a 35-percent correct classification in seven cases. Multidimensional cases with SLAR flights at different dates improve classification results to over 85 percent.

O.C.

A83-46240\*

National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**REMOTE SENSING OF SOIL MOISTURE - RECENT ADVANCES**

T. J. SCHMUGGE (NASA, Goddard Space Flight Center, Hydrological Sciences Branch, Greenbelt, MD) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 336-344. refs

Recent advancements in microwave remote sensing of soil moisture include a method for estimating the dependence of the soil dielectric constant on its texture, the use of a percent of field capacity to express soil moisture magnitudes independently of soil texture, methods of estimating soil moisture sampling depth, and models for describing the effect of surface roughness on microwave response in terms of surface height variance and horizontal correlation length, as well as the verification of radiative transfer model predictions of microwave emission from soils and methods for the estimation of vegetation effects on the microwave response to soil moisture. Such researches have demonstrated that it is possible to remotely sense soil moisture in the 0-5 cm soil surface layer, and simulation studies have indicated how remotely sensed surface soil moisture may be used to estimate evapotranspiration rates and root-zone soil moisture.

O.C.

A83-46244

**THE DIELECTRIC PROPERTIES OF WET MATERIALS**

G. P. DE LOOR (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Fysisch Laboratorium TNO, The Hague, Netherlands) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 364-369. refs

Although it is impossible to give one relation for the dielectric constant (DC) of a heterogeneous mixture, especially one containing water, boundaries can be given which come closer together as more is learned about a particular mixture. This boundary approach is useful in microwave remote sensing, in virtue of the spread in the dielectric properties of the materials involved due to their natural variability. While the behavior of heterogeneous systems containing water is complex at frequencies below microwaves, only free water is important in the microwave region because bound water has properties comparable to those of the other phase. When knowing the DC of the materials involved, the theoretical reflection, emission, and penetration depth can be determined. In all practical cases, the penetration depth for soil is smaller than the wavelength used for the observation.

O.C.

A83-46247\* National Aeronautics and Space Administration. Earth Resources Labs., Bay St. Louis, Miss.

**REMOTE SENSING OF WETLANDS**

M. K. BUTERA (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 383-392. refs

Results are given for three separate investigations of remote sensing over wetlands, including the delineations of roseau cane and mangrove from both Landsat and aircraft MSS data, and the delineation of wetland communities for potential waste assimilation in a coastal river floodplain from Landsat MSS data only. Attention is also given to data processing and analysis techniques of varying levels of sophistication, which must increase with surface cover diversity. All computer processing in these studies was performed on a minicomputer configured with the adequate memory, image display capability, and associated peripherals, using state-of-the-art digital MSS data analysis software.

O.C.



**A83-46248\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

## **RADAR BACKSCATTERING PROPERTIES OF CORN AND SOYBEANS AT FREQUENCIES OF 1.6, 4.75, AND 13.3. GHZ**

J. F. PARIS (California Institute of Technology, Jet Propulsion Laboratory, Geology Group, Pasadena, CA) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 392-400. refs

The NASA Johnson Space Center made an observational study of the radar-backscattering properties of corn and soybeans in commercial fields in a test site in Webster County, IA. Aircraft-based radar scatterometers measured the backscattering coefficient of the crops at three frequencies, 1.6 GHz (L-band), 4.75 GHz (C-band), and 13.3 GHz (Ku-band), at 10 sensor look-angles (5 to 50 degrees from the nadir in steps of 5 degrees), and with several polarization combinations. Among other findings, it was determined that: (1) row direction differences among fields affected significantly the radar-backscattering coefficient of the fields when the radar system used like-polarization at look-angles from 5 to 25 degrees; (2) row-direction differences had no effect on radar backscattering when the system used either cross-polarization or look-angles greater than 25 degrees regardless of the polarization; (3) wet surface-soil moisture conditions resulted in significantly poorer spectral separability of the two crops as compared to dry-soil conditions; and (4) on the dry-soil date, the best channel for separating corn from soybeans was the C-band cross-polarized measurement at a look-angle of 50 degrees. Author

**A83-46765\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## **DETECTING FOREST CANOPY CHANGE DUE TO INSECT ACTIVITY USING LANDSAT MSS**

R. F. NELSON (NASA, Goddard Space Flight Center, Greenbelt, MD) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Sept. 1983, p. 1303-1314. refs

Multitemporal Landsat multispectral scanner data were analyzed to test various computer-aided analysis techniques for detecting significant forest canopy alteration. Three data transformations - differencing, ratioing, and a vegetative index difference - were tested to determine which best delineated gypsy moth defoliation. Response surface analyses were conducted to determine optimal threshold levels for the individual transformed bands and band combinations. Results indicate that, of the three transformations investigated, a vegetative index difference (VID) transformation most accurately delineates forest canopy change. Band 5 (0.6 to 0.7 micron ratioed data) did nearly as well. However, other single bands and band combinations did not improve upon the band 5 ratio and VID results. Author

**A83-47218\*** National Aeronautics and Space Administration. Lyndon B. Johnson Space Center, Houston, Tex.

## **LARGE-AREA RELATION OF LANDSAT MSS AND NOAA-6 AVHRR SPECTRAL DATA TO WHEAT YIELDS**

T. L. BARNETT and D. R. THOMPSON (NASA, Johnson Space Center, Houston, TX) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 277-290. refs

Landsat MSS data transformed into Kauth-Thomas greenness were averaged over 5 n.mi x 6 n.mi. sample segments from the U.S. Great Plains winter and spring wheat (*Triticum aestivum*) regions, and related by regression analysis to yields reported by county, crop reporting district (CRD) and state levels. Evidence of a linear relation between winter- and spring-wheat yields and Landsat spectral data at a broad scale is shown for 1978 and 1979. A common slope of about 1.6 (Bu/A)/unit greenness is discerned for the relation between yield and spectral greenness. Tests at both a smaller scale on sets of field-level spectral data and yield and at a large scale on 25 mi. x 25 mi. gridded spectral data from the NOAA-6 AVHRR sensor support the relation. The implications of these results to yield estimation from satellite spectral data are discussed. Author

**A83-47220**

## **REMOTE SENSING ESTIMATORS OF POTENTIAL AND ACTUAL CROP YIELD**

J. L. HATFIELD (California, University, Davis, CA) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 301-311. Sponsorship: U.S. Department of Agriculture. refs (Contract USDA-12-14-5001-37BF)

The usefulness of spectral reflectance measurements for defining critical development stages in wheat and grain sorghum, and the canopy-air temperature summation for assaying the stress level and therefore the ultimate yield, are assessed. The sorghum was grown in irrigated, no irrigation, irrigation during the vegetative stage, and irrigation during the reproductive stage. Daily canopy temperature measurements were performed above and beneath the canopy. The wheat received no irrigation. Radiometry was carried out in bands simulating the capabilities of the MSS and TM on board Landsat, and growth records were kept of all plants. A stress-degree-day formulation was developed as an index that corresponded with the yield. Accumulation of stress-degree-days indicated a reduction in yield which, it is suggested, may be quantified if the potential crop yield is known. M.S.K.

**A83-47221\*** Florida Univ., Gainesville.

## **COMPARISON OF WINTER-NOCTURNAL GEOSTATIONARY SATELLITE INFRARED-SURFACE TEMPERATURE WITH SHELTER-HEIGHT TEMPERATURE IN FLORIDA**

E. CHEN, L. H. ALLEN, JR., J. F. BARTHOLIC, and J. F. GERBER (Florida, University, Gainesville, FL) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 313-327. Research supported by the U.S. Department of Agriculture. refs (Contract NAS10-9168)

Geostationary satellite surface temperatures derived from a Visible and Infrared Spin Scan Radiometer (VISSR) sensor (10.5 to 12.6 microns) were compared with 1.5-m air temperatures collected by a thermocouple on a traversing vehicle along rural highway transects in Florida, and with two fixed thermographs located in rural and agricultural areas. Statistical comparisons between satellite and 1.5-m observations yielded a mean correlation coefficient of 0.87 and an average sample standard deviation from regression of 1.57 C during clear nights for four winters (1978-1981). The satellite-temperature image of Lake Okeechobee was compared with its geographic outline for areal image registration. Manual overlays of temporal images were repeatable to within one pixel. Satellite-sensed water temperature of Lake Okeechobee was used as an indicator of satellite radiometer repeatability and stability. Author

**A83-47222\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## **PASSIVE MICROWAVE SENSING OF SOIL MOISTURE CONTENT - THE EFFECTS OF SOIL BULK DENSITY AND SURFACE ROUGHNESS**

J. R. WANG (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 329-344. refs

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

A83-48111

**A TECHNIQUE FOR PHENOLOGICAL OBSERVATIONS IN MEASUREMENTS OF THE SPECTRAL BRIGHTNESS COEFFICIENTS OF THE VEGETATION [METODIKA FENOLOGICHESKIKH NABLIUDENII PRI IZMERENII KOEFFITSIENTOV SPEKTRAL'NOI IARKOSTI RASTITEL'NOSTI]**

N. G. KHARIN, A. A. KIRILTSEVA, and A. G. ROZHKEEV (Akademiia Nauk Turkmenskoi SSR, Institut Pustyn', Ashkhabad, Turkmen SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 78-82. In Russian. refs

It is recommended that quantitative characteristics be assigned to measurements of the spectral brightness coefficients. As a prerequisite, however, phenological observations must be made through an integral method. The phenological distribution curve obtained from these observations can be used to provide a phenological tie-in during measurements of the brightness coefficients. The experience gained with this method in the Turkmen SSR is discussed. C.R.

A83-48113

**THE HOT SPOT EFFECT OF A HOMOGENEOUS VEGETATIVE COVER [EFFEKT OBRATNOGO BLESKA OGNORODNOGO RASTITEL'NOGO POKROVA]**

A. KUUSK (Akademiia Nauk Estonskoi SSR, Institut Astrofiziki i Fiziki Atmosfery, Tartu, Estonian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 90-99. In Russian. refs

Attention is given to the problem of modeling a vegetative cover with a plane-parallel turbid layer comprising small, nontransparent, diffusely reflecting laminae. A calculation is made of the probability of observing illuminated elements of the vegetation and earth's surface during direct solar irradiation in the region of a hot spot. C.R.

A83-48114

**THE USE OF THE MONTE CARLO METHOD IN INVESTIGATING THE INFLUENCE OF THE DIMENSIONS OF A CONIFER ON THE ANGULAR DEPENDENCE OF ITS COEFFICIENT OF SPECTRAL BRIGHTNESS [PRIMENENIE METODA MONTE-KARLO DLIA ISSLEDOVANIIA VLIIANIIA ARKHITEKTURY KHVOINOGO DEREVA NA UGLOVUII ZAVISIMOST' EGO KOEFFITSIENTA SPEKTRAL'NOI IARKOSTI]**

V. A. KANEVSKII (Akademiia Nauk Ukrainskoi SSR, Institut Botaniki, Kiev, Ukrainian SSR) and I. U. K. ROSS (Akademiia Nauk Estonskoi SSR, Institut Astrofiziki i Fiziki Atmosfery, Tartu, Estonian SSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 100-102. In Russian.

The way in which changes in the size of the crown and needle-shaped leaves of a spruce affect the angular dependence of the coefficient of spectral brightness is investigated. On the basis of the results obtained by Kanevskii and Ross (1982), the crown is considered to have a macrostructure (its shape) and a microstructure, which has to do with the dimensions of the needle-shaped leaves. Changes in the macrostructure and microstructure are shown to have a pronounced effect in the near-infrared. This suggests the possibility of using the indicatrix of scattering, obtained with aerospace vehicles, for studying the structure of the vegetative cover. C.R.

A83-48514

**SOME RESULTS OF THE SALYUT-6 PHENOLOGICAL EXPERIMENT [NEKOTORYE REZUL'TATY FENOLOGICHESKOGO EKSPERIMENTA NA POS 'SALIUT-6']**

B. V. VINOGRADOV and V. V. KOVALENOK (Akademiia Nauk SSSR, Institut Evoliutsionnoi Morfologii i Ekologii Zhivotnykh, Moscow, USSR; Akademiia Nauk SSSR, Institut Okeanologii, Leningrad, USSR; Tsentr Podgotovki Kosmonavtov, USSR) Akademiia Nauk SSSR, Doklady (ISSN 0002-3264), vol. 271, no. 2, 1983, p. 499-502. In Russian. refs

Salyut-6 observations performed in April 1981 were used for the large-scale phenological mapping of sandy pastures in

southeastern Kyzylkumakh, USSR. Results show that the repeated complex photographing of an ecosystem makes it possible to estimate the deviation of the forage reserve of the current year from a reference value and to delineate the fine structure of the phenological process. B.J.

A83-48935

**INVESTIGATION OF SIGNS OF EROSION OF AGRICULTURAL LANDS ON THE BASIS OF AERIAL AND SPACE REMOTE SENSING DATA (USING THE SOUTHWESTERN SPURS OF THE GISSAR RIDGE AS AN EXAMPLE) [IZUCHENIE PROIAVLENII EROZII SEL'SKOKHOZIAISTVENNYKH ZEMEL' PO MATERIALAM AEROKOSMICHESKIKH S'EMOK /NA PRIMERE IUGO-ZAPADNYKH OTROGOV GISSARSKOGO KHREBTA/]**

SH. M. MUKHITDINOV Geodeziia i Aerofotos'emka (ISSN 0536-101X), no. 2, 1983, p. 77-81. In Russian.

**A83-49008\* National Aeronautics and Space Administration. Wallops Flight Center, Wallops Island, Va. FEASIBILITY OF AIRBORNE DETECTION OF LASER-INDUCED FLUORESCENCE EMISSIONS FROM GREEN TERRESTRIAL PLANTS**

F. E. HOGE (NASA, Wallops Flight Facility, Wallops Island, VA), R. N. SWIFT, and J. K. YUNGEL (EG&G Washington Analytical Services Center, Inc., Pocomoke City, MD) Applied Optics (ISSN 0003-6935), vol. 22, Oct 1, 1983, p. 2991-3000. refs

The present investigation provides a demonstration of the feasibility of the airborne detection of the laser-induced fluorescence spectral emissions from living terrestrial grasses, shrubs, and trees using existing levels of lidar technology. Airborne studies were performed to ascertain system requirements necessary to detect laser-induced fluorescence from living terrestrial plants, to assess the practical acquisition of useful single-shot laser-induced fluorescence (LIF) waveforms over vegetative canopies, and to determine the comparative suitability of laser system, airborne platform, and terrestrial environmental parameters. The field experiment was conducted on May 3, 1982, over the northern portion of Wallops Island, VA. Attention is given to airborne lidar results and the description of laboratory investigations. G.R.

A83-49280

**CERTAIN RESULTS OF A COMPARISON OF AIRBORNE DATA WITH SATELLITE MEASUREMENTS [NEKOTORYE REZUL'TATY SRAVNIENIIA DANNYKH SAMOLETNYKH I SPUTNIKOVYKH IZMERENII]**

K. I. A. KONDRATEV, V. V. KOZODEROV, and V. I. KORZOV IN: Radiation studies in the atmosphere. Leningrad, Gidrometeoizdat, 1982, p. 29-37. In Russian. refs

Results of a subsatellite remote-sensing experiment designed to investigate the reflection characteristics of desert and agricultural areas are examined. Airborne data obtained with a spectral albedometer are compared with radiation-corrected multispectral imagery acquired with a Meteor satellite. The measurement results are shown to agree well for the desert area, while the divergence is significant for the agricultural objects. B.J.

A83-49283

**AN EFFORT TO DETERMINE THE WEED CONTENT OF AGRICULTURAL FIELDS IN SPRINGTIME [OPYT OPREDELENIIA ZASORENNOSTI SEL'SKOKHOZIAISTVENNYKH POLEI V VESENNII PERIOD]**

K. I. A. KONDRATEV and P. P. FEDCHENKO IN: Radiation studies in the atmosphere. Leningrad, Gidrometeoizdat, 1982, p. 64-68. In Russian. refs

A remote-sensing method for the mapping of weed content is proposed which is based on the spectral reflectance of soil-weed systems measured in the form of spectral brightness coefficients. The method was used to compile a weed-content map for a Soviet collective farm. B.J.

## 01 AGRICULTURE AND FORESTRY

**N83-31067\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.  
**MONITORING THE DEFOLIATION OF HARDWOOD FORESTS IN PENNSYLVANIA USING LANDSAT Final Report**  
C. L. DOTTAVIO, R. F. NELSON, and D. L. WILLIAMS, Principal Investigators Mar. 1983 104 p refs Original contains color imagery. Original photography may be purchased at the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E83-10367; NASA-TM-85362; NAS 1.15:85362) Avail: NTIS HC A06/MF A01 CSCL 02F

An automated system for conducting annual gypsy moth defoliation surveys using LANDSAT MSS data and digital processing techniques is described. A two-step preprocessing procedure was developed that uses multitemporal data sets representing forest canopy conditions before and after defoliation to create a digital image in which all nonforest cover types are eliminated or masked out of a LANDSAT image that exhibits insect defoliation. A temporal window for defoliation assessment was identified and a statewide data base was established. A data management system to interface image analysis software with the statewide data base was developed and a cost benefit analysis of this operational system was conducted. A.R.H.

**N83-32129\*#** Agricultural Research Service, Mandan, N. Dak. Northern Great Plains Research Center.  
**THE WATER FACTOR IN HARVEST-SPROUTING OF HARD RED SPRING WHEAT**

A. BAUER and A. L. BLACK, Principal Investigators Feb. 1983 36 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract PROJ. AGRISTARS) (E83-10376; NASA-CR-172920; EW-U3-04406; NAS 1.26:172920) Avail: NTIS HC A03/MF A01 CSCL 02C

Sprouting in unthreshed, ripe, hard red spring wheat (*Triticum aestivum* L.) is induced by rain, but sprouting does not necessarily occur because the crop is wetted. The spike and grain water conditions conducive to sprouting were determined in a series of laboratory experiments. Sprouting did not occur in field growing wheat wetted to 110% water concentration until the spike water concentration was reduced to 12% and maintained at this concentration for 2 days before wetting. When cut at growth stage 11.3, Feekes scale, Saratovskaya 20 (USSR) sprouted after 4 days drying, Olaf and Alex between 7 and 15 days drying and Columbus, recognized for its resistance to harvest time sprouting, after more than 15 days drying. Sprouting potential was enhanced after 4 wetting drying cycles in which any wetted interval was too brief to permit sufficient water imbibition to initiate sprouting. At harvest ripeness, grain water concentration exceeded spike water concentration by 0.7 percentage units. Following 6 months storage, 20% of the kernels in 300 spike bundles (simulating windrows) sprouted within 28 hrs after initiation of wetting to saturation (150% water concentration). Ninety percent sprouting occurred within 8 days in bundles maintained at 75% water concentration and higher, but less sprouting occurred in bundles dried to 50% water concentration before resaturation Author

**N83-32130\*#** Agricultural Research Service, Mandan, N. Dak. Northern Great Plains Research Center.

### **RAIN-INDUCED SPRING WHEAT HARVEST LOSSES**

A. BAUER and A. L. BLACK, Principal Investigators Feb. 1983 34 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract PROJ. AGRISTARS) (E83-10377; NASA-CR-172921; EW-U3-04405; NAS 1.26:172921) Avail: NTIS HC A03/MF A01 CSCL 02C

When rain or a combination of rain and high humidity delay wheat harvest, losses can occur in grain yield and/or grain quality. Yield losses can result from shattering, from reduction in test weight, and in the case of windrowed grain, from rooting of sprouting grain at the soil: windrow contact. Losses in grain quality can result from reduction in test weight and from sprouting.

Sprouting causes a degradation of grain proteins and starches, hence flour quality is reduced, and the grain price deteriorates to the value of feed grain. Although losses in grain yield and quality are rain-induced, these losses do not necessarily occur because a standing or windrowed crop is wetted by rain. Spike water concentration in hard red spring wheat must be increased to about 45-49% before sprouting is initiated in grain that has overcome dormancy. The time required to overcome this dormancy after the cultivar has dried to 12 to 14% water concentration differs with hard red spring cultivars. The effect of rain on threshing-ready standing and windrowed hard red spring wheat grain yield and quality was evaluated. A goal was to develop the capability to forecast the extent of expected loss of grain yield and quality from specific climatic events that delay threshing Author

**N83-32131\*#** Agricultural Research Service, Weslaco, Tex.  
**THE EQUIVALENCE OF THREE TECHNIQUES FOR ESTIMATING GROUND REFLECTANCE FROM LANDSAT DIGITAL COUNT DATA**

A. J. RICHARDSON, Principal Investigator Apr. 1983 11 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract PROJ. AGRISTARS) (E83-10378; NASA-CR-172922; EW-U3-04407; NAS 1.26:172922) Avail: NTIS HC A02/MF A01 CSCL 02C

The equivalence of three separate investigations that related LANDSAT digital count (DC) to ground measured reflectance (R) was demonstrated. One investigator related DC data to the  $\cos Z$ , where Z is the solar zenith angle, for surfaces of constant R. The second investigator corrected the DC data to the solar zenith angle of 39 degrees before relating to surface R. Both of these investigators used LANDSAT 1 and 2 data from overpass dates 1972 through 1977. A third investigator calculated the relation between DC and R based on atmospheric radiative transfer theory. The equation coefficients obtained from these three investigators for all four LANDSAT MSS bands were shown to be equivalent although differences in ground reflectance measurement procedures have created coefficient variations among the three investigations. These relations should be useful for testing atmospheric radiative transfer theory. Author

**N83-32132\*#** Missouri Univ., Columbia. Dept. of Atmospheric Science.

### **COMPARISON OF CRD, APU, AND STATE MODELS FOR IOWA CORN AND SOYBEANS AND NORTH DAKOTA BARLEY AND SPRING WHEAT**

V. FRENCH May 1983 22 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract PROJ. AGRISTARS) (E83-10379; NASA-CR-172923; YM-13-04419; NAS 1.26:172923) Avail: NTIS HC A02/MF A01 CSCL 02C

A comparison was made among the CEAS crop reporting district (CRD), agrophysical unit (APU), and state level multiple regression yield models for corn and soybeans in Iowa and barley and spring wheat in North Dakota. The best predictions were made by the state model for North Dakota spring wheat, by the APU models for barley, by the CRD models for Iowa soybeans, and by APU covariance models for Iowa corn. Because of this lack of consistency of model performance, CRD models would be recommended due to the availability of the data. Author

**N83-32133\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**LANDSAT DATA PREPROCESSING**

W. W. AUSTIN Apr. 1983 72 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract NAS9-15800; PROJ. AGRISTARS) (E83-10380; NASA-CR-171672; EW-L3-04413; JSC-18877; NAS 1 26:171672; LEMSCO-18246) Avail. NTIS HC A04/MF A01 CSCL 02C

The effect on LANDSAT data of a Sun angle correction, an intersatellite LANDSAT-2 and LANDSAT-3 data range adjustment, and the atmospheric correction algorithm was evaluated. Fourteen 1978 crop year LACIE sites were used as the site data set. The preprocessing techniques were applied to multispectral scanner channel data and transformed data were plotted and used to analyze the effectiveness of the preprocessing techniques. Ratio transformations effectively reduce the need for preprocessing techniques to be applied directly to the data. Subtractive transformations are more sensitive to Sun angle and atmospheric corrections than ratios. Preprocessing techniques, other than those applied at the Goddard Space Flight Center, should only be applied as an option of the user. While performed on LANDSAT data the study results are also applicable to meteorological satellite data.

Author

**N83-32134\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex

**SIMULATION OF METEOROLOGICAL SATELLITE (METSAT) DATA USING LANDSAT DATA**

W. W. AUSTIN and W. E. RYLAND May 1983 175 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract NAS9-15800; PROJ. AGRISTARS) (E83-10381; NASA-CR-171669; EW-L3-04414; JSC-18878; NAS 1 26:171669; LEMSCO-16928) Avail. NTIS HC A08/MF A01 CSCL 02C

The information content which can be expected from the advanced very high resolution radiometer system, AVHRR, on the NOAA-6 satellite was assessed, and systematic techniques of data interpretation for use with meteorological satellite data were defined. In-house data from LANDSAT 2 and 3 were used to simulate the spatial, spectral, and sampling methods of the NOAA-6 satellite data

A R.H.

**N83-32137\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**PRELIMINARY STATISTICAL STUDIES CONCERNING THE CAMPOS RJ SUGAR CANE AREA, USING LANDSAT IMAGERY AND AERIAL PHOTOGRAPHS [ESTUDOS ESTATISTICOS PRELIMINARES SOBRE A REGIAO CANAVIEIRA DE CAMPOS - RJ, UTILIZANDO IMAGENS LANDSAT E FOTOGRAFIA AEREAS]**

N. D. J. PARADA, Principal Investigator, S. R. X. COSTA, L. B. F. PAIAO, F. J. MENDONCA, Y. E. SHIMABUKURO, and V. DUARTE Apr 1983 16 p refs In PORTUGUESE Sponsored by NASA ERTS (E83-10384; NASA-CR-172926; NAS 1.26:172926, INPE-2723-NTE/200) Avail. NTIS HC A02/MF A01 CSCL 02C

The two phase sampling technique was applied to estimate the area cultivated with sugar cane in an approximately 984 sq km pilot region of Campos. Correlation between existing aerial photography and LANDSAT data was used. The two phase sampling technique corresponded to 99.6% of the results obtained by aerial photography, taken as ground truth. This estimate has a standard deviation of 225 ha, which constitutes a coefficient of variation of 0.6%.

N.W.

**N83-32163#** Florida Univ., Gainesville. Dept. of Agronomy. **EVAPOTRANSPIRATION ESTIMATES BASED ON SURFACE TEMPERATURE AND NET RADIATION: DEVELOPMENT OF REMOTE SENSING METHODS**

K. F. HEIMBURG, L. H. ALLEN, JR., and W. C. HUBER 20 Dec. 1982 224 p refs (Contract DI-14-34-0001-0110) (PB83-175307; WRRP-PUB-66; W83-02185; OWRT-A-040-FLA(1)) Avail. NTIS HC A10/MF A01 CSCL 08H

A generalized method for making evapotranspiration estimates using satellite data is presented. It is designed for good cumulative ET estimates based on surface temperature, air temperature, and net radiation data of limited time resolution. The surface is described by an equation relating surface to air temperature gradients, net radiation, moisture availability, bulk air thermal conductivity, saturation deficit, and a soil heat flux parameter. Given estimates of two of these factors, the other two can be determined from the correlation of temperature gradients and net radiation. GRA

**N83-32172#** Idaho Univ., Moscow. Water and Energy Resources Research Inst.

**USE OF REMOTE SENSING TECHNIQUES AND THE UNIVERSAL SOIL LOSS EQUATION TO DETERMINE SOIL EROSION**

K. M. SCHUCHARD and L. C. TENNYSON Dec 1982 33 p refs

(Contract DI-14-34-0001-2114) (PB83-182006; W83-02326; OWRT-A-080-IDA(1)) Avail. NTIS HC A03/MF A01 CSCL 08M

Satellite data with ancillary watershed information was used to determine soil erosion of agriculture, forest and range lands in the southern portion of the Hangman Creek watershed, Benewah County, Idaho. Vegetation cover types derived from satellite data and the VICAR/IBIS image processing computer software package were determined with 89% accuracy. The vegetation cover types identified on the study area were dense-mixed forest, medium density mixed forest, ponderosa pine forest, wheat, lentils, barley, bluegrass, pasture and brush. Soil erosion (tons/acre/year) was estimated with the Universal Soil Loss Equation. Author (GRA)

**N83-33282** Royal Aircraft Establishment, Farnborough (England) Space and New Concepts Dept.

**SPINE: A PAPER PRESENTED TO THE INTERNATIONAL SOCIETY OF PHOTOGRAMMETRY AND REMOTE SENSING ON THE APPLICATION AGRISPINE**

K. GREEN Jan 1983 13 p refs Conf. held at Ottawa, Aug 1982 Sponsored by ESA SPINE coordination ESTEC, ESA Earthnet Program Office ESRIN, Swedish Space Corp., Dundee Univ., United Kingdom, and Interim EUTELSAT (RAE-TM-SPACE-316; BR87189) Avail. Issuing Activity

The SPINE project, which investigates the suitability of satellite links for transferring bulk digital data at megabit rates between small customer-located Earth stations, and AGRISPINE (long term monitoring of crop and forest growth in the UK) are introduced. Test sites in Scotland, England, Greenland (iceberg formation) and the Gulf of Finland (ice formation) are discussed. Data transmission, post processing, and aerial photography and ground truth are mentioned.

Author (ESA)

**N83-33283\*#** Arkansas Univ., Fayetteville. Dept. of Electrical Engineering.

**DATA DOCUMENTATION FOR THE BARE SOIL EXPERIMENT AT THE UNIVERSITY OF ARKANSAS Technical Report, 9 Jul. - 19 Oct. 1979**

W. P. WAITE, H. D. SCOTT, Principal Investigators, and G. D. HANCOCK Jan. 1980 209 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of Interior, and Agency for International Development ERTS (Contract NAS9-14251; PROJ. AGRISTARS) (E83-10392, NASA-CR-171626; SM-AO-04008; NAS 1.26:171626) Avail. NTIS HC A10/MF A01 CSCL 02C

The reflectivities of several controlled moisture test plots were investigated. These test plots were of a similar soil texture which



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was clay loam and were prepared to give a desired initial soil moisture and density profile. Measurements were conducted on the plots as the soil water redistributed for both long term and diurnal cycles. These measurements included reflectivity, gravimetric and volumetric soil moisture, soil moisture potential, and soil temperature. Author

**N83-34395\*#** Southern Methodist Univ., Dallas, Tex. Center for Applied Mathematical and Statistical Research  
**A COMPARISON OF MINIMUM DISTANCE AND MAXIMUM LIKELIHOOD TECHNIQUES FOR PROPORTION ESTIMATION**  
 W. A. WOODWARD, W. R. SCHUCANY, H. LINDSEY, and H. L. GRAY Nov. 1982 29 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development  
 (Contract NAS9-16438; PROJ AGRISTARS)  
 (E83-10402; NASA-CR-171678; SR-62-04376; NAS 1.26:171678)  
 Avail NTIS HC A03/MF A01 CSCL 05B

The estimation of mixing proportions  $P$  sub 1,  $P$  sub 2, ...,  $P$  sub  $m$  in the mixture density  $f(x)$  = the sum of the series  $P$  sub  $i$   $f_i(x)$  with  $i = 1$  to  $M$  is often encountered in agricultural remote sensing problems in which case the  $p$  sub  $i$ 's usually represent crop proportions. In these remote sensing applications, component densities  $f$  sub  $i(x)$  have typically been assumed to be normally distributed, and parameter estimation has been accomplished using maximum likelihood (ML) techniques. Minimum (MD) estimation is examined as an alternative to ML where, in this investigation, both procedures are based upon normal components. Results indicate that ML techniques are superior to MD when component distributions actually are normal, while MD estimation provides better estimates than ML under symmetric departures from normality. When component distributions are not symmetric, however, it is seen that neither of these normal based techniques provides satisfactory results. M.G.

**N83-34396\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex  
**SEPARABILITY OF AGRICULTURAL CROPS WITH AIRBORNE SCATTEROMETRY**  
 N. C. MEHTA Jun 1983 61 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS  
 (Contract NAS9-15800; PROJ AGRISTARS)  
 (E83-10403; NASA-CR-171673, SR-L3-04428; NSC-18885, NAS 1.26:171673; LEMSCO-19422) Avail NTIS HC A04/MF A01 CSCL 02C

Backscattering measurements were acquired with airborne scatterometers over a site in Cass County, North Dakota on four days in the 1981 crop growing season. Data were acquired at three frequencies (L-, C- and Ku-bands), two polarizations (like and cross) and ten incidence angles (5 degrees to 50 degrees in 5 degree steps). Crop separability is studied in an hierarchical fashion. A two-class separability measure is defined, which compares within-class to between-class variability, to determine crop separability. The scatterometer channels with the best potential for crop separability are determined, based on this separability measure. Higher frequencies are more useful for discriminating small grains, while lower frequencies tend to separate non-small grains better. Some crops are more separable when row direction is taken into account. The effect of pixel purity is to increase the separability between all crops while not changing the order of useful scatterometer channels. Crude estimates of separability errors are calculated based on these analyses. These results are useful in selecting the parameters of active microwave systems in agricultural remote sensing. M.G.

**N83-34397\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

### **THE 1980 US/CANADA WHEAT AND BARLEY EXPLORATORY EXPERIMENT, VOLUME 1 Final Report**

R. M. BIZZELL, H. L. PRIOR, R. W. PAYNE, and J. M. DISLER Apr. 1983 94 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with NASA. Johnson Space Center ERTS 2 Vol  
 (Contract NAS8-15800; PROJ AGRISTARS)  
 (E83-10404, NASA-CR-171674; IT-L3-04398, JSC-18602, NAS 1.26:171674; LEMSCO-18629) Avail: NTIS HC A05/MF A01 CSCL 02C

The results from the U.S./Canada Wheat and Barley Exploratory Experiment which was completed during FY 1980 are presented. The results indicate that the new crop identification procedures performed well for spring small grains and that they are conducive to automation. The performance of the machine processing techniques shows a significant improvement over previously evaluated technology. However, the crop calendars will require additional development and refinements prior to integration into automated area estimation technology. The evaluation showed the integrated technology to be capable of producing accurate and consistent spring small grains proportion estimates. However, barley proportion estimation technology was not satisfactorily evaluated. The low-density segments examined were judged not to give indicative or unequivocal results. It is concluded that, generally, the spring small grains technology is ready for evaluation in a pilot experiment focusing on sensitivity analyses to a variety of agricultural and meteorological conditions representative of the global environment. It is further concluded that a strong potential exists for establishing a highly efficient technology for spring small grains. M.G.

**N83-34398\*#** Environmental Research Inst of Michigan, Ann Arbor Infrared and Optics Div  
**DEVELOPMENT, IMPLEMENTATION AND EVALUATION OF SATELLITE-AIDED AGRICULTURAL MONITORING SYSTEMS Final Report, 1 Nov. 1981 - 31 Oct. 1982**

R. CICONI, Principal Investigator, E. CRIST, M. METZLER, and T. PARRIS Nov 1982 111 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS  
 (Contract NAS9-16538; PROJ AGRISTARS)  
 (E83-10405; NASA-CR-171679; IT-E2-04377; NAS 1.26:171679, ERIM-160300-35-F) Avail: NTIS HC A06/MF A01 CSCL 14B

Research supporting the use of remote sensing for inventory and assessment of agricultural commodities is summarized. Three task areas are described: (1) corn and soybean crop spectral/temporal signature characterization; (2) efficient area estimation technology development; and (3) advanced satellite and sensor system definition. Studies include an assessment of alternative green measures from MSS variables; the evaluation of alternative methods for identifying, labeling or classification targets in an automobile procedural context; a comparison of MSS, the advanced very high resolution radiometer and the coastal zone color scanner, as well as a critical assessment of thematic mapper dimensionally and spectral structure. Author

**N83-34399\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**THE 1980 US/CANADA WHEAT AND BARLEY EXPLORATORY EXPERIMENT. VOLUME 2: ADDENDA Final Report**

R. M. BIZZELL, H. L. PRIOR, R. W. PAYNE, and J. M. DISLER  
Apr. 1983 158 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development  
Prepared in cooperation with NASA Johnson Space Center ERTS 2 Vol.

(Contract NAS9-15800; PROJ. AGRISTARS)

(E83-10406; NASA-CR-171675; IT-L3-04398; JSC-18602; NAS 1.26 171675; LEMSCO-18629) Avail NTIS HC A08/MF A01 CSCL 02C

Three study areas supporting the U.S./Canada Wheat and Barley Exploratory Experiment are discussed including an evaluation of the experiment shakedown test analyst labeling results, an evaluation of the crop proportion estimate procedure 1A component, and the evaluation of spring wheat and barley crop calendar models for the 1979 crop year. M.G.

**N83-34400\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**ARGENTINA SPECTRAL-AGRONOMIC MULTITEMPORAL DATA SET**

D. HELMER, C. KINZLER, M. A. TOMPKINS, and G. D. BADHWAR Jun. 1983 46 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development Prepared in cooperation with NASA Johnson Space Center ERTS

(Contract NAS9-15800; PROJ. AGRISTARS)

(E83-10407; NASA-CR-171683; SR-L3-04426; JSC-18884; NAS 1.26 171683; LEMSCO-19539) Avail: NTIS HC A03/MF A01 CSCL 02C

A multitemporal LANDSAT spectral data set was created. The data set is over five 5 nm-by-6 nm areas over Argentina and contains by field, the spectral data, vegetation type and cloud cover information. Author

**N83-34406\*#** Texas A&M Univ., College Station. Remote Sensing Center.

**A MATHEMATICAL CHARACTERIZATION OF VEGETATION EFFECT ON MICROWAVE REMOTE SENSING FROM THE EARTH Quarterly Report**

Y. CHOE and L. TSANG Aug. 1983 115 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS

(Contract NAG5-31, PROJ. AGRISTARS)

(E83-10415; NASA-CR-173051; SM-T3-04436, NAS 1.26:173051; RSC-139) Avail: NTIS HC A06/MF A01 CSCL 02C

In passive microwave remote sensing of the earth, a theoretical model that utilizes the radiative transfer equations was developed to account for the volume scattering effects of the vegetation canopy. Vegetation canopies such as alfalfa, sorghum, and corn are simulated by a layer of ellipsoidal scatterers and cylindrical structures. The ellipsoidal scatterers represent the leaves of vegetation and are randomly positioned and oriented. The orientation of ellipsoids is characterized by a probability density function of Eulerian angles of rotation. The cylindrical structures represent the stalks of vegetation and their radii are assumed to be much smaller than their lengths. The underlying soil is represented by a half-space medium with a homogeneous permittivity and uniform temperature profile. The radiative transfer equations are solved by a numerical method using a Gaussian quadrature formula to compute both the vertical and horizontal polarized brightness temperature as a function of observation angle. The theory was applied to the interpretation of experimental data obtained from sorghum covered fields near College Station, Texas. M.G.

**N83-34408\*#** Nebraska Univ., Lincoln. Inst. of Agriculture and Natural Resources.

**FIELD MEASUREMENTS, SIMULATION MODELING AND DEVELOPMENT OF ANALYSIS FOR MOISTURE STRESSED CORN AND SOYBEANS, 1982 STUDIES Progress Report, 1 Feb. 1982 - 31 May 1983**

B. L. BLAD, J. M. NORMAN, and B. R. GARDNER Jun 1983 296 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS

(Contract NAS9-16636, PROJ. AGRISTARS)

(E83-10417, NASA-CR-171692, SR-83-04429; NAS 1.26:171692, CAMAC-83-5) Avail NTIS HC A13/MF A01 CSCL 02C

The experimental design, data acquisition and analysis procedures for agronomic and reflectance data acquired over corn and soybeans at the Sandhills Agricultural Laboratory of the University of Nebraska are described. The following conclusions were reached: (1) predictive leaf area estimation models can be defined which appear valid over a wide range of soils; (2) relative grain yield estimates over moisture stressed corn were improved by combining reflectance and thermal data; (3) corn phenology estimates using the model of Badhwar and Henderson (1981) exhibited systematic bias but were reasonably accurate; (4) canopy reflectance can be modeled to within approximately 10% of measured values; and (5) soybean pubescence significantly affects canopy reflectance, energy balance and water use relationships. M.G.

**N83-34409\*#** National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md

**EFFECT OF LEAF VARIABLES ON VISIBLE, NEAR-INFRARED AND MID-INFRARED REFLECTANCE OF EXCISED LEAVES**

R. BELL, M. L. LABOVITZ, and R. W. LUDWIG (Maryland Univ.) Jul 1983 23 p refs ERTS

(E83-10424; NASA-TM-85076, NAS 1.15 85076) Avail NTIS HC A02/MF A01 CSCL 02F

Effects of an imposed (excised) leaf orientation, differing species and differing venation patterns on reflectance measurements in the LANDSAT-4 thematic mapper (TM) channels TM3 (0.63 to 0.69 microns), TM4 (0.76 to 0.90 microns), and TM5 (1.55 to 1.75 microns) were investigated. Orientation of leaves (random vs systematic placement) was found to affect measurements in the TM4 channel, but not the TM3 and TM5 measurements. Venation caused no significant changes for any band. Azimuth of incident radiation was not a significant main effect, but in conjunction with changes in orientation, angle did have a significant effect on reflectance values in TM3, TM4 and TM5. Specific differences were highly significant ( $P$  for = 0.006) in all but one borderline ( $P$  for = 0.0222) case for TM5. For spectral examination of excised leaves, the sampling arrangement of the leaves should be as closely approximate in situ positioning as possible (with respect to remote sensing instrumentation). This dictates a random rather than aligned arrangement. M.G.

**N83-34410\*#** Kansas Univ., Lawrence Remote Sensing Lab. **RELATING THE RADAR BACKSCATTERING COEFFICIENT TO LEAF-AREA INDEX**

F. T. ULABY, Principal Investigator, C. ALLEN, G. EGER, and E. KANEMASU Apr 1983 66 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS

(Contract NAS9-15421; PROJ. AGRISTARS)

(E83-10425; NASA-CR-171690; SR-K3-04432, NAS 1.26 171690, RSL-TR-360-20) Avail: NTIS HC A04/MF A01 CSCL 02C

The relationship between the radar backscattering coefficient of a vegetation canopy,  $\sigma^0$  sub can, and the canopy's leaf area index (LAI) is examined. The relationship is established through the development of a model for corn and sorghum and another for wheat. Both models are extensions of the cloud model of Attema and Ulaby (1978). Analysis of experimental data measured at 8.6, 13.0, 17.0, and 35.6 GHz indicates that most of the temporal variations of  $\sigma^0$  sub can can be accounted for

## 01 AGRICULTURE AND FORESTRY

through variations in green LAI alone, if the latter is greater than 0.5. M.G.

**N83-34411\*#** Maryland Univ., College Park Remote Sensing Systems Lab.

### THE CONTINUOUS SIMILARITY MODEL OF BULK SOIL-WATER EVAPORATION

R. B. CLAPP Apr. 1983 55 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract PROJ. AGRISTARS) (E83-10426; NASA-CR-173056; CP-53-04417; NAS 1.26:173056) Avail: NTIS HC A04/MF A01 CSCL 02C

The continuous similarity model of evaporation is described. In it, evaporation is conceptualized as a two stage process. For an initially moist soil, evaporation is first climate limited, but later it becomes soil limited. During the latter stage, the evaporation rate is termed evaporability, and mathematically it is inversely proportional to the evaporation deficit. A functional approximation of the moisture distribution within the soil column is also included in the model. The model was tested using data from four experiments conducted near Phoenix, Arizona; and there was excellent agreement between the simulated and observed evaporation. The model also predicted the time of transition to the soil limited stage reasonably well. For one of the experiments, a third stage of evaporation, when vapor diffusion predominates, was observed. The occurrence of this stage was related to the decrease in moisture at the surface of the soil. The continuous similarity model does not account for vapor flow. The results show that climate, through the potential evaporation rate, has a strong influence on the time of transition to the soil limited stage. After this transition, however, bulk evaporation is independent of climate until the effects of vapor flow within the soil predominate M.G.

**N83-34415#** European Space Agency, Paris (France).

### FIRST INTERNATIONAL TRAINING SEMINAR ON REMOTE SENSING APPLICATIONS TO OPERATIONAL AGROMETEOROLOGY IN SEMI-ARID COUNTRIES [PREMIER SEMINAIRE INTERNATIONAL DE FORMATION SUR LES APPLICATIONS DE LA TELEDETECTION A L'AGRO-METEOROLOGIE OPERATIONNELLE DANS LES PAYS SEMI-ARIDES]

T. D. GUYENNE, ed. Jul. 1983 75 p refs In FRENCH; ENGLISH summary Seminar held at Niamey, Nigeria, 11-29 Jul. 1983, sponsored by UN, WMO, ESA and FAO (ESA-SP-1051; ISSN-0379-6566) Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

The state of the art of agrometeorology and remote sensing; choice of different spectral bands for LANDSAT imagery; interpretation of satellite imagery; use of satellite remote sensing for locust control, flood plain mapping and rice crop prediction in West Africa; estimation of precipitation; and measurement of soil moisture and evaporation were discussed.

**N83-34418#** United Nations, New York, N. Y. Div. de l'Espace Extra-Atmospherique.

### PHYSICAL BASES OF REMOTE SENSING [BASES PHYSIQUES DE LA TELEDETECTION]

R. P. OESBERG In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 15-17 Jul. 1983 refs In FRENCH Avail: NTIS HC A04/MF A01, ESA, Paris FF 60

The physics of electromagnetic energy, electromagnetic spectra, electromagnetic energy sources, atmospheric perturbation and absorption, diffusion and diffraction; and atmospheric emission are sketched. The effects of pigments, leaf structure, and humidity on the reflectance of vegetation are summarized. Author (ESA)

**N83-34421#** Food and Agriculture Organization of the United Nations, Rome (Italy). Plant Protection Service.

### OPERATIONAL USE OF SATELLITE REMOTE SENSING FOR FORECASTING AND CONTROL OF LOCUSTS AT INTERNATIONAL, REGIONAL, AND NATIONAL LEVELS [L'UTILISATION OPERATIONNELLE DE LA TELEDETECTION PAR SATELLITE POUR LA PREVISION ET LA LUTTE CONTRE LE CRIQUET PELERIN AUX NIVEAUX INTERNATIONAL, REGIONAL ET NATIONAL]

J. U. HIELKEMA In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 27-29 Jul. 1983 refs In FRENCH Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

The use of satellites for thematic mapping of locust breeding grounds and habitats is discussed. The METEOSAT, NOAA, and LANDSAT satellites supply useful data for locust monitoring and control. The use of nonparametric techniques for analysis of ecological data is advocated. Experimental and semioperational locust control programs using satellites are very encouraging.

Author (ESA)

**N83-34423#** Joint Research Centre of the European Communities, Ispra (Italy).

### POTENTIAL AND LIMITATIONS OF REMOTE SENSING FOR CROP FORECASTING WITH AGROMETEOROLOGICAL MODELS INCLUDED: RICE GROWING IN WEST AFRICA [POTENTIALITES ET LIMITATIONS DE LA TELEDETECTION POUR LA PREVISION DES RECOLTES, AVEC INCLUSIONS DE MODELES AGRO-METEOROLOGIQUES: EXEMPLE DE LA RIZICULTURE EN AFRIQUE DE L'OUEST]

A. BERG In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 37-49 Jul 1983 In FRENCH Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

The economic and technological feasibility of satellite-borne crop monitoring in West Africa is discussed. Experience acquired during the Large Area Crop Inventory Experiment and AGRESTE program (using LANDSAT) is summarized. The use of the radiation energy budget to forecast yield is outlined. A regional (Mali-Guinea) experiment using LANDSAT data in rice farming suggests that satellite imagery is technologically feasible, but if it is to be economically viable it must be extended to the other cereals of the area. Author (ESA)

**N83-34431#** Army Engineer Topographic Labs., Fort Belvoir, Va.

### CONSTRUCTION OF NEW AREA SAMPLING FRAMES USING LANDSAT IMAGERY

D. J. COSTANZO 17 Mar. 1983 10 p refs (AD-A128806) Avail: NTIS HC A02/MF A01 CSCL 08B

The U.S. Department of Agriculture develops Area Sampling Frames (ASF's) for each state using a series of land-use maps, and utilizes them in selecting statistical samples for agricultural surveys. Recently, LANDSAT imagery provided up-to-date land-use information during construction of a new ASF for California. Multispectral Scanner false-color scenes were manually interpreted along with aerial photos, density of cultivation. Finally, these boundaries were digitized, forming a computerized ASF data base. Use of this ASF improved statistical efficiency with reduced sample size for California agricultural surveys. Author (GRA)

**N83-35446** Washington Univ., Seattle.

### REMOTE SENSING IN ARID REGIONS: THREE CASE STUDIES (SOUTHWESTERN KANSAS; MEATIQ DOME, EASTERN DESERT, EGYPT; AND KHARGA DEPRESSION, WESTERN DESERT, EGYPT) Ph.D. Thesis

P. A. JACOBBERGER 1982 134 p Avail: Univ. Microfilms Order No. DA8302342

Digital LANDSAT MSS data were used in conjunction with field mapping and soil sampling to monitor changes to agricultural soils near Garden City and Liberal, Kansas over an eight week period. Subtle changes in color and albedo, including progressive reddening of the area, were related to exposure of red subsoils

and sands. Severity of wind erosion over this region appears to be controlled by land use. LANDSAT data and sediment spectral reflectance measurements (from 0.4 to 1.1 micrometers) were combined with field mapping to map rock units in the Meatiq Dome, Egypt (26 N Lat., 33 50'E Long.) The complex igneous and metamorphic rocks in the Meatiq Dome, Egypt were mapped by: (1) production of color composite images from LANDSAT data enhanced via principal components analysis; (2) comparison of the LANDSAT data with principal components analysis; and (3) comparison of the LANDSAT data with sediment spectral reflectance measurements. Granitoid rocks were distinguishable from the surrounding more mafic rocks. The provenance and distribution of wadi sediments were mapped. The surface materials in and near the Kharga Oasis of Egypt were also mapped. Four data clusters were delineated and used to thematically map surface units. Three of the clusters occur within cases, and the fourth cluster delineates sand free soils and soils with patchy sand cover.

Dissert Abstr.

**N83-35447** Tennessee Univ., Knoxville.

**A STUDY OF WETLANDS USING GEOCHEMICAL, REMOTE SENSING AND MULTIVARIATE ANALYTICAL TECHNIQUES**  
Ph.D. Thesis

R. K. GOSWAMI 1983 152 p

Avail: Univ Microfilms Order No. DA8303688

Geochemical analysis was done to study the physical and chemical variations in wetlands soils with respect to their adjoining upland soils. The United States Fish and Wildlife Service conventional remote sensing techniques were used to study and map the wetlands in the test area. National high altitude photography (scale about 1:60,000) was useful. For the situations where no data other than topographic maps could be found, a mathematical model was developed to study the wetlands based on the limited data available from the topographic maps. An algorithm was developed to evaluate the factors involved in the model for digital terrain data. Based on the algorithm, a computer program was written and used to study and map the wetlands in the test area.

Dissert Abstr.

**N83-35448\*** Florida Univ., Gainesville. Climatology Lab.

**APPLICATION OF SATELLITE FROST FORECAST TECHNOLOGY TO OTHER PARTS OF THE UNITED STATES**  
Final Report

J. D. MARTSOLF and E. CHEN, Principal Investigators Nov. 1981 321 p refs Revised Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (Contract NAS10-9876)

(E83-10414; NASA-CR-166827; NAS 1.26:166827) Avail NTIS HC A14/MF A01 CSCL 02C

Thermal infrared data taken from the GOES satellite over a period of several hours was color enhanced by computer according to temperature. The varying temperatures were then used to assist in frost forecasting. Input from Michigan and Pennsylvania to the cold climate mapping project is emphasized in the report of the second year's activities of a two year effort.

**N83-35449\*** Florida Univ., Gainesville

**APPLICATION OF SATELLITE FROST FORECAST TECHNOLOGY TO OTHER PARTS OF THE UNITED STATES: INTRODUCTION** Final Report

In its Appl. of Satellite Frost Forecast Technol to Other Parts of the United States 31 p Nov 1981 ERTS

Avail: NTIS HC A14/MF A01 CSCL 02C

The history and status of University of Michigan and University of Pennsylvania involvement in determining if P-model for front prediction used in Florida is applicable to those geographic locations is reviewed. The possibility of using the S-model to develop a satellite front forecast system that can recall the distribution of temperatures during previous freezes from a particular area and bring that cold climate climatology to bear on present forecasts is discussed as well as a proposed GOES satellite downlink system to sectionalize the data used in Florida. A.R.H.

**N83-35450\*** Pennsylvania State Univ., University Park. Dept. of Agricultural Engineering

**FREEZE PREDICTION MODEL Final Report**

C. T. MORROW, Principal Investigator In Florida State Univ. Appl. of Satellite Frost Forecast Technol. to Other Parts of the United States 25 p Nov. 1981 refs ERTS

Avail: NTIS HC A14/MF A01 CSCL 02C

Measurements of wind speed, net irradiation, and of air, soil, and dew point temperatures in an orchard at the Rock Springs Agricultural Research Center, as well as topographical and climatological data and a description of the major apple growing regions of Pennsylvania were supplied to the University of Florida for use in running the P-model, freeze prediction program. Results show that the P-model appears to have considerable applicability to conditions in Pennsylvania. Even though modifications may have to be made for use in the fruit growing regions, there are advantages for fruit growers with the model in its present form.

A.R.H.

**N83-35451\*** Pennsylvania Crop Reporting Service, Harrisburg.  
**THE 1978 PENNSYLVANIA ORCHARD AND VINEYARD INVENTORY SURVEY Final Report**

In Florida State Univ. Appl. of Satellite Frost Forecast Technol. to Other Parts of the United States 68 p Nov. 1981 ERTS

Avail: NTIS HC A14/MF A01 CSCL 02C

Significant developments in the fruit industry in Pennsylvania are reported to provide basic information as a guide in the production and marketing of apples, pears, cherries, peaches, grapes, plums, prunes and nectarines. Tables show the number of growers, trees and acres by kind of fruit as well as the age of the trees, the number of barrels produced, and production by county and region.

A.R.H.

**N83-35454\*** Michigan State Univ., East Lansing Agriculture Experiment Station.

**APPLICABILITY OF SATELLITE FREEZE FORECASTING AND COLD CLIMATE MAPPING TO THE OTHER PARTS OF THE UNITED STATES** Final Report

In Florida State Univ. Appl. of Satellite Frost Forecast Technol. to Other Parts of the United States 59 p Nov 1981 refs Original contains color imagery Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

Avail: NTIS HC A14/MF A01 CSCL 04B

Tasks performed to determine the value of using GOES satellite thermal imagery to enhance fruit crop production in Michigan are described. An overview is presented of the system developed for image processing and thermal image and surface environmental data bases prepared to assess the physical models developed in Florida. These data bases were used to identify correlations between satellite apparent temperatures patterns and Earth surface factors. Significant freeze events in 1981 and the physical models used to provide a perspective on how Florida models can be applied in the context of the Michigan environment are discussed.

A.R.H.

**N83-35455\*** Michigan State Univ., East Lansing

**MSU TEST OF P-MODEL Final Report**

In Florida State Univ. Appl. of Satellite Frost Forecast Technol. to Other Parts of the United States 8 p Nov 1981 ERTS

Avail: NTIS HC A14/MF A01 CSCL 05B

Results of running key station data (soil, air, and dew point temperatures, net irradiation, and wind direction and speed) from Michigan through the P-model are presented. The details of each of the 55 error calculations are shown in tables. A histogram is included showing errors in degrees Fahrenheit.

A.R.H.

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**N83-35461\*#** South Dakota State Univ., Brookings. Remote Sensing Inst.

### **ADVANCED MICROWAVE SOIL MOISTURE STUDIES Final Report**

K. J. DALSTED and J. C. HARLAN Sep. 1983 92 p refs  
Original contains color imagery Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(Contract NSG-5396)

(E83-10422; NASA-CR-173054; NAS 1.26:173054;

RSI-SDSU-83-05) Avail: NTIS HC A05/MF A01 CSDL 08M

Comparisons of low level L-band brightness temperature (TB) and thermal infrared (TIR) data as well as the following data sets: soil map and land cover data; direct soil moisture measurement; and a computer generated contour map were statistically evaluated using regression analysis and linear discriminant analysis. Regression analysis of footprint data shows that statistical groupings of ground variables (soil features and land cover) hold promise for qualitative assessment of soil moisture and for reducing variance within the sampling space. Dry conditions appear to be more conducive to producing meaningful statistics than wet conditions. Regression analysis using field averaged TB and TIR data did not approach the higher  $sq R$  values obtained using within-field variations. The linear discriminant analysis indicates some capacity to distinguish categories with the results being somewhat better on a field basis than a footprint basis. A.R.H.

**N83-35463\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

### **EFFECTS OF DECREASING RESOLUTION ON SPECTRAL AND SPATIAL INFORMATION CONTENT IN AN AGRICULTURAL AREA**

Mar. 1983 44 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS

(Contract NAS9-15800; PROJ. AGRISTARS)

(E83-10427; NASA-CR-171689; EW-L3-04415; JSC-18879; NAS 1.26:171689; LEMSCO-19352) Avail: NTIS HC A03/MF A01 CSDL 02C

The effects of decreasing spatial resolution from 6 1/4 miles square to 50 miles square are described. The effects of increases in cell size is studied on; the mean and variance of spectral data; spatial trends; and vegetative index numbers. Information content changes on cadastral, vegetal, soil, water and physiographic information are summarized. Author

**N83-35468\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

### **CONTINENTAL LAND COVER CLASSIFICATION USING METEOROLOGICAL SATELLITE DATA**

C. J. TUCKER, J. R. G. TOWNSHEND (Reading Univ.), and T. E. GOFF Jun. 1983 22 p refs Submitted for publication  
(NASA-TM-85060; NAS 1.15 85060) Avail: NTIS HC A02/MF A01 CSDL 08B

The use of the National Oceanic and Atmospheric Administration's advanced very high resolution radiometer satellite data for classifying land cover and monitoring of vegetation dynamics over an extremely large area is demonstrated for the continent of Africa. Data from 17 imaging periods of 21 consecutive days each were composited by a technique sensitive to the in situ green-leaf biomass to provide cloud-free imagery for the whole continent. Virtually cloud-free images were obtainable even for equatorial areas. Seasonal variation in the density and extent of green leaf vegetation corresponded to the patterns of rainfall associated with the inter-tropical convergence zone. Regional variations, such as the 1982 drought in east Africa, were also observed. Integration of the weekly satellite data with respect to time produced a remotely sensed assessment of biological activity based upon density and duration of green-leaf biomass. Two of the 21-day composited data sets were used to produce a general land cover classification. The resultant land cover distributions correspond well to those of existing maps. Author

**N83-35470\*#** Jet Propulsion Lab., California Inst of Tech., Pasadena.

### **A FEASIBILITY STUDY: FOREST FIRE ADVANCED SYSTEM TECHNOLOGY (FFAST)**

R. G. MCLEOD, T. Z. MARTIN, and J. WARREN (Forest Service) 1 Sep. 1983 70 p refs

(Contract NAS7-100)

(NASA-CR-173103; JPL-PUB-83-57; NAS 1.26:173103) Avail: NTIS HC A04/MF A01 CSDL 02F

The National Aeronautics and Space Administration/Jet Propulsion Laboratory and the United States Department of Agriculture Forest Service completed a feasibility study that examined the potential uses of advanced technology in forest fires mapping and detection. The current and future (1990's) information needs in forest fire management were determined through interviews. Analysis shows that integrated information gathering and processing is needed. The emerging technologies that were surveyed and identified as possible candidates for use in an end to end system include "push broom" sensor arrays, automatic georeferencing, satellite communication links, near real or real time image processing, and data integration. Matching the user requirements and the technologies yielded a "strawman" system configuration. The feasibility study recommends and outlines the implementation of the next phase for this project, a two year, conceptual design phase to define a system that warrants continued development. Author

**N83-36546\*#** New Mexico Univ., Albuquerque. Technology Application Center.

### **LANDSAT MONITORING OF IRRIGATED FARMLAND ACREAGE IN CURRY COUNTY, NEW MEXICO**

M. INGLIS and T. K. BUDGE Feb. 1983 49 p refs Sponsored by NASA Prepared in cooperation with New Mexico State Univ., Las Cruces Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(Contract DI-14-34-0001-1133)

(E83-10312; NASA-CR-174457; NAS 1.26:174457; PB83-220566; WRR1-165; W83-03310; OWRT-A-069-NMEX(1)) Avail: NTIS HC A03/MF A01 CSDL 08H

Curry County, New Mexico, was selected as the study area to test the applicability of LANDSAT satellite digital data in making accurate acreage measurements of irrigated cropland. Three LANDSAT digital images of the 1981 growing season were classified for Curry County to determine (1) how well Landsat classified irrigated lands in the area; (2) how accurate Landsat acreage measurements could be; and (3) how many LANDSAT overpass dates would be required to accurately measure irrigated acreage. GRA

## 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.

**A83-42040**

### **THE USE OF REMOTE SENSING IN GLOBAL BIOSYSTEM STUDIES**

V. KLEMAS and M. HARDISKY (Delaware University, Newark, DE) (COSPAR, Workshop and Topical Meeting on Life Sciences and Space Research, Ottawa, Canada, May 16-June 2, 1982) Advances in Space Research (ISSN 0273-1177), vol. 3, no. 9, 1983, p. 115-122. refs

A remote sensing strategy is developed for the selective sampling of the properties and changes in the atmosphere, the oceans, and on land in support of global biosystems research as

proposed by NASA, including mineral cycling, ocean and terrestrial productivity, perturbation effects, and biospheric responses. It is argued that remote sensors on satellites and aircraft should be used to update existing data bases and to monitor areas of high productivity or rapid change, rather than attempting to provide a costly inventory of all biosphere resources and processes. Requirements are discussed for new remote sensing instruments and data analysis techniques which need to be developed for global biosystem monitoring. Spatial and temporal resolution requirements for coastal studies are examined. N.B.

#### A83-43137

#### DATA FROM REMOTE SENSING IN THE GEOGRAPHICAL INFORMATION SYSTEM - THE CONSTRUCTION OF TERRITORIAL DATA BANKS [DATEN DER FERNERKUNDUNG IM INFORMATIONSSYSTEM DER GEOGRAPHIE DISKUSSIONSBEITRAG ZUM AUFBAU TERRITORIALER DATENBANKEN]

R. KROENERT (Deutsche Akademie der Wissenschaften, Institut fuer Geographie und Geoökologie, Leipzig, East Germany) Gerlands Beitrage zur Geophysik (ISSN 0016-8696), vol. 92, no. 2-4, 1983, p. 171-185. In German. refs

#### A83-43138

#### COMPARISON OF LAND USE STRUCTURES FROM MULTITEMPORAL REMOTE SENSING SATELLITE DATA

H. WIRTH and K.-H. MAREK (Deutsche Akademie der Wissenschaften, Zentralinstitut fuer Physik der Erde, Potsdam, East Germany) Gerlands Beitrage zur Geophysik (ISSN 0016-8696), vol. 92, no. 2-4, 1983, p. 186-196. refs

Multispectral data, taken as photographs or scanning data, have been successfully used to construct maps of land use. The recognition problem of the land use classes can be solved by applying visual and computer aided methods with nearly the same degree of performance (mean 85 percent). For practical use of these informations, the records of land use structures must be fully compatible with given topographical map systems. Using digital techniques of geometrical transformation with a polynomial expression of third degree, mean deviations in the net of ground control points between 150 m and 300 m must be taken into account. Author

#### A83-43434

#### DETERMINATION OF AMBIENT AEROSOL AND GASEOUS SULFUR USING A CONTINUOUS FPD. III - DESIGN AND CHARACTERIZATION OF A MONITOR FOR AIRBORNE APPLICATIONS

R. W. GARBER, P. H. DAUM, R. F. DOERING, T. DOTTAIO, and R. L. TANNER (Brookhaven National Laboratory, Upton, NY) Atmospheric Environment (ISSN 0004-6981), vol. 17, no. 7, 1983, p. 1381-1385. Research supported by the U.S. Department of Energy. refs

A dual flame photometric detector for measurement of SO<sub>2</sub> and aerosol sulfur from aircraft platforms has been developed. Mass-flow controllers are used to maintain a constant flow of sample air and hydrogen to the FPD burners as altitude varies. This eliminates the variation in the sulfur signal with altitude usually observed in conventional designs and greatly reduces the altitude variation in the flame background signal. Sulfur dioxide and aerosol sulfur are differentiated by placing a quartz filter before the SO<sub>2</sub> detector and a litharge denuder before the aerosol sulfur detector. Sensitivity of the detector is enhanced by use of hydrogen doped with 100 ppb SF<sub>6</sub>. Performance of the instrument during pressure chamber tests and on test flights is discussed. Author

#### A83-45032

#### MAPPING ON THE BASIS OF SPACE PHOTOGRAPHS AND ENVIRONMENT PROTECTION [KARTOGRAFIROVANIE PO KOSMICHESKIM SNIMKAM I OKHRANA OKRUZHAUSHCHEI SREDY]

L. I. ZLOBIN, ED. Moscow, Izdatel'stvo Nedra, 1982, 256 p. In Russian.

Methods are presented for the use of satellite photographs for compiling maps concerning topics of interest for environment protection. Techniques are examined for the interpretation of satellite surveys using both original and transformed materials (preanalyzed by optical-electronic devices and computers). The sequence of work and the scheme for the course of investigations in compiling maps for environment protection and for the rational utilization of natural resources are discussed. Specific topics considered include the principles of mapping for environment protection by the use of satellite photographs, the characteristics of the thematic decoding for satellite photographs for compiling maps on environment protection topics, and the construction of map series on environment protection topics using satellite photographs. No individual items are abstracted in this volume. N.B.

#### A83-45616

#### AIR MONITORING - RESEARCH NEEDS

T. R. HAUSER, D. R. SCOTT, and M. R. MIDGETT (U.S. Environmental Protection Agency, Environmental Monitoring Systems Laboratory, Research Triangle Park, NC) Environmental Science and Technology (ISSN 0013-936X), vol. 17, Feb. 1983, p. 86A-96A. refs

Sampling and analyses difficulties encountered in the ambient, source and exposure monitoring areas of environmental data sampling of inorganic particulate matter, inorganic gases, organic particulate matter, and organic gases are discussed. Attention is given to instrumentation such as tunable lasers, ion chromatography, optical emission spectroscopy, fiber glass filters, dichotomous samplers, Teflon and other polymeric membrane filters, and electrostatic samplers. A lack of species-tailored devices is noted, as is a need to develop numerical and statistical models that will decrease the required sampling volume for reliable estimates. Finally, better characterizations of the effects that sampling has on the medium sampled are recommended. M.S.K.

#### A83-46119

#### IMPROVED LANDUSE CLASSIFICATION THROUGH PRINCIPAL COMPONENT ANALYSIS BASED ON CATEGORY STATISTICS AND SYNTHETIC VARIABLES

F. FASLER, K. I. ITTEN, and K. STAENZ (Zuerich, Universitaet, Zurich, Switzerland) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

A83-46146\* National Aeronautics and Space Administration, Washington, D. C.

#### THE USE OF THE SPACE SHUTTLE FOR LAND REMOTE SENSING

P. G. THOME (NASA, Washington, DC) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p.

The use of the Space Shuttle for land remote sensing will grow significantly during the 1980's. The main use will be for general land cover and geological mapping purposes by worldwide users employing specialized sensors such as: high resolution film systems, synthetic aperture radars, and multispectral visible/IR electronic linear array scanners. Because these type sensors have low Space Shuttle load factors, the user's preference will be for shared flights. With this strong preference and given the present prognosis for Space Shuttle flight frequency as a function of orbit inclination, the strongest demand will be for 57 deg orbits. However, significant use will be made of lower inclination orbits. Compared

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with freeflying satellites, Space Shuttle mission investment requirements will be significantly lower. The use of the Space Shuttle for testing R and D land remote sensors will replace the free-flying satellites for most test programs. Author

**A83-46164**

### **APPLICATION OF REMOTELY SENSED DATA FOR THE ASSESSMENT OF LANDSCAPE ECOLOGY**

W. KIRCHHOF (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Wessling, West Germany) and R. BACHHUBER (Muenchen, Technische Universitaet, Freising, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

**A83-46206**

### **APPLICATION OF REMOTE SENSING TECHNIQUES TO STUDY ENVIRONMENTAL CONDITIONS AND NATURAL RESOURCES IN ANTARCTIC PENINSULA**

M. ARAYA F. (Universidad de Chile, Santiago, Chile) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

**A83-46948**

### **SPATIAL AND TEMPORAL VARIATIONS OF TROPOSPHERIC AEROSOL VOLUME DISTRIBUTIONS**

B. W. FITCH (California, University, San Diego, CA) and T. S. CRESS (USAF, Office of Scientific Research, Bolling AFB, Washington, DC) Journal of Climate and Applied Meteorology (ISSN 0733-3021), vol 22, July 1983, p. 1262-1269. refs (Contract F19628-78-C-0200)

The present investigation is concerned with the broad-scale spatial and temporal variations of tropospheric aerosols as revealed by an extensive set of aerosol distributions measured over western Europe. A series of almost 600 airborne measurements of particle size distributions were made during the period from 1976 to 1978 within the lower troposphere above nine sites in western Europe. An analysis of the aerosol data shows that the volume distributions can be described well by an equation which uses a constant three log-normal distributions to describe three distinct volume modes. The dependence of the aerosol on altitude, season, and relative humidity suggests that the aerosol has a reoccurring pattern G.R.

**A83-47766**

### **OPTICAL AND LASER REMOTE SENSING**

D. K. KILLINGER, ED. and A. MOORADIAN, ED. (MIT, Lexington, MA) Berlin, Springer-Verlag (Springer Series in Optical Sciences. Volume 39), 1983, 394 p.

IR differential-absorption lidar (DIAL) techniques are discussed, taking into account airborne remote sensing measurements with a pulsed CO<sub>2</sub> DIAL system, differential-absorption measurements with fixed-frequency IR and UV lasers, remote sensing of hydrazine compounds using a dual mini-TEA CO<sub>2</sub> laser DIAL system, the Hull coherent DIAL program, and laser remote sensing measurements of atmospheric species and natural target reflectivities. Spectrometric techniques are considered along with UV-visible DIAL techniques, atmospheric propagation and system analysis, UV-fluorescence remote sensing, laser sources and detectors, advanced optical techniques, and lidar technology. Attention is given to optical remote sensing of environmental pollution and danger by molecular species using a low-loss optical fiber network system, in situ ultratrace gas detection by photothermal spectroscopy, a new spectrochemical technique called 'laser-induced breakdown spectroscopy', the spectral resolution lidar, lidar measurements of clouds, and coherent IR radar technology. G.R.

**A83-47773**

### **AIRBORNE CO<sub>2</sub> LASER HETERODYNE SENSOR FOR MONITORING REGIONAL OZONE DISTRIBUTIONS**

K. ASAI, T. ITABE, and T. IGARASHI (Ministry of Posts and Telecommunications, Radio Research Laboratories, Koganei, Tokyo, Japan) IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 44-48. refs

A study of the regional distributions of ozone concentrations is important in order to determine the mechanism involved in the occurrence of photo-chemical smogs. Airborne laser remote sensing techniques represent a powerful tool for the conduction of such a study. The present investigation is concerned with the measurement errors found in the data provided by an airborne CO<sub>2</sub> laser heterodyne sensor, taking into account ozone measurements and albedo spectra for various materials. A brief description of the employed airborne system is presented, and attention is given to laboratory experiments and tests conducted with the aid of aircraft. G.R.

**A83-47802**

### **OPTICAL REMOTE SENSING OF ENVIRONMENTAL POLLUTION AND DANGER BY MOLECULAR SPECIES USING LOW-LOSS OPTICAL FIBER NETWORK SYSTEM**

H. INABA (Tohoku University, Sendai, Japan) IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 288-298. refs

The basic configuration and the operational principle of a low-loss optical fiber network system intended for the remote sensing of a variety of chemical species by the use of differential absorption are discussed. The advantage of the scheme proposed here over other laser remote monitoring schemes is that a low-power laser or even a nonlaser source can be used in conjunction with low-loss optical fibers. Therefore, a purely optical, economical, real-time monitoring technique can be realized for various environments and severe or extreme conditions. The results of the remote monitoring of NO<sub>2</sub> molecules in the visible region near 0.5 micron and CH<sub>4</sub> molecules in the near infrared spectrum at about 1.33 micron are summarized. V.L.

**A83-49275**

### **ECOLOGICAL MONITORING AND REGULATION OF THE STATE OF THE ENVIRONMENT [EKOLOGICHESKII MONITORING I REGULIROVANIIE SOSTOIANIIA PRIRODNOI SREDY]**

IU. A. IZRAEL, L. M. FILIPPOVA, G. E. INSAROV, F. N. SEMEVSKII, and S. M. SEMENOV (Gosudarstvennyi Komitet SSSR po Gidrometeorologii i Kontroliu Prirodnoi Sredy, Laboratoriia Monitoringa Prirodnoi Sredy i Klimata; Akademiia Nauk SSSR, Moscow, USSR) IN: Problems of ecological monitoring and ecosystem simulation. Volume 4 (Problemy ekologicheskogo monitoringa i modelirovaniia ekosistem. Volume 4). Leningrad, Gidrometeoizdat, 1981, p. 6-19. In Russian. refs

Various approaches to optimizing the structure of ecological monitoring systems at different levels are discussed, including local, regional, and global approaches. A connection is established between the optimization process and the general problem of the regulation of the state of the environment at the corresponding levels. The methodological basis of the optimization of ecological monitoring is the complete analysis of the environment, which allows the main objects of the influences and effects to be classified, reveals the consequences of the anthropogenic effects on the biosphere, and compares the various types of influences with their effects. N.B.



**A83-49291**  
**INFORMATION ABOUT THE ENVIRONMENT FROM SPACEBORNE OBSERVATIONS AND THE NATIONAL-ECONOMIC SIGNIFICANCE AND COST EFFECTIVENESS OF THIS INFORMATION [INFORMATSIYA OB OKRUZHAIUSHCHEI SREDE PO NABLIUDENIYAM IZ KOSMOSA, EE NARODNOKHOZIAISTVENNOE ZNACHENIE I EKONOMICHESKAIA EFEKTIVNOST']**

K. IA. KONDRATEV, O. A. ZENKEVICH, and L. IU MAKOVA IN: Radiation studies in the atmosphere. Leningrad, Gidrometeoizdat, 1982, p. 126-135. In Russian. refs

**A83-50191**  
**AIRCRAFT OBSERVATIONS OF REGIONAL TRANSPORT OF OZONE IN THE NORTHEASTERN UNITED STATES**

J. F. CLARKE and J. K. S. CHING Atmospheric Environment (ISSN 0004-6981), vol. 17, no. 9, 1983, p. 1703-1712. refs

A regional-scale aircraft sampling program was conducted during August 1979 to obtain data for validation of a regional-scale photochemical air quality simulation model and for studying the physical and chemical processes important in long-range transport of O<sub>3</sub> and O<sub>3</sub> precursors throughout the diurnal cycle. Three aircraft were deployed in a Lagrangian sampling mode to obtain continuous measurements of O<sub>3</sub>, oxides of nitrogen, nephelometer scattering coefficient, and grab samples to be analyzed later for hydrocarbon species. The analysis reported herein is for a 24 h period during which relatively high O<sub>3</sub> concentrations, generated within urban plumes, were transported from Ohio to the NE Corridor. Author

**N83-32150\*#** Municipality of Anchorage, Alaska Planning Dept.

**INTEGRATED RESOURCE INVENTORY FOR SOUTHCENTRAL ALASKA (INTRISCA) Final Report**

T. BURNS, C. CARSON-HENRY, and L. A. MORRISSEY Jul. 1981 265 p refs Prepared in cooperation with Technicolor Government Services, Inc. Original contains color illustrations (Contract NAS2-11101) (NASA-CR-166514, NAS 1 26:166514) Avail: NTIS HC A12/MF A01 CSCL 05B

The Integrated Resource Inventory for Southcentral Alaska (INTRISCA) Project comprised an integrated set of activities related to the land use planning and resource management requirements of the participating agencies within the southcentral region of Alaska. One subproject involved generating a region-wide land cover inventory of use to all participating agencies. Toward this end, participants first obtained a broad overview of the entire region and identified reasonable expectations of a LANDSAT-based land cover inventory through evaluation of an earlier classification generated during the Alaska Water Level B Study Classification of more recent LANDSAT data was then undertaken by INTRISCA participants. The latter classification produced a land cover data set that was more specifically related to individual agency needs, concurrently providing a comprehensive training experience for Alaska agency personnel. Other subprojects employed multi-level analysis techniques ranging from refinement of the region-wide classification and photointerpretation, to digital edge enhancement and integration of land cover data into a geographic information system (GIS). Author

**N83-33487#** Meteorological Satellite Center, Tokyo (Japan).  
**GMS-2 OBSERVATION OF VOLCANIC ASHES FROM MEXICAN VOLCANO EL CHICHON**

H. FUNADA and K. ARAI In: Meteorol. Satellite Center Tech. Note, No. 7, 1983 p. 13-27 Mar. 1983 In JAPANESE; ENGLISH summary Avail: NTIS HC A06/MF A01

On the visible picture of 0600 JST April 6, 1982 some things were found over the Hawaiian Islands. They obscured the cloud and the sea hazily. We inferred them to be the volcanic ashes from Mt. El Chichon, and studied how they were transferred using the visible pictures taken during daylight hours. The volcanic ashes over the Hawaiian Islands April 6 drifted to the west, then reached over the sea south of Japan (140 deg E) April 13. Besides this,

other ashes were recognized over India and Bay of Bengal on the picture of 1800 JST April 13. These ashes were progressing opposite in the direction, that is, to the east, which would suggest that they were on a level different from that. On April 16 the ashes moving eastward extended to the Philippine Islands, and overlapped with the ashes which had been carried from the east, the Hawaiian Islands. These ashes floating on the different levels were as if they were flowing within a tube imbedded in the region between 10 deg N and 25 deg N whose width was 5 - 10 deg in latitude. From April 23 to April 26 they persisted over the tropical regions of Pacific Ocean although they were partially invisible. Finally by the middle of June, it has been difficult to detect the volcanic ashes by visual inspection of pictures. The changes of albedo associated with the phenomena mentioned above was also investigated. Author

**N83-34401\*#** Kansas Univ., Lawrence. Space Technology Center.

**AN INVENTORY OF STATE NATURAL RESOURCES INFORMATION SYSTEMS**

L. M. CARON and D. SIDOR Apr 1983 28 p refs ERTS

(Contract NAG2-201)

(E83-10408; NASA-CR-166509; NAS 1 26 166509) Avail: NTIS HC A03/MF A01 CSCL 05B

The status of a project to inventory state natural resources information systems is summarized. All tasks accomplished are described, and tasks remaining to be completed are outlined.

A.R.H.

**N83-35482#** Research Inst. of National Defence, Linköping (Sweden). Dept. 3

**DETECTION AND REMOTE SENSING OF CHEMICAL AGENTS**

P. HELANDER (Linköping Univ., Sweden), I. RENHORN, and O. STEINVALL May 1983 65 p refs (FOA-C-30324-E1, ISSN-0347-3708) Avail: NTIS HC A04/MF A01, Research Inst. of National Defence, Stockholm Kr 50

An acousto-optic detector was designed and calibrated against ethylene using different CO<sub>2</sub>-laser lines. A responsivity of 150 Vcm/W was measured, which compares well with a theoretical response of 220 Vcm/W. The absorption spectrum of four chemical agents (TMP, DMMP, DDVP and TEP) was obtained at CO<sub>2</sub> laser wavelengths ranging from 9.2 to 10.9 microns. The gas phase absorption maximum around 9.5 was compared to spectra obtained by Fourier transform spectroscopy. The applicability of CO<sub>2</sub> laser techniques for remote sensing of chemical agents is discussed and the demands on such a system are given. A minimum detectable concentration  $C \times L$  down to 50 mg/sqm and detection ranges of several km are indicated by estimates in the absence of interfering gases. Author (ESA)

03

GEODESY AND CARTOGRAPHY

Includes mapping and topography

**A83-43132**

**THE CONTRIBUTIONS OF THE ZENTRALINSTITUT FUER PHYSIK DER ERDE TO THE MERIT PROJECT [BEITRAEGE DES ZENTRALINSTITUTS FUER PHYSIK DER ERDE ZUM PROJEKT MERIT]**

H. KAUTZLEBEN, G. HEMMLEB, and H. MONTAG (Deutsche Akademie der Wissenschaften, Zentralinstitut fuer Physik der Erde, Potsdam, East Germany) Gerlands Beitrage zur Geophysik (ISSN 0016-8696), vol. 92, no. 2-4, 1983, p. 117-126. In German. refs

Observations and analyses undertaken as part of the preliminary short campaign of the project to monitor earth-rotation and intercompare the techniques of observation and analysis (MERIT) from August 1 to October 31, 1980, are reported. Optical-observation data for classical determinations of rotation



## 03 GEODESY AND CARTOGRAPHY

parameters, obtained with two photographic zenith telescopes and a Danjon astrolabe, reveal that the newer telescope gives results comparable in precision to those of other stations. LAGEOS laser range measurements from all stations are analyzed using the POTSDAM-4 orbit-correction program, which takes into account the gravitational field of the earth (up to degree and order 21 of the spherical-function representation), the gravitational forces of the sun and moon, earth tides, the radiation pressure of the sun, and atmospheric friction effects. The results are compared to the BIH astronomical values and to those calculated by other centers and found to be near the overall average. T.K.

### A83-44362

#### ACQUISITION OF LONG WAVELENGTH MAGNETIC ANOMALIES PRE-DATES CONTINENTAL DRIFT

A. GALDEANO (Paris VI, Université; Paris VII, Université, Paris, France) Physics of the Earth and Planetary Interiors (ISSN 0031-9201), vol. 32, July 1983, p. 289-292. refs

Using the low altitude MAGSAT satellite data, NASA recently published a new global magnetic map of anomalies. Using this new accurate map and paleomagnetic reconstructions of Gondwanaland, we point out that long wavelength anomalies were continuous in continents that are presently separated. Thus, continental drift would not significantly affect the geometry of these deep-source anomalies. Accordingly, the magnetization of the rocks responsible for these anomalies should mainly be induced.

Author

### A83-46336

#### INTERNATIONAL SYMPOSIUM ON GEODETIC NETWORKS AND COMPUTATIONS, MUNICH, WEST GERMANY, AUGUST 31-SEPTEMBER 5, 1981, PROCEEDINGS. VOLUME 4 - MODERN OBSERVATION TECHNIQUES FOR TERRESTRIAL NETWORKS

R. SIGL, ED. Symposium sponsored by the International Association of Geodesy. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, 188 p.

Measurement and analyses techniques, as well as available equipment for terrestrial geodetic networks are explored. The impact of the usage of an operation Global Positioning System on the geodetic surveys is assessed, as are the projected benefits of Gravsat data. Attention is given to orbital methods for the development of satellite geodetic networks, as well as to applications of inertial technology and gyro azimuths. Consideration is also devoted to the implementation of laser ranging systems, VLBI, and mobile platforms, and to the costs associated with operating geodetic methods over a large area. M.S.K.

### A83-46337

#### MODERN OBSERVATION TECHNIQUES FOR TERRESTRIAL NETWORKS

J. G. GERGEN (NOAA, National Geodetic Survey, Rockville, MD) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 7-15. refs

Modern geodetic survey networks for horizontal and vertical controls are described, with examples provided of survey data. Satellite Doppler surveys are effected in absolute and relative modes, i.e., positioning and translocation. Submeter precision can be obtained, depending on the number of passes and the ephemeris. Laser ranging systems permit distances of several hundred to several thousands of kilometers to within an accuracy of better than a decimeter. Positioning accuracy of 5 mm using a geodetic receiver under development is expected when the GPS becomes operational. Inertial survey systems are being deployed in several states and VLBI observations are being applied to define radio source coordinates, astronomical constants, and variations in the earth rotation parameters to within an accuracy of 0.01 arcsec. Combined least square solutions for North American data for 1983 are provided. M.S.K.

### A83-46338

#### GEODESY AND THE GLOBAL POSITIONING SYSTEM

I. I. MUELLER and B. ARCHINAL (Ohio State University, Columbus, OH) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 28-36. refs

U.S. efforts to develop geodetic receivers capable of performing positioning measurements with cm accuracy using a fully operational GPS system as references are described. The GPS spacecraft (18) will broadcast on L-band frequencies, with signal coding to identify individual spacecraft. The radio signal will carry timing marks from rubidium and cesium clocks, and will permit positioning determination through pseudo-range, Doppler, and interferometric techniques. The accuracy of the implementation of any of the methods will be largely determined by the DOD release of information on the GPS full signal characteristics to non-DOD users. It is concluded that the interferometric methods will yield accuracies of 3 cm with a high confidence level for long baselines, and 1 cm accuracy for baselines of 100 length. M.S.K.

### A83-46339

#### NEW METHOD FOR THE REDUCTION OF SATELLITE DATA APPLICABLE TO GEODESY

G. E. O. GIACAGLIA (Sao Paulo, Universidade, Sao Paulo, Brazil) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 45-54. Research supported by the Fundacao de Amparo a Pesquisa do Estado de Sao Paulo. refs

A method of using discrete orthogonal functions for determining the profile of the radius of the geoid when using satellite altimetry data from the sea surface is described. The only additional datum necessary for the calculations is the gravity sub-point beneath the satellite. The method is shown to account for discrete spherical harmonics, which can be expanded in a series to express the geothermal flux, topographic leveling, the magnetic field intensity, gravitational anomalies, and the radius of the geoid. Improvement of the available geopotential coefficients is demonstrated using satellite altimetry data, as is a technique for determining the quality of fit. M.S.K.

### A83-46340

#### CONSEQUENCES OF GRAVSAT AND GPS - NEW CONCEPT OF GEODETIC NETWORKS

E. GROTEN and B. STOCK (Darmstadt, Technische Hochschule, Darmstadt, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 55-82. Research supported by the Stiftung Volkswagenwerk. refs

A study of the increases in accuracy in vertical geodetic measurements which will be available when Gravsat and GPS data can be combined with ground-based data is presented. The Gravsat data will permit measurement of relative geoid undulations over distances of 100 km to an accuracy of 5 cm, and vertical deflections to within 0.1 arcsec. The GPS will permit consideration of horizontal and vertical network data simultaneously. The assayed deflections will permit conversion of astronomical positions into geodetic coordinates and geodetic coordinates into astronomical positions, considering the positions surveyed with the Hipparchos satellite. A comparison of the astrogeodetic and gravimetric geoid of California is presented. Additionally, the effect of polar motion on geodetically relevant coordinates on a global basis is assessed and concluded negligible. The density of earth stations can be arranged to meet the requirements of the area. M.S.K.

A83-46341

**ON THE USE OF ORBITAL METHODS FOR DEVELOPMENT OF SATELLITE GEODETIC NETWORKS**

N. GEORGIEV (B'lgarska Akademiia na Naukite, Tsentralna Laboratoria po Vissha Geodeziia, Sofia, Bulgana) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 83-92 refs

The possibility of using different orbit arcs in combinations with geometrical methods to calculate space triangulations of geodetic satellites is considered. It is assumed that synchronous observations will be performed of satellite instantaneous positions, thereby connecting the points of measurement with the satellite positions. Conversely, the satellite position can also be calculated by the triangulation. Identifying the orbital arc the satellite is travelling also permits positioning of the satellite when asynchronous observations are made. The position processing is effected by a least squares technique, requiring as input the satellite space geocentric coordinates characterized by Doppler measurements and values from instantaneous optical observations. M.S.K.

A83-46342

**INERTIAL TECHNOLOGY APPLICATIONS TO GEODETIC NETWORKS**

A. MANCINI (U.S. Defense Mapping Agency, Washington, DC) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 93-96 refs

The implementation of inertial technology in geodetic networks during 1976-1981 is discussed. The Defense Mapping Agency was involved in a survey of the western U.S. using 7800 Doppler stations spread over 90,000 sq mi. The survey equipment included inertial surveying system (ISS) and gravity survey instruments. A helicopter-mounted IPS was used in a 40 x 40 km area survey in the SW U.S. A total of 3700 ISS stations were installed in a 80 x 180 km network in Canada. The U.S. costs were calculated to be \$1300 per station and \$200/mi. The systems capabilities were continually upgraded through planning and field measurement procedures improvements, as well as better real-time filters and post-processing techniques. Modifications to existing systems were identified for improving accuracy, and testing was scheduled for an airborne system and a mobile gravity gradiometry vehicle. M.S.K.

A83-46343

**ADJUSTMENT PROBLEMS IN INERTIAL POSITIONING**

K.-P. SCHWARZ and M. GONTHIER (Calgary, University, Calgary, Alberta, Canada) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 97-110. Research supported by the Geodetic Survey of Canada refs (Contract DMA800-79-C-0071)

Two rigorous approaches to determination of the covariance matrix for the positions obtained from inertial survey systems are presented. Time dependent errors are known to be 100 times as large as those due to the network configuration, i.e., readings taken one hour apart when the system is stationary at one point will yield coordinates that vary by several hundred meters. For corrections, it is necessary to separate the time and network-dependent contributions to the error, a problem which is similar to conversion of a time-dependent covariance matrix into a configuration-dependent covariance matrix without neglecting correlation. Methods for correction in post processing and by a two-step procedure where time-dependent errors are first eliminated, followed by network adjustment to remove the residual errors, are described. Kalman filtering and optimal smoothing, or an approximation method, delete the time-dependent errors. Direct calculation with an integration model is analyzed, showing that an initial adjustment is possible. M.S.K.

A83-46344

**WHICH INFORMATION CAN YOU GET OUT OF AN INERTIAL SYSTEM AND WHAT CAN YOU DO WITH IT?**

M. VAN DEN HERREWEGEN (Institut Geographique National, Brussels, Belgium) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 111-138.

The operational programs and results obtained from use of the National Geographical Institute of Belgium Fils Mk II geodetic inertial survey system are presented. The Mk II is continuously torqued to produce a local geodetic reference frame in three axes. The apparent forces experienced by the motion of the local reference system with respect to the inertial space include acceleration with respect to the space and with respect to the platform axes. Output from the Mk II during closed traverse include velocity, the measured offsets between the platform or theodolite position and the survey point, the coordinates of the platform every 0.6 sec, and all operations performed by the operator of the command and display panel. The formulas for updates or surface correction, determination of a survey point, and off-line computation are defined. The system can be used by untrained personnel without producing errors, yielding an accuracy of 0.5 m. M.S.K.

A83-46345

**ORIENTATION OF GEODETIC NETWORKS BY GYRO AZIMUTHS**

W. CASPARY, H. HEISTER, and P. SCHWINTZER (Muenchen, Hochschule der Bundeswehr, Munich, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings Volume 4. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 139-147. refs

The results of an investigation of the possibilities of replacing astronomical azimuths by gyro observations for orienting geodetic networks are reported. The performances of various gyro azimuths were monitored in comparison with known points of astronomical azimuths. A small number of gyro azimuth readings were found sufficient for accuracies of 3 arcsec, provided the instrumental constant of the gyro was known. The gyro is noted to be usable in day or night conditions and is stable in windy situations. The necessary training was less with the gyro azimuths, while the actual reading time was about equal to astronomical azimuths. However, the effect of vertical deviation indicated that additional astronomical azimuth observations would in any case be necessary, although network orientation could be accomplished without them. M.S.K.

A83-46351

**INTERNATIONAL SYMPOSIUM ON GEODETIC NETWORKS AND COMPUTATIONS, MUNICH, WEST GERMANY, AUGUST 31-SEPTEMBER 5, 1981, PROCEEDINGS. VOLUME 7 - COMBINATION OF HORIZONTAL, VERTICAL AND GRAVITY NETWORKS**

R. SIGL, ED. Symposium sponsored by the International Association of Geodesy. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, 158 p.

Topics in the area of geodetic networks and computations are considered. The subjects discussed include: combination of leveling and gravity data for detecting real crustal movements, contribution to three-dimensional operational geodesy, orientation information of leveling and gravity measurements in three-dimensional regional networks, and astrogravimetric computation of the quasi-geoid of the Federal Republic of Germany. Also addressed are: interpolation of gravity anomalies and deflections of the vertical in mountainous terrain, test computations of three-dimensional geodetic networks with observables in geometry and gravity space, three-dimensional adjustment of geodetic networks using gravity field data, and review of the combination of horizontal, vertical, and gravity networks. C.D.

**A83-46352**

## **COMBINATION OF HORIZONTAL, VERTICAL AND GRAVITY NETWORKS - A REVIEW**

R. KELM (Deutsches Geodaetisches Forschungsinstitut, Munich, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 7-19. refs

The review comprises models which combine horizontal-, vertical- and gravity-sensitive measurements within an integrated estimation of geometrical and physical quantities and is restricted to geodetic networks which cover a partial area of the earth surface. The regional restriction involves problems different from those of global integrated geodesy and not yet fully investigated. After having presented the development from classical separation of horizontal, vertical and gravity networks to local four-dimensional geodesy, the problems are analyzed regarding different aspects like e.g., 'integrated' and 'operational' geodesy, considerations of estimability, sensitivity and numerical stability. Impacts on future investigations are proposed. Author

**A83-46353**

## **COMBINATION OF LEVELING AND GRAVITY DATA FOR DETECTING REAL CRUSTAL MOVEMENTS**

B. HECK (Karlsruhe, Universitaet, Karlsruhe, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 20-30. refs

When studying vertical crustal movements by geodetic methods it has become customary to use either repeated levelings or repeated gravity measurements. But neither gravity nor leveling data nor measured potential differences - if each type of data is used separately - are able to give real crustal movements without additional geophysical hypotheses. The problem may be attacked by formulating a boundary value problem, the boundary values being linear combinations of measured temporal changes of gravity and gravity potential differences. For practical computations the solution for a non-spherical boundary surface is obtained by Molodensky's series expansion. The zero-order term of this series consists of a Stokes-like spherical integral formula assuming known boundary values all over the earth's surface. As the formulation of this boundary value problem is strongly similar to Molodensky's problem the properties of the solution (existence, uniqueness, stability) are comparable too. Author

**A83-46354**

## **A CONTRIBUTION TO 3D-OPERATIONAL GEODESY. I - PRINCIPLE AND OBSERVATIONAL EQUATIONS OF TERRESTRIAL TYPE. II - CONCEPTS OF SOLUTION**

G. W. HEIN (Darmstadt, Technische Hochschule, Darmstadt, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 31-85. Research supported by the Deutsche Forschungsgemeinschaft. refs

Final linear observational equations are derived in detail for an operational or integrated geodesy as proposed by Eeg and Krarup (1973), and solution strategies for such a model are presented. Equations for astronomic latitude and longitude, absolute gravity and gravity differences, zenith distances, azimuths, horizontal directions and horizontal angles, distances and potential differences, and gravity gradient measurements are obtained. A direct and stepwise standard collocation solution to the model is first shown, and then a new two-step iterative updating solution procedure for the integrated geodesy approach is given in detail. The first step consists of a common three-dimensional least squares adjustment neglecting the physical observations and applying no reductions at the observations. The second step gives an iterative improvement of the coordinates by introducing gravity potential observations and derivatives in a model of the general

collocation type. The gravity potential and its functionals are determined. C.D.

**A83-46355**

## **ORIENTATION INFORMATION OF LEVELLING AND GRAVITY MEASUREMENTS IN THREEDIMENSIONAL REGIONAL NETWORKS**

R. KELM (Deutsches Geodaetisches Forschungsinstitut, Munich, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 86-95. refs

For high accurate three-dimensional regional networks most precise observation types of today are electronic distance measurements in near horizontal and leveling plus gravity measurements in vertical direction. For the estimation of three-dimensional Cartesian coordinates in a local reference frame - e.g., required for recent crustal movement research it is analyzed under which conditions the estimation is significantly performed without direct measurements of orientation and angle parameters in horizontal and vertical directions, only by using the orientation character of leveling plus gravity informations. Numerical results of test net estimations are given. Author

**A83-46356**

## **ON THE INTERPOLATION OF GRAVITY ANOMALIES AND DEFLECTIONS OF THE VERTICAL IN MOUNTAINOUS TERRAIN**

H. BAUSSUS VON LUETZOW (US Army, Topographic Laboratories, Fort Belvoir, VA) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 111-118. refs

The paper first addresses the interpolation of gravity anomalies in mountainous terrain, to be represented as the sum of a 'signal' variable with a quasi-stationary estimation structure and a computable 'noise' variable without a stationary character. It then develops the particular solution of the boundary value problem of physical geodesy which permits a similar representation of deflections of the vertical and draws some conclusions concerning the inapplicability of Molodensky's series approach and of the collocation method for the accurate determination of vertical deflections from unmodified gravity anomalies in mountainous terrain. Thereafter, it discusses the estimation of signal-type deflections of the vertical by means of spatial covariance functions, i.e., by a linear regression technique called statistical collocation in physical geodesy, and provides first order expansions of planar covariance functions. Author

**A83-46357**

## **TEST COMPUTATIONS OF THREEDIMENSIONAL GEODETIC NETWORKS WITH OBSERVABLES IN GEOMETRY AND GRAVITY SPACE**

K. ENGLER, E. GRAFAREND, J. ZAISER (Stuttgart, Universitaet, Stuttgart, West Germany), and P. TEUNISSEN (Delft, Technische Hogeschool, Delft, Netherlands) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 119-141. Research supported by the Nederlandse Organisatie voor Zuiver-Wetenschappelijk Onderzoek. refs

Real test-nets are adjusted in the three-dimensional mode referring to a geometric earth-fixed equatorial reference system at a reference epoch. The observables - distances, horizontal and vertical directions, astronomic longitude, astronomic latitude, gravity and azimuths - are simultaneously processed. Their observational equations (functionals) include unknowns of type coordinate corrections, disturbances of longitude and latitude (vertical deflections), disturbances of gravity and polar motion components. Author

A83-46358

**THREE-DIMENSIONAL ADJUSTMENT OF GEODETIC NETWORKS USING GRAVITY FIELD DATA**

W. I. REILLY (Department of Scientific and Industrial Research, Geophysics Div., Wellington, New Zealand) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings Volume 7. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 142-156. Research supported by the Deutsche Forschungsgemeinschaft refs

The problem of interpolating longitude, latitude, and gravitational potential at network vertices is approached by forming estimates of the differences of these quantities between pairs of vertices, expressed as functions of six coordinate parameters, and introducing these estimates as 'observations' in a three-dimensional network adjustment. The six coordinate parameters are the geocentric Cartesian coordinates (X,Y,Z) and the natural longitude, latitude, and gravity potential ( $\omega$ ,  $\phi$ , W). The two-step solution procedure measures or estimates  $g$  and the gradients of ( $\omega$ ,  $\phi$ , W) at each network vertex and, holding these values fixed, introduces estimates of the differences in ( $\omega$ ,  $\phi$ , W) between network vertices, as well as the usual observations of distance, direction, and of potential difference, solving for the six unknown coordinate parameters at each vertex. The derived gradients can be used to estimate the error variances in the differences. C.D.

A83-46359

**INTERNATIONAL SYMPOSIUM ON GEODETIC NETWORKS AND COMPUTATIONS, MUNICH, WEST GERMANY, AUGUST 31-SEPTEMBER 5, 1981, PROCEEDINGS. VOLUME 5 - NETWORK ANALYSIS MODELS**

R. SIGL, ED. Symposium sponsored by the International Association of Geodesy. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, 332 p.

Aspects of geodetic networks and computation are discussed. The subjects considered include nonstatistical method for detecting outliers, adjustment by minimizing the sum of absolute residuals, reliability and gross error detection in programmatic blocks, reliability of third and fourth order network densifications, accuracy analysis of the Finnish Laser Geodimeter Traverse, combined least squares solution using terrestrial and Doppler observations, error propagation in leveling networks, methods and optimization of leveling networks to detect crustal movements. Also addressed are: description and analysis of homogeneous horizontal strain, least-squares prediction of horizontal coordinate distortions in Canada, three-dimensional kinematics of earth deformation from geodetic observations, geodetic predictions of crustal deformations, strength analysis of angular Anblock networks with distance measurements along the perimeter, statistical analysis for geodetic adjustment computations, height-dependent errors in leveling data, optimization of the measurement process, and laser ranging studies of Australian plate deformations. C.D.

A83-46360

**ACCURACY ANALYSIS OF THE FINNISH LASER GEODIMETER TRAVERSE**

J. KAKKURI, T. PARM (Geodetic Institute, Helsinki, Finland), V. ASHKENAZI, and S. A. CRANE (Nottingham University, Nottingham, England) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 5. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 85-93. Research supported by the Science and Engineering Research Council of England. refs

A simultaneous adjustment of the Finnish Laser Geodimeter Traverse and of the Finnish Primary Triangulation Network in order to obtain a more reliable statistical estimate of the Traverse coordinates and the corresponding accuracies is discussed. The preliminary adjustment of the Primary Triangulation Network is first described, followed by details of bias modeled adjustments performed in order to determine scale differences between the different types of distance measurements, and by a

description of a combined adjustment using both terrestrial and Doppler-derived data. C.D.

A83-46361

**COMBINED LEAST SQUARES SOLUTION USING TERRESTRIAL AND DOPPLER OBSERVATIONS**

D. EHLERT (Institut fuer angewandte Geodasie, Frankfurt am Main, West Germany) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 5. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 94-103 refs

A combined network adjustment using terrestrial and Doppler observations is presented. Difficulties in the estimation of weighting factors are pointed out. The introduction of Laplace-azimuths for stabilizing small terrestrial networks is studied. The investigation shows that Doppler observations are not only suitable for the positioning of terrestrial networks in a geocentric coordinate system, but can also be applied with the objective of stabilizing the terrestrial network. Moreover in the latter case, there appears to be a danger of degenerating the quality of the neighborhood geometry.

Author

A83-48112

**AN INVESTIGATION OF THE POSSIBILITY OF DETERMINING THE GEOMETRICAL CHARACTERISTICS OF SURFACES HAVING LARGE IRREGULARITIES ON THE BASIS OF MICROWAVE-RADIOMETRIC MEASUREMENTS [ISSLEDOVANIYE VOZMOZHNOСТИ DISTANTSIONNOGO OPREDELENIYA GEOMETRICHESKIKH KHKARAKTERISTIK POVERKHNOSTEI S KRUPNYMI NEROVNOSTIAM I PO SVCH-RADIOMETRICHESKIM IZMERENIAM]**

A. A. VLASOV and I. U. K. SHESTOPALOV. Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug 1983, p. 83-89. In Russian. refs

Expressions are obtained for the emissive power of an uneven surface made up of a number of cones standing on a plane. The expressions, which are derived for vertical and horizontal polarization, relate the emissive power to the angle of observation, the angle between the base and the elements of the cone, and the permittivity. The angle between the base and the elements is the same for each cone, whereas the altitudes of the cones differ. Experiments using modeling carried out to investigate the emissive power of the surface (the permittivity being constant) show that, if a correction is made for the roughness of the surface, the average value of the slopes of the surface can be evaluated to within 3 percent. C.R.

A83-48933

**DETERMINATION OF THE GEOCENTRIC GRAVITATIONAL CONSTANT FROM SATELLITE OBSERVATIONS [K VOPROSU OPREDELENIYA GEOTSENTRICHESKOI GRAVITATSIONNOI POSTOIANNOI PO SPUTNIKOVYM NABLUDENIAM]**

G. A. USTINOV and D. I. KAPILEVICH. Geodeziya i Aerofotos'emka (ISSN 0536-101X), no. 2, 1983, p. 57-61. In Russian

A83-49279

**VERTICAL VARIATIONS OF THE ALBEDO OF THE SYSTEM INCLUDING THE UNDERLYING SURFACE AND THE ATMOSPHERE [O VERTIKAL'NOM KHODE AL'BEDO SISTEMY PODSTILAIUSHCHAI POVERKHNOST'-ATMOSFERA]**

K. I. KONDRATEV, N. P. PIATOVSKAIA, N. G. ANDRONOVA, and M. A. PROKOFEV. IN: Radiation studies in the atmosphere. Leningrad, Gidrometeorizdat, 1982, p. 23-29. In Russian. refs

A procedure is proposed for determining the diurnal and vertical variations of the albedo of the surface-atmosphere system in cloudless conditions. The proposed semiempirical formula, suitable for processing actinometric data, describes the dependence of albedo on solar height and the surface albedo for the case of a 0-deg zenith angle. This approach is used to analyze data from several experimental programs including GATE, and the results are compared with direct satellite measurements. It is concluded that the proposed method makes it possible to reconstruct the

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albedo of the surface-atmosphere system from airborne measurements in cloudless conditions. B.J.

**N83-31065** Bayerische Akademie der Wissenschaften, Munich (West Germany). Deutsche Geodaetische Commission. **SPECIAL RESEARCH PROGRAM 78 SATELLITE GEODESY OF THE TECHNICAL UNIVERSITY OF MUNICH: FOLLOW-UP REPORTS OF THE PARTIAL PROJECTS Final Report** M. SCHNEIDER 1982 199 p refs In GERMAN Sponsored Tech. Univ., Munich (SER-B-261; ISBN-3-7696-8556-3; ISSN-0065-5317) Avail: Issuing Activity

Photographic and interferometric measurements, and astronomical-geodetic measurements are presented. Doppler measurement campaign results are discussed. Models and methods for the use of measurement results in satellite geodesy are considered. Figure and field parameter determination is treated. Author (ESA)

**N83-33287\*#** Ohio State Univ., Columbus. **ON THE GEODETIC APPLICATIONS OF SIMULTANEOUS RANGE-DIFFERENCING TO LAGEOS Final Report** E. C. PABLIS Dec. 1982 229 p refs (Contract NAS5-25888) (NASA-CR-170566; NAS 1.26:170566; REPT-338) Avail: NTIS HC A11/MF A01 CSCL 08B

The possibility of improving the accuracy of geodetic results by use of simultaneously observed ranges to Lageos, in a differencing mode, from pairs of stations was studied. Simulation tests show that model errors can be effectively minimized by simultaneous range differencing (SRD) for a rather broad class of network satellite pass configurations. The methods of least squares approximation are compared with monomials and Chebyshev polynomials and the cubic spline interpolation. Analysis of three types of orbital biases (radial, along- and across track) shows that radial biases are the ones most efficiently minimized in the SRC mode. The degree to which the other two can be minimized depends on the type of parameters under estimation and the geometry of the problem. Sensitivity analyses of the SRD observation show that for baseline length estimations the most useful data are those collected in a direction parallel to the baseline and at a low elevation. Estimating individual baseline lengths with respect to an assumed but fixed orbit not only decreases the cost, but it further reduces the effects of model biases on the results as opposed to a network solution. Analogous results and conclusions are obtained for the estimates of the coordinates of the pole. Author

**N83-33288#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany). **THE GERMAN-AUSTRIAN DOPPLER CAMPAIGN [DIE DEUTSCHE-OESTERREICHISCHE DOPPLERKAMPAGNE]** 1982 130 p refs In GERMAN (SER-B-260-MITT-164; ISSN-0071-9196) Avail: NTIS HC A07/MF A01

Doppler positioning measurements at stations in West Germany and Austria were performed in order to improve classical topographical measurements. Meteorological parameters are observed. A mathematical model for data evaluation is discussed. Calibration measurements of different Doppler receiver systems are performed. The choice of station coordinates weights in the calculations is discussed. The data processing of the measurement data is considered. Doppler and terrestrial coordinates are compared.

**N83-33289#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany). **THE CONCEPT OF THE GERMAN-AUSTRIAN DOPPLER OBSERVATION CAMPAIGN (DODOC) [DAS KONZEPT DER DEUTSCHE-OESTERREICHISCHE DOPPLERKAMPAGNE]**

K. RINNER and H. SEEGER *In its* The German-Austrian Doppler Campaign p 5-11 1982 refs In GERMAN Sponsored by Oesterreichischen Fonds zur Foerderung der wissenschaftlichen Forschung Avail: NTIS HC A07/MF A01

Doppler positioning measurements at 21 uniformly distributed stations in Germany and Austria were performed in order to investigate whether Doppler measurements can improve the classical topographical measurements. Multipoint determination and other simultaneous methods, verification of the error structure of terrestrial main triangulation grids, parameter calculation for a global Doppler reference system; and calculation of geocentric three-dimensional coordinates are studied. Author (ESA)

**N83-33295#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany). **COMPARISON BETWEEN THE DODOC RESULTS FOR GERMANY AND TERRESTRIAL COORDINATES [VERGLEICHE DER DODOC-ERGBNISSE (DEUTSCHER ANTEIL) MIT TERRESTRISCHEN KOORDINATEN]** W. SCHLUETER *In its* The German-Austrian Doppler Campaign p 91-111 1982 refs In GERMAN Avail: NTIS HC A07/MF A01

The Doppler coordinates of the DODOC German stations and one Austrian station were compared with different series of terrestrial coordinates. The comparison shows a surprisingly good agreement in the relative position of the points. The geodetic grids obtained by simultaneous Doppler measurements reach the quality of the classical grids for point distances between 100 and 200 km, even without knowledge of the precise ephemeris. Apart from weather independence and automation oriented data evaluation, the Doppler method also provides three dimensional coordinates. Author (ESA)

**N83-33296#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany). **COMPARISON BETWEEN DODOC RESULTS FOR AUSTRIA AND TERRESTRIAL COORDINATES [VERGLEICH DODOC-ERGBNISSE MIT TERRESTRISCHEN KOORDINATEN (OESTERREICHISCHER ANTEIL)]** K. RINNER *In its* The German-Austrian Doppler Campaign p 113-128 1982 refs In GERMAN Avail: NTIS HC A07/MF A01

The Doppler coordinates of the DODOC Austrian stations were compared with different series of terrestrial coordinates. Depending on the terrestrial coordinate system, discrepancies from + or - 28 cm upto + or - 201 cm are found. Author (ESA)

**N83-33297#** Institut fuer Angewandte Geodaesie, Frankfurt am Main (West Germany). **FINAL CONCLUSIONS AND PROSPECTS [SCHLUSSFOLGERUNGEN UND AUSBLICK]** K. RINNER, G. SEEGER, and H. SEEGER *In its* The German-Austrian Doppler Campaign p 129-130 1982 In GERMAN Avail: NTIS HC A07/MF A01

The DODOC Doppler positioning measurements and prospects are reviewed. An efficient point determination procedure is developed, characterized by simultaneous measurements in regional overlapping areas and by a combined compensation of the different data. The error structure of the German and Austrian main triangulation grids is revealed. Doppler system accuracy is + or - 0.3 to 0.5 m, and is limited by technology, geometrical system configuration, meteorological effects, calculation system, and different computer organization in the different stations. A better accuracy of the Doppler coordinates is possible by an

improvement of orbit determination, technology, and data evaluation  
Author (ESA)

**N83-33299#** Institut fuer Angewandte Geodäsie, Frankfurt am Main (West Germany). Adv Working Group Triangulation  
**DIAGNOSTIC ADJUSTMENT OF THE GERMAN PRIMARY TRIANGULATION NETWORK: DATA [ZUR DIAGNOSE-AUSGLEICHUNG DES DEUTSCHEN HAUPTDREIECKSNETZES]**

R. SCHMIDT *In its* The 1980 Diagnostic Adjustment of the German Primary Triangulation Element. Part 1: Data and Directions p 11-43 1982 refs In GERMAN  
Avail: NTIS HC A19/MF A01

The development of the German primary triangulation, and its diagnostic adjustments from 1750 onwards are reviewed. The purposes, methods of measurement and calculation, and the obtained accuracy are presented. The shortcomings of the German primary triangulation network (1955 situation) are listed. The overall diagnostic network adjustment assembles data from 1869 until 1979 from partial nets, chains, and filling-in networks. It includes all usable angle and distance measurements. The purpose is to supply more reliable data on the quality and imperfections of the net, and to provide a systematic review of the relative accuracy of the neighboring points. The net of the diagnostic adjustment contains all 297 primary triangulation points of the investigated area.  
Author (ESA)

**N83-33300#** Institut fuer Angewandte Geodäsie, Frankfurt am Main (West Germany)  
**THE DIRECTIONS INTRODUCED IN THE DIAGNOSTIC ADJUSTMENT OF THE GERMAN PRIMARY TRIANGULATION NETWORK [DIE IN DIE DIAGNOSE-AUSGLEICHUNG DES DEUTSCHEN HAUPTDREIECKSNETZES EINGEFUEHRTEN RICHTUNGEN]**

D. EHLERT *In its* The 1980 Diagnostic Adjustment of the German Primary Triangulation Element Part 1 Data and Directions p 45-426 1982 refs In GERMAN  
Avail: NTIS HC A19/MF A01

Criteria which determine the choice of direction measurements which are sufficiently accurate and can be transferred to the diagnostic triangulation network point centers are presented. The observations were performed from 1864 till 1969 and thus include very different instruments (till 1945 mainly screw microscope theodolites, afterwards exclusively the Wild T3-theodolite). The adjusting of the different stations is explained. The observations are reduced to the Bessel ellipsoid reference plane and weighed in order to take the different observation conditions into account. Points, directions, and deviations between geodetic and astronomical-geographic coordinates are listed for the different stations.  
Author (ESA)

**N83-36457\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md  
**THE ROLE OF SATELLITE LASER RANGING THROUGH THE 1990'S**

D. C. CHRISTODOULIDIS and D. E. SMITH Sep 1983 27 p  
Presented at the 17th Gen. Assembly Intern. Union of Geodesy and Geophys., Hamburg, Aug. 1983  
(NASA-TM-85104, NAS 1.15.85104) Avail: NTIS HC A03/MF A01 CSCL 20E

Contributions of Satellite Laser Ranging (SLR) in the fields of geodesy, oceanography, geodynamics, and geopotential are reviewed. With the best current systems SLR has successfully defined an absolute vertical datum to 3 cm and a relative horizontal datum with comparable accuracy. In the areas of Earth and space physics SLR has demonstrated its ability to provide information regarding the vertical and horizontal movements of the lithosphere, the rheology of the Earth, improved understanding of the evolution of the Earth-Moon system, the Earth's albedo and upper atmosphere, the polar wander, the frequency structure of the polar motion and in the definition of fundamental constants. Future options are discussed. It is indicated that SLR will continue to

provide a unique and powerful tool for the study of space and geosciences  
J.M.S.

## 04

## GEOLOGY AND MINERAL RESOURCES

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

**A83-43139**

**PROBLEM-ORIENTED GEOLOGICAL INTERPRETATION OF SATELLITE PHOTOGRAPHS [PROBLEMORIENTIERTE GEOLOGISCHE INTERPRETATION VON SATELLITENAUFNAHMEN]**

P. BANKWITZ (Deutsche Akademie der Wissenschaften, Zentralinstitut fuer Physik der Erde, Berlin, East Germany) *Gerlands Beitrage zur Geophysik* (ISSN 0016-8696), vol. 92, no. 2-4, 1983, p. 197-220 In German.

The approaches and methods employed in the interpretation of air and satellite photographs for geological studies are discussed and illustrated. The observed features are analyzed in terms of the information they provide on four interpretative levels: vegetation and drainage (as indicators of geologic features, especially tectonics), the immediate surface (soil types, erosion patterns, weathering); the upper lithosphere (rock formations, layering, deformation), and deeper structure (indirect evidence of fault zones, block borders, divisions). Illustrative examples demonstrate both the extraction of prespecified details from an extensive body of data and the development of the investigative perspective during the process of interpretation itself.  
T.K.

**A83-43894**

**SIGNATURE EXTENSION VERSUS RETRAINING FOR MULTISPECTRAL CLASSIFICATION OF SURFACE MINES IN ARID REGIONS**

J. R. CARR, C.E. GLASS, and R. A. SCHOWENGERDT (Arizona, University, Tucson, AZ) *Photogrammetric Engineering and Remote Sensing* (ISSN 0099-1112), vol. 49, Aug 1983, p. 1193-1199. Sponsorship: U.S. Department of the Interior. refs  
(Contract DI-G-5195005)

Because governmental agencies are responsible for conducting mined land inventories on a regular basis, it is desirable to standardize the manipulation of the digital Landsat data for this purpose. Supervised classification of Landsat images was used in this study to map Arizona copper mining activity in order to demonstrate the utility of these images for dynamic, regional inventories of mined lands. A set of spectral signatures derived at a single, large mining complex were extended spatially and temporally to discriminate mining activity from natural terrain features at other sites. Accurate classifications were obtained using signature extension, and, in some cases, the accuracy exceeded that obtained by retraining the classifier for individual mines.  
Author

**A83-45013**

**AERIAL PHOTOGRAPHY AND SCANNING AERIAL METHODS IN ENGINEERING GEOLOGICAL INVESTIGATIONS [AEROFOTOGRAFICHESKIE I SKANERNYE AEROMETODY PRI INZHENERNO-GEOLOGICHESKIKH ISSLEDOVANIYAKH]**

V. M. VALIAKH Moscow, *Izdatel'stvo Nedra*, 1982, 264 p. In Russian. refs

The most recent achievements in the area of scanning (thermal) and photographic remote aerial methods, as applied to terrain-geological conditions, are discussed. The principles of an application of remote aerial methods in regional geological studies are examined. Attention is given to the methods employed in geological studies conducted with the aid of airborne radar equipment, the methodical principles concerning an application of IR photography for geological studies, and the basic principles of



## 04 GEOLOGY AND MINERAL RESOURCES

an application of multispectral aerial photography. The application of multichannel aerial photography systems for regional geological objects of study is also described, taking into consideration the employment of a topography-indicating procedure. G.R.

**A83-45785**

### **MAGNETOMETER ARRAYS AND GEODYNAMICS**

D. I. GOUGH (Alberta, University, Edmonton, Canada) IN: Evolution of the earth. Washington, DC/Boulder, CO, American Geophysical Union/Geological Society of America, 1981, p. 87-95. refs

The results of magnetometer array studies of various earth regions are discussed. The geographical areas considered are western North America, the North American central plains conductive anomaly, a rift anomaly in southern Africa, and the Southern Cape anomaly. The geography and geological structures of the various conductive anomalies are shown, and theories concerning their origin are mentioned. C.D.

**A83-46121**

### **THE APPLICATION OF PROCESSED LANDSAT IMAGERY IN PHOTO-INTERPRETATION**

R. HAYDN and M. YOUSSEF (Muenchen, Universitaet, Munich, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 8 p. refs

A new technique to optimize Landsat multispectral images for photogeologic interpretation is discussed. Special emphasis is given to subtle variations of surface materials derived via ratio processing. By the use of the IHS color model and the introduction of a synthetic stereo effect, the ratio information is added to the image without destroying brightness variations and textures. The feasibility of the technique is demonstrated in a case study of an optimized Landsat image covering an area on both sides of the Gulf of Suez. The results are compared with a Landsat standard false color rendition and black and white aerial photographs. Author

**A83-46129**

### **LITHOLOGIC MAPPING USING SOLAR INFRARED**

T. S. WESCOTT (General Electric Co., Fairfield, CT) and J. W. GABELMAN IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Sample signatures of geological formations which yield data on mineral deposits were imaged using the Landsat bands between 0.5-1.1 micron and the thematic mapper bands from 0.45-2.35 and 10.4-12.5 microns. Images taken of areas in S. Africa, New Mexico, Chile, and Utah were compared with geological maps and field photographs. The enhancement of the information content of the satellite imagery using histogram stretching and feature-specific multidimensional enhancement are described. It was determined that no single- or multi-data type image or image enhancement technique was applicable to all kinds of rocks and exposure conditions. Effective combinations of Landsat data can only be determined experimentally for each area, with the critical parameters being color, texture, and mineralogy of the outcrop or derived soil. The IR region yields more lithologic detail than visible bands due to the narrowness of the IR bands. M.S.K.

**A83-46130**

### **GEOLOGIC THERMAL-INERTIA MAPPING USING HCMM SATELLITE DATA**

K. WATSON, S. HUMMER-MILLER, and T. OFFIELD (U.S. Geological Survey, Denver, CO) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Analytical and experimental results of several uses of thermal inertia mapping in regional geologic analysis with the Heat Capacity Mapping Mission (HCMM) satellite are presented. A thermal inertia algorithm is developed, and data are provided from imaging of

the Powder River Basin, WY, and Cabeza Prieta, AZ. Histograms generated for igneous rocks revealed distinctively varying thermal inertia signatures that were related to gneiss and schist, extrusive rocks of mafic composition, and extrusive rocks with less mafic composition. The Powder River data demonstrated that soil moisture increases the thermal inertia, although no data was available on the possible relationships to lithologic content. A night image of the same area exposed a previously unobserved lineament that exhibited a thermal inertia which varied significantly from its surrounds. The feature was correlated with previous aeromagnetic data. Helium anomalies were observed and found to be associated with oil and gas fields. M.S.K.

**A83-46131\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **THE USE OF THERMAL INFRARED IMAGES IN GEOLOGIC MAPPING**

A. B. KAHLE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. NASA-supported research. refs

Thermal infrared image data can be used as an aid to geologic mapping. Broadband thermal data between 8 and 13 microns is used to measure surface temperature, from which surface thermal properties can be inferred. Data from aircraft multispectral scanners at Pismo, California which include a broadband thermal channel along with several visible and near-IR spectral channels permit better discrimination between rock type units than the same data set without the thermal data. Data from the HCMM satellite and from aircraft thermal scanners also make it possible to monitor moisture changes in Death Valley, California. Multispectral data in the same 8-13 micron wavelength range can be used to discriminate between surface materials with different spectral emission characteristics, as demonstrated with both aircraft scanner and ground spectrometer data. Author

**A83-46132\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **LANDSAT-D TM APPLICATION TO PORPHYRY COPPER EXPLORATION**

M. ABRAMS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), D. BROWN (Texasgulf, Tucson, AZ), R. SADOWSKI (AMAX, Tucson, AZ), and L. LEPLEY IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 3 p. Research sponsored by the Geosat Committee, Inc., and NASA.

For a number of years Landsat data have been used to locate areas of iron oxide occurrences which might be associated with hydrothermal alteration zones. However, the usefulness of the Landsat data was restricted because of certain limitations of the spectral information provided by Landsat. A new generation multispectral scanner will, therefore, be carried by the fourth Landsat, which is to be launched in July, 1982. This instrument, called the Thematic Mapper (TM), will have seven channels and provide data with 30 m spatial resolution. Two of the spectral channels (1.6 micron and 2.2 micron) should allow detection of hydrous minerals. Possible applications of Landsat-D TM data for copper exploration were studied on the basis of a comparison of Landsat data with simulated TM data acquired using an aircraft scanner instrument. Three porphyry copper deposits in Arizona were selected for the study. It is concluded that the new Landsat-D TM scanner will provide Exploration geologists with a new improved tool for surveying mineral resources on a global basis. G.R.

**A83-46133\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**FINDING THE LOST RIVER GAS FIELD - LINEAMENT DENSITY ANALYSIS IN HYDROCARBON EXPLORATION**

H. R. LANG (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. Research sponsored by the Geosat Committee, Inc., and NASA refs

A comparative trial analysis of lineament density in 1:500,000 Landsat and 1:48,000 aerial Landsat-simulator images of a gas-field region in West Virginia is presented. The high-contrast, band 4, 5, 7 color composite Landsat image was interpreted independently by two analysts. The slightly different lineament maps were evaluated in terms of lineament-density variation in 10 x 10-km areas, and the resulting areal-variation maps are found to be statistically equivalent. High lineament density is shown to be associated with productive gas wells. Comparison of ground-based substructural contour maps and lineament-density analyses of the Landsat-simulator images reveals good correlation between density maxima or isopleths and substructural features associated with hydrocarbon formations. A hydrocarbon-exploration strategy using both Landsat and aerial images is proposed. T K

**A83-46134**

**INTERPRETATION OF LANDSAT IMAGERY - A CASE STUDY OF LINEATIONS IN A PART OF NORTH-WESTERN HIMALAYA, INDIA**

V. K. VERMA, A. KUMAR, and D. D. JOSHI (Delhi, University, Delhi, India) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. Research supported by the Indian Space Research Organization. refs

**A83-46135**

**DESERTIFICATION IN KAOKOLAND (NORTHERN SOUTH WEST AFRICA/NAMIBIA) - FIELD EVIDENCE, RECOGNITION IN SATELLITE IMAGERY, MAPPING OF SPATIAL DISTRIBUTION BY SATELLITE IMAGE INTERPRETATION (LANDSAT 1)**

U. RUST (Muenchen, Universitaet, Muenich, West Germany) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, 7 p.

**A83-46216**

**A COMPLEX SELECTIVE KEY TO IDENTIFY GENETIC RELIEF FORMS ON SATELLITE IMAGES /FOR EDUCATION AND TRAINING IN GEOMORPHOLOGICAL INTERPRETATION/**

J. LERNER (Eotvos Lorand Tudomanyegyetem, Budapest, Hungary) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

**A83-46218\*** Jet Propulsion Lab., California Inst of Tech., Pasadena.

**RADAR SCATTEROMETRY OF SAND DUNES AND LAVA FLOWS**

R. BLOM, C. ELACHI, and A. SHEEHAN (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. NASA-sponsored research refs

Four frequency like polarized scatterometer data over a sand dune field and a volcanic field were analyzed to understand the scattering characteristics of these two terrain types as a function of frequency and incidence angle. For the frequency range studied (400 MHz to 13.3 GHz) unvegetated sand dunes are specular reflectors that return an echo to the radar antenna particularly

when the geometry is such that the dune slope is nearly perpendicular to the antenna. Vegetation on the dunes can cause significant backscatter. Lava flows are strong diffuse scatterers which have backscatter values similar to coniferous forest at certain frequencies. Different observation frequencies are required for different situations. The scatterometer data correlate well with radar images. Author

**A83-46220\*** Jet Propulsion Lab., California Inst of Tech., Pasadena.

**SHUTTLE MULTISPECTRAL INFRARED RADIOMETER - PRELIMINARY RESULTS FROM THE SECOND FLIGHT OF COLUMBIA**

A. F. H. GOETZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), L. C. ROWAN, and M. J. KINGSTON (U.S. Geological Survey, Reston, VA) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2 New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. Research supported by the U.S. Geological Survey and NASA. refs

The Shuttle Multispectral Infrared Radiometer (SMIRR) is a spectroradiometer covering the region 0.5-2.5 microns in 10 channels that acquired data from 100 m diameter spots along the subspacescraft ground track. It was flown aboard the second flight of the Space Shuttle Columbia, November 12-14, 1981. Preliminary analysis of data from one of the 17 orbits covered shows that in Egypt, carbonate rocks, kaolinite, and possibly montmorillonite can be identified by their SMIRR spectral signatures in conjunction with limited knowledge of the regional geologic setting. The SMIRR data have made possible the first remote identification of carbonate rocks and clays from orbit. Author

**A83-46221\*** Jet Propulsion Lab., California Inst of Tech., Pasadena.

**THE SHUTTLE IMAGING RADAR (SIR-A) SENSOR AND EXPERIMENT**

C. ELACHI (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. NASA-supported research.

The SIR-A acquired images which cover about 10 million square kilometers in different regions around the world. These images are being analyzed to assess the capability of spaceborne radar sensor for geologic mapping and earth observation. An overview of the data acquired and preliminary science results will be presented. Author

**A83-46222\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**GEOLOGICAL MAPPING FROM SPACEBORNE IMAGING RADARS KENTUCKY-VIRGINIA, USA**

J. P. FORD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. NASA-supported research refs

Radar images (at wavelength 23.5 cm) of a 50-km-wide swath across Kentucky and Virginia obtained with the Shuttle Imaging Radar experiment (SIR-A) in 1981 and with the Seasat SAR in 1978 are compared. Image tone and texture, lineament mapping, drainage mapping, and the effects of illumination geometry and incidence angle are considered, and sample Landsat images are evaluated. The dominant backscatter effect in the SIR-A images is found to facilitate the mapping of steeply sloping terranes and lineaments shorter than the Seasat length resolution limit of about 15 km. It is determined that optimum enhancement of topographic features is obtained when the radar look angle exceeds the surface slope angle by a discrete amount, avoiding layover or relief displacement. A variable-look-angle radar is needed to maintain low incidence angles in regions with widely varying slope angles, as illustrated by the Landsat MSS images. T K



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**A83-46223**

### **PRELIMINARY ANALYSIS OF SHUTTLE IMAGING RADAR**

J. E. ESTES (California, University, Santa Barbara, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

The implications of oil slicks in the Santa Barbara Channel are discussed, with attention given to detecting them with active microwave systems such as the Shuttle imaging radar (SIR). At least 50 documented cases of natural oil slicks have been reported since 1792, and have been determined to originate from leaks from outcroppings of oil-bearing strata. The current accelerated rate of federal leasing of offshore drilling leases is regarded as too fast for terrestrial-based monitoring systems to cover once the drilling starts in multiple areas. Active sensing systems, such as the SIR, can offer all-weather monitoring of the environmental quality around the drilling platforms. The microwave backscatter cross section coefficient provides a continuous measurement of the physical and electrochemical state of the target, i.e., the sea surface. Marine oil accumulation is detected when it alters the distribution of water wave frequency components and reduces their amplitudes. A threshold condition can be determined, taking into account the background ocean backscatter, the radar system noise level, and the absolute resolution limits. M S.K.

**A83-46233**

### **MAPPING AND ANALYSIS OF AERIAL CONDUCTIVITY MEASUREMENTS FROM INPUT SYSTEM OVER GEOTHERMAL AREAS**

V. S. JORDON, D. V. SMITH (Geo-Centers, Inc., Newton, MA), and K. U. SIVAPRASAD (New Hampshire, University, Durham, NH) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 278-284. Sponsorship: U.S. Geological Survey. refs

(Contract USGS-14-08-0001-18823)

Remotely sensed electromagnetic data taken with an INPUT system for the U.S. Geological Survey in aerial surveys over a known geothermal resource area have been reduced and plotted in a gray scale format for two- and three-dimensional projections of the apparent subsurface conductance. The apparent conductance is calculated using both the channel ratio method and the theoretical two-layer model of the earth. Matching the survey data to the two-layer model gave good results consistent with the ratio method of apparent conductance calculation and permitted the construction of maps of horizontal slices of apparent conductance at different depths into the earth, from one to fifty meters. The channel ratio and horizontal slice maps of apparent conductance give a picture of the apparent conductance which is consistent with known topographical features of the regions.

Author

**A83-46363**

### **DEFORMATION OF THE AUSTRALIAN PLATE - PRELIMINARY FINDINGS FROM LASER RANGING TO THE LAGEOS SATELLITE**

A. STOLZ, P. V. ANGUS-LEPPAN, E. G. MASTERS, and B. HIRSCH (New South Wales, University, Kensington, Australia) IN: International Symposium on Geodetic Networks and Computations, Munich, West Germany, August 31-September 5, 1981, Proceedings. Volume 5. Munich, Verlag der Bayerischen Akademie der Wissenschaften, 1982, p. 327-332. Research supported by the Australian Research Grants Committee and University of New South Wales. refs

Results of laser ranging to the LAGEOS satellite have been analyzed to derive information on the internal deformation of the Australian plate, and some preliminary results are presented. The plate tectonics of the Australasian region are summarized, and the locations of existing and proposed ranging stations are shown. A mean value of 3 196 328.86 m has been determined for nine short orbital arcs observed at different times during 1980, with individual measurements deviating by up to 0.55 m from the mean.

The results agree well with those obtained by other investigators, and from classical geodetic surveys and Doppler satellite positions. The baseline variations are principally due to the effects of gravity modeling errors and, to a lesser extent, to errors in the fixed station positions. C.D.

**A83-46795**

### **PREDICTING ERUPTIONS AT MOUNT ST. HELENS, JUNE 1980 THROUGH DECEMBER 1982**

D. A. SWANSON, T. J. CASAVALL, D. DZURISIN, C. G. NEWHALL (Cascades Volcano Observatory, Vancouver, WA), S. D. MALONE (Washington, University, Seattle, WA), and C. S. WEAVER (U.S. Geological Survey, Washington, University, Seattle, WA) Science (ISSN 0026-8075), vol. 221, Sept. 30, 1983, p. 1369-1376. refs

Thirteen eruptions of Mount St. Helens between June 1980 and December 1982 were predicted tens of minutes to, more generally, a few hours in advance. The last seven of these eruptions, starting with that of mid-April 1981, were predicted between 3 days and 3 weeks in advance. Precursory seismicity, deformation of the crater floor and the lava dome, and, to a lesser extent, gas emissions provided telltale evidence of forthcoming eruptions. The newly developed capability for prediction reduced risk to life and property and influenced land-use decisions. Author

**A83-46796**

### **SEISMIC PRECURSORS TO THE MOUNT ST. HELENS ERUPTIONS IN 1981 AND 1982**

S. MALONE, C. BOYKO (Washington, University, Seattle, WA), and C. S. WEAVER (U.S. Geological Survey, Seattle, WA) Science (ISSN 0026-8075), vol. 221, Sept. 30, 1983, p. 1376-1378. Sponsorship: U.S. Geological Survey. refs

(Contract USGS-14-08-0001-19274)

Six categories of seismic events are recognized on the seismograms from stations in the vicinity of Mount St. Helens. Two types of high-frequency earthquakes occur near the volcano and under the volcano at depths of more than 4 kilometers. Medium- and low-frequency earthquakes occur at shallow depths (less than 3 kilometers) within the volcano and increase in number and size before eruptions. Temporal changes in the energy release of the low-frequency earthquakes have been used in predicting all the eruptions since October 1980. During and after eruptions, two types of low-frequency emergent surface events occur, including rockfalls and steam or gas bursts from the lava dome.

Author

**A83-46797**

### **DEFORMATION MONITORING AT MOUNT ST. HELENS IN 1981 AND 1982**

W. W. CHADWICK, JR., D. A. SWANSON, E. Y. IWATSUBO, C. C. HELIKER, and T. A. LEIGHLEY (Cascades Volcano Observatory, Vancouver, WA) Science (ISSN 0026-8075), vol. 221, Sept. 30, 1983, p. 1378-1380. refs

For several weeks before each eruption of Mount St. Helens in 1981 and 1982, viscous magma rising in the feeder conduit inflated the lava dome and shoved the crater floor laterally against the immobile crater walls, producing ground cracks and thrust faults. The rates of deformation accelerated before eruptions and thus it was possible to predict eruptions 3 to 19 days in advance. Lack of deformation outside the crater showed that intrusion of magma during 1981 and 1982 was not voluminous. Author

A83-46798

**GAS EMISSIONS AND THE ERUPTIONS OF MOUNT S. HELENS THROUGH 1982**

T. CASADEVALL, J. EWERT, R. SYMONDS (Cascades Volcano Observatory, Vancouver, WA), W. ROSE, R. WUNDERMAN (Michigan Technological University, Houghton, MI), T. GERLACH (Sandia National Laboratory, Albuquerque, NM), and L. P. GREENLAND (Hawaiian Volcano Observatory, Hawaii National Park, HI) Science (ISSN 0026-8075), vol. 221, Sept. 30, 1983, p. 1383-1385. refs  
(Contract DE-AC04-76DP-00789)

The monitoring of gas emissions from Mount St Helens includes daily airborne measurements of sulfur dioxide in the volcanic plume and monthly sampling of gases from crater fumaroles. The composition of the fumarolic gases has changed slightly since 1980: the water content increased from 90 to 98 percent, and the carbon dioxide concentrations decreased from about 10 to 1 percent. The emission rates of sulfur dioxide and carbon dioxide were at their peak during July and August 1980, decreased rapidly in late 1980, and have remained low and decreased slightly through 1981 and 1982. These patterns suggest steady outgassing of a single batch of magma (with a volume of not less than 0.3 cubic kilometer) to which no significant new magma has been added since mid-1980. The gas data were useful in predicting eruptions in August 1980 and June 1981. Author

A83-46800

**MONITORING THE 1980-1982 ERUPTIONS OF MOUNT ST. HELENS COMPOSITIONS AND ABUNDANCES OF GLASS**

W. G. MELSON (Smithsonian Institution, Dept. of Mineral Sciences, Washington, DC) Science (ISSN 0026-8075), vol. 221, Sept. 30, 1983, p. 1387-1391. refs

The Mount St. Helens eruptive sequence of 1980 through 1982 reflects the tapping of successively less water-rich, more highly crystallized, and more viscous, highly phryic dacitic magmas. These changes reflect both syn- and preeruption processes. The decreasing water content points to a continued decline in the volume and intensity of explosive pyroclastic activity. This decreasing water content appears to be composed of a long-term trend established during a long period of repose (about 130 years) imposed on short-term trends established during short periods (about 7 to 100 days) of repose between eruptions in the present eruptive cycle. The last two eruptive cycles of this volcano, the T (A.D. 1800) and W cycles (about A.D. 1500), exhibited similar trends. These changes are inferred from a combination of petrographic, bulk chemical, and electron- and ion-microprobe analyses of matrix and melt-inclusion glasses. Author

A83-47793

**USE OF THE FRAUNHOFER LINE DISCRIMINATOR (FLD) FOR REMOTE SENSING OF MATERIALS STIMULATED TO LUMINESCENCE BY THE SUN**

W. R. HEMPHILL (U.S. Geological Survey, Reston, VA), A. F. THEISEN (U.S. Geological Survey, Flagstaff, AZ), and R. D. WATSON. IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 213-222. refs

Recent work using an airborne Fraunhofer line discriminator (FLD) to image materials luminescing in sunlight is presented. Instrumentation used consists of an FLD capable of obtaining luminescence and reflectance values by a combination of sky-looking and earth-looking radiances, and a microprocessor-controlled imaging system providing a total scan angle of 37 deg. The system has been used to prospect for phosphate rock in the Sespe Creek area of California, and to observe marine oil seeps in the Santa Barbara Channel. An improved version of the imaging FLD has also been designed which will permit operation from aircraft at 3000 m and from the Space Shuttle in a circular orbit. A.L.W.

A83-47816\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**MINERALOGIC INFORMATION FROM A NEW AIRBORNE THERMAL INFRARED MULTISPECTRAL SCANNER**

A. B. KAHLE and A. F. H. GOETZ (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Science (ISSN 0036-8075), vol. 222, Oct. 7, 1983, p. 24-27. NASA-supported research. refs

The thermal IR multispectral scanner (TIMS) has been developed for airborne geologic surveys. The resststrahlen band between 8-11 microns is exhibited by interatomic stretching vibrations of Si and oxygen bound up in the crystal lattice of silicate rocks. The crystal structure of the component minerals influence the depth and position of the detected band. The TIMS has six channels, an 80 deg field of view, and a sensitivity sufficient to detect a noise equivalent change in spectral emissivity of 0.002-0.006. The six bands measured are 8.2-8.6, 8.6-9.0, 9.4-10.2, 10.2-11.2, and 11.2-12.2 microns, using HgCdTe detectors. The data are analyzed with respect to emissivity variations as a function of wavelength, using the component transformation technique called a decorrelation stretch, with spectral differences being displayed as different colors. Sample scenes from Death Valley and the Nevada Cuprite mining district are compared with visible and near-IR color composites of the same areas, revealing the superior distinctions that are available with the TIMS. M.S.K.

A83-48105

**CERTAIN FUNDAMENTAL PARAMETERS OF SPACE PHOTOGRAPHS CONSIDERED FROM THE STANDPOINT OF GEOLOGICAL INFORMATION [O NEKOTORYKH OSNOVNYKH PARAMETRAKH KOSMICHESKIKH SNIMKOV S POZITSII IKH GEOLOGICHESKOI INFORMATIVNOSTI]**

V. N. BRIUKHANOV (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Geologii Zharubezhnykh Stran, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 39-46. In Russian. refs

Parameters for the natural generalization of images and for the visibility and spectral characteristics of space photos are presented. The effect that these parameters have on the informativeness of photos with respect to geological questions on various scales is demonstrated. C.R.

A83-48106

**INFORMATION FROM SPACE AND THE PREDICTION OF EXOGENOUS PROCESSES [KOSMICHESKAIA INFORMATSIIA I PROGNOZIROVANIIE EKZOGENNYKH PROTSESSOV]**

A. L. REVZON and B. L. IUROVSKII (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Transportnogo Stroitel'stva, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 47-53. In Russian. refs

A technique is proposed for evaluating the tectonic fragmentation of an area. It is shown that the technique can be used as a criterion in spatial geodynamic predictions. The evaluation requires statistical processing of quantitative data obtained from space photographs. In addition, investigations must be made of the probability of occurrence of exogenous processes as a function of tectonic fragmentation. C.R.

A83-48107

**TRANSREGIONAL FAULTS IN THE NORTHEASTERN PART OF THE USSR APPEARING IN SPACE PHOTOGRAPHS [TRANSREGIONAL'NYE RAZLOMY SEVERO-VOSTOKA SSSR, PROIYAVLENNYE NA KOSMICHESKIKH SNIMKAKH]**

N. I. FILATOVA (Vsesoiuznoe Aerogeologicheskoe Nauchno-Proizvodstvennoe Ob'edinenie Aerogeologii, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 54-58. In Russian.

These faults traverse sections of the earth's crust of varying structure and manifest themselves as well in elements of the Pacific Ocean bed. It is known that these structures existed in Phanerozoic times, but it is most likely that they predate these times and that the depths extended to the mantle. As the earth's crust developed, the faults delimited and directed the blocks involved in horizontal

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motion. Faults extending downward through the crust caused the formation of calc-alkali magmatic belts that are transverse to the main magmatic fracture systems. C.R.

**A83-48108**

**THE USE OF SPACE PHOTOGRAPHS FOR ANALYZING RECENT TECTONIC MOVEMENTS /USING THE AMU DARYA AS AN EXAMPLE/ [PRIMENENIE KOSMICHESKIKH SNIMKOV DLIA ANALIZA PLANA NOVEISHIKH TEKTONICHESKIKH DVIZHENII /NA PRIMERE DEL'TY AMU DAR'I/]**

M. I. BURLESHIN (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Gidrogeologii i Inzhenernoi Geologii, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 59-63. In Russian. refs

The results obtained from an interpretation of the transverse tectonic structures seen on space photographs of the delta of the Amu Darya River are considered. A relationship is found between the plicative and disjunctive dislocations that complicate these structures. Data obtained in the field that support this interpretation are discussed. C.R.

**A83-48109**

**ANALYSIS OF THE PATTERN OF GEOLOGICAL JOINTS FROM AN INTERPRETATION OF AEROSPACE PHOTOGRAPHS (USING THE PECHENGA ORE REGION AS AN EXAMPLE) [ANALIZ TRESHCHINOVATOSTI PO DANNYM DESHIFRIROVANIYA AEROKOSMICHESKIKH SNIMKOV /NA PRIMERE PECHENGSKOI RUDNOI ZONY/]**

A. F. GRACHEV, S. B. FELITSYN, N. A. BABICH, V. I. MISHIN, and N. B. FILIPPOV (Akademiya Nauk SSSR, Institut Fiziki Zemli, Moscow; Proizvodstvennoe Geologicheskoe Ob'edinenie Sevzapgeologii, Leningrad, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 64-69. In Russian. refs

The results obtained from studying the Pechenga region on the basis of aircraft and satellite photographs, field observations, and geochemical assays are discussed. From an investigation of the lineament pattern, it is shown that the Pechenga deposits can be related to an area where dislocations (with a break in continuity) are at a maximum. A relationship is also discerned between the pattern of joints and mineralization. C.R.

**A83-48110**

**RECONSTRUCTION OF THE STRIKE-SLIP FAULTS OF THE ADYCHA-TARYN REGION [REKONSTRUKTSIYA SDVIGOV ADYCHA-TARYNSKOGO RAIONA]**

V. B. KOMZIN (Proizvodstvennoe Geologicheskoe Ob'edinenie Yakutskgeologii, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 70-77. In Russian. refs

Theoretical studies, confirmed by experiment, and information gained from the northeastern part of the Yakutsk ASSR are used in considering the application of systems analysis to tectonic interpretations of space photographs. The morphology of the interpreted lineaments makes it possible to distinguish kinematically related systems of various classes (including some heretofore unknown) and to define the horizontal movement of the strike-slip faults. The advantages and limitations of the method are discussed. C.R.

**A83-48115**

**THE ANALYSIS AND DEMARCATION OF OIL-AND-GAS-BEARING REGIONS BY THE SMOOTHING OF PHOTOGRAPHIC IMAGES FROM SPACE [ANALIZ I VYDELENIE NEFTEGAZONOSNYKH OBLASTEI PUTEM SGLAZHIVANIYA KOSMICHESKIKH FOTOIZOBRAZHENII]**

M. V. SMIRNOV and L. N. ROZANOV (Vsesoiuznyi Nauchno-Issledovatel'skii Neftianoi Institut, Leningrad, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 113-119. In Russian. refs

The two approaches to the geological interpretation of space photographs are discussed. One seeks to identify the spectral characteristics of the earth's surface registered in the photos with geological formations. The other, which is less direct, takes into

account a number of topographical features. The optical properties of natural features on space photos are determined through the coefficient of spectral brightness when spectral-zone photos are used and through the overall brightness coefficient when the photos encompass the entire visible region. In general, photos do not give the brightness coefficients of individual objects; instead, the coefficients are integral and refer to an aggregation. It is shown here how an allowance can be made for the factors that affect the optical characteristics of natural formations. Attention is then given to a geological analysis of the results obtained from machine processing. C.R.

**N83-30462#** Joint Publications Research Service, Arlington, Va  
**GEOLOGICAL OBSERVATIONS BY SALYUT-7 COSMONAUTS**  
A. POKROVSKIY *In its* USSR Rept.: Space, No. 19 (JPRS-82771) p 70-72 31 Jan. 1983 Transl into ENGLISH from Pravda (Moscow), 10 Jun. 1982 p 6  
Avail: NTIS HC A06

Geological structural analyses from the Salyut-7 space station are reported. The existence of structures which was not clear in previous photography was confirmed. The boundaries of the astrakhan arch were observed and the left bank continuation of the arch could be distinguished. E.A.K.

**N83-31078#** Data Information Associates, Albuquerque, N. Mex.  
**STATISTICAL TECHNIQUES APPLIED TO AERIAL RADIOMETRIC SURVEYS (STAARS): TIME SERIES ANALYSIS OF AIRBORNE RADIOMETRIC DATA. NATIONAL URANIUM RESOURCE EVALUATION**

H. T. DAVIS Sep. 1982 62 p refs  
(Contract W-7405-ENG-36; DE-AC13-76GJ-01664)  
(DE83-000782; GJBX-215-18) Avail NTIS HC A04/MF A01

Airborne radiometric surveys over parts of the United States were conducted to assist in the location of potentially profitable mineral deposits. Techniques useful in the analysis of these survey data are presented. The concept of linearity certain point processes is outlined. The concept of filtering a point process together with the model for the process can then be used to derive the matched filter to optimally extract the ground level concentration information from the airborne data. The use of the airborne data to enhance design of ground based experiments and measurements is discussed and concepts of multivariate time series are developed to show how several energy bands can be optimally used to estimate the concentration of a single isotope using time series regression methods. Time series principal components are used to gain better signal to noise properties than are typically obtained with the use traditional principal components DOE

**N83-31630#** Joint Publications Research Service, Arlington, Va.  
**SPACE SURVEY TECHNIQUES BENEFIT GEOLOGY**

G. V. VOLKOV *In its* USSR Rept.: Space, No. 23 (JPRS-83994) p 75-77 28 Jul. 1983 Transl into ENGLISH from Izvestiya (Moscow), 15 Jan. 1983 p 3  
Avail: NTIS HC A06

Projects for the discovery of new deposits of useful minerals that are conducted on the basis of the extensive utilization of photographs from space consist of a number of sequential stages. Initially, comparatively small-scale, specialized cosmogeological and mineragenetic-prediction maps are compiled from space photographs. Elements of the structure of the Earth's crust to which increased concentrations of useful minerals can be confined are isolated on them. During the second stage, onsite confirmation of the results of interpreting the space photographs is carried out. The projects are completed by purposeful prospecting for deposits. Cosmogeological cartography is now being done on a systematic basis and encompasses this country's entire territory. Specialized maps with images of large structural elements discovered with the help of space surveying materials were compiled for the first time in world practice. Author

**N83-32138\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil).

**APPLICATION OF MSS/LANDSAT IMAGES TO THE STRUCTURAL STUDY OF RECENT SEDIMENTARY AREAS: CAMPOS SEDIMENTARY BASIN, RIO DE JANEIRO, BRAZIL [APLICACOES DE IMAGENS MSS/LANDSAT NO ESTUDO ESTRUTURAL DE AREAS SEDIMENTARES RECENTES BACIA SEDIMENTAR DE CAMPOS RIO DE JANEIRO - BRASIL]**

N. D. J. PARADA, Principal Investigator and M. P. BARBOSA  
May 1983 36 p refs In PORTUGUESE; ENGLISH summary  
Sponsored by NASA ERTS  
(E83-10385; NASA-CR-172927, NAS 1.26:172927;  
INPE-2738-RPE/434) Avail: NTIS HC A03/MF A01 CSCL 08G

Visual and computer aided interpretation of MSS/LANDSAT data identified linear and circular features which represent the "reflexes" of the crystalline basement structures in the Cenozoic sediments of the emergent part of the Campos Sedimentary Basin  
Author

**N83-32140\*#** Earth Satellite Corp., Chevy Chase, Md.  
**GEOLOGIC EXPLORATION: THE CONTRIBUTION OF LANDSAT-4 THEMATIC MAPPER DATA**

J. R. EVERETT, J. D. DYKSTRA, and C. A. SHEFFIELD 1983  
13 p Sponsored by NASA ERTS  
(E83-10387, NASA-CR-172929; NAS 1.26:172929) Avail: NTIS HC A02/MF A01 CSCL 08G

The major advantages of the TM data over that of MSS systems are increased spatial resolution and a greater number of narrow, strategically placed spectral bands. The 30 meter pixel size permits finer definition of ground features and improves reliability of the photointerpretation of geologic structure. The value of the spatial data increases relative to the value of the spectral data as soil and vegetation cover increase. In arid areas with good exposure, it is possible with careful digital processing and some inventive color compositing to produce enough spectral differentiation of rock types and thereby produce facsimiles of standard geologic maps with a minimum of field work or reference to existing maps. Hue-saturation value images are compared with geological maps of Death Valley, California, the Big Horn/Wind River Basin of Wyoming, the area around Cement, Oklahoma, and Detroit. False color composites of the Ontario region are also examined.

A R H.

**N83-32142\*#** Earth Satellite Corp., Chevy Chase, Md.  
**STUDY OF LANDSAT-D THEMATIC MAPPER PERFORMANCE AS APPLIED TO HYDROCARBON EXPLORATION Quarterly Progress Report, 7 Apr. - 7 Jul. 1983**

7 Jul. 1983 4 p ERTS  
(Contract NAS5-27384)  
(E83-10389, NASA-CR-172931; NAS 1.26:172931; QPR-3) Avail: NTIS HC A02/MF A01 CSCL 05B

Many scenes of particular interest have a light dusting of snow cover. The possible use of hue-saturation-intensity transformations to reduce the effect of snow cover is being investigated. A tape of the Greeley, Colorado scene was reviewed on the interactive system and image types to be produced (decorrelated 2,3,4, natural color 1,2,3,; hue separation value 5/2,5/7 eigen 1, 4,5,7 in two color combinations) were selected. In several instances, a 1,3,4 combination produces a more useful false color infrared version of TM data than the more common 2,3,4 arrangement, probably because band 1 is less highly correlated with the band 3 and 4 than is band 2. A review of spacecraft performance suggests that the standard corrections applied at GSFC are more complicated than necessary in some areas and insufficient in other cases. The image motion compensation device on the TM works so well that bow-typing effects are very small, there are differences in the radiometry of forward and backward scans that make additional calibration necessary  
A R H.

**N83-32224#** California Univ., Livermore. Lawrence Livermore Lab.

**AIRBORNE-TEMPERATURE-SURVEY MAPS OF HEAT-FLOW ANOMALIES FOR EXPLORATION GEOLOGY**

N. K. DELGRANDE 9 Jul. 1982 4 p Presented at the 2nd Thematic Conf. Remote Sensing for Exploration Geology, Fort Worth, Tex., 6-10 Dec. 1982  
(Contract W-7405-ENG-48)  
(DE82-019111, UCRL-87802, CONF-821204-1) Avail: NTIS HC A02/MF A01

Airborne temperature surveys were used to depict the small surface temperature differences related to heat flow anomalies. Zones with conductive heat flow differences of 45, + or - 16 micro cal/ sq cm had predawn surface temperature differences of 1.4 + or - 0.3 C. Airborne temperature surveys were coordinated with field temperature surveys at the site of a known geothermal resource area. The airborne temperature surveys recorded redundant, predawn temperatures at two wavelengths and at two elevations. Overall temperature corrections were determined by calibrating dry soil surface temperatures with thermistor probes. The probes measured air and soil temperatures within 2 cm of the surface, every twenty minutes, during the survey overflights.  
DOE

**N83-33307#** Pacific Northwest Lab., Richland, Wash.  
**REPORT ON GEOLOGIC REMOTE SENSING OF THE COLUMBIA PLATEAU**

G. A. SANDNESS, C. S. KIMBALL, K. E. SCHMIERER, and J. W. LINDBERG May 1982 360 p refs  
(Contract DE-AC06-77RL-01030)  
(DE83-010201, RHO-BW-CR-133P; PNL-3140) Avail: NTIS HC A16/MF A01

The use of remote sensing to identify faults or other geologic features which may have a significant bearing on the structural and tectonic character of the Hanford Site and the surrounding region is discussed. LANDSAT imagery, Skylab photographs, and U-2 photographs were analyzed to identify and map geologic photolineaments in the Columbia Plateau. The LANDSAT and Skylab imagery provided a regional perspective and allowed the identification of large-scale linear features. The U-2 photography provided much greater spatial resolution as well as a stereoscopic viewing capability. This allowed identification of smaller structural or geologic features and the identification of many cultural and nongeologic lineaments detected in the LANDSAT and Skylab imagery. The area studied totals, approximately 85,000 square miles, and encompasses virtually all exposures of Columbia River Basalt in the states of Washington, Oregon, and Idaho. It also includes an area bordering the Columbia River Basalt outcrop.  
DOE

**N83-34403\*#** Geosat Committee, Inc., San Francisco, Calif.  
**RECOMMENDATIONS CONCERNING SATELLITE-ACQUIRED EARTH RESOURCE DATA: 1982 REPORT OF THE DATA MANAGEMENT SUBCOMMITTEE OF THE GEOSAT COMMITTEE, INCORPORATED**

Nov. 1982 54 p Sponsored by NASA ERTS  
(E83-10411; NASA-CR-173005, NAS 1.26:173005) Avail: NTIS HC A04/MF A01 CSCL 05B

End user concerns about the content and accessibility of libraries of remote sensing data in general are addressed. Recommendations pertaining to the United States' satellite remote sensing programs urge: (1) the continuation of the NASA/EROS Data Center program to convert pre-1979 scenes to computer readable tapes and create a historical archive of this valuable data; (2) improving the EROS archive by adding geologically interesting scenes, data from other agencies (including previously classified data), and by adopting a policy to retire data from the archive; (3) establishing a computer data base inquiry system that includes remote sensing data from all publically available sources; (4) capability for prepurchase review and evaluation; (5) a flexible price structure; and (6) adoption of standard digital data products format. Information about LANDSAT 4, the status of worldwide LANDSAT receiving stations, future non-U S remote sensing

## 04 GEOLOGY AND MINERAL RESOURCES

satellites, a list of sources for LANDSAT data, and the results of a survey of GEOSAT members' remote sensing data processing systems are also considered. A.R.H.

**N83-34404\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

### **PERFORMANCE EVALUATION AND GEOLOGIC UTILITY OF LANDSAT 4 TM AND MSS SCANNERS Quarterly Report, 4 Feb. - 4 Aug. 1983**

H. N. PALEY Aug. 1983 21 p refs Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E83-10412; NASA-CR-173006; NAS 1.26:173006) Avail: NTIS HC A02/MF A01 CSCL 08G

Experiments using artificial targets (polyethylene sheets) to help calibrate and evaluate atmospheric effects as well as the radiometric precision and spatial characteristics of the NS-001 and TM sensor systems were attempted and show the technical feasibility of using plastic targets for such studies, although weather precluded successful TM data acquisition. Tapes for six LANDSAT 4 TM scenes were acquired and data processing began. Computer enhanced TM simulator and LANDSAT 4 TM data were compared for a porphyry copper deposit in Southern Arizona. Preliminary analyses performed on two TM scenes acquired in the CCT-PT format, show the TM data appear to contain a marked increase in geologically useful information; however, a number of instrumental processing artifacts may well limit the ability of the geologist to fully extract this information. A.R.H.

**N83-34505#** California Univ., Livermore. Lawrence Livermore Lab.

### **AIRBORNE-TEMPERATURE-SURVEY MAPS OF HEAT-FLOW ANOMALIES FOR EXPLORATION GEOLOGY**

N. K. DELGRANDE 10 Nov 1982 14 p refs Presented at the Intern. Symp. on Remote Sensing of Environ., Ft. Worth, Tex., 6-10 Dec. 1982

(Contract W-7405-ENG-48)

(DE83-003018; UCRL-87802-REV-1; CONF-821204-1-REV-1)

Avail: NTIS HC A02/MF A01

Precise airborne temperature surveys depicted small predawn surface temperature differences related to heat flow anomalies at the Long Valley, California, KGRA. Zones with conductive heat flow differences of  $45 \pm$  or  $-16$   $\mu$ cal/sq cm(s) has predawn surface temperature differences of  $1.4 \pm$  or  $-0.3$  C. The warmer zones had hot water circulating in a shallow (less than 60-m-deep) aquifer. Hot water is a useful geochemical indicator of geothermal and mineral resource potential. The precise airborne temperature survey method recorded redundant infrared scanner signals at two wavelengths (10 to 12 micrometers and 4.5 to 5.5 micrometers) and two elevations (0.3 km and 1.2 km). Ground thermistor probes recorded air and soil temperatures during the survey overflights. Radiometric temperatures were corrected for air path and reflected sky radiation effects. Corrected temperatures were displayed in image form with color coded maps which depicted 0.24 C temperature differences. DOE

**N83-35469\*#** Arkansas Univ., Fayetteville. Remote Sensing Lab.

### **EVALUATION OF SIR-A SPACE RADAR FOR GEOLOGIC INTERPRETATION: UNITED STATES, PANAMA, COLOMBIA, AND NEW GUINEA Final Report**

H. MACDONALD, W. P. WAITE, V. H. KAUPP, L. C. BRIDGES, and M. STORM Aug. 1983 84 p refs Prepared for JPL, Pasadena, Calif.

(Contract NAS7-918; JPL-954940)

(NASA-CR-173121; JPL-9950-874; NAS 1.26:173121;

ARSL-TR-83-2) Avail: NTIS HC A05/MF A01 CSCL 08B

Comparisons between LANDSAT MSS imagery, and aircraft and space radar imagery from different geologic environments in the United States, Panama, Colombia, and New Guinea demonstrate the interdependence of radar system geometry and terrain configuration for optimum retrieval of geologic information.

Illustrations suggest that in the case of space radars (SIR-A in particular), the ability to acquire multiple look-angle/look-direction radar images of a given area is more valuable for landform mapping than further improvements in spatial resolution. Radar look-angle is concluded to be one of the most important system parameters of a space radar designed to be used for geologic reconnaissance mapping. The optimum set of system parameters must be determined for imaging different classes of landform features and tailoring the look-angle to local topography. Author

### **N83-35475# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, DURANGO A, COLORADO DETAIL AREA, VOLUME 2C Final Report**

1983 115 p Prepared in cooperation with QEB, Inc.

(Contract DE-AC13-79GJ-01692)

(DE83-014826; GJBX-31-83-VOL-2C-DA) Avail: NTIS HC A06/MF A01

Airborne gamma ray were surveyed spectrometrically and by magnetometry. This volume contains three appendices: magnetic contour maps, multi-variant analysis maps, and geochemical factor analysis. These maps are of the Durango A detail area. DOE

### **N83-35476# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY: MONUMENT VALLEY A, UTAH, DETAIL AREA, VOLUME 2A Final Report**

1983 540 p refs Prepared in cooperation with QEB, Inc., Lakewood, Colo.

(Contract DE-AC13-79GJ-01692)

(DE83-012992; GJBX-26-83-VOL-2A(MVA)) Avail: NTIS HC A23/MF A01

Stacked profiles; geologic histograms; geochemical histograms; speed and altitude histograms; geologic statistical tables; geochemical statistical tables; magnetic and ancillary profiles, and test line data are presented and considered. DOE

### **N83-35477# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, CAMERON B, ARIZONA, DETAIL AREA, VOLUME 2B Final Report**

1983 298 p Prepared in cooperation with QEB, Inc.

(Contract DE-AC13-79GJ-01692)

(DE83-012987; GJBX-25-83-VOL-2B(CBA)) Avail: NTIS HC A13/MF A01

Volume 2 B contains appendices for flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariate analysis maps, and geochemical factor analysis maps. DOE

### **N83-35478# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY: MONUMENT VALLEY B, UTAH, DETAIL AREA, VOLUME 2A Final Report**

1983 553 p Prepared in cooperation with QEB, Inc.

(Contract DE-AC13-79GJ-01692)

(DE83-012991; GJBX-26-83-VOL-2A(MVB)) Avail: NTIS HC A24/MF A01

Airborne gamma-rays were surveyed by spectrometer and magnetometer. The following topics are discussed: stacked profiles; geologic histograms; geochemical histograms; speed and altitude histograms; geologic statistical tables; geochemical statistical tables; magnetic and ancillary profiles; and test line data. DOE

## OCEANOGRAPHY AND MARINE RESOURCES

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

**A83-41342****RADARSAT - THE CHALLENGE OF DAILY SATELLITE ICE RECONNAISSANCE**

E SHAW (Radarsat, Canada) IN: ICC '82 - The digital revolution; International Conference on Communications, Philadelphia, PA, June 13-17, 1982, Conference Record, Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, p 1G.4.1-1G.4.6

Since 1976, investigations in Canada have been concerned with the employment of synthetic aperture radar (SAR) as the primary sensor for obtaining information over the frozen and open oceans bordering Canada. SAR has also been studied in connection with forestry, geology, hydrology, and agriculture applications. The present investigation is mainly concerned with the ice reconnaissance application of SAR. Such an application is very important for arctic marine transportation in connection with the discovery of gas and oil reserves in the northern regions. Ice reconnaissance is to be provided by the Radarsat system. The data acquisition components of Radarsat are a single polar orbiting satellite equipped with a steerable swath radar, and two long-range aircraft also equipped with imaging radar. There are two satellite ground stations, each with a radar processor, and one ice information center. G R.

**A83-41793****THE BASIC PROPERTIES OF SYNTHETIC-APERTURE-RADAR IMAGES OF SEA WAVES FOR LONG SYNTHESIS TIMES, AND THEIR INTERPRETATION [OSNOVNYE SVIOSTVA SINTEZIROVANNYKH RADIOLOKATSIONNYYKH IZOBRAZHENII MORSKOGO VOLNENIIA PRI BOL'SHIKH VREMENAKH SINTEZA I IKH INTERPRETATSIIA]**

A. V. IVANOV (Akademii Nauk SSSR, Institut Radiotekhniki i Elektroniki, Moscow, USSR) Radiofizika (ISSN 0021-3462), vol. 26, no 5, 1983, p. 540-550. In Russian. refs

The synthetic-aperture-radar (SAR) imaging of sea waves is considered as a process of measuring the correlation between values of backscattered radiation of the SAR for different azimuthal positions of the SAR platform. A relatively simple description is proposed for the focusing effect peculiar to the SAR imaging of sea waves, and it is shown that the wave image contrast does not degrade with increasing synthesis time. The same results are obtained by the direct analysis of the transformation of the radar input signal (calculated in accordance with the two-scale model of scattering) into an image for the case of a sinusoidal wave without limits on the synthesis time B.J.

**A83-42041\*** California Univ., Santa Barbara.**SATELLITES FOR THE STUDY OF OCEAN PRIMARY PRODUCTIVITY**

R. C. SMITH (California, University, Santa Barbara, CA) and K. S. BAKER (California, University, San Diego, CA) (COSPAR, Workshop and Topical Meeting on Life Sciences and Space Research, Ottawa, Canada, May 16-June 2, 1982) Advances in Space Research (ISSN 0273-1177), vol. 3, no 9, 1983, p. 123-133. refs (Contract NSG-1641)

The use of remote sensing techniques for obtaining estimates of global marine primary productivity is examined. It is shown that remote sensing and multiplatform (ship, aircraft, and satellite) sampling strategies can be used to significantly lower the variance in estimates of phytoplankton abundance and of population growth rates from the values obtained using the C-14 method. It is noted that multiplatform sampling strategies are essential to assess the mean and variance of phytoplankton biomass on a regional or on

**N83-35479# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, CAMERON A, ARIZONA, DETAIL AREA, VOLUME 2B Final Report**

1983 156 p Prepared in cooperation with QEB, Inc. (Contract DE-AC13-79GJ-01692) (DE83-012990; GJBX-25-83-VOL-2B(CAA)) Avail: NTIS HC A08/MF A01

Volume 2 B contains appendices for flight line maps, geology maps, explanation of geologic legend, flight line/geology maps, radiometric contour maps, magnetic contour maps, multivariant analysis maps, and geochemical factor analysis maps. DOE

**N83-35480# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY: MONUMENT VALLEY B, UTAH, DETAIL AREA, VOLUME 2B Final Report**

1983 307 p Prepared in cooperation with QEB, Inc., Lakewood, Colo (Contract DE-AC13-79GJ-01692) (DE83-012994; GJBX-26-83-VOL-2B(MVB)) Avail: NTIS HC A14/MF A01

Flight line maps, geology maps, geologic legend, flight line/geology maps, radiometric contour maps; magnetic contour maps, and geochemical factor analysis maps are considered. DOE

**N83-35481# Research Inst. of National Defence, Linköping (Sweden). Dept. 3****LASER DEPTH SOUNDING FOR LOCALIZATION OF OIL BELOW WATER SURFACE: RESULTS FROM A FLIGHT TRIAL**

O STEINVALL Apr. 1983 15 p refs In SWEDISH; ENGLISH summary Sponsored by Swedish Coast Guard (FOA-C-30319-E1, ISSN-0347-3708) Avail: NTIS HC A02/MF A01; Research Inst. of National Defence, Stockholm Kr 50

The feasibility of airborne laser detection of oil slicks was tested. Oil samples, in the form of nets covered with oil, were detected down to 15 m depth. Approximately 1/10 of the laser beam cross section is occupied by oil. With lower areal coverage the echo from the oil disappears against a background of backscattered laser radiation from the surrounding water volume. By comparing the magnitude of the oil echo with that of the bottom at the corresponding depth, an estimate of the detection range for other water clarities is established. Author (ESA)

**N83-36544# High Life Helicopters, Inc., Puyallup, Wash. AIRBORNE GAMMA-RAY SPECTROMETER AND MAGNETOMETER SURVEY, ARIZONA. VOLUME 2A: CAMERON A DETAIL AREA Final Report**

1983 536 p Prepared in cooperation with QEB, Inc. (Contract DE-AC13-79GJ-01692) (DE83-012989; GJBX-25-83-VOL-2A(CAA)) Avail: NTIS HC A23/MF A01

Appendices for: stacked profiles, geologic histograms; and geochemical histograms are presented. Speed and altitude histograms; geologic statistical tables; geochemical statistical tables; magnetic and ancillary profiles, and test line data are also included. DOE

## 05 OCEANOGRAPHY AND MARINE RESOURCES

a global basis. The relative errors associated with shipboard and satellite estimates of phytoplankton biomass and primary productivity, as well as the increased statistical accuracy possible from the utilization of contemporaneous data from both sampling platforms, are examined. It is shown to be possible to follow changes in biomass and the distribution patterns of biomass as a function of time with the use of satellite imagery. N.B.

### A83-42171

#### **SATELLITE AND SHIP STUDIES OF COCCOLITHOPHORE PRODUCTION ALONG A CONTINENTAL SHELF EDGE**

P. M. HOLLIGAN, M. VIOLLIER (Marine Biological Association of the United Kingdom, Plymouth, England), D. S. HARBOUR (Commission of the European Communities, Joint Research Centre, Ispra, Italy), P. CAMUS (Institution Scientifique et Technique des Peches Maritimes, Nantes, France), and M. CHAMPAGNE-PHILIPPE (Etablissement d'Etudes et de Recherches Meteorologiques, Lannion, Cotes-du-Nord, France) *Nature* (ISSN 0028-0836), vol. 304, July 28, 1983, p. 339-342. Research supported by the Natural Environment Research Council, Ministry of Agriculture, Fisheries and Food, Centre National de la Recherche Scientifique and Centre National d'Etudes Spatiales. refs

The growth of coccolithophores (CLP) along the outer margin of the NW-European continental shelf is studied using in situ and Coastal-Zone-Color-Scanner (CZCS) observations made during May, 1982. The large patches of high reflectance apparent in satellite images of the area every year from late April to mid June are attributed to phytoplanktons, dominated by the CLP *Emiliana huxleyi* at densities up to 8500 cells/ml. Each cell is found to have an average of 20 attached coccoliths, while detached coccoliths reached densities of 100,000/ml. It is shown that the presence of CLP should be taken into account in the data-reduction algorithm used in estimating chlorophyll in surface waters from CZCS images. The significant contribution of CLP populations to the sedimentation of particulate CaCO<sub>3</sub> (at least 10 g/sq m for one patch studied) on a global scale is discussed. T.K.

### A83-42216#

#### **TECHNIQUES FOR MEASURING RADIANCE IN SEA AND AIR**

W. H. WELLS (TetraTech, Inc., Pasadena, CA) *Applied Optics* (ISSN 0003-6935), vol. 22, Aug. 1, 1983, p. 2313-2321. Navy-supported research. refs

The disadvantage of the radiometer class of measurements is that the inherent quantities can only be deduced indirectly by a cumbersome inversion of the equations of radiative transfer. What is more, information is lost in the process. A new type of radiometer is proposed here that circumvents these limitations. Its angular response is so contrived that the equations of radiative transfer are very easy to invert. It also makes it possible to arrange flashlamps to be used when natural light is too diffuse. Two limitations to the proposed method are discussed. The first is that the radiometer must rise or drop through the medium in question, either tethered to the experimental platform (aircraft or ship) or by radiosonde or similar means. The second is that the variations in the scattering medium must be primarily vertical. That is, the theory of the radiometer accurately applies to stratified clouds and ocean but not to the occasional features, such as thunderheads, whose height exceeds their horizontal extent. C.R.

**A83-42506\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

#### **MONITORING TROPICAL-CYCLONE INTENSITY USING ENVIRONMENTAL WIND FIELDS DERIVED FROM SHORT-INTERVAL SATELLITE IMAGES**

E. RODGERS (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD) and R. C. GENTRY (Clemson University, Clemson, SC) *Monthly Weather Review* (ISSN 0027-0644), vol. 111, May 1983, p. 979-996. refs

The feasibility of predicting changes in tropical storm intensity based on satellite observations of the dynamical relationships between the large-scale upper and lower tropospheric circulations surrounding the cyclone and the characteristics of the storm's

inner core is studied. Rapid-scan visible images from the SMS-1 and GOES-1 satellites were used to examine the local change in relative angular momentum (RAM), the lower and upper tropospheric environmental areal mean relative vorticity and transverse circulation on three consecutive days for tropical storms Caroline (August, 1975), Anita (August and September, 1977) and Ella (September, 1978). The three case studies suggest that storm intensification may be predicted from the storm's local change of net RAM, with this quantity best correlated with storm intensification after a time lag of 6 hours. Intensification is also found to be related to the environmental lower and upper tropospheric areal-mean relative vorticity, and to the upper tropospheric environmental circulation, which acts either to hinder or to enhance the storm's anticyclonic outflow channels. A.L.W.

### A83-42513#

#### **EASTERN NORTH PACIFIC TROPICAL CYCLONES OF 1982**

E. B. GUNTHER, R. L. CROSS, and R. A. WAGONER (NOAA, Eastern Pacific Hurricane Center, Redwood City, CA) *Monthly Weather Review* (ISSN 0027-0644), vol. 111, May 1983, p. 1080-1101.

Tropical cyclone activity in the eastern North Pacific in 1982 is summarized. The 1982 season was one of the most active on record, spanning 160 days with 11 hurricanes, eight tropical storms, and seven tropical depressions. Reports of damage and/or casualties were confined to but two storms, hurricanes Paul in western Mexico and Olivia in California. Satellite coverage of cyclone activity was provided by the geostationary GOES and polar-orbiting NOAA satellites; aircraft reconnaissance was also obtained of Hurricane Olivia as it moved northward off the Baja California coast. Numerically generated forecast tracks were available for the 1982 season, with the best performance shown by a statistical-dynamical model which, however, was not capable of supplying data on a real-time basis. A.L.W.

### A83-42818

#### **THE OCEANIC CRUST**

J. FRANCHETEAU (Paris VI, Universite, Paris, France) *Scientific American* (ISSN 0036-8733), vol. 249, Sept. 1983, p. 114-129.

Various aspects of the geology of the oceanic crust are considered. The sea floor spreading cycle is described, and a model of the layered structure of the oceanic crust is presented, examining unsolved problems of that model. The kinematics of the plates is described, showing faults and fracture zones, and the evidence gathered by satellite studies is presented. The structure of the midoceanic ridge called the East Pacific Rise is examined, and the use of seismic waves to study the ridges is reviewed. Experiments to study the structure and composition of the oceanic crust using drill holes, seismic waves, Rayleigh waves, and electrical conductivity tests are described. C.D.

### A83-42826

#### **ERS-1 - AN ICE AND OCEAN MONITORING MISSION**

P. R. C. GILLET (Dornier System GmbH, Friedrichshafen, West Germany) (European Space Symposium, 18th, London, England, June 8, 9, 1983) *British Interplanetary Society, Journal (Space Technology)* (ISSN 0007-084X), vol. 36, Sept. 1983, p. 387-393.

The mission, instrumentation, spacecraft configuration, ground segment, and operations of the European earth resources satellite (ERS-1) for remote sensing are described. ERS-1 is intended for ice and ocean monitoring, particularly wind fields, wave spectra, wave height, ice sheet profiles and sea-ice boundaries. The data are useful for both meteorological and physical oceanographical studies. The spacecraft will carry active microwave instrumentation operating in the C-band, including SAR and a wind scatterometer, and a radar altimeter for wave measurements. The French SPOT satellite platform will be used, with minimum modifications. Data will be transmitted over the X-band with an integrated data handling and transmission unit. The spacecraft will weigh 2160 kg, using hydrazine thrusters, and have a 2.2 kW solar array. M.S.K.



A83-42970

**THE GROUND SEGMENT FOR A EUROPEAN OCEAN-MONITORING SATELLITE ERS-1**

M. JONES (ESA, Computer Dept., Darmstadt, West Germany) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 683-694.

The general structure of the first European remote sensing satellite (ERS-1) is described. The space segment is to include a multission platform, C-band microwave equipment, a radar altimeter, two scientific packages, a 5 Gbit storage device capacity, and a data handling and transmission system for X-band transmission in three formats: direct readout low rate, raw SAR data, and up to 15 Mbit/sec playback of recorded data. The spacecraft will monitor the ocean surface, wind vectors, and coastal regions. Imagery will be needed within several hours of sensing to make use of sea-state imagery. The ground segment will also have to control and monitor the platform, receive data, generate imagery as close to real-time as possible, and generate, archive, and distribute the products. It is suggested that videotape technologies should be investigated for the data handling and storage functions at the ground station. M.S.K.

A83-43548\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**BATHYMETRY ESTIMATES IN THE SOUTHERN OCEANS FROM SEASAT ALTIMETRY**

T. H. DIXON and M. E. PARKE (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Nature (ISSN 0028-0836), vol. 304, Aug. 4, 1983, p. 406-411. NASA-supported research refs

A 70-day Seasat altimeter set, where altitude was determined by the delay of a radar signal before return, was high pass filtered to obtain bathymetric data on the southern ocean. Variations were estimated over cross-track passages over the same points, and longer wavelength effects were removed to reveal the shorter wavelength geoid features. Edge effects near land, subtle geoid structure features at continental margins, smaller boundary seas, and lakes were preserved by the high pass filter, which involved subtracting a constant height from each 6 x 6 deg square region. A volcanic origin was indicated for the nearly continuous Louisville Ridge, which had a major elongate plateau or positive gravity anomaly located just eastward and running east-west. A large Conrad Ridge was found in the Indian Ocean, compared to previous charts. The Indian Ocean was also found to contain more rises and plateaus than previously mapped. M.S.K.

A83-44400#

**OBSERVATION OF A SURFACE WIND AROUND A TYPHOON BY SEASAT-I SCATTEROMETER**

H. OKAMURA and I. ISOZAKI (Meteorological Research Institute, Tsukuba, Japan) Papers in Meteorology and Geophysics (ISSN 0031-126X), vol. 34, June 1983, p. 83-94. In Japanese, with abstract in English. refs

The wind magnitude and directions around a typhoon as measured by the Seasat A scatterometer (SASS) were compared with those predicted by a two-layer barotropic model for the marine boundary layer. It was assumed that the ocean radar cross-section was free from attenuation. The wind velocities obtained from the spacecraft data were larger than model-generated wind speeds in the 5-15 m/sec velocity interval. The governing algorithm for the SASS instrument is suggested to be overly sensitive to wind speeds in that interval. M.S.K.

A83-46070\*

**MULTICOLOR LASER ALTIMETER FOR BAROMETRIC MEASUREMENTS OVER THE OCEAN - THEORETICAL**

C. S. GARDNER, B. M. TSAI, and K. E. IM (Illinois, University, Urbana, IL) Applied Optics (ISSN 0003-6935), vol. 22, Sept. 1, 1983, p. 2571-2577. refs (Contract NSG-5049)

It is noted that the optical path length from a satellite to the earth's surface strongly depends on the atmospheric pressure along the propagation path. The theoretical basis of a surface pressure

measurement technique, which uses a two-color laser altimeter to observe the change with wavelength in the optical path length from a satellite to the ocean surface, is evaluated. The statistical characteristics of the ocean-reflected pulses and the expected measurement accuracy are analyzed in terms of the altitude parameters. The results show that it is feasible to obtain a pressure accuracy of a few millibars. NB.

**A83-46071\*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md. MULTICOLOR LASER ALTIMETER FOR BAROMETRIC MEASUREMENTS OVER THE OCEAN - EXPERIMENTAL**

J. B. ABSHIRE and J. E. KALSHOVEN, JR. (NASA, Goddard Space Flight Center, Greenbelt, MD) Applied Optics (ISSN 0003-6935), vol. 22, Sept. 1, 1983, p. 2578-2585. NASA-supported research refs

Measurement theory and results from testing a breadboard multiwavelength (355-, 532- and 1064-nm) laser altimeter over horizontal paths are presented. They show that pressure accuracies of 3 mbar can be achieved when ranging at nadir to cube corner targets when using a 500-psec resolution waveform digitizer and utilizing new calibration techniques. Streak camera-based receivers will be required for the same or higher accuracies when ranging to the ocean surface. System design calculations for aircraft and spaceborne experiments are presented. Author

**A83-46074\*# National Aeronautics and Space Administration Goddard Space Flight Center, Greenbelt, Md.****AIRBORNE MEASUREMENTS OF LASER BACKSCATTER FROM THE OCEAN SURFACE**

J. L. BUFTON (NASA, Goddard Space Flight Center, Greenbelt, MD), F. E. HOGE (NASA, Wallops Flight Center, Wallops Island, VA), and R. N. SWIFT (EG & G Washington Analytical Services Center, Inc., Pocomoke City, MD) Applied Optics (ISSN 0003-6935), vol. 22, Sept. 1, 1983, p. 2603-2618. refs

The data are taken with three different pulsed laser sources, one each in the ultraviolet (337.1 nm), visible (532.1 nm) and infrared (9.5 microns). The principal instrument is the airborne oceanographic lidar of the NASA Wallops Flight Facility. The data on mean laser backscatter and its variation with angle off nadir are found to be consistent with previous analytical work and some previous experimental work. The absolute calibration of this backscatter in terms of an effective Lambertian reflectance is less precise, but the data support values near nadir of approximately 0.20 for low wind speeds. It is noted that these values are 1 order of magnitude larger than the Fresnel reflectance for an air/water discontinuity in the refractive index. Whereas the normalized standard deviation (modulation factor) of backscatter is less well understood analytically, it is defined by these measurements to range from a few percent to over 50 percent at nadir and to increase off nadir as the tangent of theta or faster. The data are uncertain beyond 15 deg off nadir owing to a dynamic range limitation. C.R.

A83-46105

**DFVLR ACTIVITIES IN REMOTE SENSING OF WATER**

F. LANZL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p.

The characteristics of remotely sensed water imagery are reviewed and attention is given to water remote sensing activities at DVL. Water can be sensed in the microwave, IR, and visible wavelengths, with the latter due to reflection, scattering, and fluorescence of solar radiation. Of all earth features, water has the least intense signature, necessitating wavelength selection and choice of an appropriate atmospheric window and an atmospheric model for data interpretation. Data are presently obtained with the Nimbus-7 CZCS instrument, the Landsat MSS, and the OCS on the Orbiter, in addition to similar airborne instruments, thermal scanners, and radiometers. Future instrumentation will include high



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resolution spectrometry and lasers, making data available on water temperature, sea state, surface winds, currents, depth, chlorophyll and biomass, sediment, and pollution. M.S.K.

**A83-46107**

### **THE OCCURRENCE OF SEA SLICKS ON THE OCEAN SURFACE AND THEIR INFLUENCE ON REMOTE SENSING SIGNALS**

H. HUEHNERFUSS (Hamburg, Universitaet, Hamburg, West Germany) and W. ALPERS (Hamburg, Universitaet; Max-Planck-Institut fuer Meteorologie, Hamburg, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p. Research sponsored by the Deutsche Forschungsgemeinschaft. refs

The influence of monomolecular surface films ('slicks') on the signals of X- and L-band radar, L- and S-band passive microwave, and lidar sensors was demonstrated by experiments with experimental slicks at the North Sea. The application of these sensors over ocean surfaces may be limited by the occurrence of natural or man-made slicks under lower and medium wind velocities. On the other hand, due to the characteristic modification of the signals of these sensors new promising approaches for remotely determining pollutants and natural organic substances on the sea surface can be proposed. Author

**A83-46108**

### **MICROPROCESSOR CONTROLLED MICROWAVE RADIOMETER SYSTEM FOR MEASURING THE THICKNESS OF AN OIL SLICK**

A. LAAPERI and E. NYFORS (Helsinki University of Technology, Espoo, Finland) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

A layer of oil on a water surface will cause interference in the thermal microwave radiation generated by the underlying water. This makes the brightness temperature increase periodically with respect to the thickness of the oil layer. It is therefore possible to obtain the thickness of the oil layer by measuring the brightness temperatures on two different frequencies. This report gives a short account of the theory involved using signal flow graphs and describes a microprocessor based radiometer system developed for this purpose at the Radio Laboratory of the Helsinki University of Technology. Author

**A83-46124**

### **NEW RESULTS OF AIRBORNE MEASUREMENTS WITH A SENSITIVE HIGH RESOLUTION 90 GHZ RADIOMETER**

K. GRUENER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

The results of test trials with a high resolution radiometer for airborne sensing at 90 GHz are reported. The instrument was equipped with a parabolic mirror scanning antenna and a linescanner with 1 K resolution at 3750/sec sampling. Measurements were taken between February 1980 and January 1982 in varying weather conditions, ground areas, and seasons. Attention was given to buildings, roads, snow covered regions, and crops. A temporal resolution near the theoretical limit was obtained after statistical analysis of the crop data. The snow cover data, however, taken at 400 m and 300 m altitude, could not be analyzed for specific features. The passively sensed data were compared with CCD data for the buildings and roads at a 100 m altitude, showing good feature extraction. M.S.K.

**A83-46126**

### **SYNTHETIC APERTURE RADAR IMAGING OF THE SEA**

P. K. PANNEY (Canada Centre for Remote Sensing, Ottawa, Canada) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p. refs

This paper reviews qualitatively the major interactions between the ocean surface and a SAR as they impact the ability of the SAR to resolve the azimuth component of wave structure. Characteristics of the surface/system response that must find their way into a more complete model are highlighted. Recent results in prediction of azimuth wave number cut-off are reviewed.

Author

**A83-46127**

### **COMPARISON OF COMPOSITE SAR WAVE-IMAGING MODEL WITH SEASAT-SAR IMAGERY**

F. M. MONALDO (Johns Hopkins University, Laurel, MD) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

(Contract N00024-78-C-5384)

The relationship between the Seasat SAR image and the slope variance spectrum of the ocean surface is investigated. The radar cross-section is known to vary with the wave parameters slope and height according to an exact model which is dependent on a modulation transfer function expressed as products of the composite wave-imaging model, the spectral resolution response functions for a stationary target and a moving target. SAR images waves through tilt modulation, spectral modulation, and orbital velocity modulation, with the sum of all of these determining the effect of the wave imaging mechanisms on the mapping between the SAR image spectrum and the slope-variance spectrum of the ocean. Account must also be taken of the stationary scatterer and the moving scatterer resolution response functions. The model predictions are shown to agree with the Seasat-SAR spectral readings. M.S.K.

**A83-46141**

### **AN ACTIVE MICROWAVE INSTRUMENTATION FOR LAND IMAGERY AND OCEANOGRAPHIC OBSERVATIONS**

B. THEILE (Dornier System GmbH, Friedrichshafen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. Research supported by the European Space Agency.

The design approach is examined for the Active Microwave Instrumentation (AMI), which will be a major payload component for the first ESA Remote Sensing Satellite (ERS-1). The AMI is a 5.3 GHz radar which employs a synthetic aperture radar and a scatterometer (SCATT) making maximum use of common hardware. All-weather earth surface imagery and measurement of two-dimensional ocean wave spectra can be obtained using the SAR instrument. The wind vector over ocean surfaces is measured utilizing the SCATT instrument. The imagery, wave, and wind modes employ the same high power amplifier. The maximum power consumption is found to be approximately 1.1 kW in the imaging mode and approximately 0.5 kW in the wind and wave modes. The four major subsystems (RF, data, antenna, and high power amplifier subsystems) are examined in detail. N.B.

**A83-46142\*** Applied Physics Lab., Johns Hopkins Univ., Laurel, Md

**AN ANALYSIS OF THE MULTIBEAM ALTIMETER**

G. B. BUSH, E. B. DOBSON, R. MATYSKIELA, C. C. KILGUS (Johns Hopkins University, Applied Physics Laboratory, Laurel, MD), and E. J. WALSH (NASA, Wallops Flight Center, Wallops Island, VA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 3 p.

The design concept and computer simulations of a multibeam altimeter (MA) to provide satellite-based oceanographic-feature data for map construction within relatively short times are presented. The limitations of the pulse-limited radar altimeter used on GEOS-3 and SEASAT-A, in particular the narrow swath of each measurement pass, are characterized. The MA uses interferometry with two 1.2-m dish antennas separated by an 11-m boom to cover a total swath width of 100 km at satellite altitude 800 km, nominal repetition rate 6 kp/sec, and nominal integration time 2.5 sec. Simulation analysis of antenna element pattern, echo shape, tracking algorithms, tracking noise, and measurement accuracy was performed, and the general feasibility of ocean-current mapping with a one-week time delay, using two MA-equipped satellites, was demonstrated. T.K.

**A83-46155\*** Stanford Univ., Calif.

**SEASAT-SAR OBSERVATIONS OF SURFACE WAVES, LARGE-SCALE SURFACE FEATURES AND SHIPS DURING THE JASIN EXPERIMENT**

J. F. VESECKY, H. M. ASSAL (Stanford University, Stanford, CA), R. H. STEWART (California, University, La Jolla; California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), R. H. SHUCHMAN, E. S. KASISCHKE, and J. D. LYDEN (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. Navy-NOAA-NASA-supported research refs

**A83-46157**

**RESULTS FROM THE MARINE REMOTE SENSING EXPERIMENT IN THE NORTH SEA (MARSEN), PHASE I**

V. AMANN, H. VAN DER PIEPEN, H. HELBIG (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany), and R. DOERFFER (Gesellschaft fuer Kernenergieverwertung in Schiffbau und Schifffahrt, Institut fuer Chemie, Geesthacht, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p.

The primary goals of the first phase were to collect data bearing on the investigation and mapping of hydrographic features; to provide a data set for the inverse modeling of the radiative transfer and for the interpretation of imagery; to provide sea truth for the verification of airborne and satellite-borne measurements; and to provide data for the correlation of biochemical and physical water parameters with in-situ optical measurements. It is pointed out that the test sites were selected in such a way as to include a large variety of coastal water masses containing different substances and phytoplankton communities and fronts of salinity and temperature. Results obtained from an ocean front survey and from studies of the horizontal distribution of suspended matter, small scale frontal structures, and the dispersion of industrial waste material are discussed. C.R.

**A83-46158\*** Hofstra Univ., Hempstead, N. Y.

**THE DELTA-K OCEAN WAVE SPECTROMETER - AIRCRAFT MEASUREMENTS AND THEORETICAL SYSTEM ANALYSIS**

D. E. WEISSMAN (Hofstra University, Hempstead, NY), J. W. JOHNSON (NASA, Langley Research Center, Hampton, VA), and J. T. RAMSEY (Hewlett-Packard Co., Richmond, VA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 8 p. refs

Measurements of the relative strength of ocean surface wave spectral components have been made from an aircraft using the two-frequency microwave resonance technique. A coherent Ku-band radar was used to study the Bragg type resonance matching (at the difference frequency Delta-f) to the surface wave components. The spatial spectrum of the surface reflectivity modulation was then computed as the value of Delta-f was varied over a matching range of approximately 15-150 m in surface wavelength. This paper contains experimental results from flights conducted during the 1979 MARSEN project and the 1980 ARSLOE project, and the objective here is to present the radar results in terms of the variety of surface illumination geometries encountered. It will be shown that the MARSEN results, with the narrow footprint, are consistent with a one-dimensional theoretical approach and that the ARSLOE results, with a symmetric beam pattern, agree well with the existing two-dimensional theory. Author

**A83-46159\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena

**DOPPLER PARAMETER ESTIMATION TECHNIQUES FOR SPACEBORNE SAR WITH APPLICATIONS TO OCEAN CURRENT MEASUREMENT**

F. LI, D. HELD, and J. CURLANDER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs (Contract NAS7-100)

The problems of Doppler parameter estimation in the processing of spaceborne synthetic aperture radar (SAR) data are examined. The phase history of a target can be approximated by a linear FM signal with two parameters: the Doppler centroid and the Doppler frequency rate. Two methods to estimate these parameters automatically from the radar echo are presented. The accuracies of these methods were evaluated using the SEASAT SAR data. It is shown that the method for Doppler centroid determination may be applicable in the measurement of ocean current velocities. The concept behind this technique is presented and the accuracies of the measurements required are examined. Some preliminary results of testing this technique with the SEASAT data are presented. Author

**A83-46171\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena

**GLOBAL MAPS OF OCEANOGRAPHIC AND ATMOSPHERIC PARAMETERS FROM THE SEASAT SMMR**

E. G. NJOKU and T. J. CHESTER (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 3 p. refs

The Seasat satellite was launched by the U.S. in June 1978, to demonstrate techniques for, and the utility of, microwave remote sensing of the ocean surface. One of the instruments on board was a scanning multichannel microwave radiometer (SMMR), designed to measure primarily ocean surface temperature, ocean surface wind speed, atmospheric water vapor and cloud liquid water. Global maps of these parameters have been produced, representing 10-day, monthly and mission (90-day) averages of the radiometer measurements. These maps are compared with those derived from conventional surface measurements, and demonstrate the day and night, nearly all-weather capabilities of the microwave measurements. Author

**A83-46205**

## THE BRIGHTNESS TEMPERATURE OF SEA ICE AND FRESH-WATER ICE IN THE FREQUENCY RANGE 500 MHZ TO 37 GHZ

M. T. HALLIKAINEN (Helsinki University of Technology, Espoo, Finland) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Two theoretical models have been used for calculating the brightness temperature of sea ice (salinity up to 8 parts per thousand by weight) and fresh-water ice. The layered model was applied between 500 MHz and 5 GHz for sea ice and up to 37 GHz for fresh-water ice. The radiative transfer model was used between 5 GHz and 37 GHz for both ice types. The dielectric properties of ice and snow were based on measured values and the scatterers were assumed to be spherical. The theoretical results were compared with experimental brightness temperatures in the literature and with Nimbus-7 data, made available by the NASA Goddard Space Flight Center

Author

**A83-46235\*** National Aeronautics and Space Administration. Langley Research Center, Hampton, Va.

## VARIATION OF THE MICROWAVE BRIGHTNESS TEMPERATURE OF SEA SURFACES COVERED WITH MINERAL AND MONOMOLECULAR OIL FILMS

H.-J. C. BLUME (NASA, Langley Research Center, Hampton, VA), H. HUEHNERFUSS (Hamburg, Universitaet, Hamburg, West Germany), and W. ALPERS (Hamburg, Universitaet; Max-Planck-Institut fuer Meteorologie, Hamburg, West Germany) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 295-300. refs

**A83-46767**

## DETECTION OF BOTTOM FEATURES ON SEASAT SYNTHETIC APERTURE RADAR IMAGERY

E. S. KASISCHKE, R. A. SHUCHMAN, D. R. LYZENG (Michigan, Environmental Research Institute, Ann Arbor, MI), and G. A. MEADOWS (Michigan, University, Ann Arbor, MI) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Sept. 1983, p. 1341-1353 refs (Contract DMA800-78-C-0060; N00014-81-C-2254)

A distinct set of surface patterns detected in imagery collected by the Seasat synthetic aperture radar (SAR) have been shown to be the result of an interaction between a physical oceanic process and a bottom topographic feature. These patterns can be used to infer a bottom feature, and thus are a potential source of information for identifying submerged features hazardous to surface navigation. The Seasat SAR imaged bottom-related surface patterns in both deep and shallow water. Examples of these surface patterns are presented in this paper along with explanations of how they occur.

Author

**A83-46908**

## THE NEAR-SURFACE CIRCULATION OF THE NORTH PACIFIC USING SATELLITE TRACKED DRIFTING BUOYS

G. J. MCNALLY, W. C. PATZERT (California, University, La Jolla, CA), A. D. KIRWAN, JR. (South Florida, University, Saint Petersburg, FL), and A. C. VASTANO (Texas A & M University, College Station, TX) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Sept. 20, 1983, p. 7507-7518. refs (Contract N00014-80-C-0440; N00014-75-C-0537; NSF OCE-81-00628)

A Lagrangian realization of the near-surface circulation of the North Pacific subtropical gyre is constructed on the basis of velocities derived from the trajectories of 16 satellite-tracked drifting buoys over the period February 1976-May 1980. Details of the surface flow indicated regional differences in mesoscale energetics. A comparison of the drifter data with the climatological mean field of dynamic topography shows significant differences between drifter movement and inferred geostrophic flow. A comparison of the

drifter trajectories and climatological seasonal sea level pressure maps further reveals that trajectory departures from the dynamic topography can often be related to atmospheric forcing. The drifters furnish a unique insight into the spatial and temporal relationship of geostrophic and wind-driven flow components influencing the near-surface circulation of the subtropical gyre.

O.C.

**A83-46914\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

## SEA ICE EFFECTIVE MICROWAVE EMISSIVITIES FROM SATELLITE PASSIVE MICROWAVE AND INFRARED OBSERVATIONS

J. C. COMISO (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Sept. 20, 1983, p. 7686-7704. NASA-supported research refs

Near-simultaneous images from the temperature-humidity IR radiometer and dual-polarization scanning multichannel microwave radiometer of the Nimbus 7 satellite are used to investigate microwave sea ice emissivities on a global scale. Emissivities in several Arctic region study areas are found to be approximately constant during a nine-month period covering the fall, winter and spring months, in the cases of both first-year and multiyear ice. During the onset of summer, emissivity increases of about 30 percent are observed at 37 GHz in multiyear ice. A multichannel cluster analysis over very large study areas during winter indicates considerable variability in emissivities of consolidated ice clusters at 37 GHz, and only 1/3 as much variability at 18 GHz. If the variability within each cluster is quantified and taken into account by means of multispectral analysis, data on ice thickness and surface characteristics may also be obtained.

O.C.

**A83-46915**

## 'LAYOVER' IN SATELLITE RADAR IMAGES OF OCEAN WAVES

J. F. R. GOWER (Institute of Ocean Sciences, Sidney, British Columbia, Canada) Journal of Geophysical Research (ISSN 0148-0227), vol. 88, Sept. 20, 1983, p. 7719, 7720

Present models explaining radar imaging of ocean surface waves have considered variations in radar cross section of the tilted or roughened surface and velocity bunching effects caused by the doppler shifts of moving scatterers. It is pointed out here that simple 'layover' effects will cause an additional, significant modulation of the image brightness that increases the visibility of range-traveling waves.

Author

**A83-47143**

## ON THE QUESTION OF DETERMINING TROPOSPHERIC REFRACTION [K VOPROSU OPREDELENIIA TROPOSFERNOI REFRAKTSII]

G. G. SHCHUKIN, I. A. MELNIK, I. V. ANDREEV, A. M. BRIKKER, S. M. GALPERIN, V. V. KASHINOV, N. F. MIKHAILOV, A. V. RYZHKOV, V. I. SELITSKAIA, and L. I. CHUKANOV IN: Methods of active and passive radar detection in meteorology. Leningrad, Gidrometeoizdat, 1982, p. 69-80. In Russian. refs

Various methods for determining the tropospheric refraction of ultrashort radio waves above the sea surface are examined, the investigation being illustrated by results of a complex experiment conducted in the Black Sea region in the autumn of 1979. Emphasis is placed on three methods for determining refraction: the method of gradient meteorological measurements from aboard a ship; a method for measuring radio-signal attenuation; and a radiometric method. It is shown that all three methods yield comparable values of refraction in the case of a horizontally homogeneous atmosphere.

B.J.

A83-47266#

**HYDROPHYSICAL ANALYSIS OF REMOTE MEASUREMENTS OF THE OCEAN FROM SPACE**

G. K. KOROTAEV, V. K. KOSNYREV, V. N. KUDRIAVTSEV, and V. S. SUETIN (Akademiia Nauk Ukrainskoi SSR, Morskoï Gidrofizicheskii Institut, Sevastopol, Ukrainian SSR) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983 7 p. refs (IAF PAPER 83-103)

An analysis has been conducted of subpolar front position on the basis of Kosmos-1151 data for the March 10-May 23, 1983 period. Maps of the ocean surface water temperature distribution were constructed for a region covering 20-70 deg W. The position of the Gulf Stream frontal zone was determined from that of a zone of maximum temperature gradients along the satellite's trajectory. Maximum temperature gradient zones were located between 10 and 13 C isotherms. The axis of the current, as derived from satellite measurements, largely coincides with its mean climatic position in the spring season, as well as with the data obtained by NOAA satellites O.C.

A83-47267#

**DYNAMICAL INTERACTION OF SENSIBLE HEAT RELEASED BY SEA SURFACE TO THE OUTBURST OF THE COLD AIR**

L.-C. CHIEN (Academia Sinica, Institute of Physics, Taipei, Republic of China) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983 11 p. refs

(IAF PAPER 83-104)

Sea surface temperature is determined from the radiance detected by the Advanced Very High Resolution Radiometer on the Tiros-N/NOAA satellites. The determination is made via a numerical experiment, involving a four-level primitive equation model and a 24-hour forecast. It is shown that the sensible heat transported from the sea surface plays an important role in atmospheric motion during an outburst of cold air, a finding that may be of help in explaining the development of winter cyclones in the vicinity of Taiwan. B.J.

A83-47284#

**ERS-1 PROCESSING ALGORITHMS AND DISSEMINATED PRODUCTS**

J. P. GUIGNARD (ESA, Noordwijk, Netherlands) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 8 p. refs (IAF PAPER 83-129)

The status of the processing algorithms definition for the planned ESA ERS-1 remote sensing satellite is assessed, together with the directions that will be followed to complete the algorithms' development. Criteria for the algorithms include fast delivery of SAR imagery and spectra, the wind field sensed with a scatterometer, and the significant wave height detected with the radar altimeter. SAR imagery, if in range Doppler form, will use processing proven on the Seasat, while development will be needed if a SPECAN approach is selected for the 40 m resolution, 100 x 100 sq km images. The SAR wave mode image spectra requires that the radar transfer function, speckle effects, and the modulation transfer function be eliminated. Empirical data is being gained in airborne trials to furnish a relationship between the backscatter coefficient and the wind vector. M.S.K.

A83-48479

**STATISTICS OF SPECKLES IN RADIO IMAGES OF THE SEA SURFACE OBTAINED IN HORIZONTAL POLARIZATION [O STATISTIKE SPEKLOV V RADIOIZOBRAZHENIIAKH MORSKOI POVERKHNOSTI, SNIATYKH NA GORIZONTAL'NOI POL'ARIZATSII]**

F. V. BUNKIN, K. I. VOLIAK, and I. V. SHUGAN (Akademiia Nauk SSSR, Fizicheskii Institut, Moscow, USSR) Radiofizika (ISSN 0021-3462), vol. 26, no. 7, 1983, p. 802-808. In Russian. refs

A simple model is developed for the formation of radar images of the sea surface in horizontal polarization in the centimeter and decimeter ranges in the case when the level of resonance

scattering is much below the level of specular reflection. It is shown that this model can be used to explain many features of the speckle structure on such images in relation to the parameters of sea waves. Examples concerning the modulation of wind-induced waves illustrate the promise of the proposed model with regard to the interpretation of radar images of the sea surface with the aim of acquiring oceanographic information. B.J.

A83-48510

**SURFACE CIRCULATION OF THE SOUTHERN OCEAN ACCORDING TO FGGE DRIFTING-BUOY DATA [POVERKHNOSTNAIA TSIRKULIATSIIA IUZHNOGO OKEANA PO DANNYM DREIFUIUSHCHIKH BUEV PGEP]**

E. L. AMONSKII, E. I. SARUKHANIAN, and N. P. SMIRNOV (Gosudarstvennyi Komitet SSSR po Gidrometeorologii i Kontroliu Prirodnoi Sredy, Arkhticheskii i Antarkhticheskii Nauchno-Issledovatel'skii Institut, Leningrad, USSR) Akademii Nauk SSSR, Doklady (ISSN 0002-3264), vol. 271, no. 2, 1983, p. 447-451. In Russian. refs

The main large-scale features of the surface circulation in the southern part of the world ocean were investigated in the FGGE through the satellite tracking of drifting buoys. The features thus disclosed accord with those shown on surface-circulation maps obtained by other maps. This indicates that the spatial characteristics of the circulation of the southern ocean are stable, and that the drifting-buoy method is an effective one in this case. B.J.

A83-48775\* Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**SATELLITES MAP THE OCEANS**

A. R. HIBBS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) and W. S. WILSON (NASA, Washington, DC) IEEE Spectrum (ISSN 0018-9253), vol. 20, Oct. 1983, p. 46-53

Satellite remote sensing systems, both operational and planned, for monitoring the ocean winds, temperatures, chlorophyll concentrations, ice flows, and the sea surface and ocean floor topographies are described. Seasat demonstrated the effectiveness of scatterometer measurements for measuring wind velocities and directions, and a new scatterometer may be launched on the U.S. Navy NROSS spacecraft in 1988. The NOAA-7 and -8 satellites carry IR sensors to monitor ocean temperatures, and can thus forewarn of the onset of El Nino. Ocean currents are traced with radar altimeters such as the one planned for the Topex satellite as a follow-on to instrumentation tested during the three-month lifetime of the Seasat satellite. Further analytical development is required, however, to improve the data analyses of the altimeter and scatterometer readings, and to account for errors introduced by the observed features and the interposed atmospheric phenomena. M.S.K.

A83-48934

**DETECTION OF OIL ON WATER SURFACES BY AERIAL REMOTE SENSING [OBNARUZHENIE NEFTI NA VODNOI POVERKHNOSTI AEROMETODAMI]**

R. I. FIMIN (Moskovskii Institut Inzhenerov Geodezii, Aerofotos'emki i Kartografii, Moscow, USSR) and V. N. OVECHKIN (Geodeziia i Aerofotos'emka (ISSN 0536-101X), no. 2, 1983, p. 62-68. In Russian. refs

Methodology and techniques of aerial remote sensing for the detection of oil slicks are reviewed. The possibilities of oil-slick detection in the ultraviolet, visible, and infrared ranges are assessed. Particular consideration is given to such techniques as multispectral photography, MSS, electron-optic radiometers, microwave radiometers, sidelooking radar, and vidicons. B.J.

## 05 OCEANOGRAPHY AND MARINE RESOURCES

**A83-49285**

**ASSESSMENT OF THE ACCURACY OF THE DETERMINATION OF SEA-SURFACE CHARACTERISTICS IN THE MICROWAVE RANGE [OTSENKA TOCHNOSTI OPREDELENIIA KHARAKTERISTIK MORSKOI POVERKHNOSTI V SVCH DIAPAZONE]**

IU. I. RABINOVICH and E. M. SHULGINA IN: Radiation studies in the atmosphere. Leningrad, Gidrometeoizdat, 1982, p. 76-82. In Russian. refs

An evaluation is made of the accuracy with which sea-surface temperature and surface-wind velocity can be determined from thermal-microwave measurements. Particular consideration is given to satellite-borne remote-sensing measurements (e.g., from Nimbus-7, Seasat-A, and Cosmos-243). Recommendations are given on the choice of optimal wavelengths for the remote sensing of sea-surface characteristics. B.J.

**N83-32139\*#** Delaware Univ., Newark. Coll. of Marine Studies. **EVALUATION OF SPATIAL, RADIOMETRIC AND SPECTRAL THEMATIC MAPPER PERFORMANCE FOR COASTAL STUDIES Quarterly Status and Technical Progress Report, 1 Apr. - 31 Jun. 1983**

V. KLEMAS 31 Jun. 1983 4 p ERTS

(Contract NAS5-27580)

(E83-10386; NASA-TM-172928; NAS 1.26:172928) Avail: NTIS HC A02/MF A01 CSCL 05B

Radiative transfer theory was used to model upwelling radiance for an orbiting sensor viewing an estuarine environment. Radiance was calculated in TM bands 3,4, and 5 and MSS bands 4 and 5 for an optically shallow estuary of either clear or turbid water, and of three bottom types: vegetation, sand, or mud. A portion of a TM image of Chesapeake Bay was enhanced to obtain a quick look at what submerged features could be detected. The enhancements were compared with low altitude color aerial photography. The TM bands 1,2, and 3 were found to contain water and submerged features information. Band 1 contained a significant amount of noise and low contrast. Band 2 appeared to contain the most amount of bottom information. Band 3, while having the least amount of noise and best contrast, contained a lesser amount of bottom information because of increase water absorption. Several water signatures were identified which correlated with submerged vegetation shown in the aerial photography. A.R.H.

**N83-32147\*#** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**SATELLITE DATA DISTRIBUTION SYSTEM (SDDS). THE DEVELOPMENT AND DEMONSTRATION OF NEW FISHERIES SUPPORT PRODUCTS BASED ON REMOTE OCEAN SENSING FROM SATELLITES**

1 May 1980 23 p Sponsored by NASA ERTS

(E83-10399; NASA-TM-85334; NAS 1.15:85334) Avail: NTIS HC A02/MF A01 CSCL 08A

A technical approach is outlined which builds on the existing data distribution system (developed and operated under the SEASAT data utilization program project) to distribute tailored products to more fisherman using cooperative facilities and expertise. Under the proposed concept, JPL would implement and manage a 30 month demonstration program involving a combination of commercial, educational, and government organizations. Daily fisheries depiction charts and fisheries aids charts as well as weekly sea surface temperature analyses and semiweekly fisheries outlooks can enhance fishing operations and tactics. In addition to satellite observations for analyzing sea surface temperature and for initializing the atmospheric Primitive Equation forecast of surface pressure, TIROS-N cloud imagery and the coastal zone scanner on NIMBUS-7 can provide indications of areas favorable to concentration of fish foods/nutrients. Water color summaries and sea surface temperature microstructure patterns can be included in the fisheries aids charts. A.R.H.

**N83-32264#** Naval Surface Weapons Center, Dahlgren, Va. **ON COMPUTING INSTANTANEOUS GEOCENTRIC TIDES ALONG SATELLITE TRACKS, THE NSWC STT PROGRAM Final Report**

E. W. SCHWIDERSKI and L. T. SZETO Sep. 1982 101 p refs

(Contract ZR0000101)

(AD-A128568; NSWC-TR-81-264) Avail: NTIS HC A06/MF A01 CSCL 08C

The authors present three computer programs to compute geocentric tides including ocean and earth tides and ocean-loading effects along parallel satellite tracks from the harmonic ocean tidal constants listed on the NSWC GOTD Tape (Schwiderski and Szeto 1981). The first program prepares a basic standard satellite track (SST), which is shifted parallel to itself to define a 1 x 1 SST grid system. The second program computes harmonic geocentric tide data at all SST grid points, which are stored on three magnetic tapes (SST GTD Tapes 1, 2, and 3). From the prepared SST GTD tapes, the third (SST) program computes instantaneous tides along parallel satellite tracks by a smooth and fast interpolation scheme. All three programs eliminate various input-error possibilities of their preliminary versions, which have been applied to compute instantaneous geocentric tides along SEASAT tracks. The program descriptions include corresponding User's Guides and Program Listings. An extended version of the SST program is in preparation. It will include group beat effects on all major tidal components by frequency-wise neighboring minor tidal modes. Author (GRA)

**N83-32268#** Naval Ocean Research and Development Activity, Bay St. Louis, Miss.

**K-BAND RADIOMETRIC MAPPING OF SEA ICE Final Report**

R D KETCHUM, JR., L. D. FARMER, and J. P. WELSH, JR. Jan. 1983 23 p refs

(AD-A128205; NORDA-TN-179) Avail: NTIS HC A02/MF A01 CSCL 08L

The Ka-band radiometric mapping system (KRMS), an airborne 33.6 GHz passive microwave imager, was flown over sea ice in the Bering, Chukchi and Beaufort Seas and in the Canadian Archipelago. The data discussed was obtained on 14 and 16 May 1982. The system, as flown, measures the relative brightness temperature ( $T_{sub B}$ ) of the objects radiating toward the rotating antennae. Differences in  $T_{sub B}$  appear to be related to variation in ice thickness, surface moisture, deformation processes and melting and refreezing processes. A snow/ice interface development is hypothesized to relate to decreasing  $T_{sub B}$  as ice increases in age. The  $T_{sub B}$  of undisturbed new ice is warmer than open water. The  $T_{sub B}$  of first-year ice appears to decrease with increasing age and seems to be less variable than the thinner ice types. Multi-year ice appears colder than first-year ice but warmer than open water. Two different categories of multi-year ice floes were observed. Arctic basin multi-year floes were distinguished by the rounded shapes, colder  $T_{sub B}$  and irregular distribution of frozen melt ponds (warmer  $T_{sub B}$ ). Archipelago multi-year floes were less rounded, had warmer  $T_{sub B}$  and displayed a more regular (homogeneous) distribution of frozen melt ponds. Both categories of multi-year floes were radiometrically colder than the warmer (higher  $T_{sub B}$ ) first-year ice types surrounding them and thus were readily identified. GRA

**N83-33269#** Meteorological Satellite Center, Tokyo (Japan).

**OBJECTIVE ANALYSIS OF SEA SURFACE TEMPERATURE**

T. AOKI and S. NAKAMINA In: *its* Sum. of TOVS Data Process System p 105-110 Mar. 1983 refs In JAPANESE, ENGLISH summary

Avail: NTIS HC A08/MF A01

The initial guess value of the sea surface temperature is the basic data for creating the initial clear radiance field of HIRS and initial clear radiance field of AVHRR in fine mesh points, to be used in the next TOVS data processing. In this article, a method to interpolate the sea surface temperature at grid points has been shown from the data of the retrieved sea surface temperature in

the APRET (Atmospheric Parameter RETrieval) file, with the use of the technique of objective analysis. Author

**N83-33497#** Bureau of Meteorology, Melbourne (Australia).  
**THE IMPACT OF THE GLOBAL WEATHER EXPERIMENT IN THE SOUTHERN HEMISPHERE**

J. W. ZILLMAN *In* WMO The Results of the Global Weather Expt p 41-134 1983 refs

Avail: NTIS MF A01, print copy available at WMO, Geneva

The impact of the Global Weather Experiment in the Southern Hemisphere 2 1/2 yr after the completion of its observational phase is assessed. The experiment had a major positive impact on routine meteorological operations during the observational year, but the impact is poorly documented. With the FGGE-type data base and sophisticated models, essentially automated broadscale analysis in the Southern Hemisphere appears operationally feasible and useful levels of prediction skill out to about a week are achievable. Drifting buoys, automated aircraft winds and satellite temperature sounding, along with satellite cloud imagery and cloud-track winds, emerge as essential components of a future composite Southern Hemisphere observing system.

Author (ESA)

**N83-33509\*#** National Aeronautics and Space Administration, Langley Research Center, Hampton, Va.

**ARCHIVAL OF AIRCRAFT SCATTEROMETER DATA FROM AAFE RADSCAT MISSIONS**

L. C. SCHROEDER and J. L. MITCHELL (Kentron International, Inc., Hampton, Va.) Aug. 1983 25 p refs  
 (NASA-TM-84608, L-15590; NAS 1.15:84608) Avail: NTIS HC A02/MF A01 CSCL 08J

Aircraft scatterometer data obtained over the ocean with the Radiometer-Scatterometer (RADSCAT) instrument is documented. The normalized radar cross section data was obtained at 13.9 GHz for a variety of ocean surface wind conditions, which are also presented. All such valid RADSCAT ocean scatterometer data for which surface truth was obtained are included, except for ice research missions during the last year of RADSCAT's lifetime. Aircraft scatterometer data obtained for the SEASAT underflights were with a second instrument, the Airborne Microwave Scatterometer (AMSCAT). The RADSCAT data are archived on card image computer tapes and on microfiche. S.L.

**N83-34426#** Coast Guard Research and Development Center, Groton, Conn.

**AERIAL PHOTOGRAPHIC SURVEYS ANALYZED TO DEDUCE OIL SPILL MOVEMENT DURING THE DECAY AND BREAKUP OF FAST ICE, PRUDHOE BAY, ALASKA Final Report**

I. M. LISSAUER and D. A. BAIRD Sep. 1982 60 p refs  
 (AD-A126395; CGR/DC-21/82; CG-D-51-82) Avail: NTIS HC A04/MF A01 CSCL 08L

During the summers of 1979 and 1980 aerial photographs of the land fast ice north of Prudhoe Bay, Alaska, were taken. These photographs, covering two week periods, highlight the decay and break-up of the land fast ice sheet. During the period of photography, wind speed, wind direction, barometric pressure, and tidal height measurements were recorded continuously. Several larger ice floes were 'tagged' with colored plywood markers during 1979. Both these marked floes and other distinctively shaped floes were tracked on the photographic surveys to determine the effect the wind had on their movement. Within the barrier islands, average ice floe velocities as a percentage of wind speed exceeded the 3.5% figure 'normally' found in the literature. North of these islands average ice floe velocities as a percentage of wind speed were less than the 3.5% value. In addition to the flow drift calculations the photographs provide information on melt pool formation and a comparison of the decay and breakup processes between the 1979 and 1980 seasons. The decay and breakup process appears to be triggered by strong wind events in early July. Author

**N83-35459\*#** Survey of India, Dehra Dun.

**ANALYSIS OF MAGSAT AND SURFACE DATA OF THE INDIAN REGION Final Report**

G. C. AGARWAL, Principal Investigator 1983 16 p refs  
 Sponsored by NASA Prepared in cooperation with National Geophysical Research Inst., Hyderabad, India, Indian Space Research Organization, Bangalore, and Indian School of Mines, Dhanbad ERTS  
 (E83-10420; NASA-CR-173052; NAS 1.26:173052) Avail: NTIS HC A02/MF A01 CSCL 08B

Techniques and significant results of an analysis of MAGSAT and surface data of the Indian region are described. Specific investigative tasks included: (1) use of the multilevel data at different altitudes to develop a model for variation of magnetic anomaly with altitude; (2) development of the regional model for the description of main geomagnetic field for the Indian sub-continent using MAGSAT and observatory data; (3) development of regional mathematical model of secular variations over the Indian sub-continent, and (4) downward continuation of the anomaly field obtained from MAGSAT and its combination with the existing observatory data to produce a regional anomaly map for elucidating tectonic features of the Indian sub-continent.

M. G.

**N83-35466\*#** General Electric Co., Philadelphia, Pa Space Systems Operation.

**NAVAL REMOTE OCEAN SENSING SYSTEM (NROSS) STUDY Final Report**

May 1983 183 p Prepared for JPL, Pasadena, Calif.  
 (Contract NAS7-100, JPL-956524)  
 (NASA-CR-173109; JPL-9950-858; NAS 1.26:173109, DOC-83SDS4223) Avail: NTIS HC A09/MF A01 CSCL 22B

A set of hardware similar to the SEASAT A configuration requirement, suitable for installation and operation aboard a NOAA-D bus and (2) a budgetary cost for one (1) protoflight model was provided. The scatterometer sensor is conceived as one of several sensors for the Navy Remote Ocean Sensing System (NROSS) Satellite Program. Deliverables requested were to include a final report with appropriate sketches and block diagrams showing the scatterometer design/configuration and a budgetary cost for all labor and materials to design, fabricate, test, and integrate this hardware into a NOAA-D satellite bus. This configuration consists of two (2) hardware assemblies - a transmitter/receiver (T/R) assembly and an integrated electronics assembly (IEA). The T/R assembly as conceived is best located at the extreme opposite end of the satellite away from the solar array assembly and oriented in position to enable one surface of the assembly to have unobstructed exposure to space. The IEA is planned to be located at the bottom (Earth viewing) side of the satellite and requires a radiating plate S.L.

**N83-35471#** Naval Research Lab., Washington, D. C. Experimental Sciences Div.

**A REMOTE SENSING EXPERIMENT IN THE NANTUCKET SHOALS (SEBEX) Interim Report**

G. R. VALENZUELA 28 Apr 1983 16 p refs Presented at the IUCRM Symp. on Wave Dyn. and Radio Probing of the Ocean Surface, Miami Beach, Fla., 13-20 May 1981  
 (Contract RR0320841)  
 (AD-A128091; NRL-MR-5082) Avail: NTIS HC A02/MF A01 CSCL 17I

A remote sensing experiment in the Nantucket Shoals (SEBEX) is proposed for delineating and quantifying the oceanographic processes responsible for the surface expressions of bathymetry in the wave field and radar imagery over shallow water. For this purpose simultaneous and coordinated remote sensing, oceanographic, meteorological, hydrographic and bathymetric measurements are suggested. A successful experiment of this type requires precise navigation, better than + or - 0.1 nmi, achieved with Loran C, and detailed three dimensional sampling of the subsurface current field and temperature structure for proper correlation between the parameters. On the surface the Bragg resonant waves should be sampled at least at the resolution of

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SAR and SLAR radar systems In SEBEX the dynamics of fronts and their interactions with internal waves also will be investigated  
Author (GRA)

**N83-35483#** Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse (France).

**SPOT LITTORAL SIMULATIONS. PART 2: SALOUM (SENEGAL). APPLICATION OF SIMULATED SPOT DATA TO THE OBSERVATION AND MAPPING OF TROPICAL SWAMPS IN THE SALOUM ISLANDS [SIMULATIONS SPOT LITTORAL. PARTIE 2. APPLICATION DES DONNES SIMULEES SOPT A L'OBSERVATION ET LA CARTOGRAPHIE DES MARAIS TROPICAUX DE LA REGION DES ILES DU SALOUM]**

L. LOUBERSAC, D. DIAW (Dakar Univ.), and G. BELBEOCH Dec. 1982 30 p refs In FRENCH

Avail: NTIS HC A03/MF A01

Airborne simulations of SPOT multispectral scanner performance over a swampy delta are discussed. By eliminating a particular wavelength during image processing, vegetation type or landforms can be distinguished. Flooding pattern due to tides can be followed, revealing the effect of topography and plants. Image resolution is very good and image processing is much faster than for aerial photography.  
Author (ESA)

**N83-35532#** Groupement pour le Developpement de la Teledetection Aerospatiale, Toulouse (France).

**SPOT LITTORAL SIMULATIONS. PART 1: LOIRE ESTUARY (FRANCE). APPLICATION OF SIMULATED SPOT DATA TO THE OBSERVATION OF THE INERTIAL ZONE OF THE POINTE ST GILDAS (SOUTH LOIRE ESTUARY) FRANCE [SIMULATIONS SOPT 'LITTORAL'. PARTIE 1: ESTUAIRE LOIRE (FRANCE). APPLICATION DES DONNEES SIMULEES SOPT A L'OBSERVATION DE LA ZONE INTERTIDALE DE LA REGION DE LA POINTE ST. GILDAS (SUD ESTUAIRE DE LA LOIRE)]**

L. LOUBERSAC and G. BELBEOCH Sep 1982 17 p In FRENCH Sponsored by Centre National pour l'Exploitation des Oceans

Avail: NTIS HC A02/MF A01

The feasibility of using SPOT satellite data to study coastal zones was assessed by simulating (by airplane flight) data from three channels of the multispectral scanner over an intertidal zone. Results show that SPOT can provide data unobtainable from LANDSAT and aerial photography. For example, it is possible to map algae formations and to give a high resolution plot of shorelines instantaneously.  
Author (ESA)

**N83-35595#** Autometric Corp., Inc., Falls Church, Va.  
**MODIFICATION OF MUSAT AEROTRIANGULATION PROGRAMS TO ACCOMMODATE BATHYMETRIC IMAGE POINTS Final Report**

S. R. LAMBERT May 1983 64 p refs

(Contract DAAK70-79-C-0158)

(AD-A128634, ETL-0306) Avail: NTIS HC A04/MF A01 CSCL 08J

This final report presents the results of the modifications to the MUSAT aerotriangulation programs to accommodate bathymetric image points. This report develops the mathematical models for the two-media refraction problem encountered in bathymetric mapping. This report also presents the results of the modification of the AS-11 frame compilation program for the compilation of bathymetric data.  
GRA

**N83-35602#** Science Applications, Inc., Raleigh, N.C.  
**SOUTH ATLANTIC OCS (OUTER CONTINENTAL SHELF) PHYSICAL OCEANOGRAPHY (YEAR 4). VOLUME 1: EXECUTIVE SUMMARY Final Progress Report**

Feb. 1983 16 p 3 Vol.

(Contract DI-AA851-CT1-25)

(PB83-199497; MMS/AT-ES-83-01-VOL-1) Avail: NTIS HC A02/MF A01 CSCL 08J

Results of the 4th year efforts of a 5 year program to study the physical oceanography of the South Atlantic Outer Continental

Shelf are presented in 3 volumes. Volume 1 is an executive summary, presenting a brief summary of the study.  
GRA

**N83-36620#** Phoenix Corp., McLean, Va.

**A STUDY OF DEEP SEA TIDE DETERMINATION BY SEASAT ALTIMETER DATA Final Report, 1 Apr. 1982 - 31 Mar. 1983**

R D. BROWN 31 May 1983 25 p refs

(Contract N00014-82-C-0368)

(AD-A129869) Avail: NTIS HC A02/MF A01 CSCL 08C

The objective of this study was to extend the SEASAT altimeter determination of the M2 ocean tide from a single point near Cobb seamount in the northeast Pacific ocean to all the world's oceans on a 5-deg grid. After extending the grid to 32 locations covering the northeast Pacific ocean, it became apparent that the resulting tidal charts contained unrealistic features. In addition, large discrepancies existed between the altimeter determined parameters and those determined from bottom pressure gauges. Further extension of the altimeter solutions was therefore stopped and the study efforts were redirected to study the reason for the discrepancies. It was concluded that the uncertainty of the altimeter solutions was much higher than originally anticipated, due to the near-resonance of the SEASAT orbit with the dominant tidal components and the relative shortness of the SEASAT mission. The extension of the altimeter tide solution for M2 over the world's oceans requires data from a future altimeter satellite mission spanning at least one year.  
Author (GRA)

## 06

### HYDROLOGY AND WATER MANAGEMENT

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

**A83-42960**

**SOME GROUND TRUTH CONSIDERATIONS IN INLAND WATER QUALITY SURVEYS**

S. THIRUVENGADACHARI, N. G. INAMDAR, H. G. TAMBRALLI, S. V. KOTBAGI, and B. L. DEEKSHATULU (National Remote Sensing Agency, Hyderabad, India) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 537-544. refs

The ground truth measurement techniques used for airborne water quality at the National Remote Sensing Agency in India are described. Open water samples are gathered as close to flight time as possible, using boats to collect the specimens. Half-hourly samples are also taken in tidal lands and estuaries at various points and subjected to regression analyses. The water samples have been restricted to surface strata, and spectral contamination of the data, such as in the case of high water turbidity values, have been compensated for by using the Secchi depth and reference readings. Markers and buoys are deposited at sampling sites, and all samples are analyzed within 24 hr of gathering. A program of lake and river water monitoring for comparison with MSS data is described as an example.  
M.S.K.

**A83-44861**

**THE MINNEAPOLIS SNOW EVENT - WHAT DID THE SATELLITE IMAGERY TELL US?**

C. KADIN (NOAA, National Earth Satellite Services, Camp Springs, MD) National Weather Digest (ISSN 0028-0712), vol. 7, no. 3, 1982, 4 p.

On January 20, 1982, a heavy snowfall blanketed Minneapolis with an accumulation of 17 inches. The storm was associated with an upper level disturbance and had no frontal reflection at the surface. In the enhanced IR satellite imagery, this upper level disturbance was observed as a comma-shaped cloud pattern. The heaviest precipitation occurred along the southern edge of the tight IR temperature gradient of the comma head eastward to the



edge of the dry slot. The recognition of this heavy snowfall pattern utilizing IR imagery allowed the path and timing of the snowfall to be forecast. Other cases have shown a similar pattern with the heaviest precipitation occurring along the southern edge of the tight IR temperature gradient. Author

**A83-46064\*** Massachusetts Inst. of Tech., Cambridge.  
**PASSIVE AND ACTIVE REMOTE SENSING OF ATMOSPHERIC PRECIPITATION**

Y. Q. JIN and J. A. KONG (MIT, Cambridge, MA) Applied Optics (ISSN 0003-6935), vol 22, Sept. 1, 1983, p 2535-2545. refs (Contract NSF ECS-82-03390; NAG5-270; NAG5-141)

Both passive and active remote sensing of atmospheric precipitation are studied with the vector radiative transfer equations by making use of the Mie scattering phase functions and incorporating the raindrop-size distributions. For passive remote sensing, the Gaussian quadrature method is employed to solve for the brightness temperatures. For active remote sensing, an iterative approach carrying out to the second order in albedo is used to calculate for the bistatic coefficients, the backscattering cross sections/unit volume, and the interchannel cross talks. The calculated results are plotted as a function of rainfall rates and compared to various available experimental data. The theoretical model is easily applied to the remote sensing of aerosol particles, smoke, fog, and haze at infrared and visible frequencies. Author

**A83-46122**  
**REMOTE SENSING OF SNOW DEPTH BY PASSIVE MICROWAVE SATELLITE OBSERVATIONS**

M. TIURI and A. SIHVOLA (Helsinki University of Technology, Espoo, Finland) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p.

Microwave brightness temperature observations of the Nimbus-7 satellite have been applied to map the water equivalent of snow cover in Finland. In the computer analysis brightness temperature differences of two observing frequencies (e.g. 18 and 37 GHz) are applied. In addition, information about surface structures (percentage of forest areas, farm land areas, bog land areas and lake areas) is needed. This information is obtained from the land use maps. The results are compared to detailed water equivalent maps compiled regularly, by the Finnish Hydrological Office. Author

**A83-46123**  
**REMOTELY SENSED CHARACTERISTICS OF SNOW COVERED LANDS**

D. A. ROBINSON and G. KUKLA (Lamont-Doherty Geological Observatory, Palisades, NY) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 9 p. refs (Contract NSF ATM-80-01470)

Estimates were made of visible surface albedo over regions in North America with full or partial snow cover from satellite images. The distribution of gray scale levels as analyzed on an image processor and the resultant distribution statistics were used for making this assessment. The mean reflectivity of fully snow covered 3 deg x 3 deg blocks varied from 39-76 percent depending on the type and density of the vegetation. Differences in albedo up to 30 percent were found between old and fresh snow cover of equal depth within a given area. The results will help improve albedo parameterizations for use in climate models. Author

**A83-46168**  
**OBSERVATIONS OF RAINFALL RATES BY THE AIRBORNE MICROWAVE RAIN-SCATTEROMETER/RADIOMETER**

K.-I. OKAMOTO, H. MASUKO, S. YOSHIKADO, T. OJIMA, H. INOMATA, and N. FUGONO (Ministry of Posts and Telecommunications, Radio Research Laboratories, Koganei, Tokyo, Japan) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs

The airborne microwave rain-scatterometer/radiometer system that operates at X-band and Ka-band was developed for the remote sensing of precipitation, especially rain from the airplane. The total system is installed in a Cessna 404 and the remote sensing of precipitation is performed from the topside of raining area through clouds. The sensor system, flight experiments and some results of data analyses are shown. Rainfall rates R are calculated both from attenuations derived from Ka-band backscattered powers from sea surfaces and from X-band radar reflectivity factors Z. Some examples of displays of distributions of rainfall rates are also shown. Author

**A83-46201**  
**SOIL MOISTURE REMOTE SENSING APPLICATIONS STUDIES OF THE USDA-ARS**

E. T. ENGMAN and T. J. JACKSON (U.S. Department of Agriculture, Hydrology Laboratory, Beltsville, MD) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Rapid, large area soil moisture data acquisition by means of microwave remote sensing could represent a breakthrough in agricultural and hydrological research. A series of aircraft experiments have accordingly been planned which will assess the effectiveness of microwave sensing techniques in irrigation scheduling, hydrologic forecasting, partial area hydrology, and drought evaluation applications. O.C.

**A83-46202**  
**HYDROGRAPHIC SIMULATION AND ANALYSIS FROM LANDSAT-IMAGERY OF TROPICAL ZONES**

W. M. C. MUEKSCH (Dar es Salaam, University, Dar es Salaam, Tanzania) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 8 p. refs

A hydrographic analysis has been conducted for Landsat imagery pertaining to total direct surface stream runoff, where the main inputs were the Lukuledi River and catchment area and its channel pattern. The river basin has sparsely scattered vegetation and soils of alluvial material. The hydrographs obtained are strongly dependent on the interpretations of basin area and shape, and the construction of isochrones. Simple measurements of basin geometry are found to produce reasonable peak runoff rates for the topography described. O.C.

**A83-46203**  
**USE OF REMOTE SENSING TECHNIQUES TO STUDY WATER RESOURCES IN LOS ANDES RANGES, CHILE**

M. F. ARAYA (Universidad de Chile, Santiago, Chile) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

## 06 HYDROLOGY AND WATER MANAGEMENT

**A83-46228**

### **MULTISPECTRAL REMOTE SENSING OF SALINE SEEPS**

L. CHATURVEDI, K. R. CARVER, G. D. HANCOCK, F. V. SMALL (New Mexico State University, Las Cruces, NM), J. C. HARLAN, and K. J. DALSTEAD (South Dakota State University, Brookings, SD) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 239-251. refs

The feasibility of optical and microwave remote sensing techniques for the detection of saline seeps in South Dakota and Montana was experimentally assessed by using the NASA C-130 earth resources aircraft to acquire L-band and C-band scatterometer data, radiometer data, and color-IR photography. Soil moisture and salinity data were collected on a uniform 20-m grid spacing at several depths for the South Dakota site, while two Montana sites were overflown with flight lines. While fully developed seeps were detected in both bands, incipient seeps were not. Scatterometer data profiles, although showing some sensitivity to soil moisture, were influenced by surface roughness and appear to be ineffective in the accurate delineation of either fully developed or incipient seeps. O.C.

**A83-47223**

### **MODELING INLAND WATER QUALITY USING LANDSAT DATA**

D. J. CARPENTER (Australian National University, Canberra, Australia) and S. M. CARPENTER (Commonwealth Scientific and Industrial Research Organization, Div. of Mathematics and Statistics, Canberra, Australia) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 345-352. Research supported by the Department of National Development and Energy of Australia. refs

The water quality parameters turbidity and algal pigment concentration of freshwater lakes have been modeled and predicted using Landsat multispectral scanner data as multiple linear predictors. Satellite data for an area in South East Australia from seven occasions during 1978 and 1979 were used along with concurrent ground-based measurements from sampling sites on three lakes covering a wide range of water quality regimes. Data-independent models for turbidity and algal pigment were obtained using the satellite multispectral data and the water quality data from up to 21 sampling sites on one lake on six occasions. The sun elevation at the time of satellite overpass was included in the models to account for differences between dates, and the time of sample collection was included to compensate for diurnal variations in pigment fluorescence. These models were used to successfully predict these water quality parameters for this lake on a new occasion and for the two other lakes on three occasions. Author

**N83-31092#** Puerto Rico Univ., Mayaguez. Water Resources Research Inst.

### **APPLICATION OF QUANTITATIVE GEOMORPHIC ANALYSIS TO THE GEOGRAPHIC BASINS OF PUERTO RICO Final Completion Report**

N. LIBERATORE 1983 105 p refs

(Contract DI-14-34-0001-1141)

(PB83-177980; W83-02213; OWRT-A-060-PR(1)) Avail. NTIS

HC A06/MF A01 CSCL 08H

This investigation was performed with the purpose of implementing in Puerto Rico the investigation of geomorphic factors that characterize drainage systems and to elucidate and interpret the relationship between geologic-structural conditions and the hydrologic characteristics. The area selected as the sample was the Tallaboa river basin, because of its peculiarity of the distribution of its surface rocks and because of the availability of hydrologic information for the area. In order to accomplish the investigation the hydrographic network obtained from aerial photographs was designed and systematically transferred to the topographic base represented by the U. S. Geological Survey (U.S.G.S.) maps at a scale of 1:20,000. GRA

**N83-32135\*#** California Univ., Santa Barbara. Dept. of Geography.

### **LANDSAT-D INVESTIGATIONS IN SNOW HYDROLOGY Quarterly Progress Report, 1 Apr. - 30 Jun. 1983**

J. DOZIER 30 Jun. 1983 23 p refs ERTS

(Contract NAS5-27463)

(E83-10382; NASA-CR-172924; NAS 1.26:172924) Avail: NTIS HC A02/MF A01 CSCL 05B

Thematic mapper data for the southern Sierra Nevada area were registered to digital topographic data and compared to LANDSAT MSS and NOAA-7 AVHRR data of snow covered areas in order to determine the errors associated with using coarser resolution and to qualify the information lost when high resolution data are not available. Both the zenith and the azimuth variations in the radiative field are considered in an atmospheric radiative transfer model which deals with a plane parallel structured atmosphere composed of different layers, each assumed to be homogeneous in composition and to have a linear in tau temperature profile. Astronomical parameters for each layer are Earth-Sun distance and solar flux at the top of the atmosphere. Atmospheric parameters include pressure temperature, chemical composition of the air molecules, and the composition and size of the aerosol, water droplets, and ice crystals. Outputs of the model are the monochromatic radiance and irradiance at each level. The use of the model in atmospheric correction of remotely sensed data is discussed. A.R.H.

**N83-32141\*#** California Univ., Santa Barbara. Dept. of Geography.

### **LANDSAT-D INVESTIGATIONS IN SNOW HYDROLOGY Quarterly Progress Report**

J. DOZIER 1983 23 p refs Sponsored by NASA ERTS

(Contract NAS5-27463)

(E83-10388; NASA-CR-172930; NAS 1.26:172930) Avail: NTIS HC A02/MF A01 CSCL 08H

Two tapes of the southern Sierra Nevada study area were received and the TM data are being registered to digital data. The spectral, spatial, temporal, and economic characteristics of data from LANDSAT 4 TM and MSS were compared with those of NOAA-7 AVHRR data for snow cover mapping. An atmospheric radiative transfer model which accounts for both the zenith and azimuth variation in the radiative field is presented and its advantages are discussed. A Monte Carlo method for solving the atmospheric correction problem for an inhomogeneous surface is also considered. A.R.H.

**N83-32144\*#** California Univ., Santa Barbara.

### **SNOW REFLECTANCE FROM THEMATIC MAPPER**

J. DOZIER 1983 9 p refs Sponsored by NASA Original photography may be purchased from EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E83-10391; NASA-CR-172933; NAS 1.26:172933) Avail: NTIS HC A02/MF A01 CSCL 05B

Calculations of snow reflectance in all 6 TM reflective bands (i.e., 1,2,3,4,5, and 7) using a delta Eddington model show that snow reflectance in bands 4,5, and 7 is sensitive to grain size. Efforts to interpret the surface optical grain size for the spectral extension of albedo are described. Results show the TM data include spectral channels suitable for snow/cloud discrimination and for snow albedo measurements that can be extended throughout the solar spectrum. Except for band 1, the dynamic range is large enough that saturation occurs only occasionally. The finer resolution gives much better detail on the snowcovered area and might make it possible to use textural information instead of the snowline as an index to the amount of snow melt runoff. A.R.H.

**N83-34422#** Canada Centre for Remote Sensing, Ottawa (Ontario).

**TRACKING OF WATER LEVELS AND MAPPING OF FLOOD PLAINS [LE SUIVI DES PLANS D'EAU ET LA CARTOGRAPHIE DES PLANS INONABLES]**

K. P. B. THOMSON and C. PREVOST *In* ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 31-35 Jul. 1983 refs *In* FRENCH

Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

Satellite mapping in hydrology is introduced, especially for West Africa. The spectral characteristics of water are summarized. In West Africa, LANDSAT data are more useful than those of NOAA or METEOSAT, because of LANDSAT's higher image resolution and readily available data. Interpretation of water level data for the Sahel is complicated by vegetation which persist after the monsoon, hiding the true extent of the water. In the near infrared, burnt land has a reflectance similar to water. Visual interpretation and manual plotting are the most economical methods for morphological and hydrological mapping and for analyzing the environment. Author (ESA)

**N83-35433** Technische Univ., Vienna (Austria). Inst. fuer Kartographie und Reproduktionstechnik.

**GLACIOLOGY AND CARTOGRAPHY [GLAZIOLOGIE UND KARTOGRAPHIE]**

Dec 1982 154 p refs *In* GERMAN; ENGLISH summary Original contains color illustrations in the form of large maps (GEOWISS-MITT-21-1982) Avail: Issuing Activity

The problem of changes of terrestrial ice masses and variations of eustatic sea level is investigated. A review of the 1962 and 1964-65 Spitsbergen expeditions, and of geodetic and cartographic studies on the Untersulzbachkees is presented. Statistical properties of position dependent movement variations of polar ice streams are analyzed. A glacier-mechanics model of the Untersulzbach glacier is treated

**N83-35435** Technische Hochschule, Dresden (West Germany). **SPITSBERGEN EXPEDITIONS OF THE GERMAN DEMOCRATIC REPUBLIC [SPITZERGENEXPEDITIONEN DER DDR]**

L. STANGE *In* Technische Univ. Vienna Glaciology and Cartography p 33-40 Dec. 1982 refs *In* GERMAN Avail: Issuing Activity

Glaciological investigations, in particular the unstable motion of the glaciers Konsvegen and Kronen are summarized. Geodetic-photogrammetric cartography was performed. Meteorological-hydrological measurements on glaciers; periglacial morphological investigations; and ionospheric and geomagnetic measurements are discussed. Author (ESA)

**N83-35437** Technische Univ., Vienna (Austria). Inst. fuer Kartographie und Reproduktionstechnik.

**GEODEIC AND CARTOGRAPHIC STUDIES OF THE VENDIGER GROUP ON THE UNTERSULZBACHKEES GLACIER BETWEEN 1974 AND 1982 [DIE GEODAETISCHEN UND KARTOGRAPHISCHEN ARBEITEN AM UNTERSULZBACHKEES (VENDIGERGRUPPE) VON 1974 BIS 1982]**

E. JIRESCH *In its* Glaciology and Cartography p 67-112 Dec. 1982 refs *In* GERMAN Avail: Issuing Activity

Glacier-dynamics observations of the Untersulzbachkees and production of orthophotographic maps are described. The fixed point field was improved step by step. Terrestrial-photogrammetric glacier movement measurements were performed. Ablation and accumulation level were observed and calculated to study the glacier drift. Glacier orthophotographic maps were obtained. Author (ESA)

**N83-35445** Alaska Univ., Anchorage.

**BATHYMETRY OF ALASKAN ARCTIC LAKES: A KEY TO RESOURCE INVENTORY WITH REMOTE-SENSING METHODS** Ph.D. Thesis

J. C. MELLOR 1982 360 p

Avail: Univ. Microfilms Order No. DA8303737

Water depth is a major factor in predicting resources associated with tens-of-thousands of uninventoried Alaskan arctic lakes. Lakes were studied for physical, chemical, and biological resources related to water depth in 3 specific areas along a north/south transect extending from Pt. Barrow on the Arctic Ocean to the foothills of the Brooks Range. Side-looking Airborne Radar (SLAR) imagery was acquired over the same study transect to investigate its application for determining lake depth. Ice thicknesses, necessary for the interpretation of depth contours from SLAR imagery, were measured along with other parameters in the study lakes. This ice thickness data and sequential SLAR images are used to illustrate a method of contouring water depths in arctic lakes. This is based on changes in intensity of SLAR signal return which define the zone at which ice cover contacts the bottom. This intensity is a function of physical and dielectric properties of the snow, ice, water, bottom substrates, and ice inclusions within these lakes. Dissert. Abstr.

**N83-35460\*#** Maryland Univ., College Park. Remote Sensing Systems Lab.

**THE DESORPTIVITY MODEL OF BULK SOIL-WATER EVAPORATION**

R. B. CLAPP Apr 1983 56 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract PROJ. AGRISTARS)

(E83-10421, NASA-CR-173053, CP-53-04416; NAS 1.26:173053)

Avail: NTIS HC A04/MF A01 CSCL 02C

Available models of bulk evaporation from a bare-surfaced soil are difficult to apply to field conditions where evaporation is complicated by two main factors: rate-limiting climatic conditions and redistribution of soil moisture following infiltration. Both factors are included in the 'desorptivity model', wherein the evaporation rate during the second stage (the soil-limiting stage) of evaporation is related to the desorptivity parameter, A. Analytical approximations for A are presented. The approximations are independent of the surface soil moisture. However, calculations using the approximations indicate that both soil texture and soil moisture content at depth significantly affect A. Because the moisture content at depth decreases in time during redistribution, it follows that the A parameter also changes with time. Consequently, a method to calculate a representative value of A was developed. When applied to field data, the desorptivity model estimated cumulative evaporation well. The model is easy to calculate, but its usefulness is limited because it requires an independent estimate of the time of transition between the first and second stages of evaporation. The model shows that bulk evaporation after the transition to the second stage is largely independent of climatic conditions. M G.

**N83-35467\*#** P and P Industries, College Park, Md.

**PACIFIC AREA DATA COLLECTION STATIONS Final Report, Mar. 1982 - Apr. 1983**

R. C. RECTOR 1 Apr. 1983 11 p

(NASA-CR-170580, NAS 1.26:170580) Avail: NTIS HC A02/MF A01 CSCL 08H

The installation of environmental data collection systems at several remotely located sites in islands in the Pacific Ocean is summarized. The effort was designed to enhance the ability to collect hydrological information. The data collection station consists of a data acquisition system for handling data, a transmitter for uplinking information to the GOES-W geostationary satellite, and a variety of environmental sensors for data accumulation. Each system was assembled, tested, and deployed on designated islands. The concept of using microprocessors for handling data at remote sites and relaying it via a satellite link is a cost effective

## 06 HYDROLOGY AND WATER MANAGEMENT

approach. Such systems require high reliability and proven performance in the field. S.L.

### **N83-36542#** Naval Coastal Systems Center, Panama City, Fla **GROUND TRUTH ANALYSIS SUPPORTING THE HIGH RESOLUTION FLYOVER**

D. F. LOTT Mar. 1983 49 p refs  
(AD-A130026; AD-F200051; NCSC-TM-370-83) Avail: NTIS HC A03/MF A01 CSCL 08C

Ground truth measurements were collected during high resolution flyover tests designed to maximize resolution of a multispectral scanner. Tests were conducted on 27 and 31 August and 1 September 1981 at sites providing different water mass types and bottom reflectances. Measurements of water level, wave heights, surface and water column temperatures, wind speed and direction, solar radiation, diffuse and beam attenuation coefficient, and secchi depth were obtained. The environmental conditions which affected scanner performance are summarized.

Author (GRA)

## 07

### **DATA PROCESSING AND DISTRIBUTION SYSTEMS**

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

#### **A83-41339**

##### **LANDSAT-D - AN END-TO-END DATA SYSTEM**

T. C. AEPLI (General Electric Co., Space Div., Philadelphia, PA) IN: ICC '82 - The digital revolution; International Conference on Communications, Philadelphia, PA, June 13-17, 1982, Conference Record. Volume 1 New York, Institute of Electrical and Electronics Engineers, 1982, p. 1G 1.1-1G.1.5.

The Landsat-D system consists of an entirely new Flight Segment, an entirely new Ground Segment, and an assortment of new and existing supporting facilities and services which are needed to ensure the rapid flow of data from the satellite to the user. Two instruments on the Flight Segment will be employed to acquire the image data. The instruments on the Flight Segment will be employed to acquire the image data. The instruments include a Multispectral Scanner (MSS) similar to that on the earlier Landsat satellites, and the Thematic Mapper (TM), which is a totally new instrument. Attention is given to details of image data acquisition, data transmission, aspects of ground data acquisition, MSS image processing and distribution, TM image processing and distribution, and plans concerning the use of the Landsat system. G.R.

#### **A83-42957**

##### **SPATIAL RESOLUTION OF REMOTELY SENSED IMAGERY - A REVIEW PAPER**

M. R. B. FORSHAW (Imperial College of Science and Technology, London, England), A. HASKELL (Royal Aircraft Establishment, Space Dept., Farnborough, Hants., England), P. F. MILLER (GEC-Marconi Electronics, Ltd., Chelmsford, Essex, England), D. J. STANLEY (Logica, Ltd., Aerospace Group, London, England), and J. R. G. TOWNSHEND (Reading, University, Reading, Berks., England) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 497-520. refs

Parameters that can be used to assign standardized values to the image quality and information content of remotely sensed scenes are discussed. Spatial resolution has been suggested as a critical parameter, but is shown to depend on the radiometric resolution, the point on the response function selected as the threshold, the target geometry and contrast, the brightness of the illumination and the clarity of the atmosphere, and the target position relative to the satellite ground track. Furthermore, resolution is affected by the sensor geometry, the pixel sizing, resampling, blurring, the optical quality, image motion, registration,

system noise, atmospheric effects, etc. Various terrain features can also influence the image resolution in ways which have not yet been quantified. It is concluded that the radiometric resolution, spectral resolution, and temporal properties of a data set are significant factors for image quality, and that no one measure of spatial resolution can be universally applicable as a standard in remote sensing. M.S.K.

#### **A83-42958**

##### **A COMPOSITE LANDSAT IMAGE OF THE UNITED KINGDOM**

R. H. MERSON (Royal Aircraft Establishment, National Remote Sensing Centre, Farnborough, Hants., England) (Remote Sensing Society, Conference on Matching Remote Sensing Technologies and their Applications, London, England, Dec. 16-18, 1981) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 521-527.

#### **A83-42959**

##### **THE IMPORTANCE OF REMOTE SENSING FROM SPACE TO THE INDIAN SUBCONTINENT**

P. D. BHAVSAR (Indian Space Research Organization, Space Applications Centre, Ahmedabad, India) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 529-536. refs

The applications of Landsat data in India and surrounding regions is described. The variegated terrain covers 5 million sq km and holds one quarter of the world's population, mostly in rural situations. Remote sensing needs of the region include crop assessment, hydrological studies, snow melt runoffs, land use and planning studies, and monitoring of desertification, salinity, and erosion. Experimentation with Landsat data began in 1972, and a center for Landsat data was established in Bangladesh in 1974. The data has been used for studying forest and crop inventories, littoral land accretion, land use and crop patterns, desertification in North Bengal, and the water budget for the Karnafuli reservoir. Landsat MSS imagery has been studied for Pakistan, and crop inventories and land use patterns have been surveyed for Sri Lanka. Passive microwave radiometers for spacecraft remote viewing at 19 and 22 GHz are being developed in India. M.S.K.

**A83-42962\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

##### **THE TIME-SPACE RELATIONSHIPS AMONG DATA POINTS FROM MULTISPECTRAL SPATIAL SCANNERS**

F. GORDON (NASA, Goddard Space Flight Center, Greenbelt, MD) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 555-570. refs

Multispectral scanner and thematic mapper (TM) data from Landsat satellites are discussed in terms of the perceived 'simultaneity' of the images, which are obtained by scanning techniques. Scanning the scenes ensures that the data points of the images are actually sequential, even if the scan is performed at rates that are fast relative to the motion of the spacecraft. The last datum gathered by the MSS is, in fact, taken 29 sec after the first, with a 56 m distance being present between pixels. The spacing is uneven from band to band on the TM and analyses of the data to produce an image requires consideration of nonfixed time relationships for different locations on the scan within and among the bands. Additionally, corrective measures must be taken to compensate for instrument jitter and attitude changes. M.S.K.

#### **A83-42963**

##### **COMPARATIVE EXPERIMENTAL STUDY ON THE USE OF ORIGINAL AND COMPRESSED MULTISPECTRAL LANDSAT DATA FOR APPLIED RESEARCH**

K. A. ULBRICHT (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 571-582.

A83-42968

**PREPROCESSING OF SIDE-LOOKING AIRBORNE RADAR DATA**

P. HOOGEBOOM (Centrale Organisatie voor Toegepast-Natuurwetenschappelijk Onderzoek, Fysisch Laboratorium TNO, The Hague, Netherlands) (Remote Sensing Society, Conference on Matching Remote Sensing Technologies and their Applications, London, England, Dec 16-18, 1981) International Journal of Remote Sensing (ISSN 0143-1161), vol. 4, July-Sept. 1983, p. 631-637. Research sponsored by the Ministry of Transport, Water Control and Public Works. refs

Studies on microwave surface scattering in The Netherlands have indicated the need for accurate radar systems for applications in remote sensing. An SLAR system with digital recording was developed and is now being used for several programs. This system was designed with special attention to speckle reduction and system accuracy. The digital data are processed in a computer with algorithms for geometric and radiometric corrections. In the future aircraft position and attitude measurements will also be used in these correction algorithms. Examples of the results are shown. Author

**A83-43762\*** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**PRODUCTION AND ANALYSIS OF OUTPUT DATA PRODUCTS FOR LANDSAT-4 IN THE ENGINEERING CHECK-OUT PHASE**

J. C. LYON, D. FISCHER (NASA, Goddard Space Flight Center, Greenbelt, MD), and E. BEYER (General Electric Co., Valley Forge, PA) American Astronautical Society, Goddard Memorial Symposium, 21st, Greenbelt, MD, Mar 24, 25, 1983. 16 p (AAS PAPER 83-158)

The Landsat-D (now Landsat-4) program was initiated by NASA in the mid-1970's. The spacecraft was launched on July 16, 1982. Instruments on the satellite include the fourth Multispectral Scanner (MSS) and the new higher-resolution Thematic Mapper (TM). In order to achieve the planned engineering and scientific objectives, attention has to be given to the validation of spacecraft and instrument performance, the adjustment of ground processing procedures, and the definition of the measures of the TM utility. To satisfy these requirements, a Landsat Assessment System (LAS) was conceived, and the Applications Developmental Data System (ADDS) was instituted. The set of component systems collectively became known as the 'Scrounge' system. The present investigation is concerned with the Scrounge system and the results of radiometric and geometric data evaluations. Attention is given to the TM geometric correction, TM data resampling, a radiometric correction functional description, and the results of the TM geometric and radiometric correction. G.R.

A83-43892

**DIGITAL IMAGE PROCESSING USING THE APPLE II MICROCOMPUTER**

R. W. KIEFER (Wisconsin, University, Madison, WI) and F. J. GUNTHER (Computer Sciences Corp., Silver Spring, MD) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Aug. 1983, p. 1167-1174. refs

Five different digital image processing systems developed for the Apple II microcomputer are described. The microcomputer has a 48 K RAM, which can be increased to 256 K with peripheral cards, and eight expansion slots permit insertion of cards for line-printers, digitizing tablets, and x-y plotters. The memory can be expanded with hard and soft disk drives, providing 10 Mbytes and 1.1 Mbytes each, respectively. The display is 192 rows by 280 columns, and data can be obtained in an interface with a mainframe computer. The Digital Image Processing (A/DIPS) system contains programs for density slice, training set extraction, histogram plotting, scatter diagram plotting, and parallelepiped classification. The Image Processing Educator (A/PIPE) is used for personalized computer-assisted instruction of digital image processing of Landsat images, while the Personal Image Processing (APPLEPIPS), written in BASIC, is employed for both classroom and laboratory image processing. M.S.K.

A83-43978#

**HIGH-THROUGHPUT DIGITAL SAR PROCESSING**

M. JONES (ESA, Mission and Technical Coordination Office, Darmstadt, West Germany), J.-CL. DEGAVRE, and J. P. GUIGNARD (ESA, European Space Research and Technology Centre, Noordwijk, Netherlands) ESA Journal (ISSN 0379-2285), vol. 7, no. 2, 1983, p. 145-162. refs

Work done within ESA on the definition of SAR-processing requirements and study of processing technology is reviewed. This work has been driven by the need for fast-delivery processing for the Synthetic-Aperture Radar (SAR) on ERS-1 (the first European remote-sensing satellite), facilities for which will need to be installed during the second half of the 1980s. The demands of ERS-1 SAR fast-delivery processing are described and compared with those for other remote-sensing missions. The computer loads involved are analysed by reference to results of theoretical analysis and benchmarking. The current status of processor selection for ERS-1 is described. Author

A83-44261

**AN ESTIMATION-THEORETIC APPROACH TO TERRAIN IMAGE SEGMENTATION**

C. W. THERRIEN (MIT, Lexington, MA) Computer Vision, Graphics, and Image Processing (ISSN 0734-189X), vol. 22, June 1983, p. 313-326. USAF-sponsored research. refs

A method for modeling images of natural terrain is developed and applied to the segmentation of aerial photographic data. An underlying stochastic structure based on linear filtering concepts provides a means of modeling the terrain in local areas of the image. Superimposed on this is a Markov random field that describes transitions from regions of one terrain type to another. Maximum likelihood and maximum a posteriori estimation are applied to estimate regions of similar terrain. Results of application to digitized aerial photographs are presented and discussed. Author

A83-45920

**MANUAL OF REMOTE SENSING. VOLUME 2 - INTERPRETATION AND APPLICATIONS (2ND EDITION)**

J. E. ESTES, ED. Falls Church, VA, American Society of Photogrammetry, 1983, 1240 p.

The interpretation and applications of remote sensing data are discussed. The topics considered include: archaeology, anthropology, and cultural resources management; remote sensing of weather and climate, the marine environment, water resources assessment; urban/suburban land use analysis; geological applications, engineering applications, remote sensing applications in agriculture, forest resources assessments; rangeland applications, and terrestrial moons and planets. No individual items are abstracted in this volume. C.D.

A83-46117

**THE INFLUENCE OF THE IMAGE SCALE ON THE PRECISION OF MORPHOTOPE ANALYSIS FROM AERIAL PHOTOGRAPHS PERFORMED BY A DIGITAL SHAPE RECOGNITION ANALYSIS**

U. WIECZOREK (Muenchen, Universitaet, Munich, West Germany) IN. 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 8 p.

Techniques for automated shape analysis for remotely sensed images of morphological features sensed at different scales at different times are discussed. Specific metric parameters are assigned to each relief element, and a histogram, with a standard deviation, skewness, and peaks being generated for each image section considered. The relief elements comprise the area of the image relief elements (i.r.e.), their length, width, orientation, their perimeter, convex perimeter, and porosity, the relationship between the holes and total i.r.e. area, and the indices of symmetry around the length axis and central point of the i.r.e. Test data are provided for varying image scales of a tidal flat region on the W. German

coast of the North Sea, demonstrating that relief feature discrimination is possible with decreasing scales. M.S.K.

### A83-46118

#### EFFECT OF DIFFERENCES IN CATEGORIES DISPERSION PATTERNS ON DIGITAL IMAGE CLASSIFICATION RESULTS

S. L. EKENOBI (Lagos, University, Lagos, Nigeria) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p. refs

The probability density function of a maximum likelihood algorithm is examined and a categories-relative-weights term is identified for land-use classifications of remotely sensed imagery. The pdf is based on a Gaussian distribution for each pixel and category, and an adjustment is defined for the categories variances. Consideration is given to Landsat MSS data for water, farmlands, bare ground, and populated areas of a region in Nigeria. The levels of variance were employed in an automatic classification to distinguish a river from bare ground, which displays the highest levels of variance. It is shown that the relative levels of data variance of the categories can be regarded as relative weights, thereby yielding more accurate classifications when areas with low variance are weighted more heavily than areas with high variance levels. M.S.K.

### A83-46120

#### COMPARATIVE STUDY OF DATA ACQUIRED BY VARIOUS TYPES OF REMOTE SENSORS

N. DEUTSCHER and W. SCHMITT-RENNEKAMP (Berlin, Technische Universität, Berlin, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p.

The accuracy of Landsat data was assessed using a large data base for ground truth data for comparison with Landsat data for the same area. The area concerned is located in the upper Rhine Valley and the Black Forest. The data, besides ground-truth data, included measurements by airborne and satellite instrumentation. Satellite data were rotated and translated in time to produce superpositions, and a quadratic transformation equation was defined for superimposing the satellite, airborne, and ground truth data. The allowed error was estimated with an unsupervised algorithm. Channel selection was performed with a representative image segment and training samples undergoing supervised classification over all the channels in order to eliminate the channels with the least usefulness. The error rate was decreased by implementing the channel selection procedure with the image segments before generating full scenes. M.S.K.

### A83-46139

#### GROUND TRUTH COLLECTION FOR A VISUAL INTERPRETATION OF SAR-580 IMAGERY ON THE B1-SITE IN BELGIUM

M. ANTROP (Gent, Rijksuniversiteit, Ghent, Belgium) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

The methods used in gathering land-use, phenological, terrain-roughness, and soil-moisture data on the ground for use in interpreting satellite radar imagery are discussed. Six sample sectors in the B1 site in Belgium were examined at the time of the SAR-580 overflight on June 24, 1981; 110 landscape descriptions, 47 terrain-roughness descriptions, and 27 soil samples were produced by seven teams of specially instructed surveyors. Site-selection criteria are reviewed, and the sampling techniques (verbal description, sketches, horizontal and vertical-stereoscopic photography, and soil sampling) are characterized and illustrated. Special attention was given to the identification of possible natural corner reflectors such as buildings, fences, electric lines, and vehicles. Preliminary comparisons between these data and quick-look (X-band and HH-polarization) images for one of the sample sectors are found in general to confirm the value of the

methods used, although further analysis using the complete radar data will be necessary to evaluate the finer details. T.K.

### A83-46147\* General Electric Co., Philadelphia, Pa.

#### LANDSAT-D, ABOUT TO BE REALITY

T. C. AEPLI, S. C. CAPODICI (General Electric Co., Space Div., Philadelphia, PA), and J. R. BUSSE (NASA, Goddard Space Flight Center, Greenbelt, MD) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

The space and ground segments of the Landsat-D thematic mapper (TM) for remote sensing of a 185 km swath with 30 m resolution are described. Scanning the full earth once every 16 days from its 705 km sunsynchronous orbit, Landsat-D will relay its data on the ku-band through the TDRSS satellite to a ground station. The X-band will also be used to transmit data directly to foreign and domestic ground stations; the S-band will be reserved for MSS data only. Landsat-D comprises the multimission modular spacecraft and the instrument module, which features the MSS and TM, a wideband communication subsystem, a solar array, and an L-band global positioning system. Three computers on the ground provide a high degree of automation for reception, storage, retrieval, back-up, and transmission of data and commands. Additionally, a van is equipped with transportable equipment, including an antenna. Procedures followed for image generation from the MSS and TM are detailed, noting storage at Goddard until dispersal of tapes under the direction of the EROS data center. M.S.K.

### A83-46165

#### THE SYSTEM OF PHYSICAL SPATIAL UNITS ('NATURRAEUMLICHE GLIEDERUNG') AS AN AID IN THE EVALUATION OF SATELLITE DATA

H. GOSSMANN (Freiburg, Universität, Freiburg im Breisgau, West Germany) and M. LEHNER (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Optoelektronik, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p.

It is shown that the subdivision of a scene viewed by satellite remote sensing instrumentation into physical spatial units is useful for structuring and evaluating the data. An airborne survey with a scanner having a resolution of 1024 x 1024 pixels was performed to demonstrate the effect produced by defining a threshold level for white (gray level) and generating an essentially binary image. Areas of the threshold value or above were given a uniform color, thereby being visually defined. The border lines of the untreated image were subtracted from the second image. The process can be used to overlay data from any number of scanning channels. Applied to an area around Mannheim viewed with the Landsat spacecraft, to an area scanned with the Seasat-SAR instrument, and to data from the HCMM, it is demonstrated that using various training areas for individual spatial units reduces the error rate. It was also determined that assumptions of homogeneity in a landscape are not in line with physical realities. M.S.K.

### A83-46172

#### LANDSAT STANDARD FAMILY OF CCT FORMATS EUROPE SPECIFIC PROBLEMS

S. BRUZZI (ESA, Earthnet Programme Office, Frascati, Italy) and J. MURPHY (Canada Centre for Remote Sensing, Ottawa, Canada) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

Reference is made to a previous study on this subject by Thomas and Guertin (1981). Current information on the evolution of this family of formats and on the products of this family is provided. Additional applications are suggested, and tools for handling the tapes in the standard formats of the family are discussed. The particular ESA/Earthnet requirements are

described, together with the way in which the format copes with the requirements. Attention is also given to the way in which the adoption of this format has favored the development of general purpose software tools for reading, writing, and verifying the format. C.R.

A83-46174

#### PROCESSING OF MICROWAVE RADIOMETRY DATA FOR EARTH SCIENTIFIC PURPOSES

R. H. DITTEL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p.

Multispectral microwave radiometry data have been evaluated under earth scientific objectives with general signal analysis methods. The items investigated included correlation/covariance analysis for the intensity interrelations of the spectral bands, auto/cross-correlation and coherence analysis to extract radiation textures. The deviation of variations from purely statistical radiation intensity fluctuations showed to be useful for general texture characterization. The radiation properties form a good basis for multispectral classification. Author

A83-46190

#### PARAMETRIC STUDIES OF SAR-IMAGES BY MEANS OF RADAR BACKSCATTERING MODELS

M. HOELZER and W. WELLNITZ-FLEMMING (Berlin, Technische Universitaet, Berlin, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p.

In order to improve radar image interpretation, the input parameters influencing an imaging radar system's output are considered through controlled variation in a computer simulation study. Emphasis is given to the variation of the backscatter characteristics and the spatial height variations which most dramatically influence output. Attention is given to such geometrical effects as foreshortening, layover, shadow, local terrain slope, and slant range effects, as well as effects due to the antenna used. O.C.

A83-46193\* Technische Univ., Graz (Austria).

#### STEREO SIDE-LOOKING RADAR EXPERIMENTS

F. LEBERL, J. RAGGAM (Graz, Technische Universitaet, Graz, Austria), and M. KOBRICK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 7 p. Sponsorship. Bundesministerium fuer Wissenschaft und Forschung. refs (Contract BMFWF-6,931/3-27/1980, NAS7-100)

The application of side-looking radar images in geoscience fields can be enhanced when using overlapping image strips that are viewed in stereo. A question concerns the quality of stereo radar. This quality is described evaluating stereo viewability and using the concept of vertical exaggeration with sets of actual radar images. A conclusion is that currently available stereo radar data are not optimized, that therefore a better quality can be achieved if data acquisition is appropriately arranged, and that the actual limitations of stereo radar are still unexplored. Previously announced in STAR as N83-29489 S.L.

A83-46224\* Jet Propulsion Lab., California Inst of Tech., Pasadena.

#### COMPARATIVE ANALYSIS OF CO-REGISTERED SIR-A, SEASAT AND LANDSAT IMAGES

C. ELACHI, D. EVANS, and P. REBILLARD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p. NASA-supported research

A number of areas were covered by Seasat SAR and SIR-A, thus providing information at two different incidence angles (20 deg and 50 deg respectively). These angles correspond to scattering from two different surface roughness scales. The results of the analysis from two areas will be presented. The first is the San Rafael area in Utah where Seasat/SIR-A/Landsat data were coregistered and discriminant analysis is being applied to classify surface units. The second area is the Chotts area in Algeria where appreciable changes have been observed between Seasat and SIR-A images. However, it is not clear if the changes are due to the different observation geometry or changes in the surface between 1978 and 1981. Author

A83-46225\* Jet Propulsion Lab., California Inst of Tech., Pasadena.

#### SIR-A RADAR IMAGES OF SAND DUNES AND VOLCANIC FIELDS

R. BLOM, C. ELACHI, and D. EVANS (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. NASA-sponsored research. refs

Shuttle Imaging Radar (SIR-A) synthetic aperture radar images of sand dunes and volcanic fields are presented and preliminary interpretation provided. The SIR-A images are compared with Seasat images where available. Unvegetated sand dunes are recorded as black areas on SIR-A images due to the specular reflection away from the sensor at the SIR-A incidence angle. Even a very small amount of vegetation provides some backscatter, however. Interdune areas frequently contain rough lag gravels which outline the dunes. Lava flows are typically very rough surfaces which are bright areas on radar images. Cinder cones are smooth and therefore black on the image unless they have a blocky crater rim at the SIR-A incidence angle. Ash dunes and ash fields are smooth and imaged as dark areas. Author

A83-46229

#### AUGMENTING LANDSAT MSS DATA WITH TOPOGRAPHIC INFORMATION FOR ENHANCED REGISTRATION AND CLASSIFICATION

K. SEIDEL, F. ADE (Zuerich, Eidgenoessische Technische Hochschule, Zurich, Switzerland), and J. LICHTENEGGER (ESA, Earthnet Programme Office, Frascati, Italy) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 252-258. Research supported by the Swiss National Science Foundation. refs

This paper deals with problems arising in the classification of Landsat MSS data from rugged terrain. A digital terrain model (DTM) was found to be useful in several ways. For registration by cross-correlation, mountain ridges were extracted from both a synthetic image based on the DTM and a Landsat image. Information from the DTM, from thematic maps, and meteorological data were all used as ancillary data to aid in rapid snow cover determination without direct ground control in a large catchment area. In addition it is shown that the use of the DTM not only allows the assessment of relative and absolute snow distribution within given elevation zones, but also permits the extrapolation of snow cover into areas partly covered with clouds. Author



**A83-46236\*** Kansas Univ. Center for Research, Inc., Lawrence.  
**METHOD FOR RETRIEVING THE TRUE BACKSCATTERING COEFFICIENT FROM MEASUREMENTS WITH A REAL ANTENNA**

F. T. ULABY, C. T. ALLEN, and A. K. FUNG (University of Kansas Center for Research, Inc., Lawrence, KS) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 308-313. refs

(Contract NAG5-30)

Coherent and incoherent scattering produce contributions to the power backscattered by a surface at angles near normal incidence, and these contributions are further weighed by the antenna pattern. On the basis of a theoretical model describing the backscattering from a rough soil surface, a procedure is developed for retrieving the true angular pattern of the backscattering coefficient from its measured estimates, where these estimates are based on the usual assumption that the coefficient is approximately constant over the angular extent of the antenna beam for narrow beam systems. The retrieved backscattering coefficient patterns were then used to evaluate the dependence of the coefficient on soil surface roughness at 1.5, 4.25, and 7.25 GHz. O.C.

**A83-46237**

**AMPLITUDE AND PHASE ERRORS INVOLVED IN RETRIEVING DEPOLARIZED RADAR CROSS SECTION MEASUREMENTS**

A. J. BLANCHARD, R. W. NEWTON, and B. R. JEAN (Texas A & M University, College Station, TX) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 314-319. refs

The backscatter of EM waves from natural surfaces is a significant problem in the case of the response of radar systems to linearly polarized interaction processes associated with earth/land targets, especially in view of the general lack of agreement near nadir between depolarized radar data and the theoretical models attempting to describe such processes. Attention is presently given to the geometry of measurement operations, as well as the nonideal nature of realistic antennas, in an attempt to quantify possible measurement system error. Results show that induced system errors may account for several dB in the depolarized measurement, reaching their greatest significance at the nadir measurement configuration. O.C.

**A83-46238\*** General Electric Co., Philadelphia, Pa.  
**SYNTHETIC APERTURE RADAR IMAGING FROM AN INCLINED GEOSYNCHRONOUS ORBIT**

K. TOMIYASU and J. L. PACELLI (GE Valley Forge Space Center, Philadelphia, PA) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 324-329. refs

(Contract NAS2-9580)

Images of earth can be produced with an assumed synthetic aperture radar (SAR) on a satellite platform undergoing a nutating relative motion from geosynchronous altitude. From a 50 deg inclined circular orbit, the contiguous United States can be imaged in about 3 h of segmented operation at 100-m resolution with 4-azimuth-look averaging. The 2450-MHz transmitter radiates 1312 W of average power from a steerable 15-m-diam antenna. The SAR can image daily an area bounded longitudinally and latitudinally. Author

**A83-46249\*** Arkansas Univ., Fayetteville.

**SIMULATION OF SPACEBORNE STEREO RADAR IMAGERY - EXPERIMENTAL RESULTS**

V. H. KAUPP, L. C. BRIDGES, M. A. PISARUCK, H. C. MACDONALD, and W. R. WAITE (Arkansas University, Fayetteville, AR) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 400-405. refs

(Contract NAG9-3)

Computer simulation of radar imagery was used to investigate spaceborne stereo radar. The major conclusions reached are that stereo pairs representing different angles of incidence with the same look-direction appear best and that the angles of incidence and stereo intersection angle be matched to the slope and relief of terrain. A parametric tradeoff analysis was performed for eleven different angles of incidence over three different model areas. The eleven angles spanned the range from small- to large-incidence angles. The three model areas were selected as typical of relatively flat, moderately rough, and mountainous terrain. The stereo pair judged best for each model area are included. Author

**A83-46254**

**NEIGHBORING GRAY LEVEL DEPENDENCE MATRIX FOR TEXTURE CLASSIFICATION**

W. G. WEE (Cincinnati, University, Cincinnati, OH) and C. SUN (Computer Vision, Graphics, and Image Processing (ISSN 0734-189X), vol. 23, Sept. 1983, p. 341-352. refs

A new approach, neighboring gray level dependence matrix (NGLDM), for texture classification is presented. The major properties of this approach are as follows: (1) texture features can be easily computed, (2) they are essentially invariant under spatial rotation; (3) they are invariant under linear gray level transformation and can be made insensitive to monotonic gray level transformation. These properties have enhanced the practical applications of the texture features. The accuracies of the classification are comparable with those found in the literature. Author

**A83-46766\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**TECHNOLOGY FOR LARGE DIGITAL MOSAICS OF LANDSAT DATA**

A. L. ZOBRIST, N. A. BRYANT, and R. G. MCLEOD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) Photogrammetric Engineering and Remote Sensing (ISSN 0099-1112), vol. 49, Sept. 1983, p. 1325-1335. refs

(Contract NAS7-100)

Procedures and software for the digital mosaicking of Landsat data are discussed. It is noted that image processing in support of JPL's planetary program has furnished the software and procedures necessary to achieve digital image mosaicking of vidicon imagery using rigid projective geometry. The incorporation of ground-control points, by either manual or automatic ground-control point file identification, has yielded rms positional accuracies exceeding the National Map Accuracy Standards. Rotation to north vertical is effected at low computational cost. It is possible to cut input data frames in any arbitrary shape to remove cloud cover and accommodate terrain offset effects. In similar fashion, the final digital mosaic can be segmented arbitrarily to conform to user requirements. Information is presented on applications in Pennsylvania and Bolivia. C.R.

**A83-47219**

**CHANGE DETECTION USING LANDSAT PHOTOGRAPHIC IMAGERY**

P. F. CRAPPER and K. C. HYNSON (Commonwealth Scientific and Industrial Research Organization, Div. of Water and Land Resources, Canberra, Australia) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 291-300. refs

A minimal equipment, user-friendly photographic system for multitemporal change detection in remotely sensed scenes is described. The method consists of overlaying a photographic

negative, obtained either from Landsat imagery or aerial photography, with another photographic print of the same area from the same point of view and at another time. The overlay displays areas with no change as a neutral tone and areas of change as lighter or darker tones. It is shown that combining the identified areas of change with spectral and textural data of the same area can aid in identifying the agent of the change. Sample views are presented of six different Australian scenes images with different Landsat satellites M.S.K.

**A83-47224****ESTIMATING SURFACE TEMPERATURES FROM SATELLITE THERMAL INFRARED DATA - A SIMPLE FORMULATION FOR THE ATMOSPHERIC EFFECT**

J. C. PRICE (U.S. Department of Energy, Hydrology Laboratory, Beltsville, MD) Remote Sensing of Environment (ISSN 0034-4257), vol. 13, Sept. 1983, p. 353-361. refs

Improvements in remote sensing technology have made it possible to enhance the quality of thermal infrared measurements to the extent that detailed studies of surface thermal properties can be carried out. However, difficulties arise regarding the reduction of remotely sensed data to readily interpretable values of surface temperature. These difficulties are related to the required correction of satellite infrared measurements for atmospheric effects. The present investigation is concerned with the development of a formulation which facilitates application of this atmospheric correction. A description is provided of a formulation which represents a simple linear approximation to the solution of the radiative transfer equation. G.R.

**A83-47265#****METHOD OF DETERMINING OPTICAL ATMOSPHERIC PARAMETERS BASED ON SPACE-IMAGERY EARTH-SURFACE**

A. V. AGAPOV, D. A. USIKOV, and M. N. FOMENKOVA (Akademiya Nauk SSSR, Institut Kosmicheskikh Issledovaniy, Moscow, USSR) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 5 p. refs (IAF PAPER 83-102)

Techniques for deriving the atmospheric distortion parameters influencing remotely sensed data are presented. Fuzziness matching is employed in terms of the differences in spatial contrasts of the same surface areas. Alteration in the fuzziness, i.e., the spatial contrasts, obtained over different spectral bands yields the optical properties of the atmosphere. A second method, employing trace data, considers the reflective properties of the subsatellite surface. The atmosphere optical properties are determined by comparison of the observed albedo with a reference albedo of the objects identified using the trace multispectral measurement. The optical properties are calculated to account for multiple photon scattering and indicatrix anisotropy M.S.K.

**A83-47275#** National Aeronautics and Space Administration National Space Technology Labs., Bay Saint Louis, Miss.

**INFORMATION EXTRACTION FROM THEMATIC MAPPER DATA**

E. L. TILTON, III (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St Louis, MS) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 7 p. (IAF PAPER 83-114)

The improvements introduced in spectral, spatial, and radiometric capabilities through installation of the thematic mapper (TM) on the Landsat-4 spacecraft are described. The TM optical sensors scan in the visible (0.45-0.52, 0.52-0.60, and 0.63-0.69 micron), near-IR (0.76-0.90 micron), middle-IR (1.55-1.75 micron), and thermal IR (10.4-12.5 microns). The reflectances of vegetation and the differences in chlorophyll absorption by various plants are discerned more accurately than with the MSS, while the effects of land surface obscuration by water vapor are reduced. The blue-green band upgrades water measurements for bathymetry, reef, and atoll mapping, and the middle-IR increases sensitivity to leaf water content. The field-of-view is a 30 x 30 m square, one-fifth

that of the MSS. Results from sample surveys of forested wetlands in Tennessee and agricultural land use patterns are presented M.S.K.

**A83-47287#****APPLICATION OF TRACK SPECTROMETRIC STUDIES IN IMAGE PROCESSING FOR REMOTE SENSING PURPOSES**

D. N. MISHEV, P. V. PETROV, and B. L. BEKIAROV (B'lgarska Akademiya na Naukite, Tsentralna Laboratoriya za Kosmicheski Izsledvaniya, Sofia, Bulgaria) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 8 p. refs (IAF PAPER 83-138)

Algorithmic control of the spectrometric tracks and the production of multizonal images, and identification of a track image of an arbitrary geometry are described for a remote sensing satellite under manual control by an operator in a space station. It is assumed that the imagery is multitemporal, and that previous tracks can be overlaid on current images to allow corrections for changes in viewing angle, light, and upwelling radiance. A processing routine is described for eliminating discrepancies in the spatial characteristics and intercalibration of the amplitude characteristics of the images. Textural correlations are also possible, as are identifications by specific scene features. M.S.K.

**A83-48116****ASSIGNING COORDINATES TO OBJECTS ON AEROSPACE PHOTOGRAPHS [KOORDINATNAIA PRIVIAZKA OB'EKTOV AEROKOSMICHESKOI S'EMKI]**

A. N. BELINSKII, A. D. MANUILSKII, and V. A. STUIT (Vsesoiuznyi Nauchno-Issledovatel'skii i Proektno-Tekhnologicheskii Institut Kibernetiki, Moscow, USSR) Issledovanie Zemli iz Kosmosa (ISSN 0205-9614), July-Aug. 1983, p. 120-124. In Russian. refs

In using aerospace images in managing natural resources, the problem often arises of finding a particular object on a photo and assigning exact coordinates to it. For example, in the automatic compilation of mosaics from a series of overlapping photos, several reference objects must be found on each photo and those on the segment of the photo that is overlapped must be identified. The considerations that must govern the choice of space-frequency filters are discussed. Attention is also given to the automatic detection of reference objects and to increasing the speed with which coordinates are assigned to aerospace objects C.R.

**A83-48990****EXPERIMENTS ON DIGITAL IMAGE DATA COMPARISON [VERSUCHE ZUM DIGITALEN BILDDATENVERGLEICH]**

H.-P. BAEHR (Karlsruhe, Universitaet, Karlsruhe, West Germany) and H. SCHAEFER (Hannover, Universitaet, Hannover, West Germany) Bildmessung und Luftbildwesen (ISSN 0006-2421), vol. 51, Sept. 1983, p. 176-183. In German. Sponsorship: Deutsche Forschungsgesellschaft. refs (Contract DFG-BA-686)

Two Landsat scenes from 1975 and 1978 have been multispectrally classified, both independently and in combination, for the 'Hannover' test field. The comparison of individual results produces large errors, but a combined evaluation leads to better results. A digital comparison of the classification with forested areas from a 1:100,000 topographic map demonstrates the difficulty of defining 'correct' classification. C.D.

**N83-32126\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil)

## **A TRANSLATIONAL REGISTRATION SYSTEM FOR LANDSAT IMAGE SEGMENTS**

N. D. J. PARADA, Principal Investigator, G. J. ERTAL, F. R. D. VELASCO, and N. D. D. MASCARENHAS Jun. 1983 7 p refs In PORTUGUESE; ENGLISH summary Presented at the 4th Encontro Nac. de Automatica Soc. Brasil. de Mat., Belem, Para, 6-13 Jul. 1983 Sponsored by NASA ERTS (E83-10373; NASA-CR-172917; NAS 1.26:172917; INPE-2785-PRE/351) Avail: NTIS HC A02/MF A01 CSCL 05B

The use of satellite images obtained from various dates is essential for crop forecast systems. In order to make possible a multitemporal analysis, it is necessary that images belonging to each acquisition have pixel-wise correspondence. A system developed to obtain, register and record image segments from LANDSAT images in computer compatible tapes is described. The translational registration of the segments is performed by correlating image edges in different acquisitions. The system was constructed for the Burroughs B6800 computer in ALGOL language. M.G.

**N83-32127\*#** Instituto de Pesquisas Espaciais, Sao Jose dos Campos (Brazil). CNPQ/INPE LANDSAT SYSTEM Report of Activities, 1 Oct. 1982 - 31 Mar. 1983

N. D. J. PARADA, Principal Investigator, M. N. BARBOSA, and J. B. ESCADA, JR. Apr. 1983 26 p Sponsored by NASA Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E83-10374; NASA-CR-172918; NAS 1.26 172918; INPE-2711-PRE/299) Avail: NTIS HC A03/MF A01 CSCL 05B

The current status of the Brazilian LANDSAT facilities is described and main accomplishments are outlined. Receiving, recording, and processing substations and data distribution centers are discussed. Examples of the preliminary TM product produced by the Brazilian station are given. M.G.

**N83-32128\*#** Geological Survey, Reston, Va. EVALUATION OF RADIOMETRIC AND GEOMETRIC CHARACTERISTICS OF LANDSAT-D IMAGING SYSTEM Quarterly Report

L. U. BENDER, M. H. PODWYSOCKI, L. ROWAN, and J. SALISBURY, Principal Investigators Jul. 1983 3 p ERTS (Contract NASA ORDER S-12407-C) (E83-10375; NASA-CR-172919; NAS 1.26:172919; QR-1) Avail: NTIS HC A02/MF A01 CSCL 05B

Problems, accomplishments, and significant results associated with the evaluation of the LANDSAT-D thematic mapper system are outlined. The higher resolution (over MSS) causes the TM data to approach more closely the quality of high altitude photographs. Thus far, it appears that the data can be used for map inspection and in certain instances for limited map revision. Image maps can be made at a scale of 1:100,000 and perhaps up to 1:62,500. It was also shown that TM data can help locate rocks containing minerals with high hydroxol content, such as clays, gypsum, alunite, and sericite. M.G.

**N83-32136\*#** Geological Survey, Reston, Va. A PRELIMINARY EVALUATION OF LANDSAT-4 THEMATIC MAPPER DATA FOR THEIR GEOMETRIC AND RADIOMETRIC ACCURACIES

M. H. PODWYSOCKI, L. U. BENDER, N. FALCONE, and O. D. JONES 1983 18 p refs Sponsored by NASA Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E83-10383; NASA-CR-172925; NAS 1.26 172925) Avail: NTIS HC A02/MF A01 CSCL 05B

Some LANDSAT thematic mapper data collected over the eastern United States were analyzed for their whole scene geometric accuracy, band to band registration and radiometric

accuracy. Band ratio images were created for a part of one scene in order to assess the capability of mapping geologic units with contrasting spectral properties. Systematic errors were found in the geometric accuracy of whole scenes, part of which were attributable to the film writing device used to record the images to film. Band to band registration showed that bands 1 through 4 were registered to within one pixel. Likewise, bands 5 and 7 also were registered to within one pixel. However, bands 5 and 7 were misregistered with bands 1 through 4 by 1 to 2 pixels. Band 6 was misregistered by 4 pixels to bands 1 through 4. Radiometric analysis indicated two kinds of banding, a modulo-16 stripping and an alternate light dark group of 16 scanlines. A color ratio composite image consisting of TM band ratios 3/4, 5/2, and 5/7 showed limonitic clay rich soils, limonitic clay poor soils, and nonlimonitic materials as distinctly different colors on the image Author

**N83-32143\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

## **INVESTIGATION OF SEVERAL ASPECTS OF LANDSAT-4 DATA QUALITY Quarterly Progress Report**

R. C. WRIGLEY, Principal Investigator 20 Jun 1983 5 p Sponsored by NASA ERTS (E83-10390; NASA-TM-85335; NAS 1.15 85335, QPR-2) Avail: NTIS HC A02/MF A01 CSCL 05B

No unmountable problems in change detection analysis were found when portions of scenes collected simultaneously by LANDSAT 4 MSS and either LANDSAT 2 or 3. The cause of the periodic noise in LANDSAT 4 MSS images which had a RMS value of approximately 2DN should be corrected in the LANDSAT D instrument before its launch. Analysis of the P-tape of the Arkansas scene shows bands within the same focal plane very well registered except for the thermal band which was misregistered by approximately three 28.5 meter pixels in both directions. It is possible to derive tight confidence bounds for the registration errors. Preliminary analyses of the Sacramento and Arkansas scenes reveals a very high degree of consistency with earlier results for bands 3 vs 1, 3 vs 4, and 3 vs 5. Results are presented in table form. It is suggested that attention be given to the standard deviations of registrations errors to judge whether or not they will be within specification once any known mean registration errors are corrected. Techniques used for MTF analysis of a Washington scene produced noisy results. A.R.H.

**N83-32146\*#** Rochester Inst. of Tech., N. Y. Dept. of Imaging and Photographic Science.

## **COMPARISON OF MODELLED AND EMPIRICAL ATMOSPHERIC PROPAGATION DATA Quarterly Report**

J. R. SCHOTT and J. D. BIEGEL 15 Jun. 1983 3 p refs Presented at the SPIE 27th Ann. Intern. Tech. Symp., San Diego, Calif., 1983 Submitted for publication ERTS (Contract NAS5-27323) (E83-10398; NASA-CR-172940, NAS 1.26:172940; QR-3) Avail: NTIS HC A02/MF A01 CSCL 05B

The radiometric integrity of TM thermal infrared channel data was evaluated and monitored to develop improved radiometric preprocessing calibration techniques for removal of atmospheric effects. Modelled atmospheric transmittance and path radiance were compared with empirical values derived from aircraft underflight data. Aircraft thermal infrared imagery and calibration data were available on two dates as were corresponding atmospheric radiosonde data. The radiosonde data were used as input to the LOWTRAN 5A code which was modified to output atmospheric path radiance in addition to transmittance. The aircraft data were calibrated and used to generate analogous measurements. These data indicate that there is a tendency for the LOWTRAN model to underestimate atmospheric path radiance and transmittance as compared to empirical data. A plot of transmittance versus altitude for both LOWTRAN and empirical data is presented. A.R.H.

**N83-33284\*#** National Aeronautics and Space Administration  
Ames Research Center, Moffett Field, Calif.

**THEMATIC MAPPER IMAGE QUALITY: PRELIMINARY RESULTS**

R. C. WRIGLEY, D. H. CARD, C. A. HLAVKA, W. C. LIKENS, F. C. MERTZ, and J. R. HALL 1983 7 p refs Presented at the Intern. Geosci and Remote Sensing Symp, San Francisco, 31 Aug. - 2 Sep. 1983 Sponsored by NASA Prepared in cooperation with Technicolor Government Services, Inc., Moffett Field, Calif. Original photography may be purchased from EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E83-10393; NASA-TM-85256; NAS 1.15:85256) Avail NTIS HC A02/MF A01 CSCL 05B

Based on images analyzed so far, the band to band registration accuracy of the thematic mapper is very good. For bands within the same focal plane, the mean misregistrations are well within the specification, 0.2 pixels. For bands between the cooled and uncooled focal planes, there is a consistent mean misregistration of 0.5 pixels along-scan and 0.2-0.3 pixels across-scan. It exceeds the permitted 0.3 pixels for registration of bands between focal planes. If the mean misregistrations were removed by the data processing software, an analysis of the standard deviation of the misregistration indicates all band combinations would meet the registration specifications except for those including the thermal band. Analysis of the periodic noise in one image indicates a noise component in band 1 with a spatial frequency equivalent to 3.2 pixels in the along-scan direction. A.R.H.

**N83-33285\*#** Arizona Univ., Tucson Remote Sensing Center.

**MTF ANALYSIS OF LANDSAT-4 THEMATIC MAPPER**

R. SCHOWENGERDT 1983 5 p refs Sponsored by NASA ERTS (E83-10394; NASA-CR-172936; NAS 1.26:172936) Avail NTIS HC A02/MF A01 CSCL 05B

The spatial radiance distribution of a ground target must be known to a resolution at least four to five times greater than that of the system under test when measuring a satellite sensor's modulation transfer function. Calibration of the target requires either the use of man-made special purpose targets with known properties, e.g., a small reflective mirror or a dark-light linear pattern such as line or edge, or use of relatively high resolution underflight imagery to calibrate an arbitrary ground scene. Both approaches are to be used in addition to a technique that utilizes an analytical model for the scene spatial frequency power spectrum is being investigated as an alternative to calibration of the scene. A.R.H.

**N83-33286\*#** National Aeronautics and Space Administration.  
Ames Research Center, Moffett Field, Calif.

**ASSESSMENT OF THEMATIC MAPPER BAND-TO-BAND REGISTRATION BY THE BLOCK CORRELATION METHOD**

D. H. CARD, R. C. WRIGLEY, F. C. MERTZ, and J. R. HALL 1983 12 p refs Sponsored by NASA Prepared in cooperation with Technicolor Government Services, Inc., Moffett Field, Calif. ERTS (E83-10397; NASA-TM-85257; NAS 1.15:85257) Avail NTIS HC A02/MF A01 CSCL 05B

Rectangular blocks of pixels from one band image were statistically correlated against blocks centered on identical pixels from a second band image. The block pairs were shifted in pixel increments both vertically and horizontally with respect to each other and the correlation coefficient to the maximum correlation was taken as the best estimate of registration error for each block pair. For the band combinations of the Arkansas scene studied, the misregistration of TM spectral bands within the noncooled focal plane lie well within the 0.2 pixel target specification. Misregistration between the middle IR bands is well within this specification also. The thermal IR band has an apparent misregistration with TM band 7 of approximately 3 pixels in each direction. The TM band 3 has a misregistration of approximately 0.2 pixel in the across-scan direction and 0.5 pixel in the along-scan direction, with both TM bands 5 and 7. A.R.H.

**N83-34283#** Army Engineer Topographic Labs., Fort Belvoir, Va.

**TERRAIN ANALYSIS DATABASE GENERATION THROUGH COMPUTER-ASSISTED PHOTO INTERPRETATION**

D. L. EDWARDS 1983 17 p refs Presented at the ACSM-ASP Convention, Washington, D.C., 13-18 Mar. 1983 (AD-A128187; ETL-R044) Avail: NTIS HC A02/MF A01 CSCL 09B

The creation of digital terrain analysis databases through on-line photo interpretation has been the focus of computer-assisted photo interpretation research (CAPIR) at USAETL. An APPS IV analytical plotter equipped with stereo superposition linked to a minicomputer is used for photo interpretation and digitizing. Digital data is input in arc/node format with attributes and the points are stored in three dimensions, latitude, longitude, and elevation. To demonstrate these capabilities, high-altitude infrared photography of the Fort Belvoir, Virginia, area was used for photo interpretation and digitization, supplemented by large-scale photography and field data. Landforms, surface drainage, soils, and vegetation were individually interpreted and digitized. Digital elevations, measured from stereo imagery, were used to produce contour and slope overlays. The resultant digital database was readily accessed and used as a basis for analysis and modeling. This paper briefly describes the hardware, software and methods used to generate a digital terrain analysis database. GRA

**N83-34392\*#** Agricultural Research Center, Beltsville, Md. Hydrology Lab.

**INFORMATION CONTENT OF DATA FROM THE LANDSAT-4 THEMATIC MAPPER (TM) AND MULTISPECTRAL SCANNER (MSS) Progress Report**

J. C. PRICE 1983 7 p refs Original contains imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS (Contract NASA ORDER S-10772-C) (E83-10396; NASA-CR-172938; NAS 1.26:172938; PR-3) Avail: NTIS HC A02/MF A01 CSCL 05B

The progress of an investigation to quantify the increased information content of thematic mapper (TM) data as compared to that from the LANDSAT 4 multispectral scanner (MSS) is reported. Two night infrared images were examined and compared with Heat Capacity Mapping Mission data. M.G.

**N83-34394\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**DATA MANAGEMENT PROCEDURES FOR TIEPOINT REGISTRATION, PRE AND POST PROCESSING, AND ICD116**

B. S. NOWAKOWSKI Jun 1983 48 p Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract NAS9-15800, PROJ. AGRISTARS) (E83-10401; NASA-CR-171688; SR-L3-04430; JSC-18886; NAS 1.26:171688; LEMSCO-19428) Avail: NTIS HC A03/MF A01 CSCL 05B

The data management procedures for tiepoint registration, pre and post processing, and 'ICD116' are described. With each procedure description, the pertinent execs are listed and purposes defined. An example run of each of the 32 execs is included with user inputs identified. M.G.

**N83-34402\*#** California Univ., Berkeley. Space Sciences Lab.

**ANALYSIS OF THE QUALITY OF IMAGE DATA ACQUIRED BY THE LANDSAT-4 THEMATIC MAPPER AND MULTISPECTRAL SCANNERS Quarterly Status and Technical Progress Report, 1 Apr. - 30 Jun. 1983**

R. N. COLWELL, Principal Investigator 10 Aug. 1983 9 p ERTS (Contract NAS5-27377) (E83-10410; NASA-CR-173004; NAS 1.26:173004; QSTPR-2) Avail: NTIS HC A02/MF A01 CSCL 05B

The three types of LANDSAT 4 film products generally accessible to the user community were analyzed and attempts were made to acquire a data set consisting of a variety of TM

## 07 DATA PROCESSING AND DISTRIBUTION SYSTEMS

and MSS image products for the Sacramento and San Francisco Bay Area test sites. On request, the EDC developed an interim TM analytical film by using a laser beam recorder to produce black and white masters from which natural and false color composites were created. A.R.H.

**N83-34405\*#** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

### **LANDSAT-4 IMAGE DATA QUALITY ANALYSIS**

P. E. ANUTA, Principal Investigator 9 Aug. 1983 7 p ERTS (Contract NAS5-26859)

(E83-10413, NASA-CR-173007, NAS 1.26:173007;

LARS-CR-080983) Avail. NTIS HC A02/MF A01 CSCL 05B

Seven heterogeneous areas within the entire Des Moines, Iowa test site were selected to define candidate spectral training classes using a clustering algorithm. In addition to the 91 cluster nonsupervised classes, three supervised training classes were defined. The original candidate training classes were reduced to 42 spectrally separable training classes. The minimum and average transformed divergence values for the 42 spectral classes and for the best subsets of Y TM spectral bands are shown in a table. The best spectral band for any combination of 1 through 7 bands is the first middle IR band. The next best band is the near IR, followed by the red band and then the thermal IR. The best combination of four bands includes one from each of the four regions of the spectrum (visible, near IR, middle IR, and thermal IR). A.R.H.

**N83-34407\*#** National Aeronautics and Space Administration, Washington, D. C.

### **PLANET EARTH THROUGH EYES OF LANDSAT 4**

1983 12 p Original contains color imagery. Original photography may be purchased from the EROS Data Center, Sioux Falls, S.D. 57198 ERTS

(E83-10416; NASA-FACTS-138/3-83; NAS 1.20:138/3-83) Avail: NTIS MF A01; HC SOD CSCL 05B

A brief overview of the imaging capabilities of LANDSAT 4 is given. False color images of various cities, forests, farmland areas, and deserts are presented and the specific features revealed in each are pointed out. M.G.

**N83-34419#** Food and Agriculture Organization of the United Nations, Rome (Italy) Centre de Teledetection.

### **CHOICE OF DIFFERENT SPECTRAL BANDS (WORKSHOP) [CHOIX DE DIFFERENTES BANDES DE LONGUEUR D'ONDES (ATELIER)]**

C. TRAVAGLIA /In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 19-21 Jul 1983 In FRENCH

Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

Evaluation of LANDSAT black and white and color images for Earth resources use is discussed. The characteristics and gray shades of landforms as they appear in LANDSAT images are outlined. The best bandwidth for a particular analysis, e.g., roads or land use, is indicated. Author (ESA)

**N83-34420#** Food and Agriculture Organization of the United Nations, Rome (Italy) Centre de Teledetection.

### **THE PRINCIPLES OF INTERPRETING SATELLITE IMAGERY [LES PRINCIPES D'INTERPRETATION DES IMAGES SATELLITE]**

C. TRAVAGLIA /In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 23-25 Jul. 1983 refs In FRENCH

Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

The availability of LANDSAT multispectral scanner images, and the forms in which they are presented are described. Images are available as: 70 mm, black and white (bw) 1/3, 369,000 scale positive transparencies analyzed using a viewer; positive and negative 19 cm bw 1/1 million transparencies, analyzed on a viewing table; bw prints at 1/1 million, 1/5 million and 1/250,000 scales; false color composites as slides (1/1 million) and prints (1/1 million, 1/5 million, 1/250,000), and as 35 mm slides. Each

image covers 34,000 sq km. Each point is covered every 18 days. Author (ESA)

**N83-34430#** Massachusetts Inst. of Tech., Cambridge. Artificial Intelligence Lab.

### **ATMOSPHERE EFFECTS IN SATELLITE IMAGING OF MOUNTAINOUS TERRAIN M.S. Thesis**

R. W. SJOBERG Sep. 1982 93 p refs

(Contract N00014-80-C-0505)

(AD-A128431; AI-TR-688) Avail: NTIS HC A05/MF A01 CSCL 22B

It is possible to obtain useful maps of surface albedo from remotely-sensed images by eliminating effects due to topography and the atmosphere, even when the atmospheric state is not known. A simple phenomenological model of earth radiance that depends on six empirically determined parameters is developed under certain simplifying assumptions. The model incorporates path radiance and illumination from Sun and sky and their dependencies on surface altitude and orientation. It takes explicit account of surface shape, represented by a digital terrain model, and is therefore especially suited for use in mountainous terrain. A number of ways of determining the model parameters are discussed, including the use of shadows to obtain path radiance and to estimate local albedo and sky irradiance. The emphasis is on extracting as much information from the image as possible, given a digital terrain model of the imaged area and a minimum of site-specific atmospheric data. The albedo image, introduced as a representation of surface reflectance, provides a useful tool to evaluate the simple imaging model. Criteria for the subjective evaluation of albedo images are established and illustrated for LANDSAT multispectral data of a mountainous region of Switzerland. Author (GRA)

**N83-35453\*#** Pennsylvania State Univ., University Park.

### **THE ORSER SYSTEM FOR THE ANALYSIS OF REMOTELY SENSED DIGITAL DATA Final Report**

W. L. MYERS and B. J. TURNER /In Florida State Univ. Appl. of Satellite Frost Forecast Technol. to Other Parts of the United States 4 p Nov. 1981 Presented at the SAF Natl. Workshop In-Place Resource Inventories: Principles and Pract., Orono, Maine, 10-14 Aug 1981 ERTS

Avail: NTIS HC A14/MF A01 CSCL 05B

The main effort of the University of Pennsylvania's Office for Remote Sensing of Earth Resources (ORSER) is the processing, analysis, and interpretation of multispectral data, most often supplied by NASA in the form of imagery and digital data. The facilities used for data reduction and image enhancement are described as well as the development of algorithms for producing a computer map showing various environmental and land use characteristics of data points in the analyzed scenes. The application of an (ORSER) capability for statewide monitoring of gypsy moth defoliation is discussed. A.R.H.

**N83-35457\*#** Purdue Univ., Lafayette, Ind. Lab. for Applications of Remote Sensing.

### **LANDSAT-4 IMAGE DATA QUALITY ANALYSIS Quarterly Progress Report, 10 May - 9 Aug. 1983**

P. E. ANUTA 25 Aug. 1983 7 p ERTS

(Contract NAS5-26859)

(E83-10418; NASA-CR-173035; NAS 1.26:173035;

LARS-CR-080983) Avail: NTIS HC A02/MF A01 CSCL 05B

Seven heterogeneous areas within the Des Moines, Iowa area test site were selected to define candidate spectral training classes using a clustering algorithm. In addition to the 91 cluster (nonsupervised) classes, three supervised training classes were defined and subsequently included in the training statistics file. The identity of all 94 candidate classes were determined using available reference data. Through analysis of the interclass separabilities, the original 94 candidate training classes were reduced to 42 spectrally separable final classes. The minimum average transformed divergence values for the 42 spectral classes and for the best subsets of TM spectral bands are shown in a table. A.R.H.

**N83-35458\*** Business and Technological Systems, Inc.,  
Seabrook, Md.

**EVALUATION OF LANDSAT-D ORBIT DETERMINATION USING**

**A FILTER/SMOOTHER (PREFER) Final Report**

B. P. GIBBS Apr. 1982 36 p refs ERTS

(Contract NAS5-26807)

(E83-10419; NASA-CR-170557, NAS 1.26 170557) Avail: NTIS

HC A03/MF A01 CSCL 05B

Simulated range and range rate data for five tracking stations were first generated using batch least squares orbit determination (GTDS). Then GTDS was used (in the differential correction mode) to produce a nominal trajectory which was input to PREFER. The GTDS differential correction (DC) run was made using models which differed from those used to produce the simulated data. These model differences were chosen to be fairly realistic approximations to the errors in the models actually used for operational orbit determination. Several different simulation runs were made with different types of model errors in order to determine the sensitivity to these errors. The nominal trajectory and the simulated measurement data were input to PREFER to produce a smoothed ephemeris file. Numerous runs of PREFER were made in which parameters describing the statistics of the model errors were varied. The likelihood function computed by the Kalman filter determined the "best" choice of input parameters. There was strong negative correlation between the likelihood function and the errors in the smoothed ephemeris.

A R H.

**N83-35462\*** National Aeronautics and Space Administration.  
Earth Resources Labs, Bay St. Louis, Miss

**THE USE OF LANDSAT-4 MSS DIGITAL DATA IN TEMPORAL DATA SETS AND THE EVALUATION OF SCENE-TO-SCENE REGISTRATION ACCURACY Quarterly Report, 22 Jun. - 21 Aug. 1983**

J. E. ANDERSON, Principal Investigator 27 Aug 1983 18 p refs ERTS

(E83-10423; NASA-TM-85420; ERL-222; NAS 1.15 85420) Avail NTIS HC A02/MF A01 CSCL 05B

The MSS sensor on LANDSAT 4 is, in certain performance aspects, different from those on LANDSAT 1 through 3. These differences created some concern in the NASA research community as to whether individual data sets can be registered accurately enough to produce acceptable data sets for multitemporal data analysis. The use of LANDSAT 4 MSS digital data in temporal data sets is examined and a method is presented for estimating temporal registration accuracy based on the use of an X-Y digitizer and grey tone electrostatic plots. Results indicate that the RMS temporal registration errors are not significantly different from the temporal data sets generated using LANDSAT 4 and LANDSAT 2 data (33.35 meters) and the temporal data set constructed from two LANDSAT 2 data sets (33.61 meters). A derivation of the model used to evaluate the temporal registration is included.

Author

## 08

### INSTRUMENTATION AND SENSORS

Includes data acquisition and camera systems and remote sensors.

**A83-41146\*** Jet Propulsion Lab., California Inst. of Tech.,  
Pasadena.

### AMBIGUITIES IN SPACEBORNE SYNTHETIC APERTURE RADAR SYSTEMS

F. K. LI and W. T. K. JOHNSON (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IEEE Transactions on Aerospace and Electronic Systems (ISSN 0018-9251), vol. 19, May 1983, p. 389-396. refs

(Contract NAS7-100)

An examination of aspects of spaceborne SAR time delay and Doppler ambiguities has led to the formulation of an accurate method for the evaluation of the ratio of ambiguity intensities to that of the signal, which has been applied to the nominal SAR system on Seasat. After discussing the variation of this ratio as a function of orbital latitude and attitude control error, it is shown that the detailed range migration-azimuth phase history of an ambiguity is different from that of a signal, so that the images of ambiguities are dispersed. Seasat SAR dispersed images are presented, and their dispersions are eliminated through an adjustment of the processing parameters. A method is also presented which uses a set of multiple pulse repetition sequences to determine the Doppler centroid frequency absolute values for SARs with high carrier frequencies and poor attitude measurements.

O.C.

**A83-41560\*** National Aeronautics and Space Administration.  
Goddard Space Flight Center, Greenbelt, Md.

### THE AIRBORNE LASER RANGING SYSTEM - ITS CAPABILITIES AND APPLICATIONS

W. D. KAHN, J. J. DEGNAN (NASA, Goddard Space Flight Center, Greenbelt, MD), and T. S. ENGLAR, JR. (Business and Technological Systems, Inc., Seabrook, MD) Bulletin Geodesique (ISSN 0007-4632), vol. 57, no. 2, 1983, p. 180-194. refs

The Airborne Laser Ranging System is a proposed multibeam short pulse laser ranging system on board an aircraft. It simultaneously measures the distances between the aircraft and six laser retroreflectors (targets) deployed on the earth's surface. Depending on the host aircraft and terrain characteristics, the system can interrogate hundreds of targets distributed over an area as large as 60,000 sq. km in a matter of hours. Potentially, a total of 1.3 million individual range measurements can be made in a 6 hr flight. The precision of these range measurements is approximately 1 cm. These measurements are then used in a procedure which is basically an extension of trilateration techniques to derive the intersite vector between the laser ground targets. By repeating the estimation of the intersite vector, strain and strain rate errors can be estimated. These quantities are essential for crustal dynamic studies which include determination and monitoring of regional strain in the vicinity of active fault zones, land subsidence, and edifice building preceding volcanic eruptions.

Author

**A83-43763#**

### LANDSAT-4 THEMATIC MAPPER CALIBRATION AND ATMOSPHERIC CORRECTION

W. A. HOVIS American Astronautical Society, Goddard Memorial Symposium, 21st, Greenbelt, MD, Mar. 24, 25, 1983 11 p. (AAS PAPER 83-162)

The improved radiometric quality of the Thematic Mapper (TM) over the Multi Spectral Scanner (MSS) provides a number of opportunities to obtain more accurate research results. The spectral range for the TM has been extended into the blue and the near infrared, while the bits per word have been increased to eight. In order to utilize the TM as a radiometer for quantitative

measurements, attention must be given to a number of factors which were not nearly so important in the case of the MSS. Thus, a calibration of the sensor prior to launch, and during flight is needed. It has been found that a system developed to monitor the calibration of the CZCS on Nimbus-7 with time can be utilized to monitor the performance of the TM. Attention is given to Rayleigh backscatter correction, the calculation of Rayleigh correction factors, and aspects of monitoring calibration with time. G.R

**A83-43772\*#** National Aeronautics and Space Administration, Washington, D. C

## MULTISENSOR SATELLITES AND DATA SYSTEMS FOR EARTH OBSERVATIONS

P. G THOME (NASA, Office of Space Science and Applications, Washington, DC) American Astronautical Society, Goddard Memorial Symposium, 21st, Greenbelt, MD, Mar. 24, 25, 1983 13 p.

(AAS PAPER 83-195)

The applications of multisensor satellites for earth sciences studies in the next two decades are discussed in terms of instrumentation and expected technology developments. Passive microwave and IR sounders with better resolution than currently available are forecast for the mid- to late-1980's, enabling improved understanding of the coupling between the atmosphere, ocean, land, and the biosphere. The global troposphere will be examined for sources, sinks, and fluxes of its chemistry, and interactions among radiation, chemistry, and dynamics in the upper atmosphere. The Landsat 4 Thematic Mapper, along with imagers, radars, and spectrometers carried aloft on the Shuttle are being used and tested to characterize the relative utility of various parts of the electromagnetic spectrum. Hydrologic studies with spacecraft imagery have led to the development of moisture models that will give improved predictive ability to soil moisture, snow cover variations, and the distribution and magnitude of global precipitation and evapotranspiration M S.K.

**A83-45706\*** Wisconsin Univ., Madison.

## HEAVY THUNDERSTORMS OBSERVED OVER LAND BY THE NIMBUS 7 SCANNING MULTICHANNEL MICROWAVE RADIOMETER

R. W. SPENCER, W. S. OLSON, D. W. MARTIN, J. A. WEINMAN, D. A. SANTEK (Wisconsin, University, Madison, WI), and R. WU (Wisconsin, University, Madison, WI; Central Meteorological Bureau, Beijing, People's Republic of China) Journal of Climate and Applied Meteorology (ISSN 0733-3021), vol 22, June 1983, p 1041-1046. refs

(Contract NOAA-NA-80SAC00742, NAGW-380)

Brightness temperatures obtained through examination of microwave data from the Nimbus 7 satellite are noted to be much lower than those expected on the strength of radiation emanating from rain-producing clouds. Very cold brightness temperature cases all coincided with heavy thunderstorm rainfall, with the cold temperatures being attributable to scattering by a layer of ice hydrometeors in the upper parts of the storms. It is accordingly suggested that brightness temperatures observed by satellite microwave radiometers can sometimes distinguish heavy rain over land. O.C.

**A83-45707**

## IMPROVEMENTS IN CLOUD PHOTOGRAMMETRY USING AIRBORNE, SIDE-LOOKING, TIME-LAPSE CAMERAS

C. J. BITER, T. W. CANNON, E. L. CROW, C. A. KNIGHT, and P. M. ROSKOWSKI (National Center for Atmospheric Research, Boulder, CO) Journal of Climate and Applied Meteorology (ISSN 0733-3021), vol. 22, June 1983, p. 1047-1055. refs

Attention is given to the instrumentation, photogrammetric theory, and cloud measurement derivation procedures employed in a 1978 convective cloud study which used inertial navigation system-coupled airborne photography. An empirical error analysis based on photographs of terrestrial targets is also given. Cloud top heights determined without any reference height in the photographs are judged accurate to within 440 m at a range of 60 km, with the greatest source of error being the uncertainty in

determining aircraft-to-cloud distance, rather than photographic system inaccuracy. This error may in future studies be reduced by flying at altitudes that are as close as possible to the cloud features of interest. O.C.

**A83-45721**

## LAUNCHING LARGE ANTENNAS

H. W. BRANDLI Satellite Communications (ISSN 0147-7439), vol 7, Sept. 1983, p. 40, 42.

Large antennas will provide communication to rural and remote areas in times of need. This is seen as facilitating the work of law enforcement agencies. All mobile radio communications will enjoy advantages in distances covered and information relayed owing to the large number of beams possible from super radio transmitters in space. If the antennas are placed in low-earth orbit, advantages will be realized in the remote sensing of the earth's resources. It is pointed out that with umbrella or bicyclelike antennas turned outward toward space, the universe could be scouted for signals from intelligent life. Various concepts that have been put forward by U.S. companies are described. These include the radial rib, wrap rib, and parabolic erectable truss designs. Others are the mesh hoop column collapsible umbrella made of gold and molybdenum and the maypole design. C.R.

**A83-45921**

## MANUAL OF REMOTE SENSING. VOLUME 1 - THEORY, INSTRUMENTS AND TECHNIQUES /2ND EDITION/

D. S. SIMONETT, ED Falls Church, VA, American Society of Photogrammetry, 1983, 1268 p.

Theory, instruments, and techniques of remote sensing are discussed. The subjects addressed include development and principles of remote sensing, the nature of electromagnetic radiation, matter-energy interaction in the optical and microwave regions, interaction mechanisms within the atmosphere, photographic systems for remote sensing, electrooptical imaging and nonimaging sensors, radar fundamentals and scatterometers, imaging radar systems, passive microwave radiometry, and Landsat satellites. Also considered are microwave and infrared satellite remote sensors, meteorological satellites, communication and data transmission systems, orbital mechanics for remote sensing, data processing and reprocessing, pattern recognition and classification, remote sensing software systems, digital hardware, image geometry and rectification, geographic information systems and remote sensing, ground investigations in support of remote sensing, and image analysis of data in the visible, infrared, and microwave regions. No individual items are abstracted in this volume C.D.

**A83-46077#**

## PASSIVE RADIOMETRY FOR VERTICAL SOUNDING FROM METEOROLOGICAL SATELLITES

W. L. SMITH (NOAA, Development Laboratory, Madison, WI) Applied Optics (ISSN 0003-6935), vol. 22, Sept. 1, 1983, p. 2641-2643 refs

**A83-46114\*** National Aeronautics and Space Administration, Washington, D. C.

## THE NASA RADAR REMOTE SENSING PROGRAM

K. R. CARVER (NASA, Washington, DC) IN. 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

The NASA radar remote sensing program is structured to conduct scientific research for earth and planetary exploration using the microwave spectrum. The program began in 1966 and has since developed a complement of radar sensors for satellite, aircraft and ground-based platforms which have been used in both land and oceanic research. Basic measurements of radar scattering coefficient signatures are carried out with airborne and ground-based scatterometers. SAR imagery is being used for geological, hydrological, geographical, and agricultural microwave remote sensing research. For oceanic investigations, altimeters are used for ocean topography experiments and scatterometers for ocean wind and current research. Future satellite radar



instruments being proposed include SIR-B, SAMEX, FIREX, TOPEX and a Scatterometer Experiment  
Author

#### **A83-46115 DEVELOPMENT OF ACTIVE MICROWAVE SENSORS IN JAPAN**

K. MATSUMOTO (National Space Development Agency of Japan, Earth Observation System Dept., Tokyo, Japan), H. KISHIDA, H. YAMADA, and Y. HISADA (National Space Development Agency of Japan, Tsukuba Space Center, Sakura, Ibaraki, Japan) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Active microwave sensors under development in Japan to be incorporated as part of a future remote sensing satellite are described. The microwave altimeter will have RF, signal processor, and tracking processor sections. FM radar pulses would be emitted using SAW technology. Advances are still required to effectively configure the on-board signal processing equipment for maximum likelihood estimation with a 16-bit microprocessor. A pulse Doppler wind scatterometer, similar to the Seasat SASS instrument, will have fan beam scanning with a swath width of 500 km. The Doppler filter will identify 20 unit cells 25 x 25 km in size, using six antennas switched on in 2 sec intervals. An SAR unit would involve a chirp modulator with a SAW dispersive delay line, with the received echo detected for recording with the transmitted signal as a hologram for on-board storage or transmission on the X-band. M.S.K.

#### **A83-46116 EARTH FEATURE CLASSIFICATION DEVELOPMENTS FOR REMOTE SENSING**

H. M. THOMAS (Martin Marietta Aerospace, Denver, CO) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

The design features of smart sensors which would screen out useless information on board remote sensing satellite systems in order to reduce the data transmitted to the ground segment are described. The NASA Information Adaptive System (IAS) is being studied for removing sensor nonlinearities and suppressing unwanted data with earth-feature classification techniques. The data sensed are compared with reference data, e.g., vegetation indices, and used to eliminate all other data not fitting the model. Examples are presented of earth feature classification through sensing radiation from water, vegetation, and bare soil radiance. It is noted that unless the smart sensors are used, the total data being transmitted each day would be the equivalent of one million 300 page books per day. M.S.K.

#### **A83-46136 THE EUROPEAN SAR-580 PROJECT**

A. HASKELL (ESA, Toulouse, France) and B. M. SORENSEN (INTRADAN Environmental Consultants, Kerteminde, Denmark) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. Research sponsored by the European Space Agency and Commission of the European Communities. refs

The principal sensor on board the Convair 580 aircraft is a dual-band, dual-polarization SAR that can be operated in the X and C band or the X and L band. The sensor makes it possible to select the angle of incidence, the operating altitude, the transmitted polarization, and the recording/processing conditions. The objectives are threefold: (1) to assess the potential and the role of SAR for land applications; (2) to gain experience in SAR processing, calibration, and parameter optimization; and (3) to gain experience in relevant ground data collection methods and image interpretation methods. In all, 40 flights were completed, for a total of 117 flight hours. Attention is called to the slow progress made in processing the data. C.R.

#### **A83-46143**

**PERFORMANCE SIMULATION OF A WIND SCATTEROMETER**  
D. MILLER and P. HANS (Dornier System GmbH, Friednchshafen, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

The wind scatterometer, a sensor planned for the satellite that will succeed ERS-1, will measure wind vectors over the oceans. A description is given of the computer simulation that will be used to optimize the sensor design and predict the merit of the extracted data. Monte Carlo simulation with a simplified error model is used on a mainframe computer to demonstrate the probability of successful data extraction. Detailed geometry and propagation path modeling on a desktop computer furnishes an interactive design tool for a particular system design. The principles and geometry for two system concepts are illustrated; these are Doppler filtering and range gating. In addition, the problems posed by ambiguous solutions are explained. C.R.

**A83-46148\*** National Aeronautics and Space Administration Earth Resources Labs., Bay St. Louis, Miss.

#### **LANDSAT-D THEMATIC MAPPER SIMULATOR**

G. F. FLANAGAN and E. L. TILTON, III (NASA, National Space Technology Laboratories, Earth Resources Laboratory, Bay St. Louis, MS) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p.

The design and testing program for the airborne Landsat-D thematic-mapper simulator (TMS) is summarized. The TMS is intended to provide data similar enough to those expected from Landsat-D to facilitate the development of data-processing software. The design process comprised mainly modifications on the existing MSS-simulator fiber optics, dichroics, and detectors to provide 7-channel coverage of the 0.45-12.3-micron range at 60-deg angle of view, corresponding to a 418-element, 13.8-km-wide ground swath. The TMS is carried on a Lear 23 aircraft operating at 750 km/h and 12-m altitude and equipped with a 15.2-cm aerial mapping camera and a ground-updated inertial navigational system. Agricultural, forestry, and geological trial applications are reviewed, and some sample results are given. The significant improvements predicted for the Landsat-D thematic mapper (relative to the Landsat MSS) are seen as confirmed, with the possible exception of the 120-m-resolution version of channel 7. T.K.

#### **A83-46150**

#### **DEFINING SYSTEM REQUIREMENTS FOR ACQUIRING AND PROCESSING LAND REMOTE SENSING DATA**

J. H. CHESTEK (General Electric Co., Fairfield, CT) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. Research sponsored by the General Electric Co. refs

Results are presented for an overall systems level study of the use of next generation solid state multispectral imagers in a space-based earth-observation mission. Both the space and ground segments were examined in the study, as well as the communications that link them. Among other findings, it is determined that additional analysis and simulation are required for several areas, primarily in the image processing, in order to achieve the desired system accuracy. The data compression algorithms should be chosen with attention to the link noise and the impact upon the ground processing required to obtain geometric registration. In addition, it is determined that the capability to provide geometric registration to a few meters, using state of the art navigational and attitude measurements, needs to be assessed, assuming that sub-pixel geometric registration precision is required no matter how small the pixel. N.B.

## 08 INSTRUMENTATION AND SENSORS

**A83-46151\*** Arizona Univ., Tucson.

### **ABSOLUTE RADIOMETRIC CALIBRATION OF ADVANCED REMOTE SENSING SYSTEMS**

P. N. SLATER (Arizona, University, Tucson, AZ) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs (Contract NAG5-196)

The distinction between the uses of relative and absolute spectroradiometric calibration of remote sensing systems is discussed. The advantages of detector-based absolute calibration are described, and the categories of relative and absolute system calibrations are listed. The limitations and problems associated with three common methods used for the absolute calibration of remote sensing systems are addressed. Two methods are proposed for the in-flight absolute calibration of advanced multispectral linear array systems. One makes use of a sun-illuminated panel in front of the sensor, the radiance of which is monitored by a spectrally flat pyroelectric radiometer. The other uses a large, uniform, high-radiance reference ground surface. The ground and atmospheric measurements required as input to a radiative transfer program to predict the radiance level at the entrance pupil of the orbital sensor are discussed, and the ground instrumentation is described. Previously announced in STAR as N83-28544 M.G.

**A83-46152**

### **TRENDS IN SOLID STATE IMAGE SENSORS FOR REMOTE SENSING**

J. L. LOWRANCE (Princeton University, New Observatory, Princeton, NJ) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

Remote sensing in the 1980s will draw heavily on solid-state image sensor technology. Linear self-scanned arrays of photo sensors fabricated on silicon using large-scale integrated circuit technology offer many advantages for satellite-borne imaging systems. Mission requirements envisaged as typical in the 1980s are summarized. On this basis, image sensor specifications are deduced. Current solid-state array concepts are surveyed and compared. It is expected that the most successful solid-state line arrays for the imaging of earth resources will rely to a great extent on subarrays with parallel readout every few hundred pixels to reduce the readout rate. This introduces the formidable problem of the data output of these multispectral arrays. The necessity of limiting the number of spectral channels, or the line length that is transmitted, is discussed. It is noted that the push-broom scanning concept is generally accepted as the optimum means for obtaining high-resolution multispectral images of the earth from a satellite platform. C.R.

**A83-46153**

### **SOLID-STATE SENSORS FOR THE 1990'S**

T. M. ABBOTT (Ball Corp., Aerospace Systems Div., Boulder, CO) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p.

Silicon detector arrays represent an imaging technique that employs linear arrays of solid-state detectors operating in what is called a 'pushbroom scan' mode. In a system of this type, a detector array is used to image the scene in the cross-track direction, and the satellite's motion provides the orthogonal scan component. With the array oriented in a cross-track configuration, continuous coverage of a wide swath of terrain is possible. Since the satellite subpoint motion along the ground track provides the scanning motion, mechanical scanning is eliminated. Large arrays can be put together containing several thousand detector elements (pixels). High-density linear arrays offer high-resolution capabilities. The precise geometric alignment of the detector elements resulting from microcircuit fabrication techniques offers the advantage of high accuracy in the ground reconstruction of images. The detectors are operated in an integration mode, thereby providing a high

scan efficiency. The 'exposure' time of each pixel is limited only by the permissible image motion at the optical focal plane. C.R.

**A83-46169\*** General Electric Co., Philadelphia, Pa.

### **SENSOR TECHNOLOGY FOR FUTURE ATMOSPHERIC OBSERVATION SYSTEMS**

U. R. ALVARADO (General Electric Co., Space Systems Div., Philadelphia, PA) and L. S. KEAFER, JR. (NASA, Langley Research Center, Hampton, VA) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p.

The remote sensing instruments that will be needed for research in atmospheric environmental quality in the future are considered. The needs are determined on the basis of a model that incorporates scientific knowledge objectives, measurement needs, and potential space missions, spacecraft and instruments in order to discern the technology requirements. While emphasis is placed on global surveys that make full use of the synoptic observation capabilities of spaceborne sensors, the importance of airborne and ground-based sensors in this research is also recognized. Several of the instruments that are identified to fulfill the knowledge objectives are spectrometers and radiometers using such passive measurement techniques as interferometer correlation absorption radiometry, and heterodyne spectrometry. Lidar instruments are also seen as important future developments C.R.

**A83-46170**

### **MICROWAVE ATMOSPHERIC SOUNDER FOR EARTH LIMB OBSERVATIONS FROM SPACE**

P. HEINECKE and M. BOISON (Dornier System GmbH, Friedrichshafen, West Germany) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p. refs

Attention is called to the need for global sets of atmospheric data in modern atmospheric research as input to model calculations. It is only by means of space-borne remote sensing observing techniques that such data sets can be obtained. These sensors possess the required global coverage and have a high repetition rate. The radiation emanating from the atmospheric limb in the frequency range from 60 to 200 GHz is to be measured by the Microwave Atmospheric Sounder (MAS). The MAS will be part of the fourth mode of the Microwave Remote Sensing Experiment. The mission objectives are described, and an account is given of the MAS system and the modifications of the MRSE that will be necessary. The MAS will operate in two submodes, that is, the pointing mode and the elevation scan mode. In the second, the antenna axis scans with a constant velocity of 1.25 deg/s through the elevation angle, which ranges from 10 deg to 16 deg. The azimuth angle here is fixed at 0 deg. C.R.

**A83-46175**

### **APPLICATION POSSIBILITIES OF ACTIVE MICROWAVE SYSTEMS FOR REMOTE SENSING - A SURVEY OF RESPECTIVE DFVLR ACTIVITIES**

W. KEYDEL (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) IN 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs

**A83-46176\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**THE SEASAT SYNTHETIC APERTURE RADAR - ENGINEERING PERFORMANCE EVALUATION**

D. N. HELD (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA), J. R. BENNET (MacDonald, Dettwiler and Associates, Ltd., Richmond, British Columbia, Canada), and R. A. SHUCHMAN (Michigan, Environmental Research Institute, Ann Arbor, MI) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. refs  
(Contract NAS7-100)

Results are presented for a study conducted in order to characterize the quality and consistency of the SEASAT Synthetic Aperture Radar image data set. The study evaluated a large spectrum of parameters, including the resolution, position location accuracy, and the amplitude calibration of the imagery produced from the raw data by processors at several institutions. It is demonstrated that this data set can be used to obtain resolution up to the theoretical limit of 6 m x 21 m, absolute position location to within 200 m, and relative calibration of the image data to within + or - 2 dB.

N.B.

**A83-46180**

**A DESIGN OF AN INEXPENSIVE SLAR-SYSTEM**

K. R. RICHTER and H. PAAR (Graz, Technische Universitaet, Graz, Austria) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. Research sponsored by the Fonds zur Foerderung der Wissenschaftlichen Forschung

The development of a side-looking airborne imaging radar operated in the X-band for microwave remote sensing is examined. This system incorporates low-cost design features which provides moderate resolution (along track 14 m/km, slant range 7.5 or 15 m). A digital data output is employed for further data and image processing which is highly important for modern remote sensing applications. The radar system is a combination of commercially available units and specially designed units. A detailed estimate of the costs of this radar system is presented.

Author

**A83-46199**

**INFLUENCE OF THE ATMOSPHERE ON THE PERFORMANCE OF A MULTICHANNEL MICROWAVE RADIOMETER**

A. GUISSARD (Louvain, UniversiteCatholique, Louvain, Belgium) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 6 p. Sponsorship: European Space Agency. refs  
(Contract ESA-4124/79)

Attention is given to the influence exerted by atmospheric hydrometeors on the retrieval of ground (or sea) and atmospheric parameters from 5-90 GHz frequency range multichannel radiometry. A numerical integration of the radiative transfer equation, together with a maximum likelihood procedure, are used in an evaluation of error estimates for variable rain conditions. Multichannel radiometry may be useful in the production of cloud structure statistics, since heavy clouds produce attenuations that are not less than equal to those of light rains.

O.C.

**A83-46214**

**REMOTE SENSING AS A TOOL FOR RESOURCE DEVELOPMENT**

R. MUEHLFELD (Bundesanstalt fuer Geowissenschaften und Rohstoffe, Hanover, West Germany) IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest Volume 2. New York, Institute of Electrical and Electronics Engineers, 1982, 4 p. refs

Criteria for the selection of remote-sensing (RS) techniques to provide information for the development of mineral, hydrocarbon, water, and soil resources are summarized and illustrated. The

relationship between the type of information required, the natural conditions prevalent in the area under study, and the possible use of satellite or airborne mapping techniques is explored. It is shown that geological and structural features, especially linear elements and crystalline rocks, are directly accessible to RS, whereas soil types and other features must be determined indirectly from vegetation distribution. The spectral absorption/reflectance characteristics of different geological and plant features are reviewed, and the capabilities of available instruments are listed. Adequate resolution is often obtainable only with airborne instruments. RS-image processing by computer methods is discussed, including geometric correction, image enhancement, data compression, and classification.

T.K.

**A83-46227\***

**INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM, UNIVERSITAET MUENCHEN, MUNICH, WEST GERMANY, JUNE 1-4, 1982, PROCEEDINGS**

A. J. SEIBER, ED (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) Symposium sponsored by IEEE, BMFT, NASA, et al IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, 178 p.

The present conference on geoscience and remote sensing considers the multispectral remote sensing of saline seeps, the augmentation of LANDSAT MSS data with topographic data, thematic mapping, the sampling problem in radiation budget studies, aerial conductivity measurements over geothermal areas, a comparison of multifrequency band radars for crop classification, the improved estimation of vegetation-covered soil by combined active/passive microwave remote sensing, and atmospheric water vapor profiling by ground-based radiometry. Also discussed are SAR imaging from an inclined geosynchronous orbit, the classification of agricultural crops in radar images, the Ocean Color Experiment on the second orbital flight test of the Space Shuttle, the dielectric properties of wet materials, remote sensing systems for the mm-wave region, and the simulation of spaceborne stereo radar imagery.

O.C.

**A83-46230**

**THE THEMATIC MAPPER - AN OVERVIEW**

J. L. ENGEL (Santa Barbara Research Center, Goleta, CA) and O. WEINSTEIN (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 258-265.

The thematic mapper (TM), a second-generation earth resources sensor developed for NASA's LANDSAT-series spacecraft, was placed in orbit aboard LANDSAT-D in July, 1982. The performance specifications for the TM were formulated to produce performance improvements in the next-generation sensor. The TM acquires data in seven spectral bands covering the visible, near-IR, middle-IR, and thermal-IR regions of the EM spectrum, and comprises a scan mirror, a telescope, a scan line connector, a prime focal plane, relay optics, a cooled focal plane, a radiative cooler, an on-board calibrator, and an electronics module. Attention is given to the system's performance in spectral coverage, radiometric sensitivity, square wave modulation, band-to-band registration, and geometric accuracy.

O.C.

**A83-46246**

**APPLICATION POSSIBILITIES OF PASSIVE REMOTE-SENSING SYSTEMS IN THE MILLIMETER-WAVE REGION**

K. GRUENER, W. KEYDEL, and H. SUESS (Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Institut fuer Hochfrequenztechnik, Oberpfaffenhofen, West Germany) (International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982) IEEE Transactions on Geoscience and Remote Sensing (ISSN 0196-2892), vol. GE-21, July 1983, p. 376-382 refs

The advantages of microwave radiometry in comparison with optical and active microwave methods include all-weather capability, penetration depth, low power consumption, and oblation

of biological and environmental impacts. Attention is presently given to several possible applications based on airborne measurements at 32 and 90 GHz, which include (1) earth observation with respect to vegetation conditions, ground moisture and snow cover; (2) traffic control at land and sea, and the sensing of road conditions; and (3) earth observation in conditions of poor ground visibility. Future developments will have as their primary goals the increase of data rates, as well as geometrical and temperature resolution improvements through the use of multireceiver systems. O.C.

**A83-47137**

## **METHODS OF ACTIVE AND PASSIVE RADAR DETECTION IN METEOROLOGY [METODY AKTIVNOI I PASSIVNOI RADIOLOKATSII V METEOROLOGII]**

V. D. STEPANENKO, ED., I. A. MELNIK, ED., and G. G. SHCHUKIN, ED. Leningrad, Gidrometeoizdat (Glavnaia Geofizicheskaya Observatoriya imeni A. I. Voeikova, Trudy, No. 451), 1982, 144 p. In Russian.

Topics discussed include the use of model representations and empirical data in the case of the passive-active radar sounding of clouds and precipitation; the thermal-microwave radiometric determination of the moisture content of a cloudy atmosphere; a method for determining water-vapor content in the atmosphere using joint infrared and microwave radiometric measurements; and the effect of the inertia of hydrometeors on the statistical characteristics of a radar signal. Also considered are methods for the determination of the tropospheric refraction of ultrashort waves; the mechanism of mesoscale variations with height of low cloud cover; the use of the synthetic-aperture method in radar meteorology; and the experimental evaluation of the visual efficiency of devices for the display of meteorological radar data. B.J.

**A83-47139**

## **EXPERIMENTAL THERMAL-MICROWAVE RADIOMETRIC DETERMINATION OF THE MOISTURE CONTENT OF A CLOUDY ATMOSPHERE [EKSPERIMENTAL'NOE OPREDELENIE VLAGOSODERZHANIYA OBLACHNOI ATMOSFERY]**

G. G. SHCHUKIN, L. P. BOBYLEV, V. N. VIUGINOV, I. A. K. ILIN, and A. I. LIASHKO. IN: Methods of active and passive radar detection in meteorology. Leningrad, Gidrometeoizdat, 1982, p. 18-26. In Russian. refs

The present study examines results of two experiments involving the ground-based thermal-microwave radiometric determination of the moisture content of clouds. The first experiment involved the determination at wavelengths of 0.8 and 1.35 cm of the moisture content of stratus clouds above Estonia during the summer of 1976. The second experiment involved the determination at a wavelength of 0.86 cm of the moisture content of thick cumulus clouds above the Crimea during the summer of 1979. B.J.

**A83-47140**

## **INFORMATION CONTENT, ACCURACY, AND OPTIMAL CONDITIONS OF INDIRECT GROUND-BASED THERMAL-MICROWAVE RADIOMETRIC MEASUREMENTS OF THE INTEGRAL WATER-VAPOR CONTENT OF THE ATMOSPHERE, AND THE WATER CONTENT AND EFFECTIVE TEMPERATURE OF CLOUDS [INFORMATIVNOST', TOCHNOST' I OPTIMAL'NYE USLOVIA KOSVENNYKH NAZEMNYKH RADIOPELOKATSIONNYKH IZMERENII INTEGRAL'NOGO SODERZHANIYA VODIANOGO PARA ATMOSFERY, VODOZAPASA I EFFEKTIVNOI TEMPERATURY OBLAKOV]**

L. P. BOBYLEV and G. G. SHCHUKIN. IN: Methods of active and passive radar detection in meteorology. Leningrad, Gidrometeoizdat, 1982, p. 26-39. In Russian. refs

**A83-47141**

## **A METHOD FOR DETERMINING WATER-VAPOR CONTENT IN THE ATMOSPHERE ON THE BASIS OF JOINT INFRARED AND MICROWAVE RADIOMETRIC MEASUREMENTS [K METODIKE OPREDELENIYA SODERZHANIYA VODIANOGO PARA V ATMOSFERE PO SOVMESTNYM IK I SVCH RADIOMETRICHESKIM IZMERENIYAM]**

A. S. NOVOKRESHCHENOVA and G. G. SHCHUKIN. IN: Methods of active and passive radar detection in meteorology. Leningrad, Gidrometeoizdat, 1982, p. 40-49. In Russian. refs

A comparison is made between measured and calculated values of the downwelling radiation of the atmosphere in the 7-14 micron region and at a wavelength of 1.35 cm. The radiative fluxes and brightness temperature are related to the total moisture content of the atmosphere for various sight angles and seasons of the year. It is shown that the proposed method makes it possible to determine optical thicknesses of the atmosphere in the 7-14 micron range using only results of joint IR and microwave radiometer measurements. The need for radio-sounding data and theoretical models of long-wave radiation transfer is eliminated. B.J.

**A83-47244#**

## **A SPACE STATION EXPERIMENT ON LARGE ANTENNA ASSEMBLY AND MEASUREMENT**

T. IIDA, K. OKAMOTO (Ministry of Posts and Telecommunications, Radio Research Laboratories, Koganei, Tokyo, Japan), Y. OHKAMI, S. KIBE, H. KOSHISHI, M. NAKA, and H. YAMAMOTO (National Aerospace Laboratory, Chofu, Tokyo, Japan). International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct 10-15, 1983. 9 p. refs (IAF PAPER 83-50)

An experimental antenna assembly task for a Space Station crew is described. The 10-m antenna would be assembled in three phases: assembly of test articles using manipulators, evaluation of the mechanical and electrical performance of the antenna, assessment of the performance of the pointing control system, and operation of the weather radar and large aperture microwave radiometer equipment. The antenna would have 10 segments and be carried aloft by the Shuttle. Once in orbit the parts, held in a container, would be extracted and assembled with a manipulator. The test equipment is specified, together with the test procedures for the initial antenna and a weather radar unit. The antennas would be disassembled and returned to the container after the trials were complete. Areas of further development needed before the construction, configuration of the connectors, wiring procedures, and use of manipulators could be attempted are identified. M.S.K.

**A83-47261#**

## **THE ACTIVE MICROWAVE INSTRUMENT (AMI) FOR ERS-1**

B. THEILE (Dornier System GmbH, Friedrichshafen, West Germany), G. DIETERLE (ESA, Toulouse, France), and I. W. MCMILLAN (Marconi Space and Defence Systems, Ltd., Portsmouth, England). International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 7 p. (IAF PAPER 83-92)

The performance parameters and hardware, including circuitry, of the active microwave imaging systems to be installed on the ESA ERS-1 remote sensing satellite are described. The microwave system will function at 5.3 GHz in three measuring modes, imaging, wave sensing and spectra, and wind vector detection. Each image pixel will represent 15 m resolution, with the ground swath being 80 km. Data will be generated in either SAR or scatterometer modes. The image signal path in the processing circuitry is traced for each mode. Details of the RF subsystem, the antennas, the high power amplifier, an automated calibrator, the power conditioner, and the scatterometer processor are provided. M.S.K.

**A83-47262#****INCREASE OF THE RESOLUTION OF PASSIVE RADIOMETRIC SYSTEMS THROUGH JOINT PROCESSING WITH VISIBLE RANGE DATA**

D. MISHEV (B'lgarska Akademiia na Naukite, Tsentralna Laboratoriia za Kosmicheski Izsledvaniia, Sofia, Bulgaria) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983 5 p. refs (IAF PAPER 83-93)

The capabilities and data processing algorithms, as well as the on-board equipment of the Meteor-Priroda remote sensing satellite are described. The spacecraft instrumentation has a 32 channel spectrometric scanner for the 450-900 nm range. Microwave sensing can be performed in the 100-360 K range with a 0.3 K sensitivity. A microwave radiometer operates at the 0.8, 1.25, and 1.6 cm wavelengths has a 100-320 K range with 1.5 K resolution. Finally, visible scans at 500-700 nm and IR viewing from 700-1100 nm is possible. Numerical modes for the brightness temperature measurements of the scenes under view are presented. M.S.K.

**A83-47263#****RESEARCH AND DEVELOPMENT OF SYNTHETIC APERTURE RADAR**

Y. ITOH and Y. HISADA (National Space Development Agency of Japan, Tsukuba Space Center, Tsukuba, Ibaraki, Japan) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983 6 p. (IAF PAPER 83-94)

A synthetic aperture radar (SAR), one of the promising microwave sensors for earth observation, is being researched and developed by National Space Development Agency of Japan (NASDA). It is planned that SAR will be equipped as a payload for the earth observation satellite in near future such as Earth Resource Satellite-1 of Japan (J-ERS-1). The current status, particularly the system design of the on-board hardware and the test results of critical components, is described in this paper. Author

**A83-47270#****ADVANCED VISIBLE AND NEAR-INFRARED RADIOMETER FOR EARTH OBSERVATION**

S. TAKAMURA, T. ARAKI (National Space Development Agency of Japan, Tokyo, Japan), R. KUWANO, R. NAGURA, Y. NARIMATSU, and T. SATOH (Nippon Electric Co., Ltd., Yokohama, Japan) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 6 p.

(IAF PAPER 83-107)

A Japanese visible and near-IR radiometer (VNR) under development for installation on earth resources satellites is described. The design goals of the instrument include improvements of multispectral scanner technology, compactness, lightweight, low power consumption, and simple interface with the satellite. Upwelling radiance is divided into four bands and focussed on a CCD array measuring from 450-520 nm, 520-600 nm, 630-690 nm, and 760-950 nm. The field of view is 25 m, swath width 150 km, and power consumption is 100 W. The entrance path of the radiance is through two aspherical dioptric telescopes, eventually falling on the CCD arrays, which have 6000 elements per band. M.S.K.

**A83-47271#****THE SPOT-HRV INSTRUMENT - AN OVERVIEW OF DESIGN AND PERFORMANCE**

J. P. MIDAN (Centre National d'Etudes Spatiales, Toulouse, France) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 10 p.

(IAF PAPER 83-109)

The SPOT spacecraft's High Visible Resolution (HVR) earth resources sensor performance requirements, system and subsystem design features, and technology development

considerations, are discussed. Attention is given to such problem areas involving extensive design tradeoff analyses and testing as those uncovered by mechanical design and thermal distortion studies and SNR analysis and calibration considerations. The SPOT spacecraft will be placed in orbit in 1985. O.C.

**A83-47274#****BAS - THE PROJECT OF AN EARTH-ATMOSPHERE-SPECTROPHOTOMETER FOR BASIC RESEARCH**

U. LEITERER and M. WELLER (Aerologisches Observatorium, Lindenberg, East Germany) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 9 p. refs

(IAF PAPER 83-113)

The calibration procedures, performance range, and applications of the BAS spectrophotometer are described. Calibration is achieved by determining the extraterrestrial voltages for each of the channels by the Langley technique, assigning the voltages to the measured spectral irradiances, assaying the effective solid angle for each channel, and dividing the extraterrestrial irradiances by the effective solid angle. The instrument is sensitive in the visible and the near-IR in 40 steps with half-widths of 10-15 nm. A three-sec interval is needed to scan the entire viewed spectrum of sources up to 2 pi steradian. The spectrophotometer can be used for viewing geographical regions, minor constituents of the atmosphere, and water. M.S.K.

**A83-47283#****THE SWEDISH SPOT DATA ACQUISITION AND PROCESSING SYSTEM**

G. LARSSON (Satellite Image Corp., Kiruna, Sweden) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983 3 p. (IAF PAPER 83-128)

Owing to its geographical location, the station at Kiruna, Sweden, will be able to acquire data from SPOT on every orbit. It is expected that data corresponding to approximately 700 scenes will be recorded each day every day of the year. After bulk processing of the data, the following products will be available: catalog material, quick-look imagery, computer-compatible tapes, and high-resolution photographic imagery. To accomplish the processing, two dual-computer systems with dedicated hardware are to be used in the Kiruna system for the 'archiving' process and for the production of computer compatible tapes (CCTs). These systems have high-density tape recorders up front, two 300-Mbyte disk drives for data buffering, an array processor for number crunching, and, further downstream, a dry silver photo recorder and CCT drive. C.R.

**A83-47775****INTERFEROMETRIC MEASUREMENTS OF ATMOSPHERIC SPECIES**

D. G. MURCRAY, A. GOLDMAN, F. H. MURCRAY, and F. J. MURCRAY (Denver, University, Denver, Co) IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 71-77.

Problems of current interest in atmospheric chemistry make it desirable to obtain data on the atmospheric concentration of many compounds present in the atmosphere at very low levels. The possibility exists of using infrared techniques to obtain the required detail for many of the species in the atmosphere. The interferometric technique has over many other techniques the advantage that spectral data are obtained over a fairly wide spectral region. In the considered procedure, the sun is used as the infrared source. Attention is given to solar spectra observed from an altitude of 33 km at various zenith angles, and NO and NO<sub>2</sub> profiles from a balloon flight conducted on October 10, 1979. G.R.

**A83-47776****DETECTION OF TRACE GASES USING HIGH-RESOLUTION IR SPECTROSCOPY**

A. S. ZACHOR (Atmospheric Radiation Consultants, Acton, MA), T. ZEHNPFENNIG (Visidyne, Inc., Burlington, MA), and A. T. STAIR, JR. (USAF, Geophysics Laboratory, Bedford, MA) IN Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 81-89.

The present investigation is concerned with the capability of a Fourier Transform Spectrometer (FTS) system to detect and characterize trace gases in a localized cloud, such as the effluent from a stationary source. An FTS sensor with imaging capability can be employed to obtain the spectrum of the spatial contrast produced by the cloud. Zacher et al (1981) and Herget (1982) have determined the detection limits for a variety of trace gases under ideal conditions. In the present investigation the relations affecting the possibilities for the detection and the characterization of trace gases for an ideal detection scenario are considered as a basis for a study of the actual conditions which involve spatially and spectrally structured backgrounds. A description is provided of two promising techniques for suppressing these backgrounds.

G.R.

**A83-47780\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**REMOTE DETECTION OF GASES BY GAS CORRELATION SPECTRORADIOMETRY**

J. S. MARGOLIS, B. J. MCCLEESE, and J. V. MARTONCHIK (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 114-117.

The present investigation is concerned with the application of a pressure modulated radiometer (PMR) to the remote sensing of trace amounts of gases in the atmospheres as well as to the direct measurement of upper atmospheric winds. The PMR operates as a gas correlation spectrometer. Compared to conventional gas correlation parameters, it has some advantages which are related to greater versatility and the employment of a simpler method for maintaining electrical/optical balance. The PMR has a high sensitivity in connection with its essentially very high effective resolution. It represents a passive system and emits no radiation. A PMR is flown on Nimbus 6 which was launched in 1975. The instrument has also been used on the Nimbus 7 satellite and the Tiros N satellite.

G.R.

**A83-47796\*** Jet Propulsion Lab., California Inst. of Tech., Pasadena.

**DEVELOPMENT OF COMPACT EXCIMER LASERS FOR REMOTE SENSING**

J. B. LAUDENSLAGER, I. S. MCDERMID, and T. J. PACALA (California Institute of Technology, Jet Propulsion Laboratory, Pasadena, CA) IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 236-244. refs

The capabilities of excimer lasers for remote sensing applications are illustrated in a discussion of the development of a compact tunable XeCl excimer laser for the detection of atmospheric OH radicals. Following a brief review of the operating principles and advantages of excimer lasers, measurements of the wavelength dependence of the net small signal gain coefficient of a discharge excited XeCl laser are presented which demonstrate the overlap of several absorption lines of the A-X(0,0) transition of OH near 308 nm with the wavelengths of the XeCl laser. A range of continuous narrow bandwidth tunability of from 307.6 to 308.4 nm with only a 30 percent variation in output is reported for an XeCl laser used as a double-pass amplifier for a frequency-doubled dye laser, and measurements demonstrating the detection of laser-induced fluorescence from OH in a methane-oxygen flame are also noted. The design of an oscillator-amplifier excimer system comprising a corona-pre-ionized, transverse-discharge oscillator and amplifier is then presented. Output energies of 12-15 mJ have been achieved in the regions where injection locking was established, with energies of 8-10 mJ elsewhere.

A.L.W.

**A83-47798****PROGRESS IN LASER SOURCES FOR REMOTE SENSING**

A. MOORADIAN, P. F. MOULTON, and N. MENYUK (MIT, Lexington, MA) IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 257-263. USAF-sponsored research. refs

Recent progress in the development of tunable laser sources suitable for both active and passive remote sensing is reviewed. The sources discussed and include transition-metal ion-doped solid-state lasers, semiconductor diode lasers operating in an external cavity, miniature CO<sub>2</sub> TEA lasers, and sources with frequency conversion in infrared nonlinear materials. The principal performance characteristics and some applications of the above laser sources are examined.

V.L.

**A83-47807****ATMOSPHERIC REMOTE SENSING USING THE NOAA COHERENT LIDAR SYSTEM**

R. M. HARDESTY (NOAA, Wave Propagation Laboratory, Boulder, CO) IN: Optical and laser remote sensing. Berlin, Springer-Verlag, 1983, p. 350-355.

A pulsed coherent CO<sub>2</sub> lidar system has been used by NOAA as a remote sensing tool to study various atmospheric phenomena. The system employs a hybrid TEA transmitter which is grating-tunable across most of the P and R lines of the 00(0)1, 10(0)0 CO<sub>2</sub> transmission. To produce a single longitudinal mode output, the low-pressure continuous-wave mode control laser operates within the cavity to seed the UV-pre-ionized pulsed TEA laser. A hill-climbing servo-loop adjusts the piezoelectric transducer to maintain operation on line-center of the low-pressure laser. Calibration and pulse characteristics of the system are discussed, and the results of the measurements of returns, aerosol profiles, and velocities are presented.

V.L.

**A83-48490****A TWO-FREQUENCY 1.35-CM RADIOMETER [DVUKHCHASTOTNYI RADIOMETR DIAPAZONA 1,35 SM]**

V. A. RASSADOVSKII and N. K. GORIACHEV (Nauchno-Issledovatel'skii Radiofizicheskii Institut, Gorki, USSR) Radiofizika (ISSN 0021-3462), vol. 26, no. 7, 1983, p. 895, 896. In Russian

A radiometer is described which implements the quasi-null reception method where the reference signal is atmospheric radio emission on the slope of the water-vapor absorption line. The radiometer is a two-frequency detector having two modes of operation: a mode of separate reception in two channels centered at frequencies of 22.23 and 20.73 GHz; and a mode in which the difference of signal power in these channels is measured. The radiometer has been used since 1980 to study the intrinsic radio emission of the atmosphere from the earth's surface and from aircraft and ships. A sensitivity of 0.15 K at a time constant of 1 sec has been achieved; the gain drift did not exceed 1.5 percent over 8 h of operation. A block diagram of the radiometer is presented.

B.J.

**A83-49618****VERTICAL OZONE PROFILES DETERMINED FROM SATELLITE METEOR SPECTROMETER MEASUREMENTS**

U. FEISTER (Meteorologisches Hauptobservatorium, Potsdam, East Germany) Zeitschrift fuer Meteorologie (ISSN 0084-5361), vol. 33, no. 4, 1983, p. 197-217. refs

Vertical ozone profiles have been inferred from upward directed radiances in the 9.6 micron band measured by Fourier spectrometers onboard METEOR satellites. A version of the Goody random model served as transmission function and was also utilized to simulate the dependence of radiances on latitude and season. The obtained profiles were compared with those measured by balloon-borne ozone sondes. Assumed ozone sonde errors including noncollocation in space and time were removed from the observations. The method under consideration provided a gain of information only for the lower stratosphere. A very similar distribution of information was obtained by applying a regression method to determine the vertical ozone distribution from some



predictors. This latter method is easy to handle, consumes less computer time, and provides a slight increase in accuracy of total inferred ozone compared to the remote sensing method. C.D.

#### A83-49724

#### SPATIAL AND TEMPORAL VARIATIONS OF CLOUD LIQUID WATER DETERMINED BY AIRCRAFT AND MICROWAVE RADIOMETER MEASUREMENTS IN NORTHERN COLORADO OROGRAPHIC STORMS

R. M. RAUBER, L. O. GRANT (Colorado State University, Fort Collins, CO), and J. B. SNIDER (NOAA, Boulder, CO) IN: Conference on Cloud Physics, Chicago, IL, November 15-18, 1982, Preprints. Boston, MA, American Meteorological Society, 1982, p. 477-480. Army-supported research. (Contract NSF ATM-81-09590)

Initial results of the analysis of three storms occurring during the Colorado Orographic Seeding Experiment are summarized. Three aspects of the liquid water measurements are considered. Aircraft measurements of vertical and horizontal distributions of cloud water within several different storm systems are presented. Attention is also given to radiometric measurements of the liquid water distribution within the cloud system obtained from continuous azimuth scans. A case study is presented to demonstrate the time variation of liquid water within a cloud system that develops, produces extensive precipitation, and dissipates. C.R.

A83-49728\* Management and Technical Services Co., Beltsville, Md.

#### THE EVOLUTION OF FLORIDA THUNDERSTORMS ON 23 SEPTEMBER 1979 AS OBSERVED BY AN AIRBORNE PASSIVE MICROWAVE RADIOMETER

I. M. HAKKARINEN (GE Management and Technical Services Co., Beltsville, MD), E. B. RODGERS, and M. C. MCCUMBER (NASA, Goddard Space Flight Center, Laboratory for Atmospheric Sciences, Greenbelt, MD) IN: Conference on Cloud Physics, Chicago, IL, November 15-18, 1982, Preprints. Boston, MA, American Meteorological Society, 1982, p. 504-507 refs

The observations made by the aircraft are examined in order to determine sensing parameters for future satellite missions. Minimum brightness temperatures substantially below atmospheric temperatures are revealed in the data. Scattering by an ice layer within the clouds is postulated as the cause. A one-dimensional cloud model initialized with a representative local sounding gives reasonable values for the height and thickness of this ice layer. The model cloud is similar to the observed cloud in both cloud top height and radar reflectivity. A 'mystery' feature observed by the microwave sensors as an area of enhanced scattering, suggesting an updraft core of graupel that in turn is indicative of a convective tower is considered of particular interest. It is noted that this feature was masked in the visible and infrared sensors by the presence of upper-level semitransparent cirrus. The detection of this mystery feature is seen as suggesting that passive microwave sensing of convective areas may provide information regarding the location and/or strength of the more active towers which cannot be detected now with conventional visible or infrared instruments because of a uniform higher-level cloud cover. C.R.

A83-50142\*# National Aeronautics and Space Administration, Marshall Space Flight Center, Huntsville, Ala  
NASA'S AVE/VAS PROGRAM

C. K. HILL and R. E. TURNER (NASA, Marshall Space Flight Center, Systems Dynamics Laboratory, Huntsville, AL) American Meteorological Society, Bulletin (ISSN 0003-0007), vol. 64, July 1983, p. 796, 797.

A discussion is presented concerning the Atmospheric Variability Experiment (AVE) which was conducted during the spring of 1982 as part of NASA's Visible and Infrared Spin-Scan Radiometer (VISSR) Atmospheric Sounder (VAS) demonstration. The AVE/VAS Ground Truth Field Experiment is examined in detail, which comprised the obtaining of rawinsonde observations during various meteorological conditions on four different days when VAS data were obtained. These experiments were performed over 24 hr periods in a mesoscale network of 24 National Weather Service

rawinsonde sites and 13 NASA and NOAA special sites. The VAS, operating as a part of the GOES satellite system, was employed to provide two-dimensional cloud mapping capability during each of the AVE/VAS experiment periods. Among the goals of this AVE/VAS program, in addition to management of the acquisition and processing of the data, were to perform the research and development needed to produce data products from VAS radiances, to validate the data, and to assess the impact of the data on mesoscale meteorological forecasting and research requirements. N.B.

N83-30459# Joint Publications Research Service, Arlington, Va.  
FRAGMENT SPACE SYSTEM FOR NATURAL RESOURCE STUDY

G. A. AVANESOV and Y. L. ZIMAN *In its* USSR Rept.: Space, No. 19 (JPRS-82771) p. 55-63 31 Jan. 1983 Transl. into ENGLISH from Zemlya i Vselennaya (Moscow), no. 4, Jul. - Aug. 1982 p. 6-12

Avail: NTIS HC A06

The fragment equipment, carried aboard the Meteor satellite, was developed for investigation of the Earth's natural resources in the optical waveband. The orbit of the satellite, approximately 650 km high, allows the same areas on the ground to be seen at the same time of day once every 15 days. E.A.K.

N83-30466# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany).  
DFVLR/ISRO COLLOQUIUM ABOUT A DECADE OF COOPERATION IN THE FIELD OF SPACE RESEARCH AND TECHNOLOGY

Jan. 1983 141 p refs Colloq. held in Bangalore, India, 27 Jan. 1982

(DFVLR-MITT-83-03) Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 35,20

Germano-Indian cooperation in remote sensing and communications (satellite-borne and airborne), plasma physics, and space projects was discussed.

N83-30467# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Cologne (West Germany)  
THE DFVLR, GERMANY'S SPACE PROGRAM AND ITS COOPERATION WITH INDIA

H. JORDAN *In its* DFVLR/ISRO Colloq. about a Decade of Cooperation in the Field of Space Res. and Technol. p. 11-17 Jan. 1983

Avail: NTIS HC A07/MF A01, DFVLR, Cologne DM 35,20

German space projects, including astronomy missions (the X-ray satellite ROSAT), a helium cooled infrared telescope GIRL to be flown on Spacelab, US-German Jupiter mission Galileo and the Active Magnetospheric Particle Explorer project of NASA are introduced. Germano-Indian cooperation on the Multispectral Electro-optical Stereo Scanner and Automatic Payload Control projects is mentioned. Author (ESA)

N83-30470# Indian Space Research Organization, Bangalore.

#### A ROHINI 150 KG REMOTE SENSING MISSION

U. R. RAO, M. G. CHANDRASEKHAR, and K. KASTURIRANGAN *In* DFVLR - DFVLR/ISRO Colloq. About a Decade of Cooperation in the Field of Space Res. and Technol. p. 67-88 Jan. 1983

Avail: NTIS HC A07/MF A01, DFVLR, Cologne DM 35,20

The effects on the satellite design of nonideal orbit characteristics for a multispectral scanner mission are discussed, and configurations employing skirt type solar panel deployment, two single-axis driven panels, and two two-axis driven panels are compared. Satellite structure, thermal control system, power supply, attitude control, stabilization, sensor, and data handling requirements are outlined. The simplest option is skirt type panel deployment but two-axis driven deployable panels provides additional weight margin. A prototype is proposed for structural, thermal and electrical tests and as a back up for the flight model. Author (ESA)



## 08 INSTRUMENTATION AND SENSORS

**N83-30473#** Indian Space Research Organization, Ahmedabad. Space Applications Centre.

**MICROWAVE REMOTE SENSING PROGRAM OF THE INDIAN SPACE RESEARCH ORGANIZATION (ISRO) AND DFVLR**

D. S. KAMAT *In* DFVLR DFVLR/ISRO Colloq. About a Decade of Cooperation in the Field of Space Res. and Technol. p 103-111 Jan. 1983

Avail: NTIS HC A07/MF A01; DFVLR, Cologne DM 35,20

The design and development of a spaceborne microwave radiometer system for Bhaskara satellites and an X band airborne real aperture radar system are summarized. Other projects include development of a 2 to 8 GHz scatterometer, an 8 to 18 GHz scatterometer, an L band radiometer, an X band field scatterometer, and an L or C band SAR system. Author (ESA)

**N83-32145\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**IMPACT OF LANDSAT MSS SENSOR DIFFERENCES ON CHANGE DETECTION ANALYSIS**

W. C. LIKENS and R. C. WRIGLEY 1983 21 p refs Sponsored by NASA Original photography may be purchased from EROS Data Center, Sioux Falls, S.D. 57198 ERTS (E83-10395; NASA-TM-85336; NAS 1.15.85336) Avail: NTIS HC A02/MF A01 CSCL 05B

Some 512 by 512 pixel subwindows for simultaneously acquired scene pairs obtained by LANDSAT 2,3 and 4 multispectral band scanners were coregistered using LANDSAT 4 scenes as the base to which the other images were registered. Scattergrams between the coregistered scenes (a form of contingency analysis) were used to radiometrically compare data from the various sensors. Mode values were derived and used to visually fit a linear regression. Root mean square errors of the registration varied between .1 and 1.5 pixels. There appear to be no major problem preventing the use of LANDSAT 4 MSS with previous MSS sensors for change detection, provided the noise interference can be removed or minimized. Data normalizations for change detection should be based on the data rather than solely on calibration information. This allows simultaneous normalization of the atmosphere as well as the radiometry. A.R.H.

**N83-33424#** Bern Univ. (Switzerland). Inst. of Applied Physics. **WATER VAPOR DISTRIBUTION MEASURED IN THE MIDDLE ATMOSPHERE WITH AN AIRBORNE MICROWAVE RADIOMETER**

K. F. KUNZI, E. LOBSIGER, and G. K. HARTMANN (Max-Planck Inst. fuer Aeronomie, Katlenburg-Lindau, West Germany) *In* ESA Sixth ESA Symp. on European Rocket and Balloon Programs and Related Res. p 173-174 Jun. 1983 refs Sponsored by Max-Planck-Gesellschaft and Swiss National Science Foundation (Contract DFG-MICA-AZ-HA-1141/3-1) Avail: NTIS HC A21/MF A01

Stratospheric and mesospheric water vapor was measured with an airborne microwave radiometer at 183 GHz as part of the Cold Arctic Mesopause mission. Two water vapor profiles are presented. Due to technical problems with the spectrum analyzers measurement accuracy is much reduced, but the profiles are consistent with measurements made over the Pacific Ocean.

Author (ESA)

**N83-33466#** World Radiation Center, Davos (Switzerland). Physikalisch-meteorologisches Observatorium.

**SOLAR RADIOMETRY FROM HIGH ALTITUDE BALLOONS**

R. W. BRUSA, C. FROEHLICH, and C. WEHRLI *In* ESA Sixth ESA Symp. on European Rocket and Balloon Programs and Related Res. p 429-433 Jun. 1983 refs

Avail: NTIS HC A21/MF A01

A balloon experiment was devised to determine the solar constant and the spectral solar irradiance at selected wavelengths. The solar constant was determined as 1366.2 and 1367.8 W/sqm. Comparisons with other measurements reveal the importance of having both continuous (satellites) and spot measurements in order to assess the short term variability and the long term trends of the solar constant. A time series analysis of the Sun photometer

data shows several peaks in the 5 min range. The high coherence with simultaneous measurements from the Solar Maximum Mission satellite indicates the solar origin of the peaks, which are likely to be low degree p-mode oscillations of the Sun. Author (ESA)

**N83-33467#** Leeds Univ. (England). Dept. of Physics.

**OBSERVATIONS OF LARGE SCALE EMISSION IN THE FAR INFRARED**

N. C. BIRTWELL, A. R. CLARKE, P. L. MARSDEN, J. S. REEHAN, and C. D. SMITH *In* ESA Sixth ESA Symp. on European Rocket and Balloon Programs and Related Res. p 435-443 Jun. 1983 refs Sponsored by UK Science Research Council

Avail: NTIS HC A21/MF A01

A balloon-borne far infrared spectrometer for the investigation of extended sources in the wavelength range 80 to 500 microns was flown in 1980 and 1982 from Texas. During both campaigns periodicities of many minutes were detected in the IR gradients. In 1982 clear evidence for the existence of large scale stratospheric emission exhibiting weak azimuthal gradients, but strong elevational gradients was found. The large angle scanning technique enables the spatial extent and variability of the stratospheric phenomena, which may be linked to the El Chichon, Mexico, volcanic eruption in April 1982 to be investigated. Author (ESA)

**N83-34287#** Naval Research Lab., Washington, D. C.

**SSM/I (SPECIAL SENSOR MICROWAVE/IMAGER) PROJECT Summary Report**

J. P. HOLLINGER and R. C. LO 20 Apr. 1983 111 p refs (Contract W0524CC)

(AD-A128803; NRL-MR-5055) Avail: NTIS HC A06/MF A01 CSCL 171

The Special Sensor Microwave/Imager (SSM/I) is a passive microwave radiometric system designed to provide retrievals of the environmental parameters sea surface wind, precipitation, atmospheric moisture content, soil moisture and sea ice conditions. It is a joint Navy/Air Force project developed by the Hughes Aircraft Company under the direction of the Navy Space System Activity (NSSA) and the Air Force Space Division to be flown on the Defense Meteorological Satellite Program (DMSP). The Space Sensing Applications Branch of the Naval Research Laboratory has served as a technical consultant to NSSA beginning in fiscal year 1982. A summary description of the SSM/I instrument; and descriptions of the geophysical models, the interaction model, the retrieval technique and climatology used for the SSM/I environmental retrieval algorithm are presented. This information may serve as an introduction to the SSM/I for those individuals who have an interest in the SSM/I and its geophysical data products. The studies, conducted at the request of the NSSA to evaluate and investigate specific details of the instrument and algorithms are attached as Appendix A through E. Author (GRA)

**N83-34391\*#** Arizona Univ., Tucson. Optical Sciences Center. **SPECTRORADIOMETRIC CALIBRATION OF THE THEMATIC MAPPER AND MULTISPECTRAL SCANNER SYSTEM Quarterly Report, 1 May - 1 Aug. 1983**

P. N. SLATER, Principal Investigator and J. M. PALMER 1 Aug. 1983 27 p refs ERTS

(Contract NAS5-27382)

(E83-10188; NASA-CR-173022; NAS 1.26:173022; QR-3) Avail: NTIS HC A03/MF A01 CSCL 14B

The results obtained for the absolute calibration of TM bands 2, 3, and 4 are presented. The results are based on TM image data collected simultaneously with ground and atmospheric data at White Sands, New Mexico. Also discussed are the results of a moments analysis to determine the equivalent bandpasses, effective central wavelengths and normalized responses of the TM and MSS spectral bands; the calibration of the BaSO<sub>4</sub> plate used at White Sands; and future plans. M.G.

**N83-34393\*#** Lockheed Engineering and Management Services Co., Inc., Houston, Tex.

**METSAT INFORMATION CONTENT: CLOUD SCREENING AND SOLAR CORRECTION INVESTIGATIONS ON THE INFLUENCE OF NOAA-6 ADVANCED VERY HIGH RESOLUTION RADIOMETER DERIVED VEGETATION ASSESSMENT**

M. L. MATHEWS Mar. 1983 44 p refs Sponsored by NASA, USDA, Dept. of Commerce, Dept. of the Interior, and Agency for International Development ERTS (Contract NAS9-15800; PROJ AGRISTARS) (E83-10400; NASA-CR-171682; EW-L3-04402; JSC-18606; NAS 1.26:171682; LEMSCO-19199) Avail: NTIS HC A03/MF A01 CSCL 04B

The development of the cloud indicator index (CII) for use with METSAT's advanced very high resolution radiometer (AVHRR) is described. The CII is very effective at identification of clouds. Also, explored are different solar correction and standard techniques and the impact of these corrections have on the information content of AVHRR data. Author

**N83-34425#** Reading Univ. (England). Dept. of Meteorology. **PRECIPITATION ESTIMATION [ESTIMATION DES PRECIPITATIONS]**

G DUGDALE In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 55-70 Jul. 1983 refs In FRENCH Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

Radar, microwave radiometer, visual and infrared remote sensing of rainfall is reviewed. Cloud index, cloud history, and combined radar/satellite techniques are introduced. Applications in West Africa are discussed. The advantages of polar versus geostationary orbits for remote sensing are summarized. The high cost of calibrated radar eliminates it for most West African countries. Since most of the rain falls at night, and since a 9 to 15 hr development period is normal, the use of infrared sensors on board geostationary satellites is recommended. Author (ESA)

**N83-35456\*#** Florida Univ., Gainesville. Dept. of Fruit Crops. **A SATELLITE FROST FORECASTING SYSTEM FOR FLORIDA Final Report**

J. D. MARTSOLF In Florida State Univ. Appl. of Satellite Frost Forecast Technol. to Other Parts of the United States 21 p Nov. 1981 refs ERTS (Contract NAS10-9168; NAS10-9892) Avail: NTIS HC A14/MF A01 CSCL 04B

Since the first of two minicomputers that are the main components of the satellite frost forecast system was delivered in 1977, the system has evolved appreciably. A geostationary operational environmental satellite (GOES) system provides the satellite data. The freeze of January 12-14, 1981, was documented with increasing interest in potential of such systems. Satellite data is now acquired digitally rather than by redigitizing the GOES-Tap transmissions. Data acquisition is now automated, i.e., the computers are programmed to operate the system with little, if any, operation intervention. A.R.H.

**N83-36538\*#** Environmental Research Inst. of Michigan, Ann Arbor Infrared and Optics Div.

**STUDY ON SPECTRAL/RADIOMETRIC CHARACTERISTICS OF THE THEMATIC MAPPER FOR LAND USE APPLICATIONS Quarterly Status and Technical Progress Report, 21 Jun. - 20 Sep. 1983**

W. A. MALILA, M. D. METZLER, Principal Investigators, and E. P. CRIST 26 Sep. 1983 52 p refs ERTS (Contract NAS5-27346) (E83-10409; NASA-CR-174539; NAS 1.26:174539; ERIM-164000-4-T; QSTPR-4) Avail: NTIS HC A04/MF A01 CSCL 08B

Previous characterization of scan-related low-frequency noise was extended and refined through detailed analysis of shutter calibration data on CCT-ADDS tapes and reflective-band data from nighttime acquisitions. A recommended correction procedure was identified that uses calibration shutter data both as a diagnostic

and to obtain correction values. Through comparison of coincident TM and MSS data, illustrations of the added information content of TM data for agricultural applications were developed. The capability of improved spatial resolution to better define boundaries and to resolve spatial details is shown. Spectral analysis of tasseled-cap transformations of TM and MSS data shows high correlation between greenness features, greater signal range for TM, and indications that a subset of TM bands could accurately simulate MSS data, if required M.G.

**N83-36539\*#** National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.

**APERTURE SYNTHESIS FOR MICROWAVE RADIOMETERS IN SPACE**

D. M. LEVINE and J. C. GOOD Aug. 1983 37 p refs Submitted for publication (NASA-TM-85033; NAS 1.15:85033) Avail: NTIS HC A03/MF A01 CSCL 14B

A technique is described for obtaining passive microwave measurements from space with high spatial resolution for remote sensing applications. The technique involves measuring the product of the signal from pairs of antennas at many different antenna spacings, thereby mapping the correlation function of antenna voltage. The intensity of radiation at the source can be obtained from the Fourier transform of this correlation function. Theory is presented to show how the technique can be applied to large extended sources such as the Earth when observed from space. Details are presented for a system with uniformly spaced measurements. Author

**N83-36540#** Defense Logistics Studies Information Exchange, Fort Lee, Va. Hydrographic/Topographic Center.

**USE OF LANDSAT FOR NAVIGATION PRODUCTS AT DMA (DEFENSE MAPPING AGENCY) Final Report**

E. B. JAMES May 1983 14 p refs Presented at the 39th Ann. Meeting of the Inst. of Navigation, Houston, Tex., 21-23 Jun. 1983 (AD-A129079) Avail: NTIS HC A02/MF A01 CSCL 08B

LANDSAT exploitation for hydrographic support has been under study and in use on a limited scale for some time. The Defense Mapping Agency (DMA) has found LANDSAT's multispectral scanner imagery particularly useful in augmenting the completeness of its products. Recently, a program has been implemented using this remotely sensed imagery in routinely updating and maintaining nautical charts and publications. This paper provides a general description of the LANDSAT system and applications at DMA as well as limitations of its use in navigation. Author (GRA)

## 09

### GENERAL

Includes economic analysis.

**A83-42889**

**METHODOLOGICAL PROBLEMS IN THE DEVELOPMENT OF SPACE SYSTEMS FOR THE REMOTE SENSING OF EARTH RESOURCES [METODOLOGICHESKIE PROBLEMY SOZDANIYA KOSMICHESKIKH KOMPLEKSOV ISSLEDOVANIY PRIRODNYKH RESURSOV ZEMLI]**

V. V. ALAVERDOV, A. A. ASTASHKIN, V. K. SAULSKII, and G. P. USPENSKII IN: Problems of mechanics and heat transfer in space technology. Moscow, Izdatel'stvo Mashinostroyeniya, 1982, p 175-185. In Russian.

Two methodological approaches to determining the makeup and main characteristics of satellite systems for the remote sensing of earth resources are described. The first approach is an approximate one which is based on an analysis of only the most important parameters (survey detail and periodicity) and is intended for an explicit definition of the main design features of the space

## 09 GENERAL

remote sensing system. The second approach is a strict one which is based on a maximally complete consideration of all the characteristics for an improved determination of the system parameters. The general character of a system designed in accordance with these approaches is described B.J.

### A83-43769

#### THE SIGNIFICANCE OF A STRONG VALUE-ADDED INDUSTRY TO THE SUCCESSFUL COMMERCIALIZATION OF LANDSAT

F. B. HENDERSON, III. American Astronautical Society, Goddard Memorial Symposium, 21st, Greenbelt, MD, Mar. 24, 25, 1983. 7 p.

(AAS PAPER 83-185)

A strong, value-added industry is discussed as the basis for transferring the Landsat satellites from the government to the private sector. Specifically, attention is given to satellites which follow the Landsat configuration, with solid state multiline array systems, various spectral bands, and differing spatial resolutions using radar as a sensing medium. The success of commercialization resides on the ability of ground operators to acquire, archive, and process the data into a saleable format, whether the ground segment is operated by the government or the private sector. Typical users may be mineral resources development companies and universities. A global marketing and servicing infrastructure is yet necessary, steps which private industry can not at present afford to develop. It is suggested that the present government policy of discontinuance of the thematic mapper (TM) system without assuring transfer and operation of the system by a private entity may place the U.S. in the position of destroying the developing remote sensing market and remote sensing capabilities before private sector industries can support the technology, thereby depriving the U.S. of the data available from the TM. M.S.K.

### A83-43770#

#### THE ECONOMIC BENEFITS OF OPERATIONAL ENVIRONMENTAL SATELLITES

W. J. HUSSEY (NOAA, Satellite Services Div., Washington, DC) American Astronautical Society, Goddard Memorial Symposium, 21st, Greenbelt, MD, Mar. 24, 25, 1983. 43 p.

(AAS PAPER 83-188)

The mission objectives of the U.S. operational environmental satellite program are related to the regular monitoring of the atmosphere on a global basis, the provision of quantitative data for numerical weather prediction services, the monitoring of environmental features in the western hemisphere, and the application of environmental satellite data for the purpose of improving environmental services. A description is given of the Geostationary Operational Environmental Satellite (GOES) system, which includes two satellites. The Polar Orbiting Satellite System consists also of two satellites. Activities benefiting from operational environmental satellite programs are discussed, taking into account ocean current navigation for fuel savings, commercial fishing industry, agricultural industry, search and rescue operations, ice monitoring, snow cover mapping, natural disaster warning, large scale weather forecasting, and miscellaneous activities. G.R.

### A83-43820#

#### REMOTE SENSING

Y. V. VENKATESH (Indian Institute of Science, Bangalore, India) Aeronautical Society of India, Journal (ISSN 0001-9267), vol. 34, Aug.-Nov. 1982, p. 121-131.

The basic principles and instrumentation involved in remote sensing of earth resources are outlined. Remote sensing consists of detection of electromagnetic radiation emanating from the source, i.e., the ground feature under observation, and in pertinent cases the temporal variations of the signal from a specific area. The energy perceived by the sensors, except for some thermal energy, is solar radiation that is reflected, transmitted, absorbed, or scattered. The sensor has a linear response to specific wavelengths of EM radiation and is connected to a processor which treats the incoming data for storage, filtering, and/or transmission. In processing, account is taken of the atmospheric effects on the signal. The instruments used include multi-band

camera, radiometers, passive scanners, SAR, and passive microwave systems. M.S.K.

### A83-45604

#### SPACE TECHNOLOGY - REMOTE SENSING: THE BEST VIEW IN TOWN

G. KAPLAN. IEEE Spectrum (ISSN 0018-9235), vol. 20, Sept. 1983, p. 62-64.

The development of remote sensing satellite capabilities is traced from the invention of the multispectral scanner in the 1960s to features of the SPOT spacecraft. Landsats 1 and 2 carried multispectral scanners, three high-resolution return beam vidicon tubes, and instrument resolution of 80 x 80 m. Landsat 3 scanner and video tubes have a 40 x 40 m resolution. Landsat 4 carries multispectral scanner and a thematic mapper, which covers seven different spectral bands and has a scene resolution of 30 x 30 m. The SPOT spacecraft will be equipped with redundant high resolution instruments for a ground resolution of 10 x 10 m from an 832 km orbit. The finer resolution is panchromatic, and 20 x 20 km resolution will be available in three color bands. The Shuttle will begin carrying imaging spectrometers in 1987. Even though the Landsat D spacecraft is experiencing failures, the data stored thus far far exceeds the ground segment's processing capabilities. M.S.K.

### A83-46101\*

#### 1982 INTERNATIONAL GEOSCIENCE AND REMOTE SENSING SYMPOSIUM, MUNICH, WEST GERMANY, JUNE 1-4, 1982, DIGEST. VOLUMES 1 & 2

Symposium sponsored by IEEE, BMFT, NASA, et al. New York, Institute of Electrical and Electronics Engineers, 1982, p. Vol. 1, 559 p.; vol. 2, 374 p.

Theoretical and experimental data which have defined and/or extended the effectiveness of remote sensing operations are explored, with consideration given to both scientific and commercial activities. The remote sensing of soil moisture, the sea surface, and oil slicks is discussed, as are programs using satellites for studying geodynamics and geodesy, currents and waves, and coastal zones. NASA, Canadian, and Japanese radar and microwave passive and active systems are described, together with algorithms and techniques for image processing and classification. The SAR-580 project is outlined, and attention is devoted to satellite applications in investigations of the structure of the atmosphere, agriculture and land use, and geology. Design and performance features of various optical scanner, radar, and multispectral data processing systems and procedures are detailed. M.S.K.

### A83-46125

#### MODELING AND DECONVOLUTION FOR RECONSTRUCTION OF AIRBORNE GAMMA RAY RADIOMETER DATA

C. A. POMALAZA, C. D. MCGILLEM, and P. E. ANUTA (Purdue University, West Lafayette, IN). IN: 1982 International Geoscience and Remote Sensing Symposium, Munich, West Germany, June 1-4, 1982, Digest. Volume 1. New York, Institute of Electrical and Electronics Engineers, 1982, 5 p. refs (Contract NSF ENG-78-20466)

A mathematical model is developed to represent the output of an airborne gamma ray sensor of the type used for geophysical surveying. The model takes into account the motion of the sensor during the measurement interval, the finite view angle of the sensor, and the random nature of the radiation being measured. This model is then used as a basis for an improved procedure to estimate the spatial distribution of the radioelement concentration on the ground. The proposed procedure is a combination of a nonlinear processing operation followed by a noise-constrained deconvolution. Some preliminary simulation results are presented.

Author

**A83-47277#****STUDIES ON JAPAN'S EARTH RESOURCE SATELLITE-1**

Y. HORIKAWA and H. OHBA (National Space Development Agency of Japan, Tokyo, Japan) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct 10-15, 1983. 8 p.  
(IAF PAPER 83-120)

The Japanese earth resources satellite ERS-1, an active microwave sensing satellite with synthetic aperture radar, is described. Preliminary design results are summarized, with consideration given to system and subsystem design including SAR, the visible and near infrared radiometer, telemetry, tracking and command, electrical power, reaction control, and attitude control. Also discussed are such aspects of system analysis as orbital selection, power analysis, fuel budget, and link calculation.

B.J

**A83-47278#****TROPICAL EARTH RESOURCES SATELLITE (TERS)**

A. P. HOEKE (Nederlands Instituut voor Vliegtuigontwikkeling en Ruimtevaart, Delft, Netherlands) and M. IRSYAM (Indonesian National Institute of Aeronautics and Space, Jakarta, Indonesia) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 8 p.  
(IAF PAPER 83-121)

It is noted that the zero-degree inclination orbit at an altitude of 1680 km will have an orbital period of 120 min. The swath-width of the high resolution multispectral instrument can be pointed anywhere between 10 deg N and 10 deg S; this will offer the equatorial countries an opportunity to observe a part of their territory four times each day. The high cloud cover percentage in the tropics will lower this frequency, but a forward-looking cloud sensor will make it possible to detect the area that is free of clouds and to point the instrument field of view accordingly.

C.R.

**A83-47279#****SATELLITE BASED REMOTE SENSING PROGRAM - A PERSPECTIVE IN THE INDIAN CONTEXT**

S. KALYANARAMAN (Indian Space Research Organization Satellite Centre, Bangalore, India) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 9 p.  
(IAF PAPER 83-122)

The achievements made with the satellites Bhaskara-I and Bhaskara-II are summarized, and a table setting forth their technical characteristics is included. With remote-sensing payloads, these satellites, using the same main-frame as India's first technology satellite, Aryabhata, provided TV images in the visible and near-infrared with a resolution of 1 km and passive microwave images in the 19, 22, and 32 GHz bands with resolutions of 125 km. With this background, the Indian Space Research Organization has planned a semioperational/operational remote-sensing satellite series for the 1980s. First in this series will be IRS-1A (Indian Remote Sensing Satellites), which will provide images with resolutions of 73 m and 37.5 m in four bands of the visible/near infrared regions of the spectrum. IRS-1A will be devoted to agriculture, forestry, geology, and hydrology. Plans have been made to supplement the data provided with Landsat D and SPOT data.

C.R.

**A83-47280#****SATELLITE IMAGE PROCESSING FOR A SMALL COUNTRY - THE HUNGARIAN CASE**

T. HAJOS, G. BUETTNER, F. CSILLAG, and A. SZILAGYI (Institute of Geodesy and Cartography, Budapest, Hungary) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 10 p. Research supported by the Ministry of Food and Agriculture. refs  
(IAF PAPER 83-123)

**A83-47282\*#** National Aeronautics and Space Administration, Washington, D. C.

**NASA/NOAA IMPLEMENTATION OF THE USAID-SPONSORED SATELLITE GROUND STATION AND DATA PROCESSING FACILITY FOR BANGLADESH**

J. C. DODGE (NASA, Washington, DC) and C. H. VERMILLION (NASA, Goddard Space Flight Center, Greenbelt, MD) International Astronautical Federation, International Astronautical Congress, 34th, Budapest, Hungary, Oct. 10-15, 1983. 7 p. refs  
(IAF PAPER 83-127)

A description is given of a project to transfer multiple environmental satellite data reception, processing, and interpretation capabilities from the U.S. to Bangladesh. The goal of the project is to improve the management of resources related primarily to agriculture, water development, forestry, and fisheries. It is also hoped to improve the existing cyclone/storm surge warning system. An account is given of the interagency and international cooperation underlying the project. The remote-sensing installation in Dhaka, Bangladesh, is described, and the most likely system applications are summarized. Attention is also given to the special requirements concerning this type of technology transfer, and an assessment is made of the project's practical value to Bangladesh.

C.R.

**N83-33792\*#** National Aeronautics and Space Administration, Washington, D. C.

**RECORDS OF ACHIEVEMENT: NASA SPECIAL PUBLICATIONS**

1983. 141 p. Original contains color illustrations.  
(NASA-SP-470, NAS 1.21.470) Avail: NTIS and NASA Scientific and Technical Information Facility, P.O. Box 8757, B.W.I. Airport, Md. 21240. CSCL 05B

This annotated bibliography cites all NASA Special Publications issued since 1961. The Reference Publications and Conference Publications are included. Entries are arranged by SP number. The entries are grouped in eight categories: general, handbooks and data compilations, histories and chronologies, technology utilization, management evaluation and analysis standards, bibliographies, space vehicle design criteria, and specifications. The Reference Publications and Conference Publications are listed separately according to RP and CP number. Approximately 1400 entries are listed. Each entry includes the title, author, NASA accession number, NASA SP, RP, or CP number, original sales source, and publication date. An index of the SP, RP, and CP numbers according to NASA subject category is provided. Highlights of NASA's achievements since 1958 are included as a tribute to NASA's 25th anniversary.

A.R.H.

**N83-33920#** Committee on Science and Technology (U. S. House).

**UNITED STATES CIVILIAN SPACE PROGRAMS. VOLUME 2: APPLICATIONS SATELLITES**

M. S. SMITH, J. BORTNICK, B. A. LUXENBERG, L. H. RALEIGH, T. K. MCKNIGHT, and J. REICHHARDT. Washington: GPO, 1983. 401 p. refs. Presented to the Subcomm. on Space Sci. and Appl. of the Comm. on Sci. and Technol., 98th Congr., 1st Sess., May 1983. Prepared by the Library of Congr., Congr. Res. Serv.

(GPO-20-255) Avail: Subcommittee on Space Science and Applications

Accomplished in the area of applications satellites (communications, meteorology, Earth resources and environmental monitoring, ocean sensing, geodynamics, navigation, and tracking and data replay) since the inception of our space program are reviewed. Several significant issues for consideration are identified.

S.L.

## 09 GENERAL

N83-34417# United Nations, New York, N. Y. Div. de l'Espace Extra-Atmospherique.

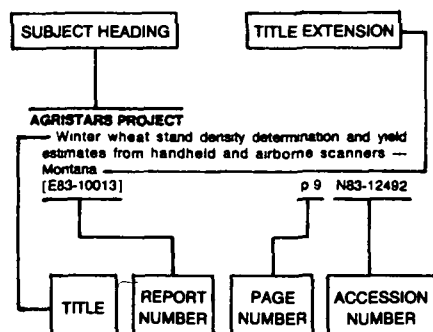
**GENERAL TALK ON REMOTE SENSING: STATE OF THE ART  
[EXPOSE GENERAL SUR LA TELEDETECTION: DERNIER ETAT  
DES CONNAISSANCES EN LA MATIERE]**

R. P. OESBERG /In ESA First Intern. Training Sem. on Remote Sensing Appl. to Operational Agrometeorol. in Semi-Arid Countries p 7-14 Jul. 1983 In FRENCH

Avail: NTIS HC A04/MF A01; ESA, Paris FF 60

Satellite-borne remote sensing of Earth resources and the environment, and the role of the UN African Economic Commission in remote sensing program development are discussed. Active and passive systems are described, and the trend towards multichannel, multipurpose satellites is noted. Integrated specialized satellite/ground support network systems are suggested as a cheaper option for agrometeorology. The use of Fourier spectrometers and multifrequency radiometers to overcome problems caused by clouds is described. Author (ESA)

### 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.

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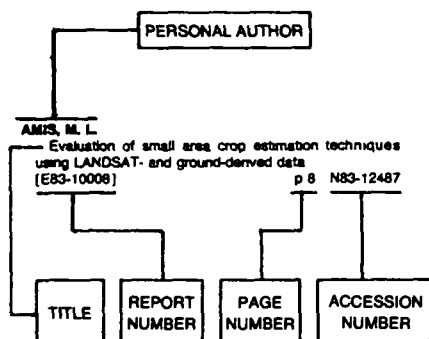
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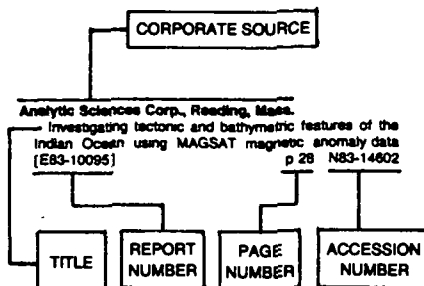
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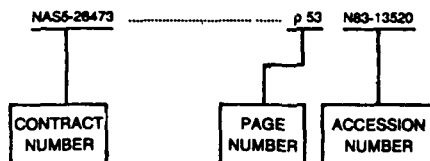
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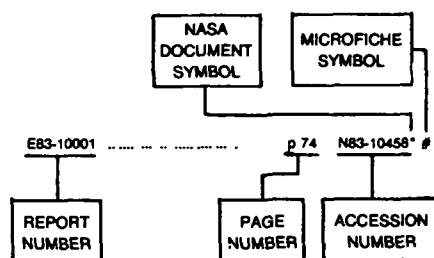
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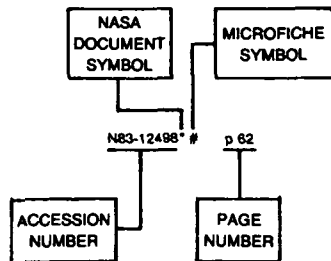
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